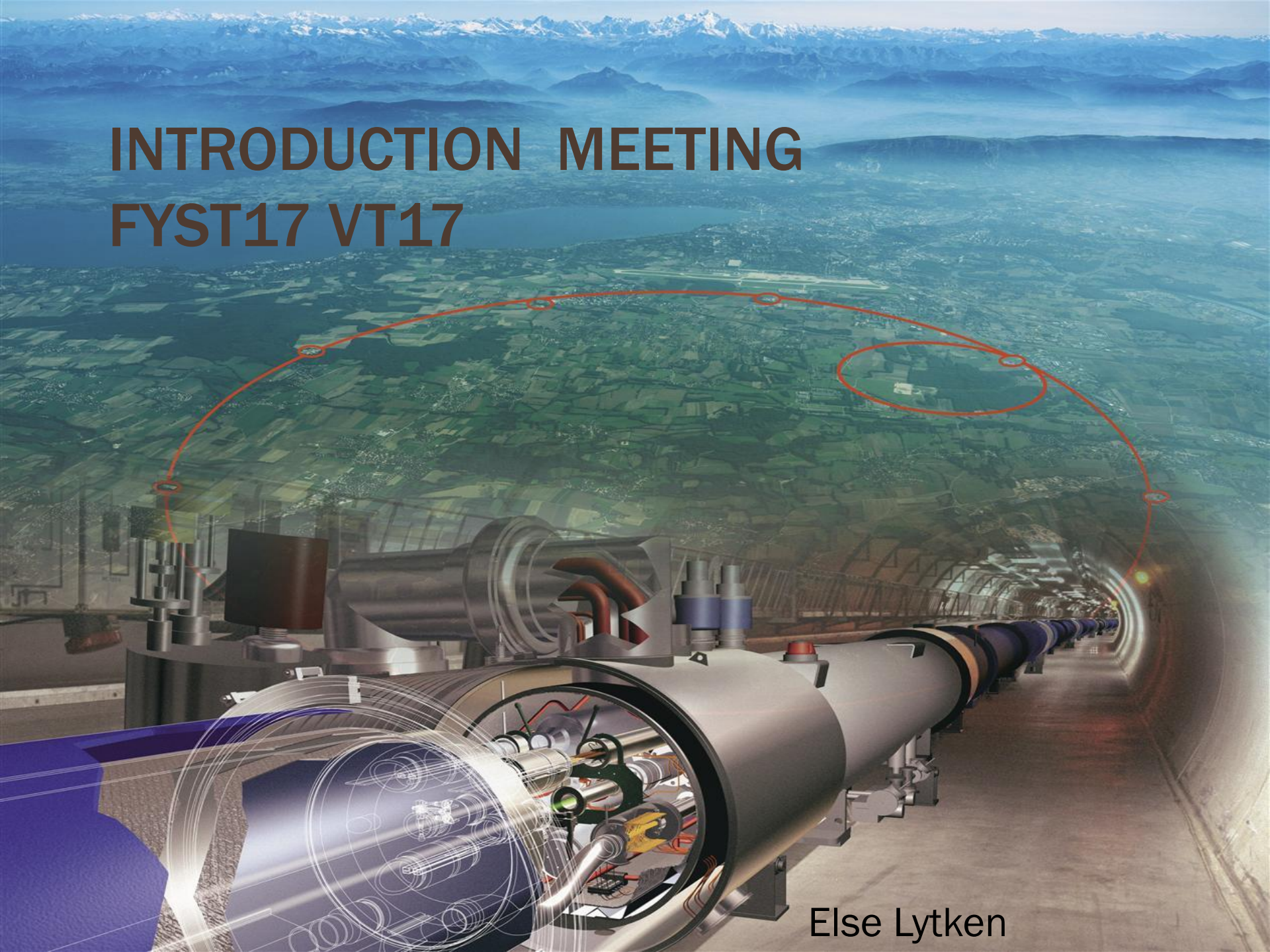


INTRODUCTION MEETING

FYST17 VT17



Else Lytken

TODAY'S AGENDA

- ✘ Learning outcomes and prerequisites
- ✘ Course plan
- ✘ Literature and lecturers
- ✘ Evaluation
- ✘ Introducing the Particle Physics division
- ✘ Summer schools
- ✘ Remaining questions

LEARNING OUTCOMES

- ✘ The purpose of this course is to provide advanced knowledge of current aspects of experimental particle physics
 - + Current status and challenges
 - + Experimental programs current and future
 - + Basic statistical methods in particle physics
- ✘ Students should also:
 - + Learn to acquire scientific knowledge, including reading scientific papers
 - + Improve their problem solving skills in the area
 - + Improve communication skills, both written and oral

PREREQUISITES

- ✘ Basic knowledge of quantum mechanics and four-vectors and relativistic mechanics
 - + More info on the homepage "Notes on particle kinematics, cross-sections etc"
- ✘ Basic knowledge of the Standard Model of particle physics
 - + For local students I presume you have taken the Physics 3 course FYSC14: High energy physics, accelerators and cosmology
 - + Other useful courses are FYSN11, 15 ; FYTN04, MNXB01

COURSE PLAN

- ✘ See detailed lecture schedule online
 - + More details on the Standard Model, Beyond the Standard Model, and experimental techniques
 - + Including special lectures on heavy ion physics and guest lecture on ESS
 - + Statistical tests and analysis examples
- ✘ 2 sets of written exercises
 - + SM physics, Heavy ion physics
- ✘ Student project work
 - + Read up on topic, present to rest of class + computer exercise

STUDENT PROJECTS

- ✗ Groups of ~4
- ✗ Day 1: Pick and read outreach level article (will be provided) and prepare short (< 5mins) presentation
- ✗ End of day 2: present to class
- ✗ Day 3: Computing exercise. Learn how ROOT notebooks work and then plot distributions from your article. (and more, if time allows)

LECTURE PLAN (PRELIMINARY)

Modern Experimental Particle Physics FYST17 S...

<http://www.hep.lu.se/courses/fyst17/schedule17.html>

Schedule Spring 2017

Modern Experimental Particle Physics FYST17

Date	Location	Topic	Lecturer
Mon, Jan 16	K262	Introductory meeting	E. Lytken
Wed, Jan 18	K262	The Standard Model I	E. Lytken
Thu, Jan 19	H322	The Standard Model II	E. Lytken
Mon, Jan 23	K262	Neutrinos	E. Lytken
Wed, Jan 25	K262	Detectors I	E. Lytken
Thu, Jan 26	H322	Detectors II	E. Lytken
Mon, Jan 30		No lecture	
Wed, Feb 1	K262	LHC Physics I	E. Lytken
Thu, Feb 2	H322	LHC Physics II Deadline PP exercises	E. Lytken
Mon, Feb 6	K262	MC + Simulation	E. Lytken
Wed, Feb 8	K262	PP exercises back	E. Lytken
Thu, Feb 9	H322	Statistics: fitting and hypothesis testing	E. Lytken
Mon, Feb 13	K262	Statistical methods in particle physics/td>	E. Lytken
Wed, Feb 15	K262	The Higgs discovery	E. Lytken

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Modern Experimental Particle Physics FYST17 S...

<http://www.hep.lu.se/courses/fyst17/schedule17.html>

Thu, Feb 16	H322	Beyond the SM I	E. Lytken
Mon, Feb 20	K262	Beyond the SM II	E. Lytken
Wed, Feb 22	K262	Heavy Ion Physics I	P. Christiansen
Thu, Feb 23	H322	Heavy Ion Physics	P. Christiansen
Mon, Feb 27	K262	The Cosmic connection	E. Lytken
Wed, March 1	K262	Backup/overflow	E. Lytken
Thu, March 2	H322	Student work	C. Doglioni, E. Lytken
Mon, Mar 6	K262	Student presentations	C. Doglioni, E. Lytken
Wed, Mar 8	K262*	Project work	C. Doglioni
Thu, Mar 9	H322	ESS lecture	E. Laface

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IMPORTANT DATES

- ✘ Lectures Mon-Wed-Thu 13:15 to 15:00 starting this Wednesday.
 - + Mon, Wed: K262
 - + Thu: H322
- ✘ Feb 02: turn in of first HW
- ✘ March 2-8: project work
- ✘ March 9: ESS guest lecture
- ✘ March 14: hand-out exam
- ✘ March 16: hand-in exam

LITERATURE

- ✘ Main material covered in G. Barr et al. "Particle Physics in the LHC Era", Oxford Masters Series in Particle Physics, 2016
- ✘ Additional literature: chapters 3, 8, and 10 in "Data analysis in high energy physics: a practical guide", O. Bahnke et al
- ✘ e-book links on homepage
- ✘ Additional lecture notes/material will be distributed at the lectures
- ✘ Slides will be posted on the homepage of course

LECTURERS

Main responsible: Else Lytken

Office A426, Else.Lytken@hep.lu.se



Peter Christiansen



Lecturer
Heavy ion
physics

Caterina Doglioni



Instructor
project
work

Emanuele Laface



Lecturer
ESS

EVALUATION

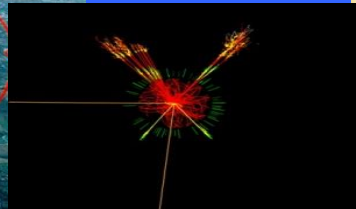
- ✘ FYST17 gives 7.5 ECTS credits
- ✘ **Final exam** is a take-home written exam, will be passed out March 14 (tentatively) and turn-in date is March 16 (tentatively). *It must be the work of the individual student, no collaboration*
- ✘ **Homework:** *must* be passed before examination. PP and HI homework grade counts as 20% in the final grade. Collaboration on ideas allowed but each student should write down individual solutions
- ✘ **Project work** *must* be passed before final examination. P/NP grade . Talk to me in advance for alternatives if you think this could be a problem for you

CERN Summer Student Programme 2017

ELEMENTARY PARTICLES

Leptons	Quarks	u	c	t	γ
		d	s	b	g
		ν_e	ν_μ	ν_τ	Z
		e	μ	τ	W
		I	II	III	

Three Generations of Matter



Apply to experience CERN first-hand !

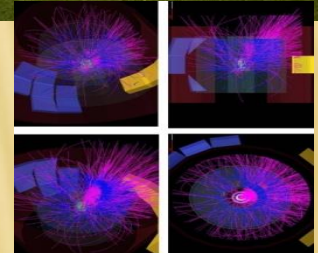
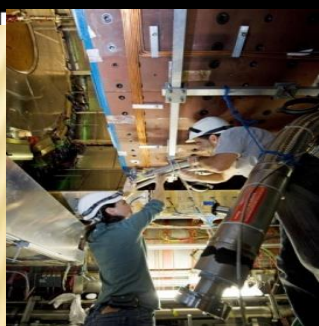
Participants in the CERN Summer Student programme join research activities and have lectures about particle physics from gifted lecturers

Every Summer about 100 students from around the world come to CERN as Summer students, to learn about fundamental physics, participate in research, enjoy the location near Geneva on the border of France and Switzerland, and to form new friendships.

Places are awarded on a competitive basis, to students who have finished the first years of their university education that Summer (typically bachelor in Science/engineering/computer science)

Application deadline is 27 January 2017

Travel + generous stipends paid
8-13 weeks in the
Summer of 2017



SUMMER STUDENT PROGRAMS

- ✘ Both CERN and DESY labs have summer student programs – find programs online
- ✘ Deadline every January – next deadlines are 27/1 (CERN) and 31/1 (DESY)
- ✘ Need letters of recommendation
 - + Preferably from project supervisors – not necessarily particle physicists.
- ✘ Intended for university students in physics, engineering, and computer science
- ✘ You need at least 3 years of university studies and a good knowledge of English
- ✘ CERN: Preference for students from CERN member states

CERN researchers



THE LUND PARTICLE PHYSICS DIVISION

Mainly involved in the LHC experiments ALICE and ATLAS but also in the design of new experiments and e-Science

Come to the A400 corridor and ask about possible projects!

Quark-gluon plasma (ALICE@LHC)

Colliding heavy ions to explore nuclear matter under extreme temperatures and densities.

- Recreating the Quark-Gluon Plasma state that existed shortly after the Big Bang
- Unique tracking and particle ID capabilities at the LHC

Searches for exotic particles and interactions (ATLAS@LHC)

- Strong gravity effects
- New heavy particles
- Supersymmetry
- Extra dimensions of space
- Flavor/CP violation
- Dark matter
- Additional Higgs bosons

to help us understand the workings of our Universe

Strategies:

- Jet mass and angular distribution (The LHC "Rubberford" experiment)
- Kinematic edges and resonance searches
- Multilepton and same-sign dilepton searches

Detector development and future accelerators

ATLAS-LUCID

- Luminosity monitor
- Leadership
- Analysis & Performance

ATLAS Transition Radiation Tracker

- Electronics
- Calibration & software

ALICE TPC

- Electronics
- Monitoring & software
- Analysis

Upgrade from MWPC's to GM's in 2015/16

Detector studies for future colliders

- Linear collider: Electronics + TPC
- Circular collider: Calorimeters

e-Science and computing

Lund e-Science group develops ARC - a software that:

- brings together many of the computing centers worldwide that contribute to LHC computing
- provides common interface to facilities of different kind like Linux clusters and supercomputers

IF YOU HAVEN'T SIGNED UP FOR THIS COURSE YET

- ✘ and want to, check with Tomas or Yvonne if it is possible

YOUR EXPECTATIONS

- ✘ What is your background?
- ✘ Why (experimental) particle physics?
- ✘ What are some things you hope to learn from this course?