Application for Joint Nordic Use of Research Infrastructure

norden NordForsk

Beslutning: Mottagit: Ref.nr.:

1 Main Applicant (Project Leader)			
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Administrative Manager: The person who holds power of attorney to represent the Project Manager vis-á-vis NordForsk.			
Last name: Montelius	First name: Lars	Title/Position: Prof./Department Head	

3 Title of the project/activity (max 50 characters)

LHC and beyond

4 Time span for activities (dd.mm.yyyy):

From: 01.01.2008 To: 31.12.2010

5 Subject area (See last page)

Physics

6 Estimated number of participants	DK	FI	IS	NO	SE	EE	LT	LV	RU	Other inside the EU*	Other outside the EU*	Total	Men	Women
Research groups	3	4		5	5	1			1	1		20		
Researchers	17	17		29	31	7			11	1		113	96	17
PhD students	8	17		19	20	2			2			68	58	10
Other participants														

* Other countries Other inside EU: NORDITA, now in Stockholm.

7 Summary. Give a short description of the project's targets and aims (max 200 words). NordForsk reserves the right to use parts of the text or the text in full for information purposes.

Our Nordic Joint Consortium has been formed to exploit the physics at the Large Hadron Collider, LHC, at the European Organization for Nuclear Research, CERN, in Geneva, Switzerland. LHC is expected to enable us to make the next big leap in particle research by providing us with higher energies and energy densities in laboratory conditions than ever before. We are thus approaching the conditions shortly after the Big Bang, entering a regime in which it will be possible to test and understand the fundamental mechanisms governing elementary particles. LHC is now at the final phases of installations and tests, and the collider will be starting in 2008.

The aim of this project is to maximize the physics outcome of LHC for the Nordic scientific community, and to plan for next steps beyond the LHC.

The project objectives are:

- to strengthen and optimize the Nordic participation in the LHC experiments,
- to promote further the co-operation and sharing of best practices between the Nordic research partners, including using the Nordic Data Grid Facility (NDGF) for analysis of the LHC data,
- to optimize joint Nordic R&D for the future generation of particle physics experiments, and
- to prepare for a joint infrastructure application for the European Union.

8 Total amount requested from NordForsk for the activity

1 000 000,00 NOK

9 Co-ordinating group (title, name, university, e-mail). A short presentation of the participants in the co-ordinating group must be enclosed. Use the enclosed form (Point 15).

Title	Name	University or equivalent	E-mail
Prof.	Tord Ekelöf	Uppsala University	Tord.Ekelof@tsl.uu.se
Prof.	Sten Hellman	Stockholm University	sten@physto.se
Title	Name	University or equivalent	E-mail
Prof.	Bengt Lund-Jensen	KTH	lund@particle.kth.se
Prof.	Torbjörn Sjöstrand	Lund University	torbjorn@thep.lu.se
Title	Name	University or equivalent	E-mail
Prof.	Farid Ould-Saada	Oslo University	see group form
Prof.	Per Osland	University of Bergen	per.osland@ift.uib.no
Title	Name	University or equivalent	E-mail
Prof.	Anna Lipniacka	University of Bergen	see group form
Prof.	Joakim Nystrand	University of Bergen	see group form
Title	Name	University or equivalent	E-mail
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Prof.	Jens Jørgen Gaardhøje	Niels Bohr Institute	gardhoje@nbi.dk
Title	Name	University or equivalent	E-mail
Prof.	Francesco Sannino	Univ. of Southern Denmark	sannino@ifk.sdu.dk
Prof.	Paolo Di Vecchia	Nordita	divecchi@nbi.dk
Title	Name	University or equivalent	E-mail
Prof.	Katri Huitu	University of Helsinki	katri.huitu@helsinki.fi
Prof.	Risto Orava	University of Helsinki	risto.orava@helsinki.fi
Title	Name	University or equivalent	E-mail
Prof	Jorma Tuominiemi	Helsinki Institute of Physics HIP	jorma.tuominiemi@hip.fi
Sen. Scient.	Jan Rak	HIP and University of Jyväskylä	jan.rak@phys.jyu.fi
Title	Name	University or equivalent	E-mail
Sen. Res.	Martti Raidal	Nat. Inst. of Chem. and Biophys.	martti.raidal@cern.ch
Head of Lab.	Grigory Feofilov	St. Petersburg State University	see group form

10 Other sources of funding

Source	Amount applied for (NOK)	Received (NOK)	Reply pending (date)

11 Budget

	Year 1	Year 2	Year 3
EXPENSES	**Budget (NOK)**	**Budget (NOK)**	**Budget (NOK)**
a) refundable from NordForsk			
Personnel			
Post docs (According to NordForsk's General Guidelines).			
Visiting Professors (According to NordForsk's General Guidelines).			
Other (rates of employer incl. 20% overhead)	50 000,00	50 000,00	50 000,00
Honoraria			
Salaries Total	50 000,00	50 000,00	50 000,00
Travel and accomodation	210 000,00	120 000,00	240 000,00
Material (Equipment)	50 000,00	50 000,00	50 000,00
Other	10 000,00	10 000,00	10 000,00
Administration (max 10%)	35 500,00	25 600,00	38 900,00
b) not refundable			
Other			
TOTAL EXPENSES (a+b)	355 500,00	255 600,00	388 900,00
INCOME			
Requested from NordForsk	355 500,00	255 600,00	388 900,00
Other income/ Own resources			
TOTAL INCOME	355 500,00	255 600,00	388 900,00
BALANCE	0,00	0,00	0,00

This part should be completed in free style and must address the issues mentioned below. In addressing the issues you should demonstrate that you meet the criteria of the call and of the participating institutions

12 The main applicant/project leader's CV (Background of the applicant including summary of research, as well as supervision, collaboration, and project managing skills) **Max 3 A4 pages.**

Curriculum Vitae *Paula Anna-Maria Eerola*

Personal data. Born January 10, 1962 in Joensuu, Finland. Not married. One son born in 1995. Finnish and Swedish citizen. Mother tongue Finnish. Fluent in Swedish and English (oral, written). A fair knowledge of French and German.

Current position. Professor of Particle Physics, Division of Experimental High Energy Physics, Lund University, Sweden, since 1.6.2001. Division Head since 1.1.2005.

Work address. P.O. Box 118, SE-22100 Lund, Sweden. Tel: +46-46-222 7695,
fax +46-46-222 4015. email: paula.eerola [at] hep.lu.se, homepage: http://www.hep.lu.se/staff/eerola/
Home address. Vegagatan 22, SE-224 57 Lund, Sweden. Tel./fax +46-46-12 98 49.

Docent of experimental particle physics in University of Helsinki, Finland, 1994.
Doctor of Philosophy (PhD) in experimental particle physics, University of Helsinki, Finland, 1990.
Master of Science in physics, University of Helsinki, Finland, 1985.

Previous professional appointments
1.7.1998-30.6.2004 **Special Researcher** (Swedish Research Council), Lund University, Sweden.
1.8.-31.12.1997 **Associate professor *locum***, Physics Department, University of Helsinki, Finland.
1.8.1996-31.7.2001 **Assistant professor** in experimental particle physics, Physics Department, University of Helsinki, Finland. On leave of absence 1.8.1996-31.5.1997, 1.8.-31.12.1997, 1.7.1998-31.7.2001.
1.6.1993-31.5.1997 **CERN Staff Research Physicist,** Particle Physics Experiments Division, CERN, Geneva, Switzerland.
1.1.1994-31.12.1998 **Research Assistant** in the Research Institute for High Energy Physics, University of Helsinki, Finland. On leave of absence 1.1.1994-31.12.1998.
1.6.1991-31.5.1993 **CERN Research Fellow**, Particle Physics Experiments Division, CERN, Geneva, Switzerland.
15.1.1991-31.5.1991 **Junior Research Associate *locum***, Academy of Finland, Finland.
1.1.1988-31.12.1992 **Research Assistant** in the Research Institute for High Energy Physics, University of Helsinki, Finland. On leave of absence 1.1.1988-31.12.1990, 15.1.1991-31.12.1992.
1.1.1987-31.12.1990 **Research Assistant**, Academy of Finland, Finland.
15.9.1984-31.12.1986 **Research Assistant *locum*** in the Research Institute for High Energy Physics, University of Helsinki, Finland.

Publications. 114 publications in journals and collaboration publications, 39 publications in conference proceedings, 5 edited publications, 27 preprints and technical notes. See the complete publication list in
http://www.hep.lu.se/staff/eerola/pub.pdf

Present research interests. ATLAS experiment (1992-): All aspects of B physics at LHC-ATLAS. Physics beyond the Standard Model at LHC-ATLAS. Application of GRID-technologies to LHC data processing. Design and construction of the ATLAS Transition Radiation Tracker. B-physics triggers, track trigger using the ATLAS Transition Radiation Tracker.

Past research interests. DELPHI experiment (1985-1994): Soft gluon structure in hadronic final states. Heavy flavours in Z^0 Decays. Neural Networks. Search for non-minimal Higgs bosons. DELPHI microvertex detector: Mechanics of the detector upgrade. Muon trigger and event tagging in the DELPHI Hadron Calorimeter.
Linear colliders (1991-1992): Simulation of charged Higgs boson production.
Analysis of UA1 data (1984-1985): Measurement of the strong coupling constant from jet rates.
UA2 experiment (1984): on-line filter for top-quark searches.

Main coordinator of a Nordforsk Research and Training Network `Discovery Physics at LHC´ in 2001-2005.
Member of the NorduGRID Steering Group since 2000.
Member of the Swedish LHC-consortium since 1998.
Member of the ATLAS TRT Steering Committee since 1998.
Daily coordination of the ATLAS TRT group of Lund since 1998.

Member of the ATLAS Physics Coordination 1997-2005.
Convener of the B-physics working group of ATLAS 1993-2005.
Convener of the Neural Network working group in the Nordic LHC-meeting, Copenhagen, 1991.
Coordinator of the DELPHI physics analysis group of Helsinki 1990-1991.
Coordinator of the DELPHI Hadron Calorimeter group of Helsinki 1989-1990.

Member of the **Swedish National Committee for Pure and Applied Physics**, The Royal Swedish Academy of Sciences, 2004-.
Member of the **Board of the Swedish Physical Society**, 2004-.
Member of **Kungliga Fysiografiska Sällskapet**, 2007-.
Nordic Member of the **Project Overview Board** of the LHC Computing Grid project 2003-.
Nordic Member of the **LHC Computing Grid Memorandum-of-Understanding taskforce** 2004-2005.
Member of the **Board of the Physics Institution** of Lund University 2005-.
Member of the **Board of Directors of SNIC**, Swedish National Infrastructure for Computing 2002-.
Member of the **SWEGRID** committee of the Swedish Natural Science Research Council 2000-2002.
Member of the **CERN-committee** of the Swedish Natural Science Research Council 1999-2005.
Member of the **Working Group for Equal Opportunities** at the Physics Institution, Lund university, 2003-
Member of the **Equal Opportunities Committee** of the Science Faculty, Lund university, 2004-.
Member of the **Staff Appointments** and **Scholarship Committees** in Physics and Mathematics in the Science Faculty of Lund University, 2006-.
Representative of Finland in **Restricted ECFA** - European Committee for Future Accelerators 1997-1998.
Member of the **Physics Panel, Human Potential Programme within the Fifth Framework Programme, European Commission.** Evaluation of proposals for Research and Training Networks in 1999.
Member of the **Physics Panel, Human Potential Programme within the Sixth Framework Programme, European Commission.** Evaluation of proposals for Research and Training Networks in 2003, Marie Curie fellows 2004, 2005 and 2006.
Member of the **Evaluation group 1 under the Physics Committee of the Swedish Natural Science Research Council**. Evaluation of applications to NFR and FRN in 1999-2000.
Member of the **Evaluation group NT-M of the Swedish Science Research Council**. Evaluation of applications to VR in 2001-2004.
Member of the **KFI (Research Infrastructure Committee) Evaluation group 1 of the Swedish Science Research Council** 2005-.

Member of the ATLAS Editorial Committee (editors of ATLAS publications) 2000-2003.
Main editor of the ATLAS Physics Performance Technical Design Report (c. 1000 pages), 1999.
Member of the DELPHI Editorial Committee (editors of DELPHI publications) 1992-1993.
Linear Collider Workshop in Saariselkä, Finland, September 1991. Editor of the proceedings.
Referee for IEEE Transactions on Nuclear Science. Frequently trusted as an expert evaluator for faculty positions and PhD theses.

About 30 talks in international and national conferences since 1990. Lectures to general public, tv- and radiointerviews.
Organizer of several physics conferences and workshops.

Main supervisor of 4 MSc theses, out of which the thesis by A. Padadelis was granted a prize for **"the best Swedish master thesis in physics in 2004"** by a jury consisting of members of the Royal Swedish Academy of Sciences. Main supervisor of one Lic.Sc. thesis, one PhD thesis. Currently the main supervisor of one PhD student and deputy supervisor for two PhD students. Physics lectures, exercises and seminars since 1986.
This CV can be found in http://www.hep.lu.se/staff/eerola/cv_short.pdf

13 A list of the main applicant's publications (maximum 20 titles)

2000-2007: Publications in journals and collaboration publications

95. P. Eerola, *BEAUTY'99 Conference Summary*, Nucl. Instr. and Meth. A 446 (2000) 384.
96. T. Akesson *et al*., *Particle Identification using the Time-over-Threshold Method in the ATLAS Transition Radiation Tracker*, Nucl. Instrum. and Methods A474 (2001) 172.
97. T. Akesson *et al*., *An alignment method for the ATLAS end-cap TRT detector using a narrow monochromatic X-ray beam*, Nucl. Instr. and Meth. A 463 (2001) 129.
98. J. Damet, P. Eerola, A. Manara and S.E.M. Nooij, *Searching for physics beyond the Standard Model in the decay B+ → K+K+ π-*, Eur. Phys. Journal Direct C7 (2001) 1.
99. J. Bijnens, P. Eerola, M. Maul, A. Mansson and T. Sjöstrand, *QCD Signatures of Narrow Graviton Resonances in Hadron Colliders*, Phys. Lett. B 503 (2001) 341.
100. T. Akesson *et al., Tracking Performance of the Transition Radiation Tracker Prototype for the ATLAS Experiment*, Nucl. Instrum. and Methods A485 (2002) 298.
101. The ATLAS and CMS Collaborations, *High transverse momentum physics at the large hadron collider*, Eur. Phys. Journal Direct C, Vol. 4, CN1 (2002) 1.
102. C. Driouichi, P. Eerola, M. Melcher, F. Ohlsson-Malek and S. Viret, *Observation potential of the decays $B^0_{s,d} \rightarrow J/\psi\,\eta$*, Eur. Phys. Journal Direct C, Vol. 4, CN2 (2002) 1.
103. S. Almehed, C. Driouichi, P. Eerola, U. Mjörnmark, O. Smirnova, C. Zacharatou Jarlskog and T. Åkesson, *Regional research exploitation of the LHC: a case-study of the required computing resources*, Comp. Phys. Comm. 145 (2002) 341.
104. T. Akesson *et al., An X-ray scanner for wire chambers*, Nucl. Instrum. and Methods A507 (2003) 622.
105. T. Akesson *et al., Aging studies for the ATLAS Transition Radiation Tracker (TRT)*, Nucl. Instrum. and Methods A507 (2003) 622.
106. P. Eerola *et al*., *Building a Production Grid in Scandinavia*, IEEE Internet Computing vol. 7 issue 4, pp. 27-35 (2003).
107. T. Akesson *et al., Status of design and construction of the Transition Radiation Tracker (TRT) for the ATLAS experiment at the LHC*, Nucl. Instrum. and Methods A 522 (2004) 131.
108. T. Akesson *et al., Operation of the ATLAS Transition Radiation Tracker under very high irradiation at the CERN LHC*, Nucl. Instrum. and Methods A 522 (2004) 25.
109. T. Akesson *et al., ATLAS Transition Radiation Tracker test-beam results*, Nucl. Instrum. and Methods A 522 (2004) 50.
110. C.-H. Chang, C. Driouichi, P. Eerola and X.-G. Wu, *BCVEGPY: An Event Generator for Hadronic Production of the Bc Meson*, Comp. Phys. Comm. 159 (2004) 159.
111. M. Capeans *et al., Recent aging studies for the ATLAS Transition Radiation Tracker*, IEEE Trans.Nucl.Sci.51 (2004) 960.
112. R. Sturrock *et al.* (ATLAS DC1 Task Force Collaboration), *A step towards a computing Grid for the LHC experiments: ATLAS Data Challenge 1*, CERN-PH-EP-2004-028, submitted to Nucl.Instrum.Methods A.
113. P. Cwetanski *et al., Acceptance Tests and Criteria of the ATLAS Transition Radiation Tracker*, IEEE Trans. Nucl. Sci. 52 (2005) 2911.
114. H. Burckhart and P. Eerola, *ATLAS status and first run scenarios for B physic*, to be published in Nucl. Phys. B (Proc. Suppl.). Already refereed.

2000-2007: Preprints and technical notes

24. P. Nason *et al*., *Bottom production*, hep-ph/0003142 (March 2000).
25. P. Ball *et al*., *B decays at LHC*, hep-ph/0003238 (March 2000).
26. C. Driouichi, P. Eerola, Ch. Zacharatou Jarlskog, *Execution times for B-physics simulation*, Lund Preprint LUNFD6/(NFFL-7206)2001, ATLAS Communication ATL-COM-SOFT-2001-009 (Dec 2001).
27. P. Eerola *et al*., *`The NorduGrid: Building a Production Grid in Scandinavia´*, ATLAS Note ATL-SOFT-2003-002 (Nov 2002).

2000-2007: Conference proceeding

14 papers

For a full publication list, see http://www.hep.lu.se/staff/eerola/pub.pdf

14 Project description Provide a detailed project description (max 8 A4 pages) containing, in any chosen order, the following:	
a	Overall aims and objectives and how it addresses the objectives of the Joint Nordic Use of Research Infrastructure call.
b	Proposed methodology (if applicable).
c	Description of the research environment and service provided by the suggested infrastructure.
d	Novelty of the proposed project, positioning the project in the international context of research in this field, and expected results.
e	Impact and potential for promoting scientific innovation.
f	Work plan – milestones and targets for the proposal.
g	Management and project organisation.
h	In which way(s) will the project create "Nordic Strength"?

14.a. LHC and beyond – Overall aims and objectives

A Nordic Joint Consortium has been formed to exploit the physics at the Large Hadron Collider, LHC, at the European Organization for Nuclear Research, CERN, in Geneva, Switzerland. The aim is to maximize the physics outcome of LHC for the Nordic scientific community, and to plan for next steps beyond LHC.

The project objectives are:

- to strengthen and optimize the Nordic participation in the LHC experiments,
- to promote further the co-operation and sharing of best practices between the Nordic research partners, including using the Nordic Data Grid Facility (NDGF) for analysis of the LHC data,
- to optimize joint Nordic R&D for the future generation of particle physics experiments, and
- to prepare for a joint infrastructure application for the European Union (EU).

The Consortium behind this application includes all the Nordic experimental high-energy physics groups participating in the LHC experiments, and Nordic particle physics phenomenology groups. The Swedish groups are: Lund University (ATLAS, ALICE and theory), Uppsala University (ATLAS and theory), Stockholm University (ATLAS) and KTH (ATLAS). The Norwegian groups are: University of Oslo (ATLAS and ALICE), University of Bergen (ATLAS, ALICE and theory) and Bergen University College (ALICE). The Danish groups are: Niels Bohr Institute at University of Copenhagen (ATLAS and ALICE) and University of Southern Denmark (theory). The Finnish groups are: University of Helsinki and Helsinki Institute of Physics (CMS, TOTEM and theory), and University of Jyväskylä (ALICE). Nordita is also included (theory). In addition, our Consortium includes a team from St. Petersburg State University (ALICE), and a team from National Institute of Chemical Physics and Biophysics in Tallinn (CMS and theory). The Consortium agreement is being formulated and can be obtained upon request from the Project Leader.

14.a.1 Physics at the Large Hadron Collider

The next accelerator at CERN, LHC, is expected to enable us to make the next big leap in particle research by providing us with higher energies and energy densities in laboratory conditions than ever before. We are thus approaching the conditions shortly after the Big Bang, entering a regime in which it will be possible to test and understand the mechanisms of electroweak symmetry breaking (separation of the electromagnetic and weak forces), to discover evidence for theories beyond the Standard Model of particle interactions, and to discover firm evidence of and understand the properties of quark-gluon plasma.

Proton-proton physics. At LHC, two beams of protons (p) will be accelerated and collided head-on at a centre-of-mass (c.m.s.) energy of 14 TeV and a luminosity of 10^{34} $cm^{-2}s^{-1}$. LHC is now at the final phases of installations and tests, and the collider will be starting in 2008. The high collision energy and luminosity of LHC give the possibility of exploring a new high-energy frontier at the TeV scale. The Standard Model (SM) encompasses electromagnetic, weak and strong interactions, and it has been experimentally verified with a very high precision. Nevertheless, there are experimental hints of physics beyond the SM, such as the observed large fraction of "dark" matter of the Universe, neutrino masses and other properties of neutrinos, and the observed matter-antimatter asymmetry of the Universe. Furthermore, the SM is theoretically unsatisfactory: the Higgs sector is highly fine-tuned (the "hierarchy" problem); there is no natural explanation for the smallness of the electric dipole moment of the neutron within the SM (the strong CP problem); the SM can fit but cannot explain the number of generations and their mass texture.

The electroweak (EW) symmetry breaking is the key issue at LHC, since there is yet no direct evidence for the symmetry breaking via the Higgs mechanism. The discovery of the Higgs boson(s) and the verification of their properties are crucial for establishing the theory of EW symmetry breaking and are amongst the major goals of LHC. The EW symmetry breaking sector of the SM will also allow us to study new extensions of the SM such as Supersymmetry, or

dynamical EW symmetry breaking scenarios in which Higgs is not an elementary particle but a composite object.

The best motivated extension of the SM is Supersymmetry (SUSY), and in particular the Minimal Supersymmetric Standard Model (MSSM). Investigating SUSY models, their parameters and the consequent phenomenology, is thus a central problem in current particle physics research. At LHC, SUSY is expected to manifest as new supersymmetric particles. Extensions of the SM can also show up as new effects in flavour physics. With the high-precision measurements of B hadrons at LHC, possible effects of new models can be distinguished. In the lepton sector, the SM fails to give a correct description of the neutrino mixing data. LHC can shed light also on the lepton sector, for example through searches for lepton flavour violation in tau decays.

In the end of 1990's, extra dimensions as an alternative mechanism for solving the hierarchy problem has been proposed. Depending on the model, the main experimental signatures are so-called Kaluza-Klein towers, or a Higgs-like new light scalar particle, the radion. It is also possible that the Higgs boson is, per se, a Goldstone boson. These models are termed little Higgs models and would explain why the Higgs may be light. In spring 2007, the "unparticle physics" scenario has emerged, involving a hidden scale-invariant sector weakly coupled to the SM. The new sector appears experimentally as missing energy, with an energy spectrum dictated by a non-integer number of massless particles.

ATLAS and CMS are the two large general-purpose high-energy physics experiments at LHC. Both experiments have been designed to maximize the discovery potential for new physics and to have the capability of high-accuracy measurements over almost the full solid angle.

Heavy ion physics. LHC is not only a p-p collider, but it has been designed to have the possibility to accelerate and collide heavy ions as well. Lead-lead collisions occur at a c.m.s. energy of 5.5 TeV per nucleon pair. Quantum Chromodynamics (QCD) predicts that strongly interacting matter should undergo a phase transition when subject to extreme temperatures or energy densities. The goal of ultra-relativistic heavy-ion interactions is to explore the nuclear phase diagram and to probe the boundary between confined, hadronic matter and the quark-gluon plasma. The field has developed dramatically during the last seven years. The results from Relativistic Heavy-Ion Collider (RHIC) have revealed that an extremely dense and comparatively long-lived state of matter is produced in the collisions between two heavy nuclei. Its properties are hard to explain from conventional hadronic models, so data from LHC, at 30 times higher collision energies, will be needed to establish the exact nature of this new state of matter. The main physics questions which will be addressed are: a) Does the system thermally equilibrate? b) What are the properties of the strongly coupled plasma? c) Mapping the high temperature phase diagram of QCD. Recently superstring-inspired models trying to model the high temperature plasma and its signatures have appeared. First principle lattice computations provide also a number of predictions associated to the spectrum of states at high temperature.

The dedicated heavy-ion experiment at LHC is called ALICE. It will study Pb+Pb collisions at the highest c.m.s. energy. The ALICE physics programme includes also regular p-p runs and special p-nucleus runs. These are needed in order to obtain reference data for the heavy-ion programme, and to address specific physics topics accessible to ALICE.

Forward physics. The TOTEM experiment, located in the forward region of CMS, will, together with CMS, cover more phase space than any other detector at a hadron collider. The TOTEM collaboration focuses on physics that is complementary to the general purpose experiments at LHC. The physics programme of the experiment consists of: (1) Elastic p-p scattering, total p-p cross section, and soft and hard diffraction. In addition, more detailed features of diffractive and small-x processes, such as jet, W, J/ψ, b- and t-quark production will be available to experimentation. (2) TOTEM could threshold scan for spin-parity selected new particle states, including the Higgs boson, SUSY particles, radions, extra dimensions *etc*. In particular the interaction: $pp \rightarrow p + H + p$ (together with the central CMS detectors) is considered as a benchmark process, with an exclusive access to the J^{PC} structure of the Higgs boson. (3) In addition to the TOTEM physics programme, the experiment provides an extension to the kinematic reach of CMS, and enables accurate measurement and monitoring of the LHC luminosity.

Access to data through Nordic Grid. Several PetaBytes of data will be collected per year by each of the LHC experiments. The computing power needed to process these data, and to produce and process comparable amounts of simulated data required for analysis, has driven the development of the Grid concept more than anything else. Our Nordic high energy physics community has been heavily involved in preparations for analysis of the LHC data. The NorduGrid research collaboration, that develops and supports the Advanced Resource Connector (ARC) Grid middleware, has for example participated continuously in ATLAS simulation production already since 2003.

The joint Nordic Grid research led to the creation of the Nordic Data Grid Facility, NDGF. NDGF already serves the Nordic LHC community – the ALICE, ATLAS, CMS and TOTEM Virtual Organizations – through the operation of the Nordic Tier-1, which together with the other 10 Tier-1s of the overall World Wide LHC Computing Grid (W-LCG) will collect, store and process the data produced at CERN.

14.a.2 Joint Nordic use of LHC

LHC is the main particle physics commitment world-wide for the coming decade, and all the major European experimental particle physics research groups are involved in the LHC experiments, which are unprecedented high-energy physics research facilities in size and complexity. Researchers from all over the world will search for discoveries when the physics data starts pouring in during 2008.

Within this consortium we have joined the Nordic forces for exploiting LHC. Our aim is to promote and support research collaboration among the Nordic physicists through joint activities, so that we will be better prepared for the data analysis and interpretation right from the beginning of LHC operation at the competitive environment in the physics community. The consortium is building on the highly successful Nordic "Discovery Physics at the LHC" Network[1], which was supported by NorFA/NordForsk 2001-2005. The network included all the Nordic ATLAS and CMS groups as well as theoreticians. The network activities – working groups, workshops, training courses, mobility – had a very stimulating effect for recruiting and supervising students, and bringing the groups together. Our new consortium behind this application comprises all the groups in the previous network, plus the Nordic heavy-ion community (ALICE groups) and the TOTEM group. The consortium encompasses thus now the whole spectrum of LHC physics.

Another building block leading to our consortium is joint Nordic Grid R&D. Our consortium includes all the founding members of the NorduGrid[2] research collaboration, which initiated joint Grid research already in 2001. Since then, NorduGrid has become a world-wide recognized player in the field. In this project we are now aiming at optimizing the use of NDGF for LHC data analysis, simulation and model building by cooperating in practical issues such as implementing and testing experiments' software at NDGF, and sharing best practises for the use of NDGF.

The third foot on which our consortium is standing on is joint Nordic detector development (see next chapter). The high energy physics groups in the Nordic countries have gradually built up competence in detector technology through developing and building many new types of detectors, such as semiconductor detectors, ring-imaging Cherenkov detectors, novel types of calorimeters, new gaseous detectors *etc.* for the previous generation of experiments at CERN and Brookhaven, and for the four experiments at LHC. In view of the next generation of detectors for LHC upgrades and linear colliders, the Nordic groups are thus very well positioned for pursuing front-line detector research. Our project is aiming at facilitating closer collaboration between the detector development activities in form of joint R&D, shared know-how, and sharing of equipment and test facilities.

14.a.3 The next generation of experiments beyond LHC

LHC upgrade. The luminosity of LHC will be upgraded around year 2015 by an order of magnitude, up to 10^{35} $cm^{-2}s^{-1}$. This will require a significant upgrade of the ATLAS, CMS and TOTEM experiments to meet the increased particle rates and radiation levels. Challenges will be to develop sensors that can withstand an order of magnitude more radiation than the present ones, and to invent integration techniques for fabrication of very large area and fine-grained detector systems.

Oslo, Bergen and Uppsala groups plan to contribute to the upgrade of the Inner Detector of ATLAS with a large area pixel detector system for the inner layers and pad/mini-strip detectors for the outer layers. The upgrade will require pixel sensor arrays of high granularity (up to 500 Mpixels) with pixel sizes of 25 μm x 25 μm, a low material budget, radiation hardness up to 100 MRad and an data acquisition speed of less than 25 ns, possibly down to 10 ns.

The silicon 3D detectors are recently developed, new type of solid state radiation detectors, where the conventional planar structure has been modified so that the electron-hole pairs are collected with electrodes configured as tiny rods inside of the silicon wafer. The close positioning of the electrodes enables a significantly lower operation voltage compared to conventional detectors, and improved charge collection efficiency. A major challenge is how to collect signals from such detectors at high speed at a reasonable cost and yield. The plan is to integrate the first stage of pre-amplification with the detector in order to create a monolithic design. The 3D detector would offer practically edgeless active area, which could also be exploited *e.g.* as very forward detectors within Roman pots in TOTEM experiment. The Helsinki group is also actively involved in this development work.

The large amount of background radiation that is produced at LHC does not only limit the lifetime of silicon detectors and electronics, but it also causes inefficiencies, worsened resolutions and ghost tracks in tracking detectors as well as increased pile-up fluctuations that degrade the energy resolution in the calorimeters. ATLAS has constructed an elaborate multi-layered shielding system in order to minimize these effects. For the LHC luminosity upgrade, an improved shielding system will be a crucial part in the upgrade of ATLAS. The Lund group has had a leading role in the design and construction of the present shielding system and will contribute to this area.

Future linear colliders. The accelerators foreseen for the era after LHC are the linear electron-positron (e^+e^-) colliders

ILC (International Linear Collider) and CLIC (Compact Linear Collider). ILC will collide e^+ and e^- at 500 GeV c.m.s. energy (upgradeable to 1 TeV). The location of ILC is not yet decided, but R&D on both accelerator and detector solutions are going on all over the world. The available energy at ILC will be less than at LHC, however high enough to exceed production thresholds of most physics phenomena expected to show up at LHC. The great advantage of e^+e^- collisions is the absence of strong interactions in the initial state, allowing for very clean, high precision measurements.

At e^+e^- colliders, the collision rate is low and the driving force in detector development is to push the resolution to perfection. This necessitates detector readout with a very high granularity. In this respect, heavy-ion experiments have similar ambitions for resolving many nearby particles. European efforts towards ILC detectors are concentrated in the EUDET project within the Integrated Infrastructure Initiative programme of FP6. Lund is a member of EUDET, participating in the global design effort to construct a TPC (Time Projection Chamber) for high resolution tracking. The TPC will use GEMs (Gas Electron Multipliers) or Micromegas avalanche chambers for readout, which allow for an order of magnitude more channels per unit area compared to today's TPCs. Lund develops readout electronics together with the electronics division at CERN. The proposed solution is based largely on the ALICE TPC readout and the final goal is a full integration of analog and digital functions in the same chip. Helsinki participates also in EUDET (3D detectors).

CLIC is planned to reach a c.m.s. energy up to 5 TeV, belonging thus to the next generation of accelerators after ILC. Nevertheless, the realization of CLIC requires a significant amount of R&D already now, because a substantial increase of the acceleration gradient is needed. CERN is leading this work, and in the Nordic countries Uppsala and Oslo are participating in the CLIC project and the CLIC test facility CTF3 through work on advanced beam instrumentation.

14.a.4 A joint infrastructure application for the European Union

The EU FP7 programmes offer a wealth of opportunities for innovative research. EU is in particular strongly supporting actions involving effective use of European infrastructures and regional co-operation. Concerning particle physics related research, EU is currently in the process of approving targeted R&D projects for LHC and super-LHC, ILC and neutrino facility. One of our goals within this project is to facilitate joint Nordic participation in the upcoming EU calls. This requires long-term planning involving first discussions and visits between the groups and contacts to other possible partners in Europe and elsewhere, and then pre-studies to formulate the concrete work plan. Our project will provide for a natural platform for all these activities. Furthermore, from the outside point of view, a coherent Nordic consortium speaking with one voice appears much stronger and more visible than individual groups.

14.b. Proposed methodology

Particle physics research involves several phases. A very crude and simplified description of the phases is: 1) development of theoretical ideas and definition of the phenomenological signatures, 2) Monte Carlo (MC) studies and modelling of the experimental signatures, definition of selection criteria for finding the signal and rejecting the background, 3) analysis of experimental data, including detailed analysis of the detector signals and possibly iterating the modelling of the signatures, 4) comparison of the data with reference data and/or MC, 5) interpretation of the results, and 6) finalize and publish the results.

Our consortium includes both theoreticians and experimental physicists, and the experimental physicists belong to several different experiments. Nevertheless, it is evident that the analysis chain described here above benefits greatly from a close collaboration between theoreticians and experimentalists, giving insight to the significance of the results and prospects for further research directions. Sharing best practices for example in MC modelling, analysis tools and methods between physicists analyzing data from different experiments makes it easier to combine experimental results from different collaborations, and thus achieve a superior combined precision.

To obtain results, a significant amount of computing time, storage space and software know-how is needed both for processing the LHC data and producing simulated reference samples which describe the detector geometry and efficiency as accurately as possible, as well as the trigger. The Nordic groups are in an excellent position here, thanks to the NDGF. The effective access and use of NDGF requires, however, a fair amount of further optimization work between the experimental groups and NDGF staff.

Detector R&D needs, apart from physics and engineering expertise, also prototyping and testing facilities, and contacts to high-tech manufactures. Complementary facilities exist at the laboratories of the experimental groups in the consortium. For example, Helsinki has clean rooms and a gas laboratory with unique analysis instrumentation, including a system for analysis of large organic molecules built in collaboration with the Tallinn partner NICPB and VTT, for development of gaseous radiation detectors. Uppsala, Oslo and Bergen groups have produced a large number of Silicon Detector Modules for the ATLAS SemiConductor Tracker, so these groups are well equipped with bonding machines and facilities for electrical and mechanical assembly and testing. Lund has a gas laboratory for testing gas detectors, and electronics test

bench including a test robot for chip testing. The Stockholm group includes the System Instrumentation team which is in particular specialized in development of read-out and trigger systems. This project is aiming at boosting further co-operation between the experimental groups for detector development, and rationalizing the use of experimental facilities and equipment. Several groups are already collaborating with local or national R&D institutes/companies: *e.g.* VTT in Finland and SINTEF in Norway. Through our consortium we can help more groups to get into contact with these institutes/companies and look for further industrial partners.

14.c. Description of the research environment and service provided by LHC and CERN

CERN, the European Organization for Nuclear Research, is the world's largest particle physics centre near Geneva with 20 Member States, among them Denmark, Finland, Norway and Sweden. CERN is funded through membership fees, payed by the Member States according to their GNPs. CERN employs about 3000 people, and some 6500 visiting scientists, half of the world's particle physicists, come to CERN for their research. CERN provides accelerators, research infrastructure and coordination of research activities. The CERN accelerator complex is a succession of machines with increasingly higher energies. The highest-energy machine of the complex is LHC.

An anticipated initial LHC running scenario 2008-2010 is given below. This is a preliminary schedule, which is subject to change depending *e.g.* on the performance of the accelerator and the physics results obtained during the first runs.

- start up of the LHC machine in May 2008, first p-p collisions at 14 TeV c.m.s. energy in July 2008,
- short special high statistics runs for the TOTEM experiment starting already at the running-in stages of the machine,
- pilot run with p-p collisions, with a target luminosity of 10^{32} $cm^{-2}s^{-1}$ by end of 2008,
- regular p-p runs, increasing the luminosity up to 10^{34} $cm^{-2}s^{-1}$ (2009-2010),
- a heavy-ion pilot run in 2008, one month of Pb+Pb collisions (2009 and 2010),
- one month of p+Pb (or d+Pb, α+p) (2010 or 2011).

The plans for the longer term heavy-ion operation include runs with lighter ions, a dedicated p-p run at 5.5 TeV, and a Pb+Pb collision energy scan.

14.d. Novelty of the proposed project, positioning the project in the international context of research in this field, and expected results

The partners in our consortium perform research at the frontiers of theoretical and experimental high-energy physics. Our goal is to create synergy between the consortium partners to exploit the full potential of LHC. LHC has been designed as a discovery machine – LHC does not only provide us with yet another step in measurement precision, but it is expected to help us in breaking ground into a deeper level of understanding of the fundamental interactions. We expect to contribute to determining the EW symmetry breaking method and the underlying model by studying the properties of the Higgs boson, when it has been discovered. Concerning SUSY, one of our primary interests is investigating the SUSY breaking mechanism from measurements. The relation between collider searches and dark matter is being studied.

There is a significant amount of internationally recognized expertise in the Nordic countries in theory and model development as well as in experimental analysis. Various aspects of SUSY models and the consequent phenomenology have been studied by Huitu *et al*. in Helsinki, Osland *et al.* in Bergen and Raidal *et al.* in Tallinn. Experimental SUSY feasibility studies have been performed *e.g.* in Bergen, Oslo, Lund, Stockholm/KTH and Tallinn. Alternative models for physics beyond the SM, such as extra dimensions, black holes, technicolor *etc.* have been investigated by Chaichian *et al.* in Helsinki and Sannino in Odense. Experimental studies of this kind of exotic signatures have been performed *e.g.* in Lund, NBI and Stockholm. Theoretical work in the Higgs sector has been pursued by Osland *et al.* in Bergen and Raidal *et al.* in Tallinn, and experimental signatures have been studied in detail in Uppsala, NBI, Helsinki and Tallinn. There is world-wide known expertise for QCD and Monte Carlo modelling in the group of Sjöstrand in Lund. Ingelman and Rathsman in Uppsala are also pursuing this line of research. Experimental QCD and parton physics is of particular interest for the Helsinki TOTEM group, and also Lund has worked on QCD in the past. Finally, several aspects of B hadrons within and beyond SM have been experimentally investigated *e.g.* in Lund and Bergen.

The relevant signatures for new physics searches include jets, missing transverse energy, τ-leptons, *b*-jets, electrons/photons, muons, and "long-lived" charged hadrons. Although the Nordic groups are quite small, they have jointly a significant collective expertise for the key elements needed in the analyses:

- Jet/missing transverse energy signals, alone and in combination with lepton signatures – Stockholm and Helsinki;
- τ-reconstruction and triggering – Helsinki, NBI and Bergen;
- Secondary vertex reconstruction, b-tagging – Lund, Bergen, Oslo, Uppsala;
- Electromagnetic calorimetric signals – KTH;
- Muon trigger and reconstruction – Bergen;
- Charged hadron reconstruction – NBI and Lund;
- Reconstruction of signatures of massive (quasi)-stable particles – NBI and Stockholm;

- Leading proton detection at LHC – Helsinki;
- Luminosity determination – Lund.

Virtually every analysis in the complex LHC environment will require a thorough understanding of all these key elements. By increased intra-Nordic co-operation we can create a pool of knowledge and skills which will give a solid base for the active participation of the Nordic groups in the front-line analyses.

Two of the physics topics that are likely to attract most interest in ALICE during the first heavy-ion runs are 'jet-quenching' and collective flow. The term 'jet-quenching' refers to the suppression of particles with high transverse momenta and the modification of jet shapes. These effects have been shown to result from the interaction between partons and the medium produced in the collisions and serve as probes of the produced matter. The strong collective flow observed in nucleus-nucleus collisions of intermediate centrality is a measure of the hydrodynamic pressure in the medium and is thus a key variable for determining the equation of state. These are just two examples from a multitude of physics topics that can be investigated by ALICE. Others include measurements of the global multiplicity and transverse energy, particle production in ultra-peripheral collisions, heavy-quark production, event-by-event fluctuations *etc.*

The Nordic groups have together outstanding expertise in advanced detector systems, trigger and read-out, and data processing. In the framework of this project, we could make a significant contribution to the development of next generation's detectors. There are several synergy effects which could be further exploited: *e.g.* GEM detectors are being developed both in Helsinki/TOTEM and in Lund/ILC+ALICE upgrade; 3D silicon detector development is ongoing in Uppsala, Oslo and Bergen for the ATLAS upgrade, and in Helsinki for TOTEM further stages and for ILC.

14.f. Work plan

The work plan includes **workshops, student training courses,** and **mobility**. We plan to organize workshops in which the research students and senior researchers report and discuss ongoing analyses and new ideas. In addition, the workshops include training courses and invited lectures. Experience from the Nordic LHC Network, with a similar work plan, proves that the model was working well and found to be fruitful: during 2000-2007 we arranged in total 14 workshops with about 30 training courses. Eight students benefited from the student exchange programme (2001-2005).

We foresee the following schedule for the workshops:

- Jan 2008 Spåtind – co-organized with Spåtind organization (Finland 2008)
- Summer 2008 Stockholm – co-organized with the Nordita programme "TeV-scale physics and Dark Matter"
- Spring 2009 Helsinki/St. Petersburg/Tallinn
- Jan 2010 Spåtind – co-organized with the Spåtind organization (Norway 2010)
- End 2010 Lund/Copenhagen/Odense

As can be seen from the layout of the workshops, we aim at reaching further synergies at the Nordic level by organizing part of the workshops together with other constellations of physicists. The biannual Spåtind meeting has been collecting Nordic particle physicists together since 1966, and the responsibility for organizing the workshop has been rotating among the four Nordic countries. Last time, in 2006, the workshop was co-organized jointly with Sweden and the LHC-physics network, which resulted in an outstanding scientific programme and good participation. Encouraged by the positive experience we plan to organize two of the workshops jointly with the Spåtind organization.

The recently approved Nordita programme "TeV-scale physics and Dark Matter" was initiated by the Nordic LHC network. The programme will last two months, June-July 2008. Several internationally distinguished theoreticians working on Beyond the SM phenomenology have agreed to form the core of the programme. In addition, a number of Nordic theoreticians will participate. The programme includes a workshop for both theorists and experimentalists, and we have agreed to organize the workshop jointly, if this project is approved.

The following research topics are anticipated to be the central ones in our workshops, although new ones might emerge:

- Supersymmetry (SUSY),
- New models: extra dimensions, black holes, unparticle physics, alternative dark matter candidates,…
- Higgs physics and extended Higgs-models,
- CP-violation in B-decays, rare B-decays, top-decays,
- QCD and Monte Carlo modelling,
- Jet-quenching and collective flow.

Our project will contribute to and follow carefully the general progress in theoretical physics, test the experimental feasibility of the new models, implement the theoretical ideas to analysis of experimental LHC data, and finally extract results. It is difficult to give exact time scales or work-package breakdowns for this kind of basic research. Nevertheless, work typically proceeds best in heterogeneous small working groups with complementary expertise including theorists and experimental experts of the key elements needed to extract the signal from the data.

Apart from the physics topics, the workshops are foreseen to contain sessions devoted to detector development and data analysis through NDGF. For the detector development this means presenting and discussing on-going work, planning of joint activities and sharing of resources, and planning of joint Nordic participation in the upcoming EU calls. Data processing issues related to NDGF are of practical nature, in need for technical discussions about sharing experience and best practices, and organizing hands-on tutorials.

Another central aspect of the project is training of research students by providing training-through-research, and up-to-date training courses spanning over a wide range of rapidly evolving topics. We plan to include **training courses** and **invited lectures** in connection to the workshops. In the past, these elements of the network workshops have been very popular and highly appreciated by the students, and also by the senior researchers. We will continue inviting top-class researchers to give pedagogical lectures of the latest research developments. Together these lectures make a unique collection of in-depth reviews of topical subjects. The lectures will be, along with all the presentations in the workshops, available through the project homepage for further use.

We plan to encourage and pursue **mobility** through researcher and/or research student exchange between the consortium nodes. Although it is difficult to arrange long-term visits, due to multiple commitments of the senior researchers, and due to tight schedules for the doctoral studies, shorter visits with a duration between one and two months are foreseen. In particular the groups from St. Petersburg and Tallinn will be given a priority in the exchange programme.

Dissemination of project results. Scientific results will be published in international scientific journals and international conferences. The project web-page will be used to inform about the project and its results. The work performed by the PhD students will be documented in their theses. Public outreach is a community duty for all research projects, also this one. Within our project we have extended experience in this area: E. Johansson of Stockholm has for several years led the ATLAS outreach group and chairs the EPS EPOG group. Many others, *e.g.* Oslo and Helsinki, have been active in outreach as well. We foresee to include an outreach component into the project, *e.g.* information aimed at the general public in our web-pages, public lectures in connection with the workshops *etc.*

14.g. Management and project organization

Coordination. The scientific responsibility of the project lies with the Steering Group, which consists of the coordinators (scientists in charge) of the participating groups. The project coordinator has the overall responsibility for the project execution and reporting. The Steering Group will meet about twice per year in order to monitor the progress of the project, to make decisions concerning the workshop programmes and visits, and to address eventual problems in the project should they arise. The Steering Group meetings will be organized in connection with the workshops, and by teleconferencing between them.

Management. The project is managed by the project coordinator. The project coordinator (P. Eerola) has a significant experience of research planning, project execution, budgeting and administration. She has been the main coordinator of the Nordic Research and Training Network on "Discovery Physics at LHC", supported by NorFA/NordForsk 2001-2005. The network was coordinated by a similar management structure and was found to work well. The practical financial issues are managed by a professional administrator at Lund (B. Wlosinska). Since the consortium consists of a fairly large number of groups, the financial administration has to be delegated out to the groups to the largest possible extent to avoid bottlenecks. This means that as much as possible of the funds will be distributed to each partner from the start, which facilitates the local management and financial planning, and allows each group to adapt the administrative procedures to national legislation and administrative praxis. Each node has a local coordinator plus professional administrator(s) for taking care of the use of funds, and providing necessary financial reports to the project coordinator.

h. In which way(s) will the project create "Nordic Strength"?

Nordic interest in research in this field. During the coming decade, LHC will be the largest research facility world-wide in the field of particle physics. LHC will thus have a central role in the emerging European Research Area. The CERN Council, in its function as international Science programme adviser for Particle Physics, has prepared a Strategy Document[3] which is part of the ESFRI Roadmap[4]. In the CERN Council Strategy Document, the top priorities for the European Particle Physics are:

- LHC*: "the highest priority is to fully exploit the physics potential of the LHC…"*
- A subsequent major luminosity upgrade (Super-LHC): *"R&D for machine and detectors has to be vigorously pursued now and centrally organized towards a luminosity upgrade by around 2015."*
- CLIC and neutrino facility: *"a coordinated programme should be intensified, to develop the CLIC technology and high performance magnets for future accelerators…"*
- ILC: *"there should be a strong well-coordinated European activity, including CERN, through the Global Design Effort, for its design and technical preparation towards the construction decision…"*

- European theoretical physics: "*Strong theoretical research and close collaboration with experimentalists are essential to the advancement of particle physics and to take full advantage of experimental progress; the forthcoming LHC results will open new opportunities for theoretical developments…*"

EU is already in the process of approving targeted R&D projects within the Capacities programme for LHC and super-LHC, ILC and neutrino facility, so EU is implementing the Strategy Document recommendations.

LHC is the main particle physics commitment in the Nordic countries for the coming decade, and all the experimental groups are involved in the LHC experiments. The Nordic countries have invested significant financial and intellectual resources into construction of the LHC detectors, data handling resources and physics pre-studies. Now when the harvest time is approaching, it is extremely important that the Nordic physicists are fully prepared to analyze the data and participate in the eventual discoveries.

Creating Nordic Strength. The Nordic high-energy physics groups are quite small, consisting typically of 5 to 10 researchers and a few students. The overall size of the Nordic high-energy physics community is at the average or below the average level[5]. One of the main goals of this project is to improve the situation by enhancing the training of current graduate students, by increasing the interest of Master's level students in high-energy physics, by pooling resources, and by facilitating mobility. The groups will also benefit from intra-Nordic collaboration by gaining more weight within large collaborations. Our overall goal is thus integrating the Nordic research community.

The Nordic LHC Physics Network has been acknowledged by all the participating groups as a very valuable way for creating joint research projects, training students, holding the physicists up-to-date of the new developments in the field, and, last but not least, creating social contacts between the groups and thus creating a truly joint research community, which has *e.g.* resulted in an increased recruitment of students, post-docs and faculty staff between the network partners.

Synergy with national and international activities. All the groups participating in this project have a strong support at the national level. In addition, research groups participating in experiments obtain funds from their national funding agencies for hardware investments in experiments, and for operational costs. Furthermore, many of the groups participate in or coordinate various EU-funded projects (Marie Curie programmes, R&D projects *etc.*). Through this project our goal is to give an additional boost to these activities by providing for a joint platform for research and training, which is well in line with the national priorities. All the groups are also typically collaborating with a large number of international research groups, within their respective experiments or otherwise. A Nordic platform can facilitate these cooperations by providing *e.g.* access to research instruments, computing tools, and research methods, and help in establishing new joint research programmes across the experiments' borderlines.

Integration of teams from North-West Russia and Estonia. In our consortium, we have research teams from St. Petersburg (RU) and Tallinn (EE). The team from St. Petersburg, member of the ALICE experiment, is a well-established, experienced research team, and from the research point of view the team is no less competent than the other teams. The tight financial situation, however, leads to problems for conducting research and training a new generation of researchers.

The Tallinn team, which includes both a theory group and an experimental group participating in CMS, is a relatively new emerging team in a country which does not have a long tradition in particle physics research. The team includes, on the other hand, young active physicists who have a large international experience. Our aim is to facilitate the Tallinn team to develop international research contacts, to enhance knowledge transfer, and to train a new generation of Estonian researchers.

Nordic work market. Our project will help in providing the researchers and students with cutting-edge skills in high-energy physics, and bringing the Nordic community closer together. Since the institutions of higher education in the Nordic countries will soon be suffering from a retirement wave, there is an urgent need for a new generation of experienced researchers to take over the responsibilities. This project will enhance the recruitment through joint projects and informal contacts. Furthermore, experience has shown that the skills acquired by young high-energy physicists are nowadays in great demand also in industry and commerce. We use methods applicable in other fields, ranging from advanced electronics to highly sophisticated theoretical modelling. The ability for both analytical thinking and practical problem solving, *e.g.* by using computer simulations, gives young researchers unique experience which is valuable for both basic research and applications for example in high-tech industry, information technology, and banking. There are also many examples of persons with a background in particle physics becoming successful entrepreneurs.

1. http://www.hep.lu.se/nlhc/
2. http://www.nordugrid.org/
3. http://council-strategygroup.web.cern.ch/council-strategygroup/Strategy_Brochure.pdf, July 2006.
4. ftp://ftp.cordis.europa.eu/pub/esfri/docs/pse-report-roadmap-wg-2006_en.pdf, October 2006.
5. "Survey of European Experimental Particle Physics", ECFA/RC/06/342/Rev.2, August 2006.

15 A detailed budget for the activity (a specification of point 11).
(Please note that a maximum of 10% may be used for administrative costs.)

Detailed budget

	2008	2009	2010
EXPENSES			
Salaries			
*Other	50 000	50 000	50 000
Salaries total	50 000	50 000	50 000
**Travel and accommodation	210 000	120 000	240 000
***Material (equipment)	50 000	50 000	50 000
****Other	10 000	10 000	10 000
*****Administration	35 500	25 600	38 900
TOTAL EXPENSES	355 500	255 600	388 900

*Salaries, other: 50 000 NOK per year. This is for arranging visits and exchanges between the consortium nodes. The groups from St. Petersburg and Tallinn will be given a priority in the exchange programme.

**Travel and accommodation: 120 000 NOK per workshop, divided in the following way.
"Normal" workshops, tentatively Workshop 1 spring 2009: Helsinki/St. Petersburg/Tallinn,
Workshop 2 end 2010: Lund/Copenhagen/Odense:
-organizer (invited speakers, lecture hall rent, other organization costs): 50 000 NOK
-to groups: 70 000 NOK shared by the Consortium groups.
Workshop jointly with Nordita/Stockholm:
-this workshop is co-organized and co-financed with the Nordita programme "TeV-scale physics and Dark Matter" during summer 2008 in Stockholm. Due to the co-financing, the organizers share has been reduced to 20 000 NOK. 70 000 NOK will be shared by the Consortium groups.
Spåtind workshops:
-these are co-financed and co-organized by the Nordic countries in rotating order, 2008 Finland, and 2010 Norway. This co-financing is typically obtained for inviting speakers, so therefore the organizers share has been reduced to 20 000 NOK. On the other hand, Spåtind is an expensive place for the participants since they are required to book full lodging. Therefore the groups' share has been increased to 100 000 NOK.

	2008	2009	2010
Workshops total	210 000	120 000	240 000
Spåtind org	20 000		20 000
Spåtind to groups	100 000		100 000
Stockholm, org	20 000		
Stockholm, groups	70 000		
Workshop 1, org		50 000	
Workshop 1, groups		70 000	
Workshop 2, org			50 000
Workshop 2, groups			70 000
Summary:			
To groups	170 000	70 000	170 000
To organizers	40 000	50 000	70 000

***Material (equipment): mainly smaller purchases for prototype material for the detector R&D work.

****Other: reserved for outreach activities, *e.g.* organizing public lectures, producing outreach material, *etc.*

*****Administration: central management paperwork, payments, reporting, mail *etc.*

16 Presentation of participating groups (maximum one page per group)
(you can copy this page)

Group leader's last name	First name	Sex	Position
Eerola	Paula	F	Professor

University	Academic degree
Lund University	PhD, docent
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Subject area (See last page)
Physics

Other participants in the group (use more space if necessary)

Last name	First name	Sex	Position
Boelaert	Nele	F	PhD student
Christiansen	Peter	M	Post-doc (forskarassistent)
Dobrin	Alex	M	PhD student
Gros	Philippe	M	PhD student
Groth-Jensen	Jacob	M	PhD student
Gustafsson	Hans-Åke	M	Professor
Hedberg	Vincent	M	Lecturer
Ji	Wei-Na	F	PhD student
Jönsson	Leif	M	Professor
Oskarsson	Anders	M	Lecturer
Smirnova	Oxana	F	Lecturer
Stenlund	Evert	M	Professor
Åkesson	Torsten	M	Professor

Description of the group and its activities

The research activities of the Division of Experimental High Energy Physics at the Lund University, relevant to this application, cover ATLAS and ALICE experiments at LHC, detector R&D for ILC, and Grid development.

Research topics we are pursuing in ATLAS in include physics beyond the Standard Model, and investigation of physics associated with the b-quark. The Lund group has designed and produced significant parts of the TRT read-out electronics. Lund is also involved in the ATLAS luminosity working group.

Our ALICE research topics include global observables, jet tomography to establish the composition of the jet, jet–jet and γ–jet correlations, and Onium production. Lund has developed and fabricated six integrated circuits for ALICE, including the delivery of 500k channels of readout electronics for the ALICE TPC.

Our current research efforts in the ILC/EUDET project are concentrated on the development and tests of read-out electronics for the central tracking detector TPC, as well as design of the front-end IC boards and performance tests. Furthermore Lund will contribute to the data acquisition system for both the test facility and the final system.

Lund has been actively involved in the Nordic Grid activities from the start. We are currently involved in NorduGrid project (technical coordination), NDGF (CERN Coordinator), KnowARC (project leader) and NGiN projects.

Together with the theoretical high-energy physics group in Lund we are the hosting the Lund-HEP EST graduate school, supported by the EU Marie Curie Mobility-2 programme.

16 Presentation of participating groups (maximum one page per group)
(you can copy this page)

Group leader's last name	First name	Sex	Position
Ekelöf	Tord	M	Professor

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Uppsala University	Professor

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Subject area (See last page)

Physics

Other participants in the group (use more space if necessary)

Last name	First name	Sex	Position
Brenner	Richard	M	Lecturer
Ingelman	Gunnar	M	Professor
Rathsman	Johan	M	Lecturer
Mahmoudi	Nazila	F	Postdoc
Bélanger-Champagne	Camille	F	Doctoral student
Coniavitis	Elias	M	Doctoral Student
Eriksson	David	M	Doctoral student
Flechl	Martin	M	Doctoral student
Stål	Oscar	M	Doctoral student

Description of the group and its activities

Phenomenology: Phenomenology of quarks and leptons and their fundamental strong and electroweak interactions as described in quantum field theories by the exchange of gluons and photon, W, Z, respectively. Our speciality is computer simulation of high energy particle physics processes, mainly in collider experiments but also in particle astrophysics.

ATLAS experiment: New fundamental particles, like the Higgs boson and Supersymmetric particles, are currently searched for in the D0 experiment at the Tevatron collider at Fermilab in Chicago and - from 2008 - in the ATLAS experiment currently in preparation at the future LHC collider at CERN in Geneva. Outstanding research issues are the origin of mass and the breaking of symmetry in nature. IKP contributes to the ATLAS detector with Silicon microstrip modules and Detector control systems and in the D0 and ATLAS data analysis with studies of the top quark and charged Higgs searches.

16 Presentation of participating groups (maximum one page per group)
(you can copy this page)

Group leader's last name	First name	Sex	Position
Hellman	Sten	M	Professor

University	Academic degree
Stockholm University	PhD

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106 91	Stockholm	Sweden	sten@physto.se

Subject area (See last page)
Physics

Other participants in the group (use more space if necessary)

Last name	First name	Sex	Position
Bergeås	Elin	F	PhD student
Bohm	Christian	M	Professor
Clement	Christophe	M	VR Researcher - Lecturer
Eriksson	Daniel	M	PhD student
Johansen	Marianne	F	PhD student
Johansson	Erik	M	Professor
Jon-And	Kerstin	F	Professor
Mermod	Philippe	M	Post-doc
Milstead	David	M	KVA Researcher - Lecturer
Moa	Torbjörn	M	Research engineer
Selldén	Björn	M	Lecturer
Silverstein	Samuel	M	Lecturer
Sjölin	Jörgen	M	Assistant professor (FoAss)
Åsman	Barbro	F	Professor

Description of the group and its activities

The SU group combines the skills of the Elementary Particle Physics and the System Instrumentation Physics groups. The most relevant of the groups activities are:

1) Search for (quasi)stable heavy particles and their characterisation,

2) Search for SUSY particles in the di-leptons plus jets channel by consideration of exclusive final states,

3) Generic search for beyond the standard model physics through inclusive studies of properites of events containing two leptons, jets and missing transverse energy,

4) Preparation of upgrade proposals in the hardware areas where we have our present activity, *i.e.* hadron calorimeter digitizing electronics and first level calorimeter trigger.

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Group leader's last name	First name	Sex	Position
Lund-Jensen	Bengt	M	Professor

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Subject area (See last page)
Physics

Other participants in the group (use more space if necessary)

Last name	First name	Sex	Position
Hansson	Per	M	PhD student
Grahn	Karl-Johan	M	PhD student

Description of the group and its activities

The KTH group is contributing to the ATLAS calorimetry, with a shared responsibility for the presampler. The main research topic is the search for physics beyond the standard model, especially supersymmetric particles. To obtain this goal, the group is furthermore studying hadronic calibration of the ATLAS calorimeter system.

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Group leader's last name	First name	Sex	Position
Sjöstrand	Torbjörn	M	Professor

University	Academic degree
Lund University	Ph.D.
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Subject area (See last page)
Physics

Other participants in the group (use more space if necessary)

Last name	First name	Sex	Position
Bijnens	Johan	M	Professor
Gustafson	Gösta	M	Professor
Lönnblad	Leif	M	University Lecturer
Carloni	Lisa	F	Graduate student
Corke	Richard	M	Graduate student
Flensburg	Christoffer	M	Graduate student
Lavesson	Nils	M	Graduate student
Lu	Jie	M	Graduate student

Description of the group and its activities

The Lund group in Particle Theory has a long and successful record of internationally recognized research in QCD phenomenology. Most essential have been models for the parton-hadron transition (the Lund string hadronization model) and resummation and approximation schemes for parton cascades, both for initial- and final-state radiation. These activities are complemented in a fruitful way by the study of flavour dynamics and its relation to QCD, including such topics as the understanding of hadronic decays and low-energy hadronic reactions. Our group has also been actively involved in the study of a wide range of physics topics within and beyond the Standard Model, in areas such as Higgs physics, supersymmetry and extra dimensions, where we make use of our expertise of QCD effects to provide a realistic understanding both of signal processes and of their backgrounds.

A necessary complement for comparisons with experiments has been the development of efficient Monte Carlo simulation programs that describe in detail all aspects of a collision process, with applications to different types of high-energy reactions. We have been pioneers in this new trend in physics. Our PYTHIA generator has been the program most used by experimentalists for LHC physics preparations.

Our group is well integrated in the international community, *e.g.* with participation in many workshop activities. We have members in two EU Marie Curie Research Training Networks, MCnet, dedicated to the development of the next generation of Monte Carlo event generators, and FLAVIAnet, dedicated to the high-precision study of flavour physics. Together with the experimental high-energy physics group in Lund we run the Lund-HEP EST graduate school supported by the EU Marie Curie Mobility-2 program. We have also been active participants in previous Nordic activities, like the NorFA/NordForsk-sponsored Nordic LHC Physics Network.

In summary, all group members share a common interest in the physics that will come out of LHC, from the early tests of minimum-bias physics to the hoped-for discoveries of new physics, and have the expertise to contribute to this exploration, not least by a fruitful interaction with the experimental groups in the Nordic countries.

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Group leader's last name	First name	Sex	Position
Ould-Saada	Farid	M	Professor

University	Academic degree
Oslo	Ph.D.

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0316	Oslo	Norway	Farid.ould-saada@fys.uio.no

Subject area (See last page)
Physics

Other participants in the group (use more space if necessary)

Last name	First name	Sex	Position
Read	Alex	M	Professor
Bugge	Lars	M	Professor
Stapnes	Steinar	M	Professor
Buran	Torleiv	M	Professor
Tveter	Trine Spedstad	F	Professor
Løvhøiden	Gunnar	M	Professor
Bravina	Larissa	F	Professor
Skaali	Bernhard	M	Professor
Pylypchenko	Yuriy	M	Post-doc
Røhne	Ole	M	Post-doc
Samset	Bjørn	M	Post-doc
Taga	Adrian	M	Post-doc
Cameron	David	M	Post-doc
Nyiri	Agnes	F	Post-doc
Zabrodin	Eugen	M	Post-doc
Milosevic	Jovan	M	Post-doc
Pajchel	Katarina	F	Ph.D. Student
Lund	Esben	M	Ph.D. Student
Jon K. Nilsen	Ole	M	Ph.D. Student
Frågåt	Thomas	M	Ph.D. Student
Arsene	Ionut C.	M	Ph.D. Student
Tywoniuk	Konrad	M	Ph.D. Student
Aamodt	Kenneth	M	Ph.D. Student
Hille	Per Thomas	M	Ph.D. Student

Description of the group and its activities

The University of Oslo (UiO) is involved in 4 High Energy Physics-related activities.

The project “High Energy Particle Physics project (HEPP)”, lead by UiO, is active in the ATLAS experiment at LHC: SiliCon Tracker (SCT), Software and Grid development, and physics analysis related to symmetry breaking (Higgs), extra symmetries (supersymmetry, new gauge bosons) and extra dimensions (gravitons, microscopic black holes).

The High Energy Nuclear Physics (HENP) project takes part in the ALICE heavy-ion experiment: Photon detector (PHOS), Software development, and physics analysis related to signals from the early stages of the HI collisions, in particular anisotropic flow, jets and electromagnetic signals.

The Instrumentation in High Energy Nuclear and Particle Physics (IHENPP) project, lead by UiO, is involved in design and processing of 3D silicon sensors (with SINTEF-Norway), develops corresponding electronics and participates in R&D for a novel linear collider concept at CERN, CLIC.

Finally, UiO plays a leading role in several Grid projects: NorduGrid, KnowARC, NGIn, NGN, and the Nordic Data Grid Facility (NDGF).

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Group leader's last name	First name	Sex	Position
Lipniacka	Anna	F	Professor

University	Academic degree
Bergen	dr. philos. , docent

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Subject area (See last page)

Physics

Other participants in the group (use more space if necessary)

Last name	First name	Sex	Position
Eigen	Gerald	M	Professor
Stugu	Bjarne	M	Professor
Sandaker	Heidi	F	postdoctor
Buanes	Trygve	M	PhD student
Tonoyan	Arshak	M	PhD student

Bergen group is active in ATLAS and in R&D for ILC detectors – CALICE calorimeter. It collaborates closely with microelectronics research group at the Department (detectors). The group has taken part in tests and assembly of the ATLAS silicon detector and it is now active in commissioning. Activities related to test of 3d silicon detectors for LHC upgrade are starting.

The most relevant group activities are:
1) tau reconstruction with ATLAS detector.
2) search for supersymmetry with taus and reconstruction of masses of supersymmetric particles.
3) generic search for Dark Matter production in ATLAS in channels with taus and missing energy.
4) top quark charge mesurement and search for top production in t→Wb→ tau nu b channel.
5) b-physics , rare B decays, related studies of muon trigger and muon reconstruction in ATLAS.
6) cosmic ray studies for educational purpose.

16 Presentation of participating groups (maximum one page per group)
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Group leader's last name	First name	Sex	Position
Nystrand	Joakim	M	Professor

University	Academic degree
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Allegaten 55	555 89440

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Subject area (See last page)
Physics

Other participants in the group (use more space if necessary)

Last name	First name	Sex	Position
Röhrich	Dieter	M	Professor
Kanaki	Kalliopi	F	Postdoc
Richter	Matthias	M	Ph.D. student
Bablok	Sebastian	M	Ph.D. student
Larsen	Dag Toppe	M	Ph.D. student
Øvrebekk	Gaute	M	Ph.D. student
Aamodt	Kenneth	M	Ph.D. student

Description of the group and its activities

The main activity in the group during the next decade will be focussed on the ALICE experiment at the LHC. The group is responsible for the High-Level Trigger in ALICE (jointly with the University of Heidelberg), and has made significant contributions to the development of the read-out electronics for the ALICE Time-projection Chamber and Photon spectrometer. The group is also trying to develop a program for ultra-peripheral collisions within ALICE. The initial data analysis will be focussed on ultra-peripheral collisions, production of anti-nuclei, and jet-shape modifications in central nucleus-nucleus collisions. The group has a strong collaboration with the microelectronics group at the Department of Physics and Technology at the University of Bergen.

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Group leader's last name	First name	Sex	Position
Helstrup	Håvard	M	Professor

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Subject area (See last page)
Physics

Other participants in the group (use more space if necessary)

Last name	First name	Sex	Position
Hetland	Kristin Fanebust	F	Associate Professor
Kileng	Bjarte	M	Associate Professor
Røed	Ketil	M	Ph.D. Student

Description of the group and its activities

The group is involved in ALICE analysis at several levels, spanning from development of electronics for the TPC detector to grid computing activities. The group also takes active part in TPC calibration and analysis.

The activity at Bergen University College is organised in close collaboration with the Nuclear Physics Group at Department of Physics and Technology at University of Bergen. The Department of Computing at Bergen University College has recently started a master degree programme in applied program development. Several such projects have also been organised connected to ALICE activities.

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Group leader's last name	First name	Sex	Position
Osland	Per	M	Professor

University	Academic degree
Bergen	dr. philos.

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Subject area (See last page)
Physics

Other participants in the group (use more space if necessary)

Last name	First name	Sex	Position
El Kaffas	Abdul Wahab	M	PhD student
Vereshagin	Alexander	M	PhD student
Hassanabadi	Hassan	M	PhD student
Raklev	Are Reinert	M	postdoctor

Description of the group and its activities

The research activities of the particle theory group in Bergen are focused on Beyond-Standard-Model phenomenology. Of particular interest are supersymmetric phenomenology, CP violation, extra dimensions, studies of extended Higgs sectors and alternative dark-matter candidates. The group has an extensive network of external collaborators.

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Group leader's last name	First name	Sex	Position
Hansen	Peter	M	Associate Professor

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Copenhagen	PhD

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Subject area (See Last Page)
Physics

Other participants in the group (use more space if necessary)

Last name	First name	Sex	Position
Dam	Mogens	M	Associate Professor
Dines Hansen	Jørn	M	Professor
Renner Hansen	John	M	Professor
Xella Hansen	Stefania	F	Assistant Professor
Beck Hansen	Jørgen	M	Assistant Professor
Mackeprang	Rasmus	M	Phd Student
Klinkby	Esben	M	Phd Student
Czyczula	Zofia	F	Phd Student
Facius	Katrine	F	Phd Student

Description of the group and its activities

The group carries the responsibility for experimental particle physics in Denmark and also coordinates the overall Danish activities at CERN. It has four permanent university positions, four temporary positions, four PhD and six master students. The main research activities of the group are in the following areas:

1) Electronics and software for the ATLAS Transistion Radiation Tracker
2) The second level tau-trigger at ATLAS
3) Higgs search in the tau channel with ATLAS
4) Standard model measurements (*e.g.* W mass, pdf's, α_S) at ATLAS
5) SUSY and exotica searches (*e.g.* R-hadrons, mini black holes) at ATLAS
6) Cosmic rays studies for educational purposes

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Group leader's last name	First name	Sex	Position
Gaardhøje	Jens Jørgen	M	Professor

University	Academic degree
University of Copenhagen	Dr. Sc.
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Subject area (See last page)
Physics

Other participants in the group (use more space if necessary)

Last name	First name	Sex	Position
Bearden	Ian	M	Lektor
Bøggild	Hans	M	Lektor
Christensen	Christian Holm	M	Postdoc
Nielsen	Børge	M	Lektor
Guldbrand	Kristjan	M	Postdoc
Larsen	Truls Martin	M	PhD student
Ristea	Catalin	F	PhD student

Description of the group and its activities

The High Energy Heavy Ion (HEHI) group at the Niels Bohr Institute studies ultrarelativistic heavy ion collisions at RHIC and CERN.

The group has had a leading role in the BRAHMS experiment at RHIC and has contributed with detector hardware and physics analysis. J.J. Gaardhøje from NBI is deputy spokesman of the experiment. The physics activities at RHIC have concentrated on particle multiplicities, jet suppression, nuclear stopping and single particle spectra over a large rapidity range. The RHIC physics program has led to the identification of the strongly interacting QGP (sQGP).

The group is now building the forward multiplicity detector (a 50000 channel Si-strip detector) and the laser calibration system for the ALICE detector at LHC- CERN. AT LHC the group will study particle multiplicities, elliptic flow, jet quenching and effects related to the color glass condensate. JJG is project leader of the forward detectors in ALICE and Hans Bøggild is deputy collaboration chair. Both are part of the ALICE management board. Ian Bearden is the groups computing representative in the ALICE computing board.

16 Presentation of participating groups (maximum one page per group)
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Group leader's last name	First name	Sex	Position
Sannino	Francesco	M	Professor

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Subject area (See last page)
Physics

Other participants in the group (use more space if necessary)

Last name	First name	Sex	Position
Dietrich	Dennis	M	Assistant Professor (DK)
Kouvaris	Chris	M	Post Doc (DK)
Järvinen	Matti	M	Post Doc (DK)
Foadi	Roshan	M	Post Doc (DK)
Frandsen	Mads	M	PhD Student (DK)
Ryttov	Thomas	M	PhD Student (DK)
Heikinheimo	Matti	M	Graduate Student (FIN)
Karavirta	Tuomas	M	Graduate Student (FIN)
Kähärä	Topi	M	Graduate Student (FIN)
Tuominen	Kimmo	M	Senior Assistant (FIN)

Description of the group and its activities

The nordic particle physics group described above contains the one in Odense (DK) and the one in Jyväskylä (FIN). The extended group is represented by Dennis Dietrich, Francesco Sannino and Kimmo Tuominen at the faculty level and by many very young and active researchers. We have a very high international scientific profile having held research positions or studied at prestigious universities or research labs such as Yale, CERN, MIT, Heidelberg and NORDITA. We are also strong at the European level, given that Sannino is the winner of the prestigious EU commission Excellence Grant.

We are involved in various topics in particle physics phenomenology. Our interests range from the development of new and sensible extensions of the Standard Model which will be tested at LHC to the study of the phase diagram of strongly coupled theories as function of temperature, density and fermionic representation. We are also involved in the development of new tools and limits which will allow us to gain a better understanding of strong dynamics. These tools wil be relevant for gaining a deeper understanding of the new results from LHC, for beyond standard model physics, and for the status of matter in extreme conditions investigated at RHIC in US and the and ALICE at LHC. Our results are also interesting to cosmology since we have been able to suggest new Dark Matter candidates.

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Group leader's last name	First name	Sex	Position
Di Vecchia	Paolo	M	Professor

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Nordita	Italian Dottore in physics

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Subject area (See last page)

Physics

Other participants in the group (use more space if necessary)

Last name	First name	Sex	Position

Description of the group and its activities

Construction of string models that contain the Standard Model by means of intersecting and magnetized branes and the study of non-perturbative effects that could be detected in future experiments at LHC.

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Group leader's last name	First name	Sex	Position
Huitu	Katri	F	Professor

University	Academic degree
University of Helsinki	PhD

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Subject area (See last page)
Physics

Other participants in the group (use more space if necessary)

Last name	First name	Sex	Position
Chaichian	Masud	M	Professor
Honkavaara	Tuomas	M	Grad student
Rai	Santosh Kumar	M	Scientist
Ruppell	Timo	M	Grad student
Tiitola	Paavo	M	Grad student
Tureanu	Anca	F	Scientist

Description of the group and its activities

The group consists of theoreticians working on the Beyond the Standard Model phenomenology. The theoretical frameworks mostly used in the studies are supersymmetric models, models with extra dimensions, and models with extended gauge structure.

Members of the group have extensive experience on electroweak symmetry breaking physics, including exotic Higgs sectors. For example, models where the Higgs boson is mixed with other neutral scalars (radion of extra dimensions, supersymmetric partner of neutrino, extra Higgses due to additional properties like spontaneous CP or R-parity violation), or where the Higgs boson has other nonstandard properties, like double charge, have been studied.

Supersymmetry phenomenology in general is another long term research line in the group. These studies include signals of particular supersymmetry breaking methods and other phenomenology of interest.

Also noncommutative gauge theories are under study in the group, special interest in this respect is consequences of noncommutative standard model.

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Group leader's last name	First name	Sex	Position
Orava	Risto	M	professor

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PL64	

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Subject area (See last page)
Physics

Other participants in the group (use more space if necessary)

Last name	First name	Sex	Position
Österberg	Kenneth	M	University lecturer
Van Remortel	Nick	male	Research Assistant
Kurvinen	Kari	M	Detector physicist
Garcia	Francisco	M	Research Associate
Brucken	Erik	M	PhD student
Hilden	Timo	M	PhD student
Kallikoski	Matti	M	PhD student
Oljemark	Fredrik	M	PhD student
Ottela	Mikael	M	PhD student

Description of the group and its activities

The Helsinki TOTEM group is responsible for the construction, testing and operating of the T2 spectrometer of the TOTEM experiment, forward physics planning and simulation tasks (physics coordination) and has a central role in forward proton simulation.
The Helsinki CDF group, on the other hand, is responsible for top quark mass measurement in the all hadronic decay channel and for the operation of the CDF vertex detector (svx).

The group has produced 25 PhD's since 1990, now has 8 PhD students (Tuula Mäki, Petteri Mehtälä, Timo Aaltonen in Helsinki CDF group and Erik Brucken, Timo Hilden, Fredrik Oljemark, Mikael Ottela and Matti Kallikoski in Helsinki-TOTEM group).
The Helsinki TOTEM group actively develops new detector techniques, both gas amplified detectors such as GEM (Gas Electron Multiplier) and semiconductor detectors such as 3D silicon detector structures.

16 Presentation of participating groups (maximum one page per group)
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Group leader's last name	First name	Sex	Position
Tuominiemi	Jorma	M	Programme Director, professor

University	Academic degree
Helsinki Institute of Physics	Docent
Department/Institution	Telephone (work)
CMS Programme	+358-9-191 50566
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Gustaf Hällströminkatu 2B	358-9-191 50522

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Subject area (See last page)
Physics

Other participants in the group (use more space if necessary)

Last name	First name	Sex	Position
Karimäki	Veikko	M	Project leader
Kinnunen	Ritva	F	Senior scientist
Lehti	Sami	M	Senior scientist
Kortelainen	Matti	M	PhD student
Wendland	Lauri	M	PhD student

Description of the group and its activities

The group forms the nucleus of the CMS Physics Analysis Project of the CMS Programme at the Helsinki Institute of Physics. Its main research topic is the search for the Standard Model and Minimal Supersymmetric Model Higgs bosons with the CMS experiment at the LHC.

The group has been contributing to the studies of CMS discovery potential from the very beginning of the CMS project at CERN. It has developed algorithms and tools for physics analysis in CMS as well as core reconstruction software of the experiment.

At present it has two PhD students working on the the MSSM Higgs search in CMS. The group has been participating many years in the Nordic network for LHC physics.

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Group leader's last name	First name	Sex	Position
Rak	Jan	M	Senior Scientist

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HIP and University of Jyväskylä	Ph.D.

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Subject area (See last page)
Physics

Other participants in the group (use more space if necessary)

Last name	First name	Sex	Position
Trzaska	Wladyslaw H.	M	Senior Scientist
Kim	Dong Jo	M	Post Doc
Malkiewicz	Tomasz	M	Ph.D. student
Diaz Valdes	Rafael	M	Ph.D. student
Alho	Timo	M	Ph.D. student
Nivitzky	Norbert	M	Ph.D. student

Description of the group and its activities

Our group is participating in construction, operation and data analysis of ALICE experiment. We have the main responsibility for the trigger and fast timing detector T0 and for bonding of silicon tracker components. Presently the main focus of our work is shifting towards exploration of the hard scattering physics in p+p and Pb+Pb collisions by use of two-particle, direct photons and jet correlations methods. We look for parton properties and their modifications induced by strongly interacting excited nuclear matter.

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Group leader's last name	First name	Sex	Position
Raidal	Martti	M	Senior researcher

University	Academic degree
National Institute of Chemical Physics and Biophysics	Ph.D.
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Subject area (See last page)
Physics

Other participants in the group (use more space if necessary)

Last name	First name	Sex	Position
Hektor	Andi	M	researcher
Kadastik	Mario	M	researcher
Kajiyama	Yuji	M	researcher
Kannike	Kristjan	M	researcher
Koshik	Oleg	M	graduate student
Livenson	Ilja	M	student
Muentel	Mait	M	researcher
Rebane	Liis	F	researcher

Description of the group and its activities

The research interests of the theory group of NICPB are closely related to the ones of the theory division of CERN. The topics of interest are sypersymmetric phenomenology, neutrino masses, leptogenesis, dark matter and little Higgs models. The main emphasis is put on finding relations between those observables in models beyond the Standard Model. This research is related to the CERN study ”Flavour in the Era of LHC”. In particular the group works on the extensions of the Standard Model which have measurable predictions for the LHC experiments. The group has strong ties with the CMS Collaboration since the group leader is also a leader of Estonian CMS experimental group at CERN. Examples of theory topics worked out in the NICPB theory group and later studied by the NICPB CMS group include studies of neutrino mass mechanisms in the little Higgs models which are directly testable at LHC.

The CMS group of NICPB represents Republic of Estonia at CERN. The group consists of relatively young physicists who started to contribute the the CMS physics analyses just few years ago. The groups research interests include searches for the signals of little Higgs models and probing the supersymmetric parameter space consistent with Dark Matter at CMS experiment. The group participates actively in the development of Grid computig facilities and participates in CERN Computing Software Analyses Challenges which test the readiness of LCG for the CMS data analyses.

16 Presentation of participating groups (maximum one page per group)
(you can copy this page)

Group leader's last name	First name	Sex	Position
Feofilov	Grigory	M	Head of Laboratory of Ultra-High Energy Physics

University	Academic degree
St.Petersburg State University	PhD
Department/Institution	Telephone (work)
Theoretical Department/V.Fock Institute of Physics	007-812-4284548
Dept. address	Telefax (work)
Ulyanovskaya str.,1, Petrodvorets	007-812-4287240

Postal code	City	Country	E-mail
19850	St.Petersburg	Russia	feofilov@hiex.phys.spbu.ru

Subject area (See last page)
Physics

Other participants in the group (use more space if necessary)

Last name	First name	Sex	Position
Vechernin	Vladimir	M	Leading sci.res. (Dr.Sci 2006)
Kolevatov	Rodion	M	Juniour scientific researcher
Asryan	Angei	M	Juniour scientific researcher
Vinogradov	Leonid	M	Seniour sci.res. (PhD 1973)
Kondratiev	Valeriy	M	Seniour sci.res.(PhD 1985)
Valiev	Farhat	M	Sci.researcher (PhD 2000)
Kolojvari	Anatoliy	M	Sci.researcher
Zarochentsev	Andrey	M	Leading programmer
Nauomenko	Petr	M	Leading programmer (PhD 2006)
Igolkin	Serguey	M	Leading engineer
Derkach	Denis	M	PhD student
Ivanov	Andrey	M	PhD student

Description of the group and its activities

1. SPbSU team is participating since 1992 in the experimental and theoretical preparations for ALICE at the LHC at CERN. In 1992-2001 it was coordinating the R&D on two central ALICE subsystems (ITS-CMA and FMD-MCP). Since 1996 the team was a participant of the NA57 experiment at SPS at CERN, it is also currently a member of NA61 collaboration at CERN. All experiments are in line with the main scientific interest of the SPbSU team: a search for the long-range correlations (LRC) as a manifestation of string fusion phenomenon in ultra-relativistic hadron collisions at high and ultra-high energies. Event-by-event studies of LRC between multiplicities, the multiplicity and transverse momentum and between the transverse momenta of charged particles can be an indication of onset of the new physical phenomenon of color string fusion. Theoretical and experimental studies of string fusion may produce the new information on the very early stage of quark-gluon plasma formation. Analysis of long-range correlations induced by strong interaction dynamics and saturation of parton densities on the basis of the experimental data is a task that requires special attention both from theoretical and experimental points of view. Therefore the joint efforts of experimentalists and theoreticians are necessary in these studies.
2. Since 2006 the research experimental and theoretical work in SPbSU is performed by the newly formed Laboratory of Ultra-High Energy Physics with the participation of teachers and students of the Faculty of Physics. Currently the team is supported by the grant #1547 of the Ministry of Education and Science, RF, that is limited in 2007 to the basic salaries (continuation of this grant is expected in 2008)..
3. The activity of SPbSU team includes the following directions in 2007 and in the coming years 2008-2011:
   (i) participation in the experimental programs of ALICE at the LHC and NA61 at the SPS, CERN;
   (ii) preparation of the Physical Program for ALICE and development of some theoretical aspects of ultra-relyativistic heavy-ion collisions (including LRC percolation model analysis, multi-Pomeron exchange model with collectivity for pp interactions, analysis of performance and modification of some HEP event generators like PYTHIA, HIJING, PSM and development of the new MC model codes)
   (iii) development of the AliRoot- (and ROOT-) based software for the event-by-event analysis of the long-range correlations in pp, pA and AA collisions using ALICE and NA61 experimental data and search for LRC.
4. SPbSU team has a long-term experience in coordination of international scientific grants in the framework of the ISTC and INTAS programs: ISTC#345, ISTC$1666, ISTC#1999 and CERN-INTAS#542 (in 1996-2003). SPbSU was also participating in 2004 – 2006 in the international program "Nordic Grid Neighbourhood" http://www.nicpb.ee/NordicGrid/), coordinated by the Oslo University, and in the VISBY program, coordinated by the Lund University. NGN and VISBY programs had a strong impact on the applications of GRID in SPbSU. HEP packages like GEANT, FLUKA, ROOT as well as the new MC model simulation codes developed by SPbSU were already successfully tested using such GRID platforms like LCG, AliEn, gLite, NorduGrid/ARC. Active cooperation with the Nordic Grid Neighbourhood program provided an efficient stimulus for the SPbSU team progress both in the support and running of the SPbSU GRID-cluster and in preparations towards the LHC data future analysis. It has formed also the base for some other possible joint applications like 'GRID for the Hadron Therapy' (see "ENLIGHT++ " http://www.cern.ch/enlight/).

Confirmation by the Main Applicant (Project Leader) **I hereby assure that the information I have presented in this application is correct and that all facts essential for the processing of the application have been included. I assure that the institutions hosting the research teams included in this application have been informed about the "Joint Nordic use of Research Infrastructure" call and this application. I also confirm that the Project Manager has accepted to administer the grant according to NordForsks rules and conditions.**		☒
Last name Eerola	First name Paula	Date dd.mm.yyyy 31.08.2007

All information must be included in this application form and submitted as one PDF file; appendices are not accepted.

The application must reach NordForsk no later than 4th of September, 16.00 hours. (Norwegian time)
NordForsk´s general guidelines for applicants
NordForsk´s standard terms and conditions of contract

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Subject area

Humanities

- Language, Linguistics
- History
- Folklore, Ethnology
- Music
- History of Art, Architecture
- Theology, Religion
- Literature
- Philosophy
- Archaeology
- Film and Theatre
- Culture
- Other and combined subjects

Social Studies

- Law
- Economics
- Economic Geography
- Sociology
- Political Science
- Social Anthropology
- Psychology
- Pedagogy
- Media and Communication
- Other and combined subjects

Mathematics / Natural Science

- Mathematics
- Physics
- Chemistry
- Earth Sciences
- Biology
- Informatics
- Other and combined subjects

Medical subjects

- Medicine (Basic)
- Paraclinical Sciences
- Clinical Medicine
- Clinical Odontology
- Psychiatry
- Social Medicine
- Other and combined subjects

Technology

- Mining, Ore and Oil Technology
- Building and Construction
- Electronic, Electric technologies
- Machine Technology and Mechanics
- Physical Technology
- Shipping Technology
- Materials Technology
- Fishing and Fisheries Technology
- Other related subjects

Agricultural Technology

- Farming and horticulture
- Forestry
- Livestock
- Alimentation