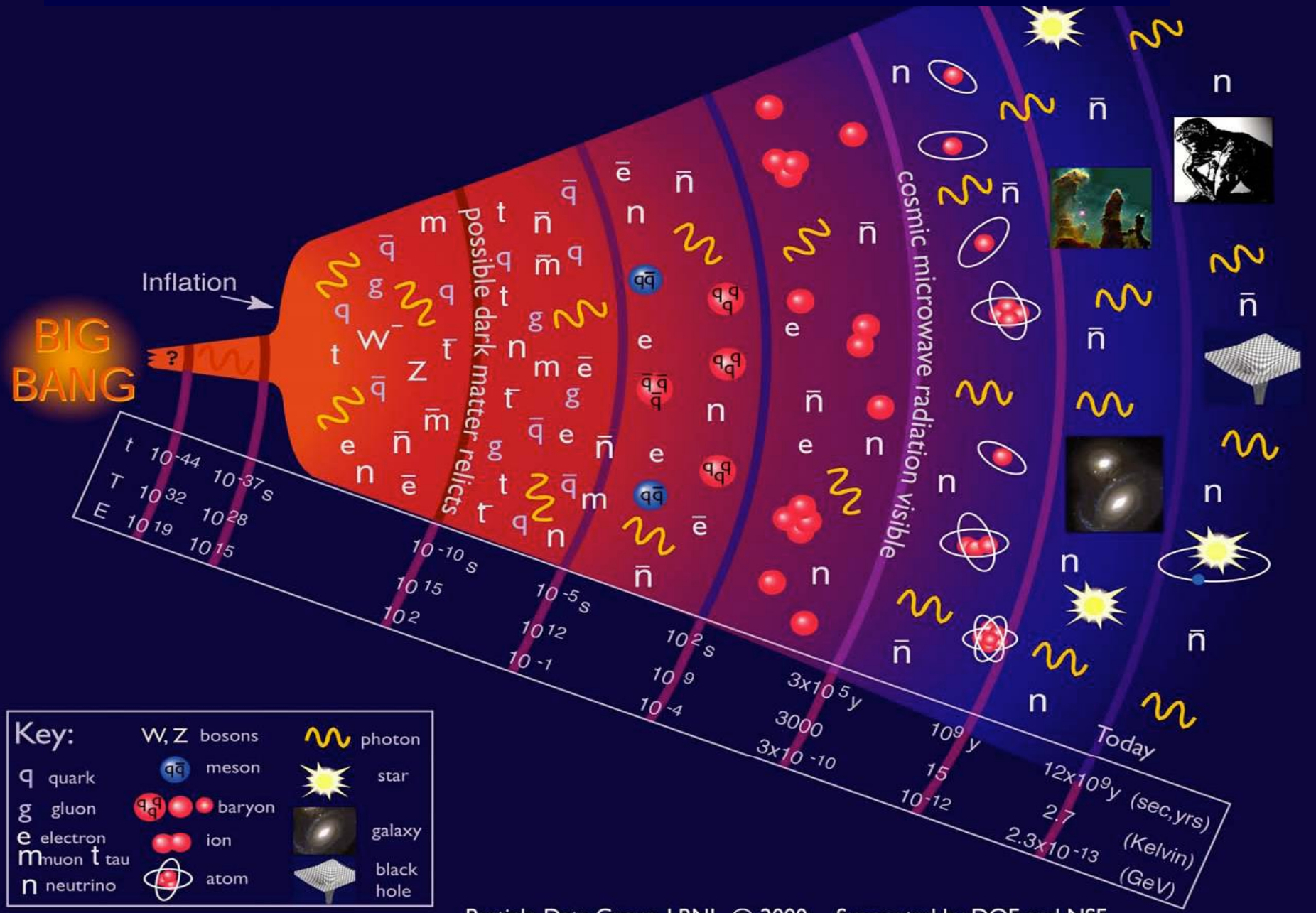
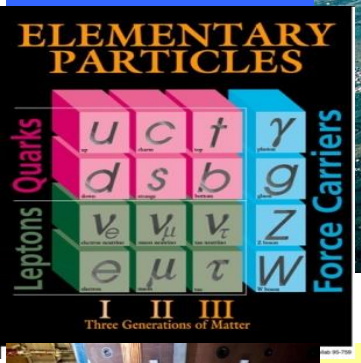
Introduction



Particle Data Group, LBNL, © 2000. Supported by DOE and NSF

CERN Summer Student Programme 2015



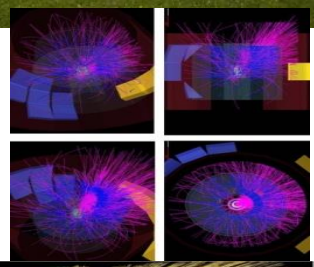
Apply to experience CERN first-hand !

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)

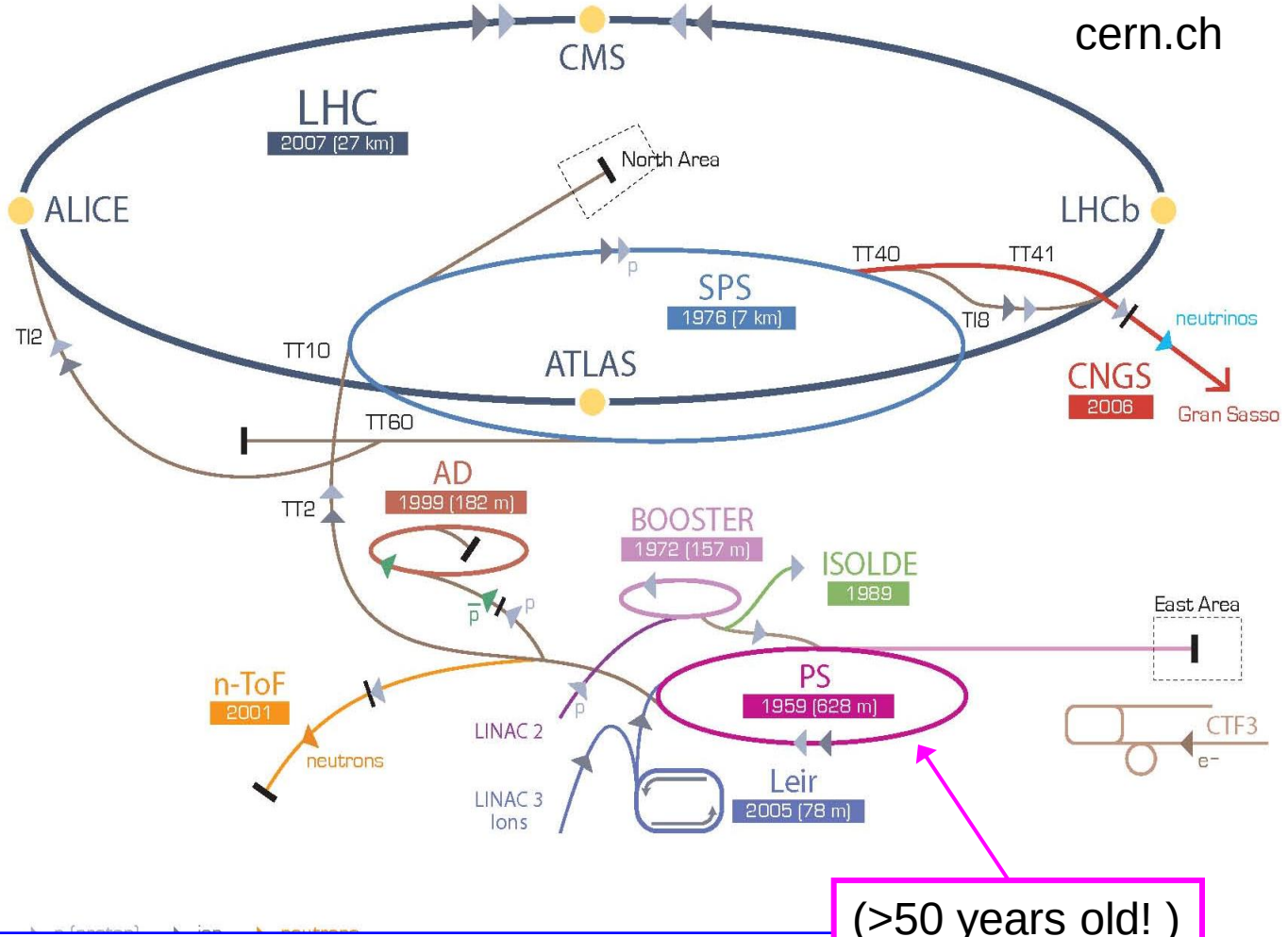
Application deadline is 28 January 2015

Travel + generous stipends paid
8-13 weeks in the
Summer of 2015



CERN accelerator complex

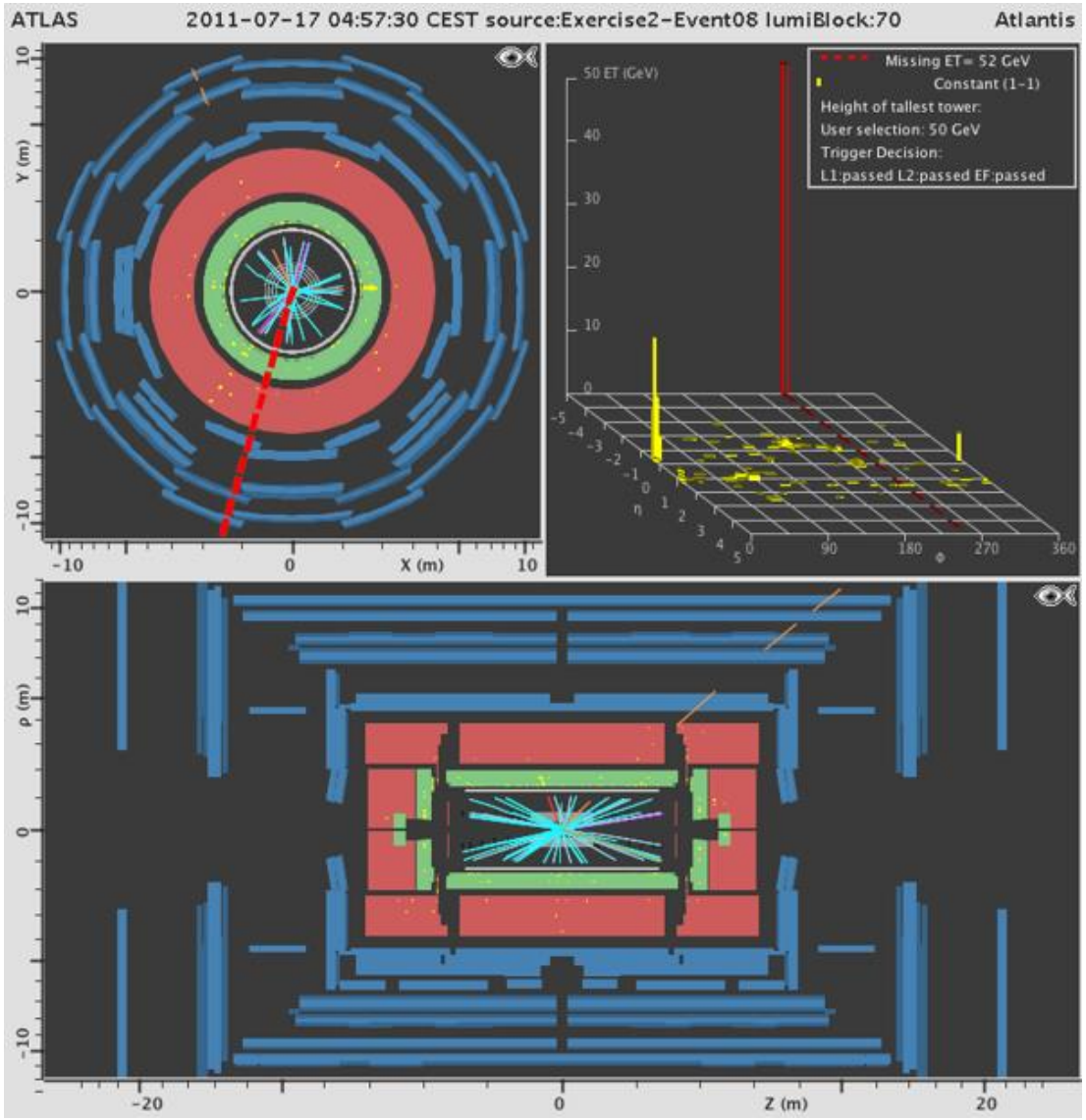
cern.ch



(>50 years old!)

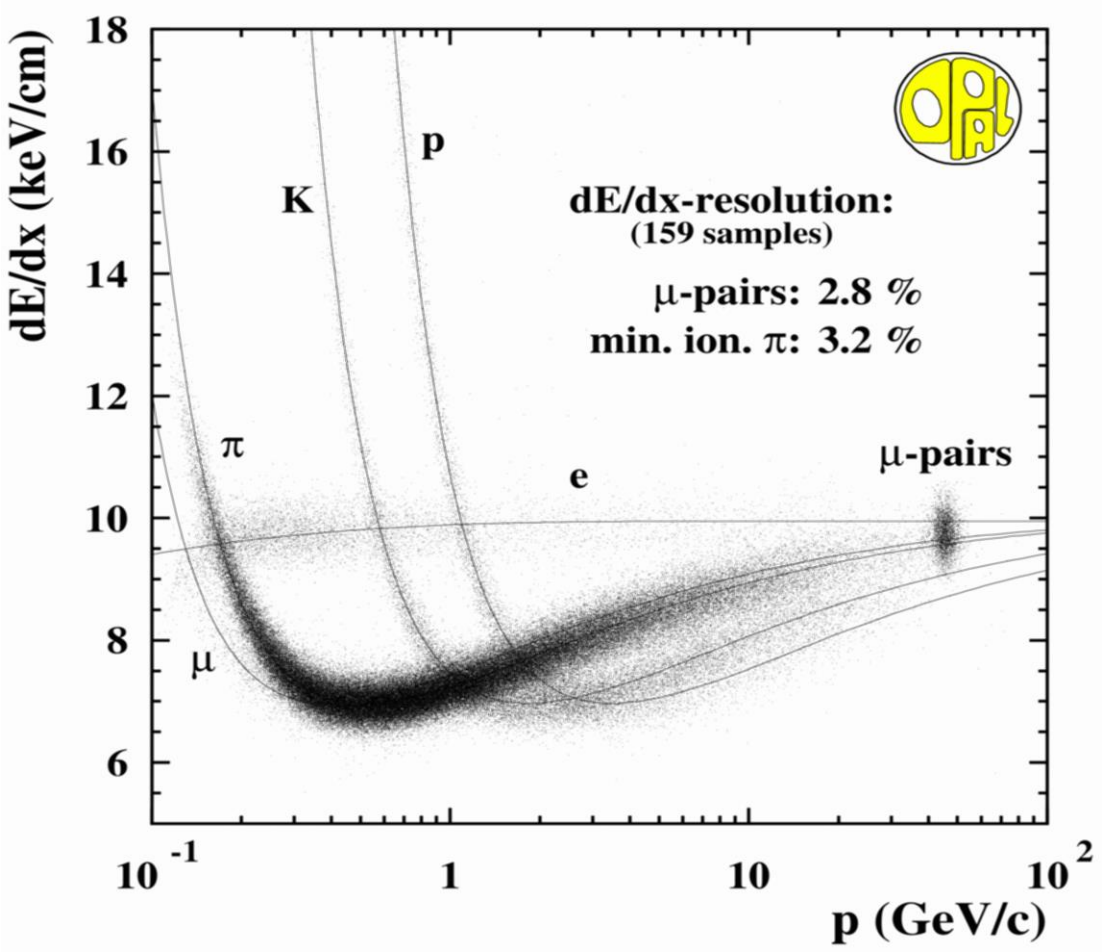
	Top energy/GeV	Circumference/m
Linac	0.12	30
Booster	1.4	157
PS	26	628 = 4 x Booster
SPS	450	6'911 = 11 x PS
LHC	7000	26'657 = 27/7 x SPS

An event display



What is this?

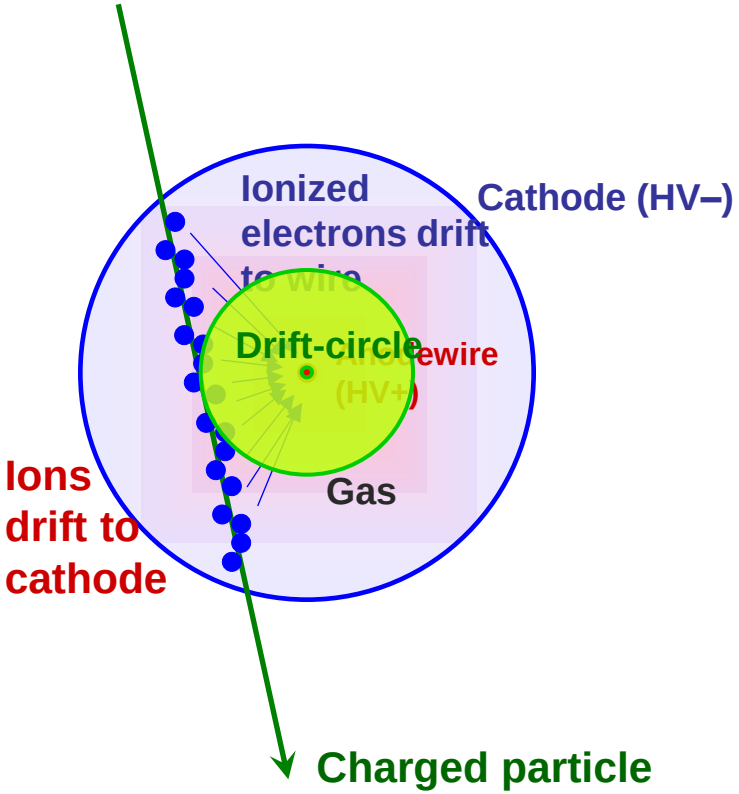
Particle ID using dE/dx



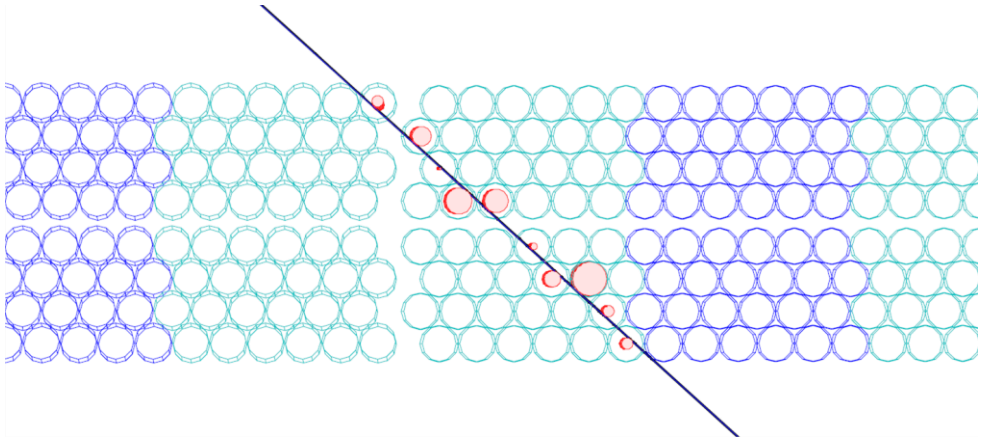
Particle Data Group/ OPAL

Drift tubes

Classical detection tecnique for charged particles based on ionization of gas and measurement of the drift-time

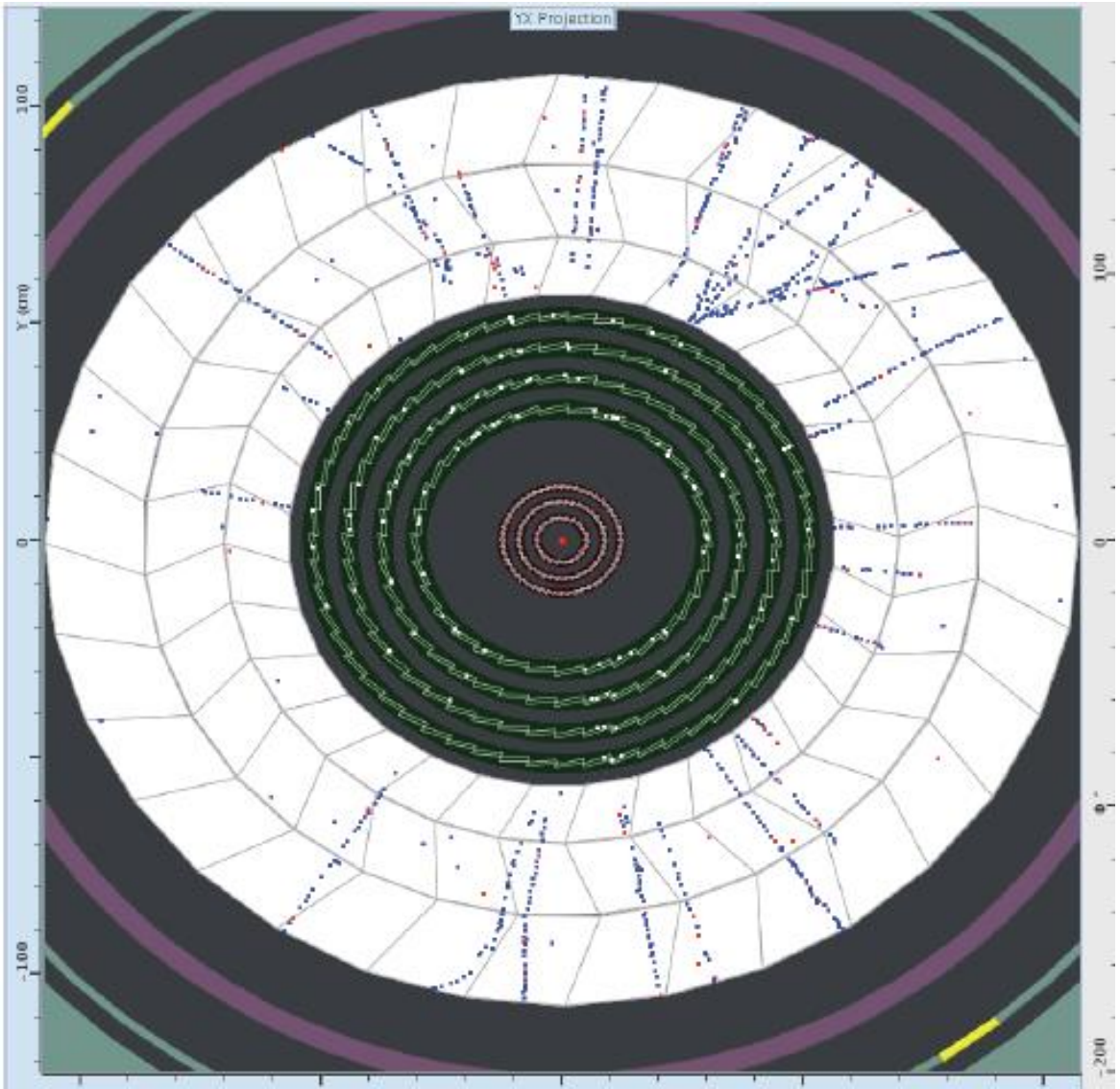


Example: muon passing muon drift tubes

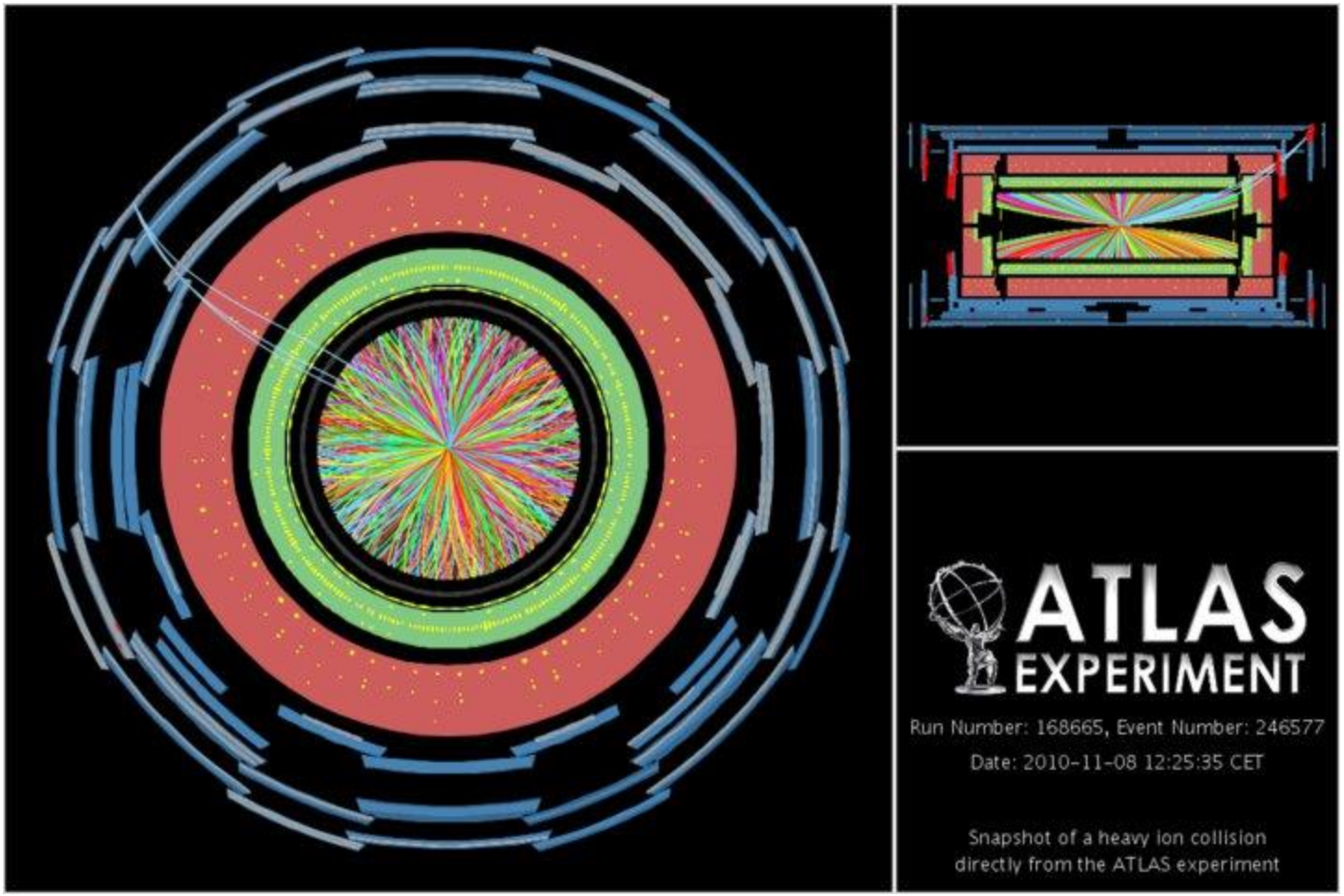


TRT: Kapton tube, ∅ = 4 mm
MDT: Aluminium tube, ∅ = 30 mm

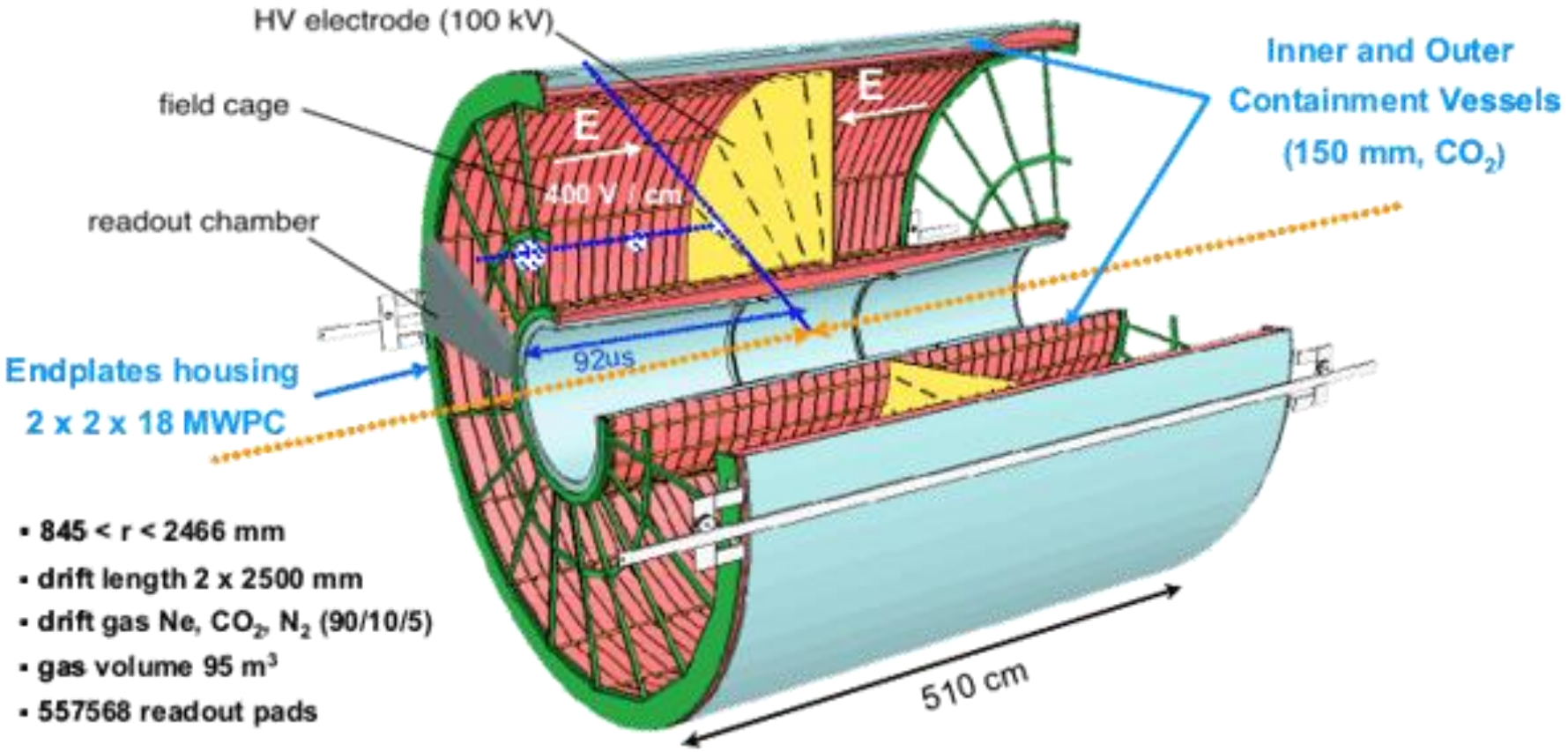
Example drift tube chamber: the ATLAS tracker



Heavy ion collisions!

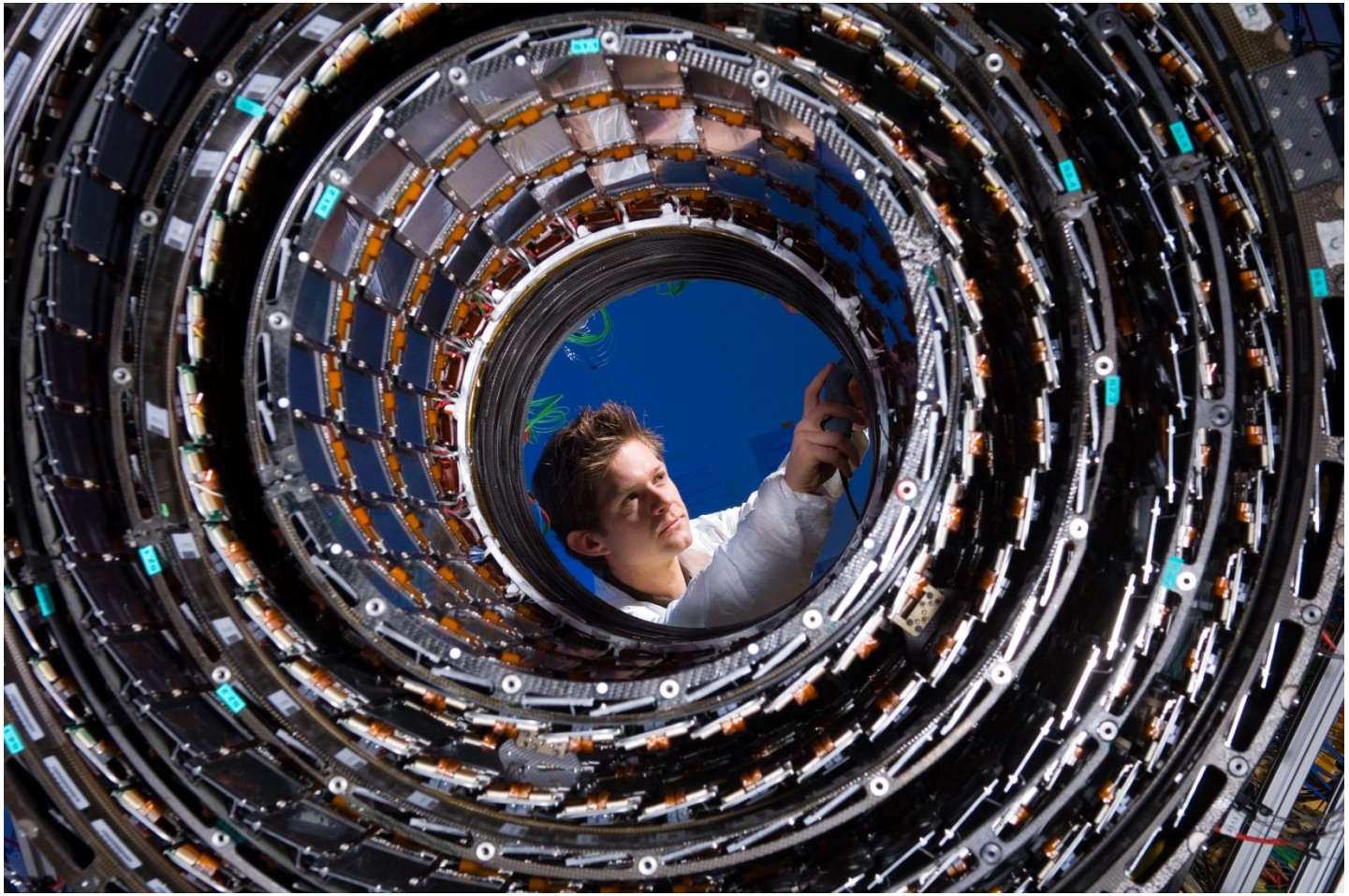


The ALICE TPC



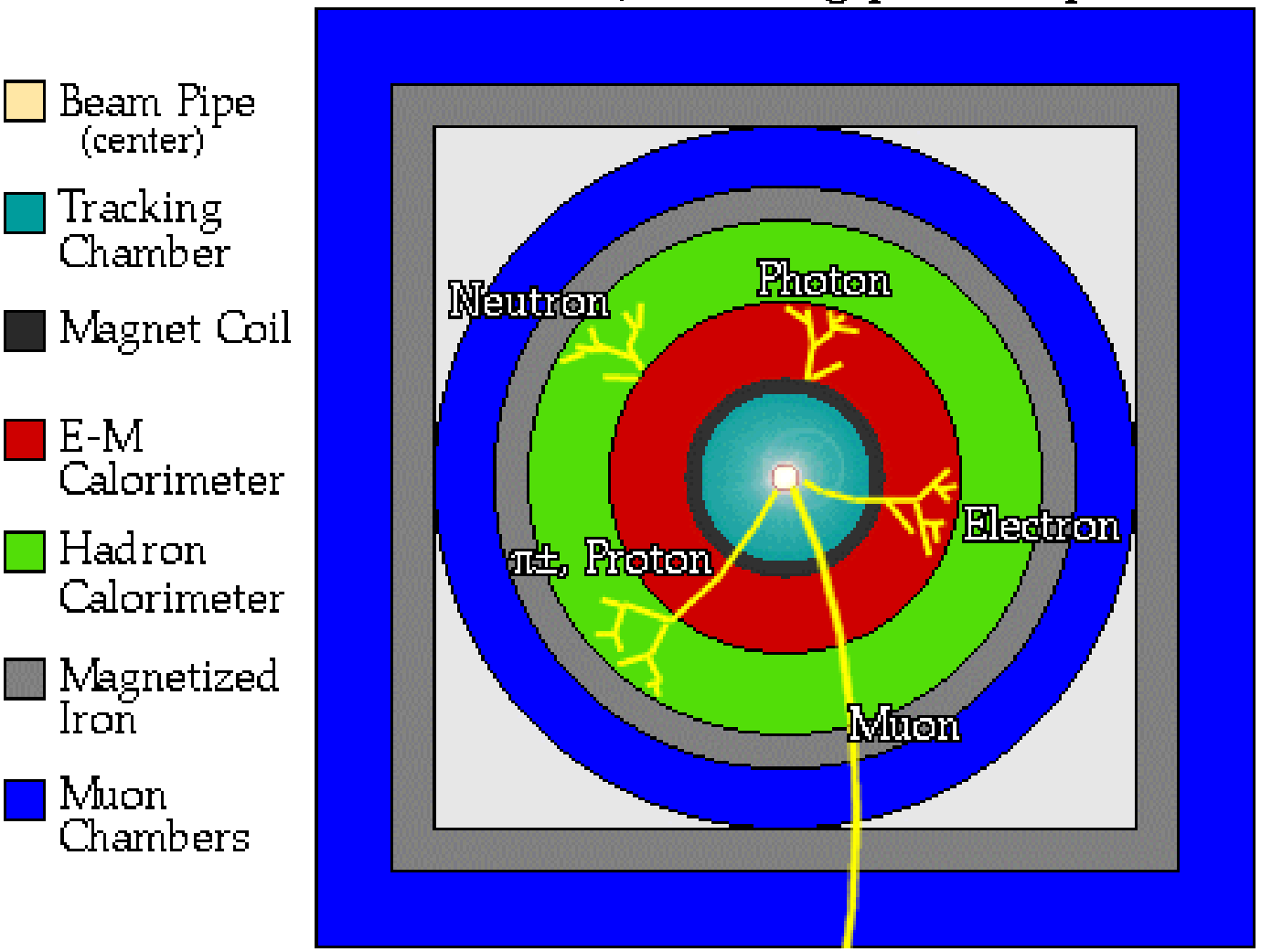
A Si strip tracker

Compact muon solenoid



stfc.au.uk

A detector cross-section, showing particle paths



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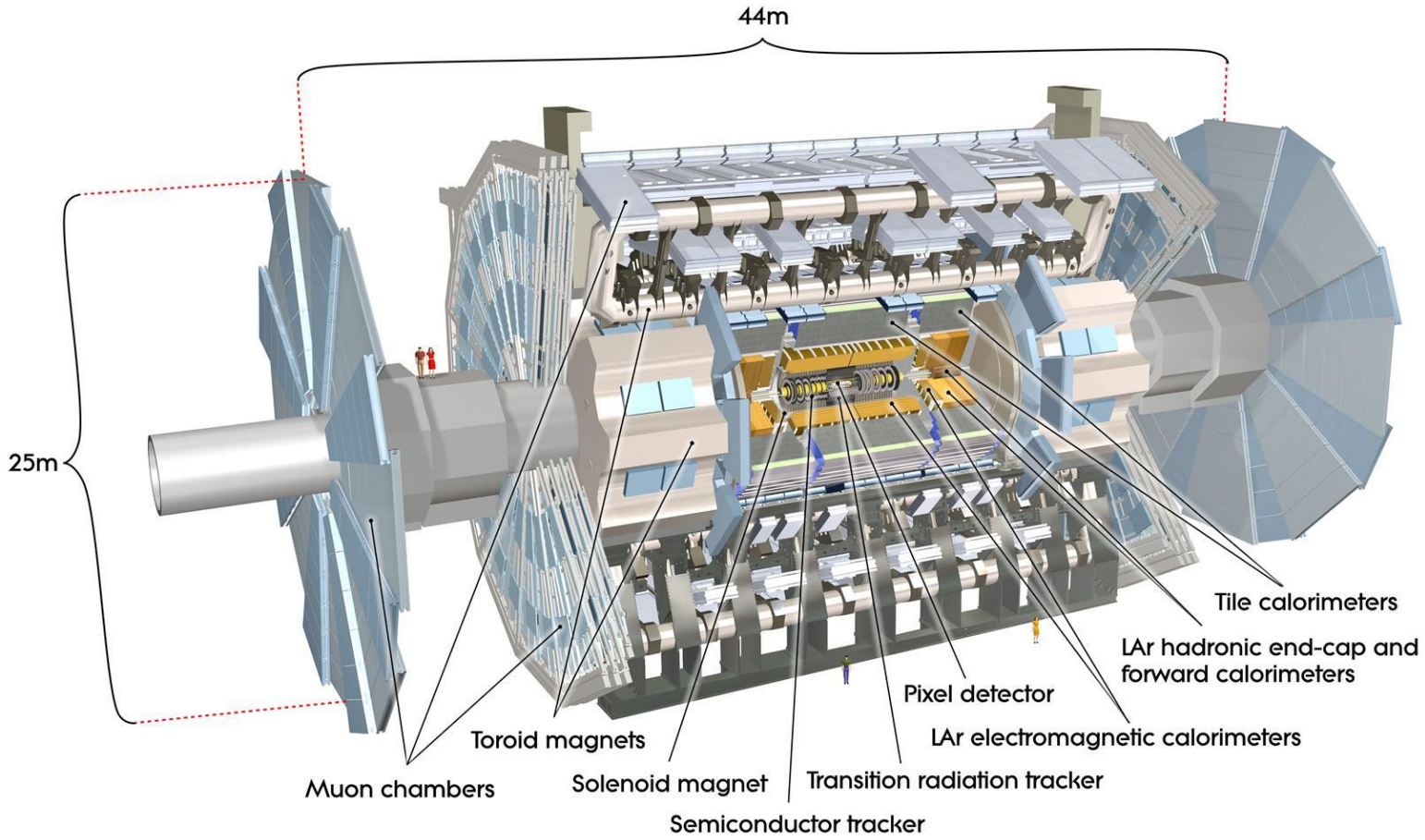
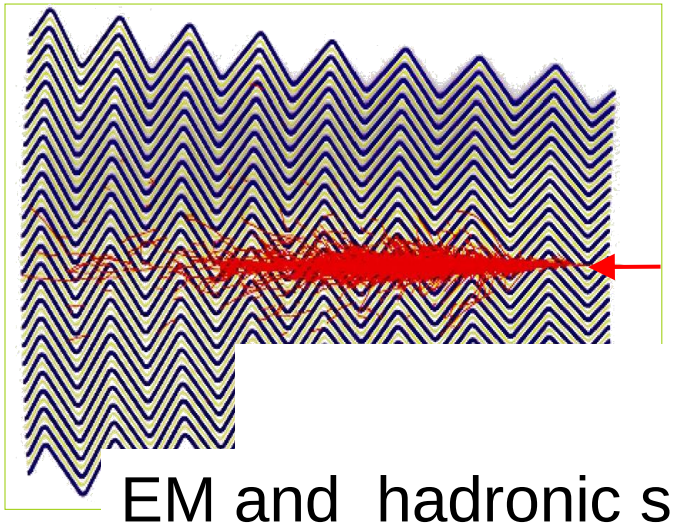
Real dimensions

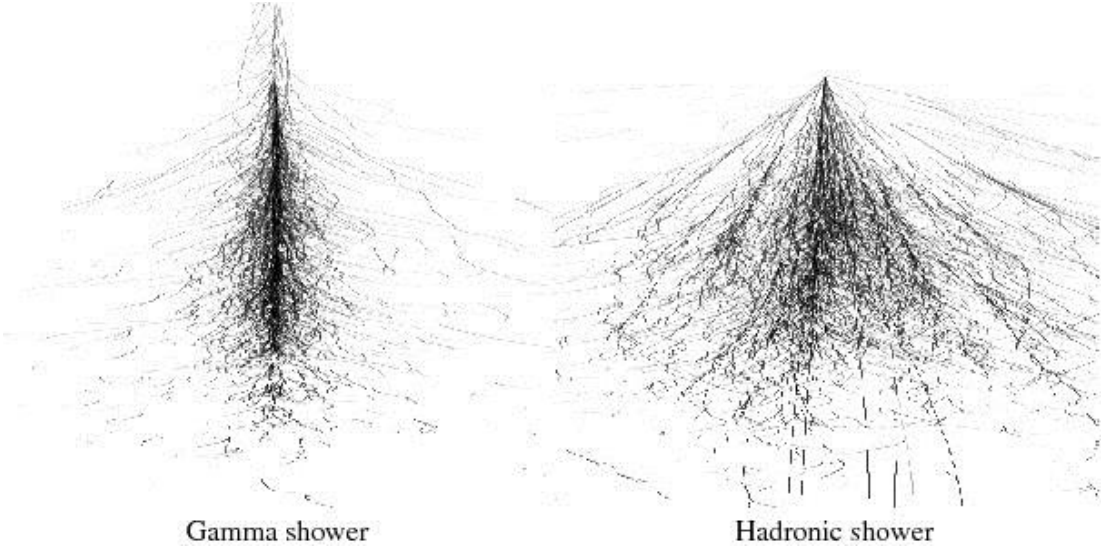


Calorimeter showers

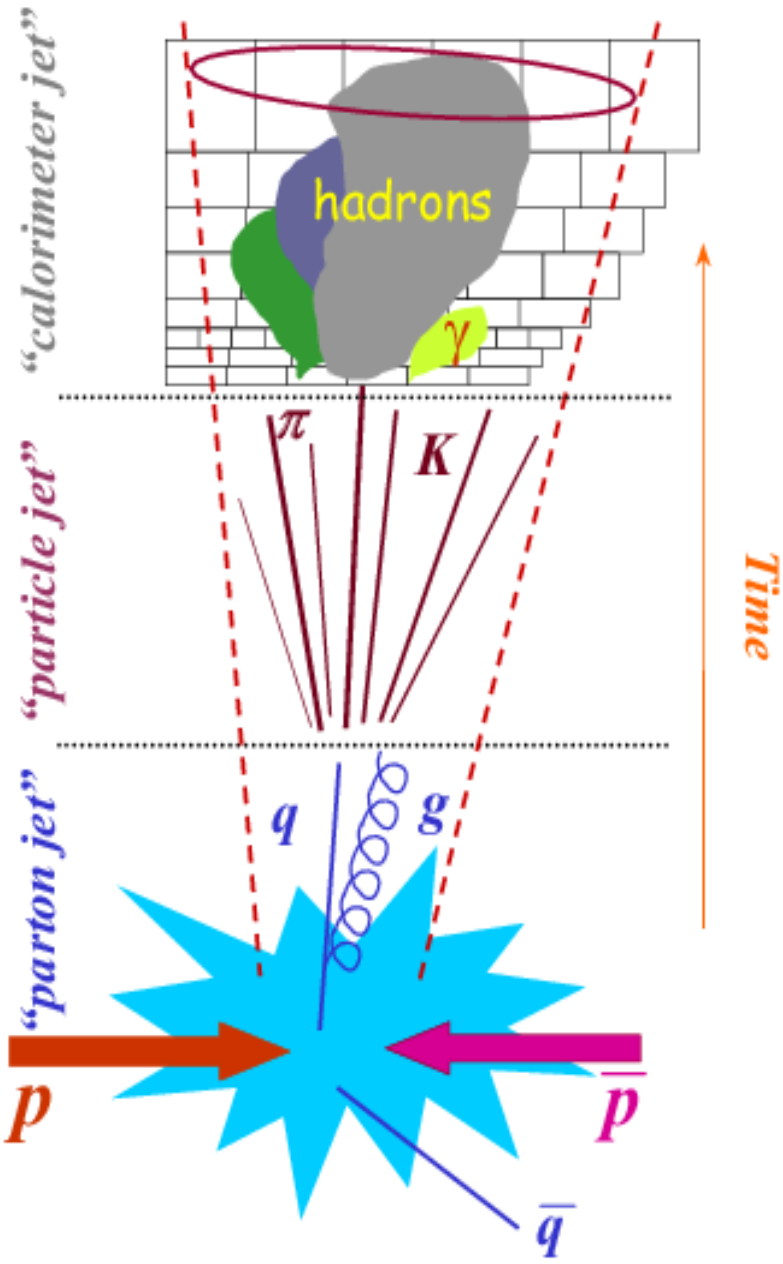


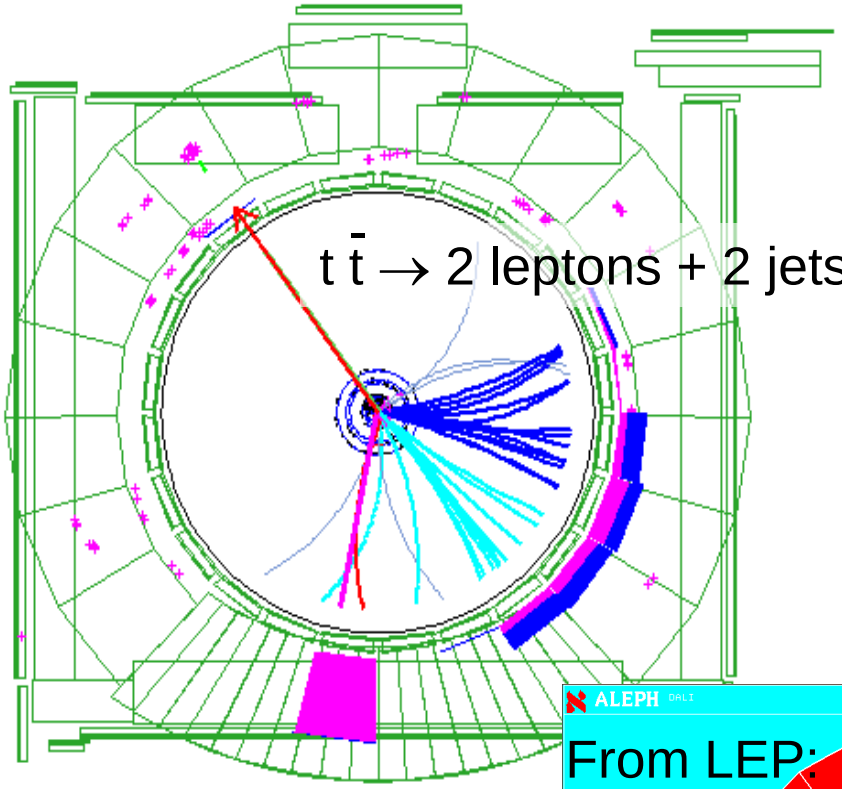
Example of electromagnetic shower (ATLAS)

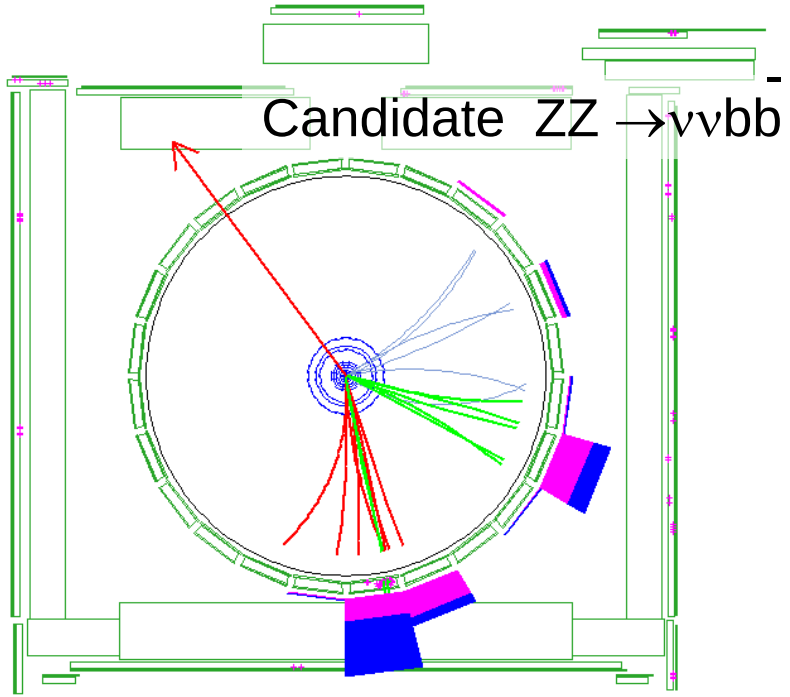
EM and hadronic shower from gamma ray telescopes (K. Bernlöhr et al.)

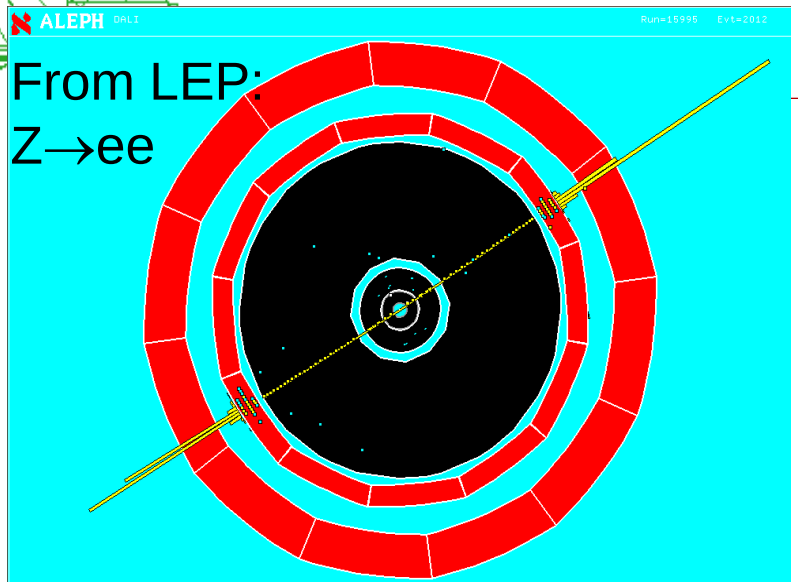


Resolution: Energy measurement of particle jets

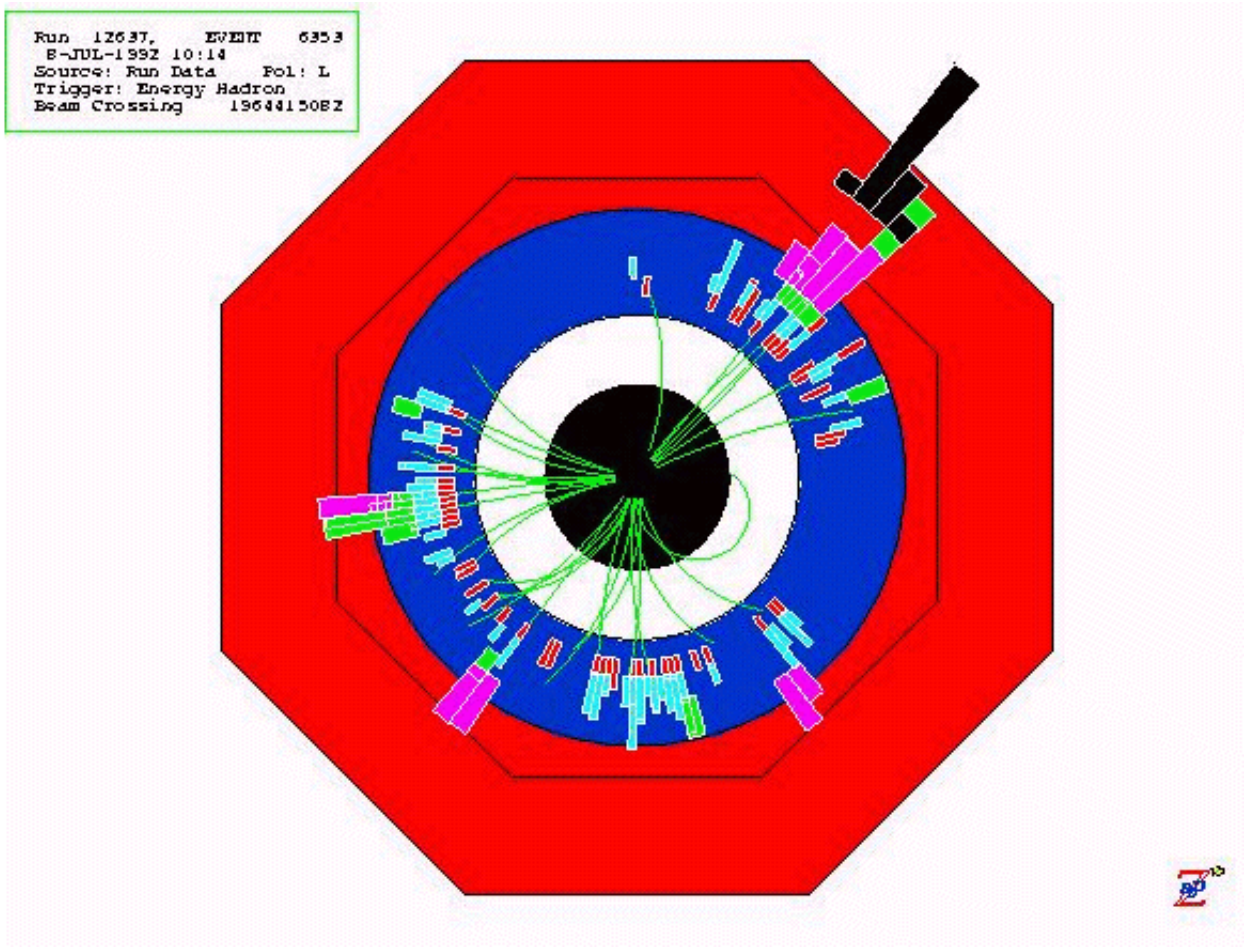



$t\bar{t} \rightarrow$ 2 leptons + 2 jets

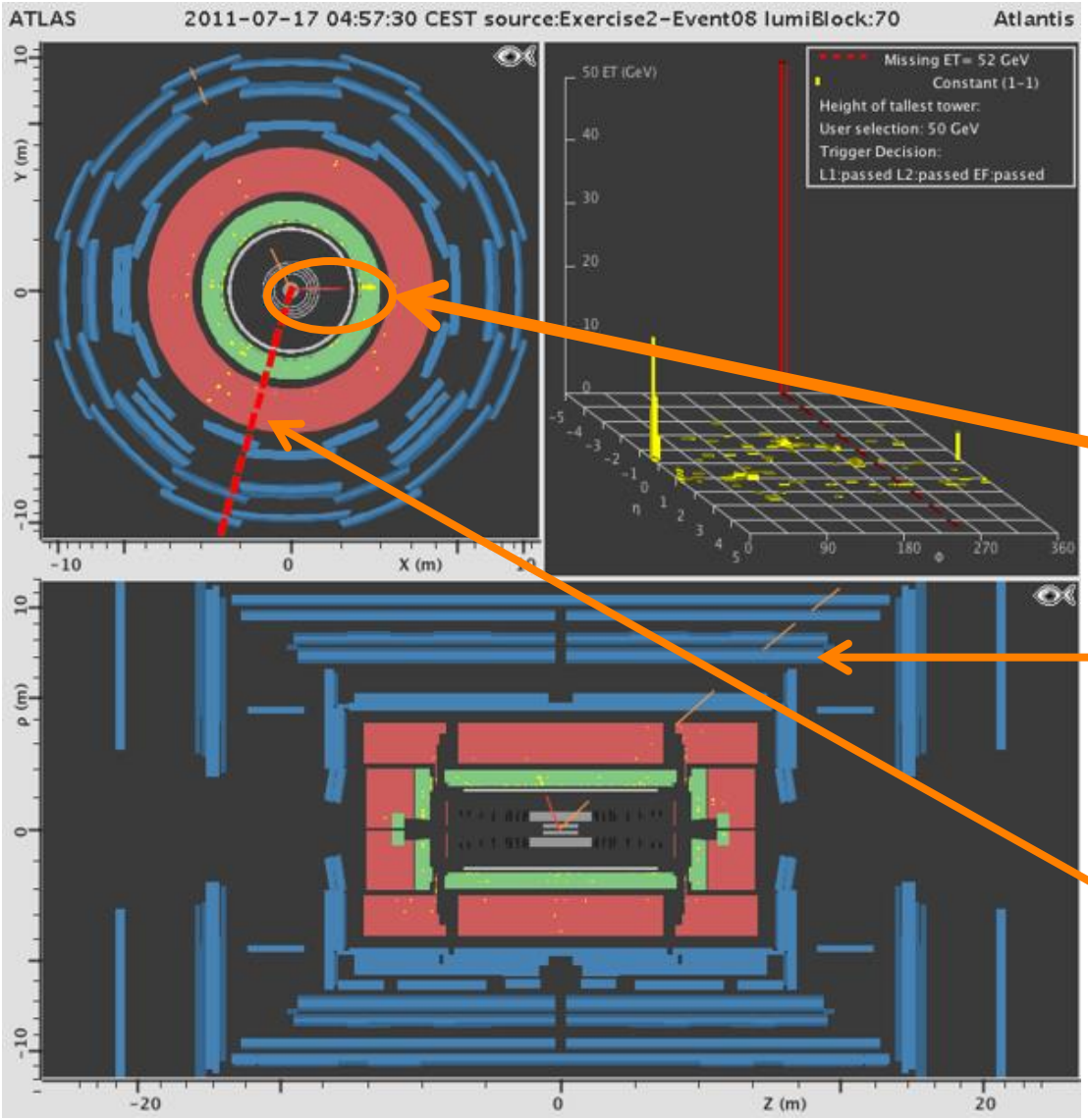

Candidate $ZZ \rightarrow \nu\nu b\bar{b}$


ALEPH
From LEP:
$Z \rightarrow ee$

3 jet event BABAR



The first event display again



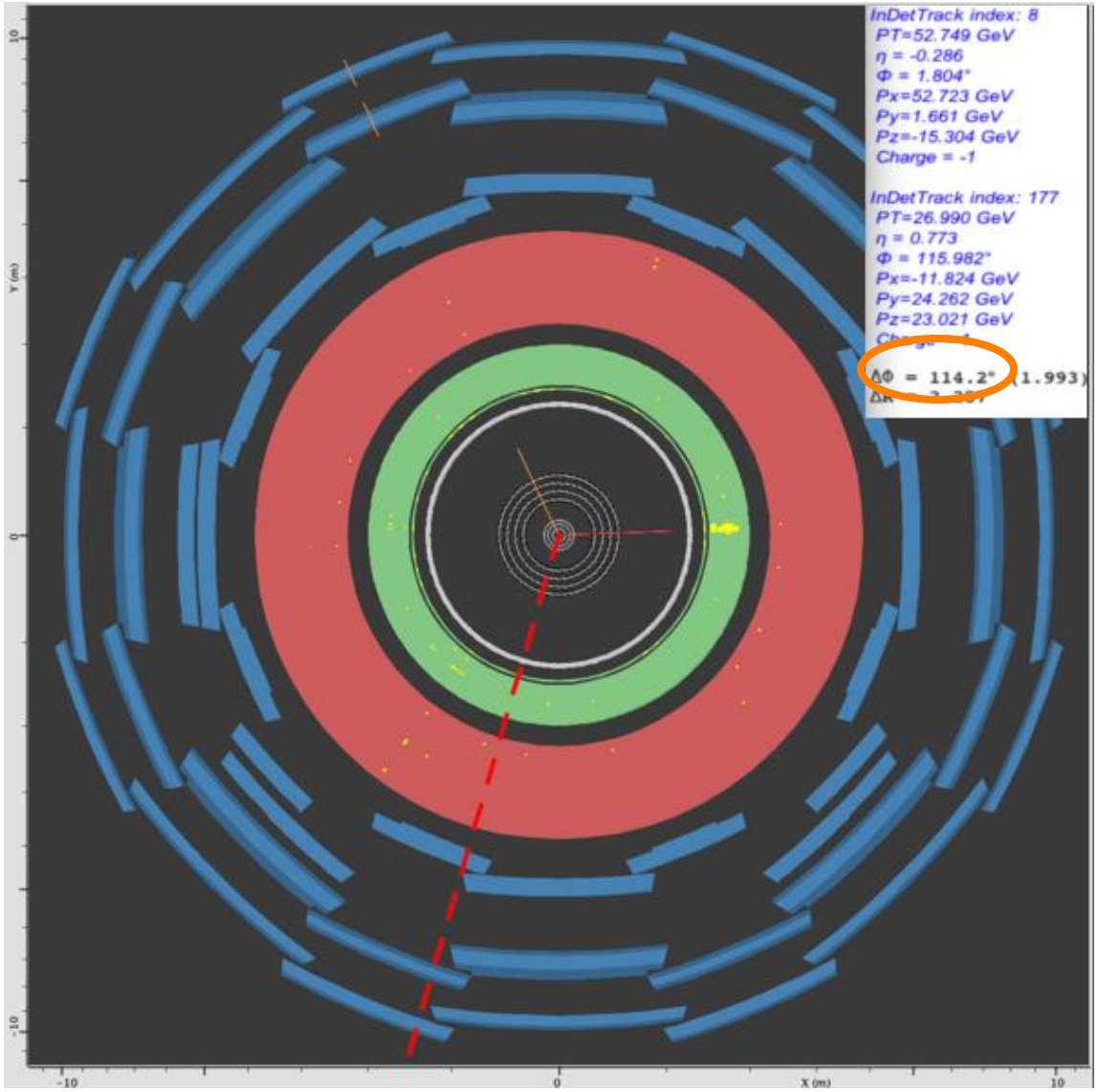
After applying pt cut of 20 GeV only 2 tracks left

electron

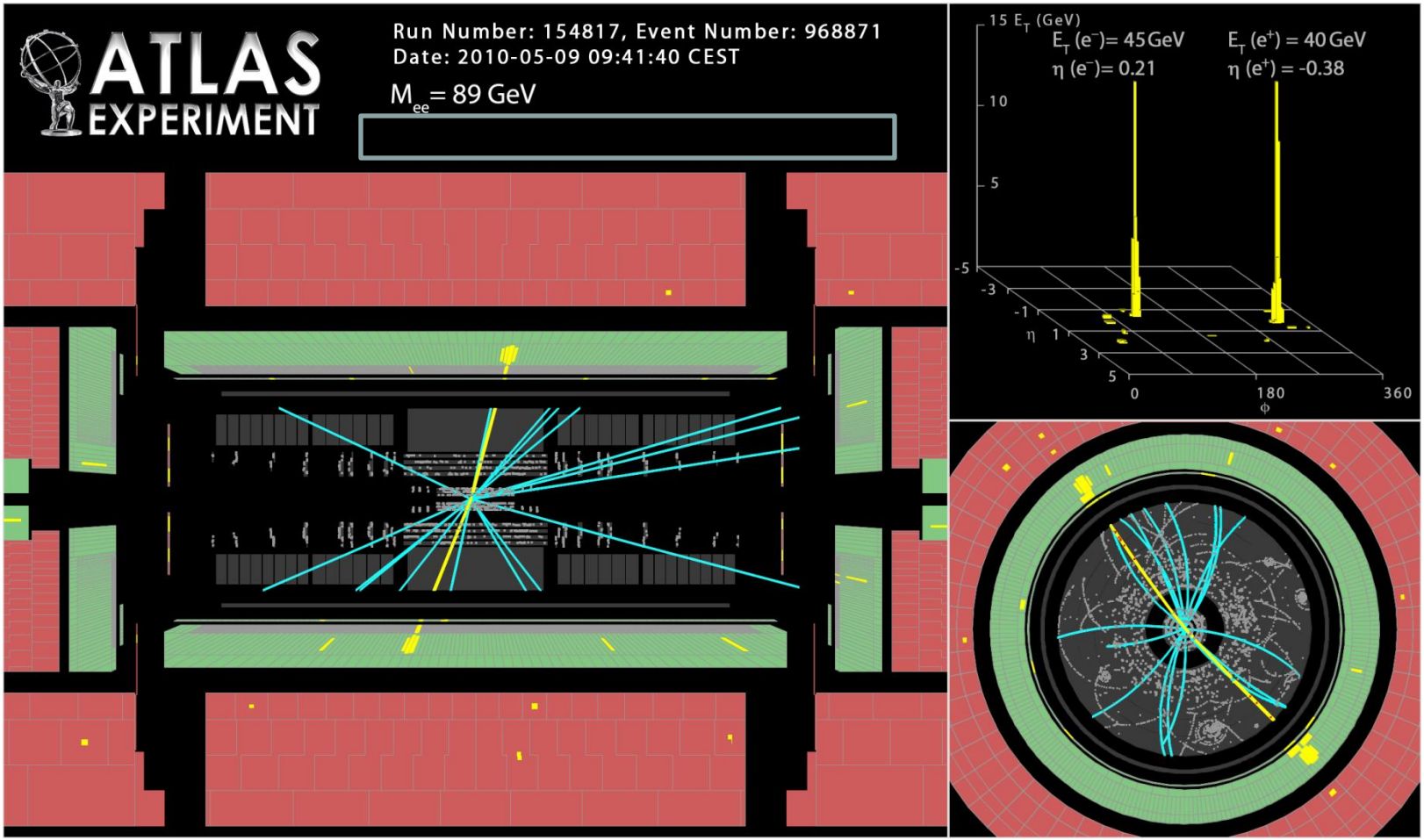
muon

missing energy

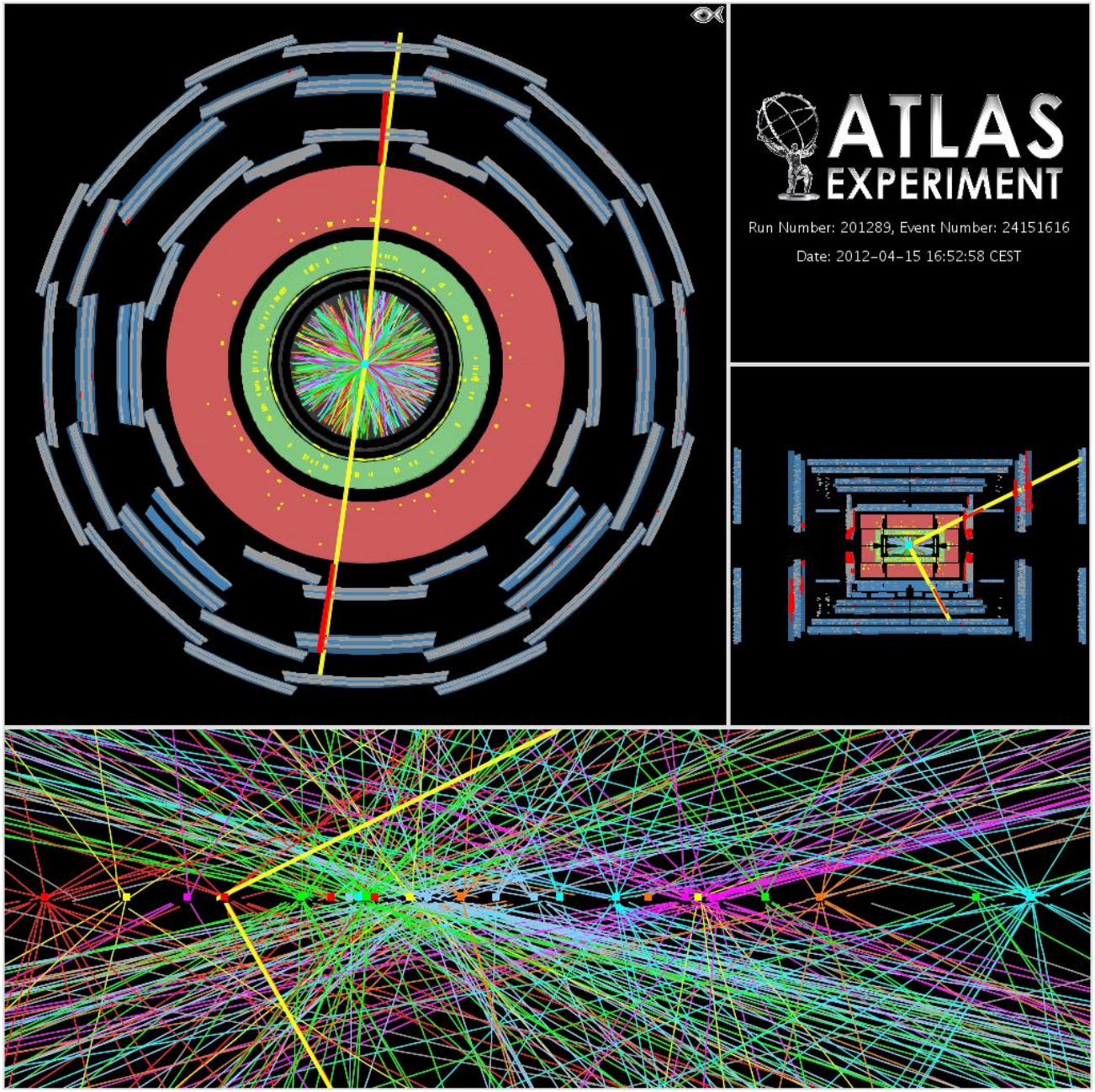
H → WW candidate!



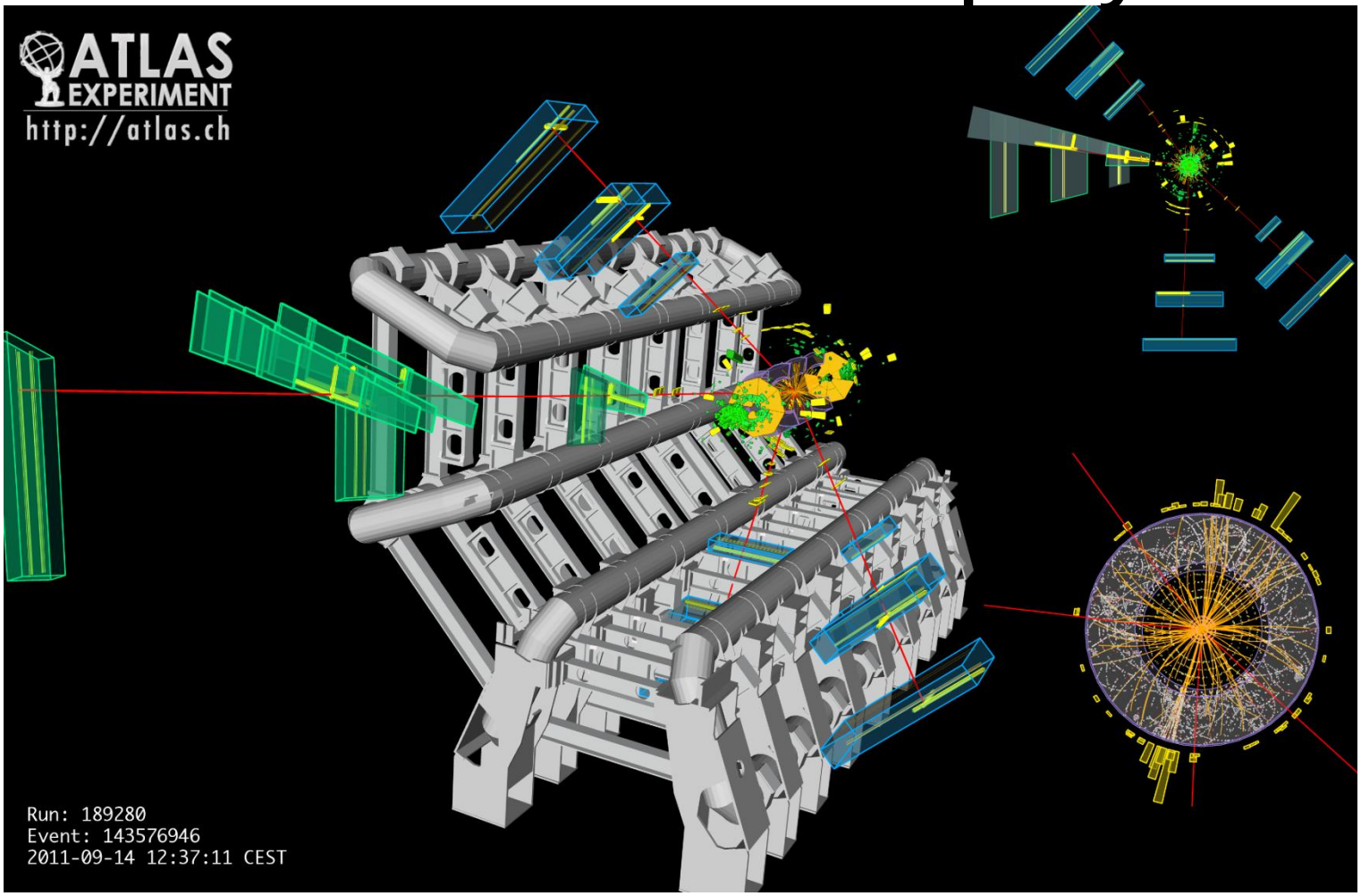
ATLAS event display



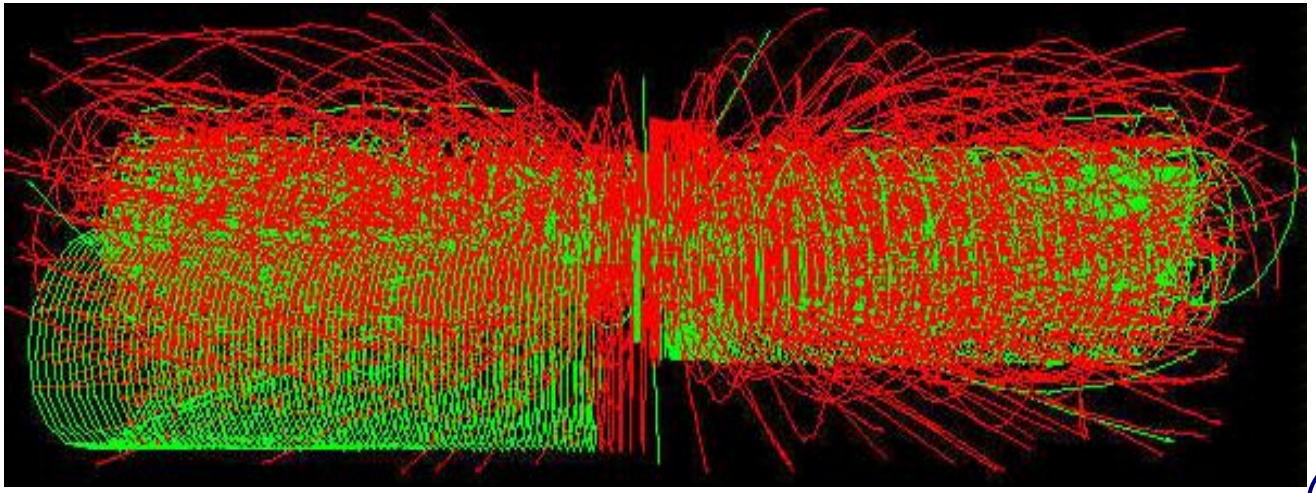
ATLAS event display

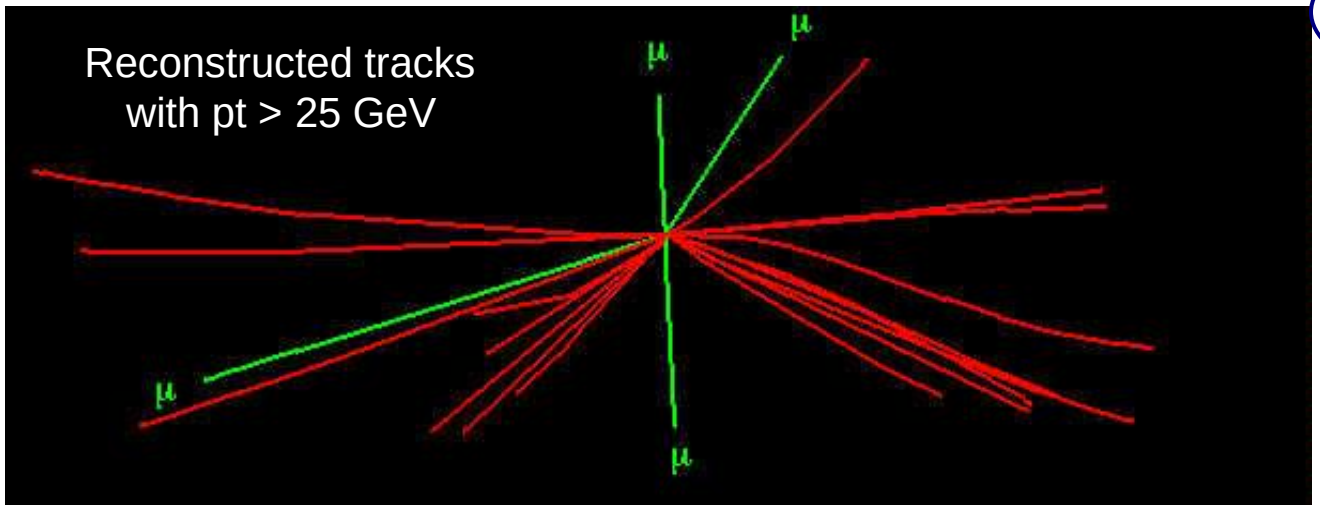


ATLAS event display



Simulation

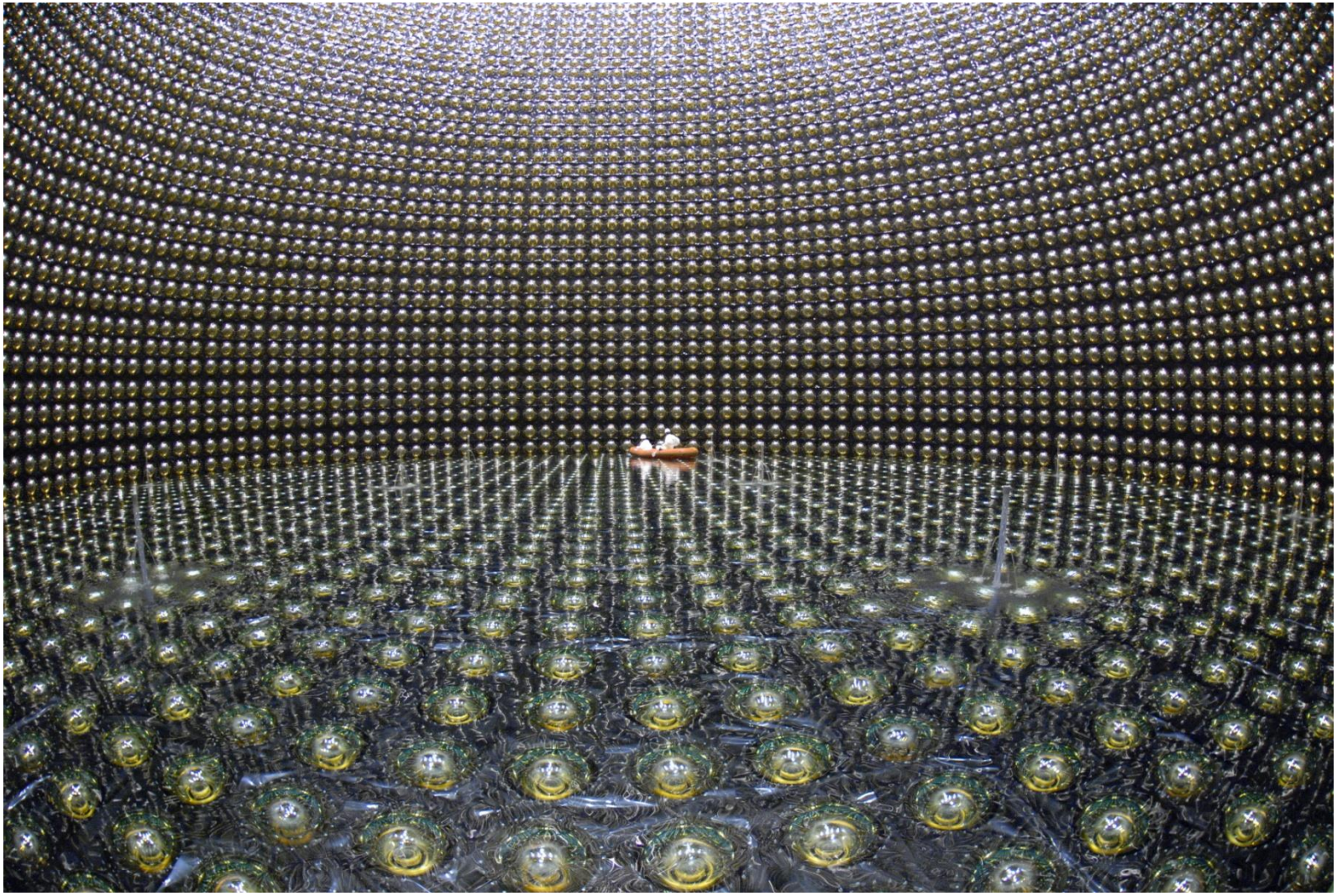




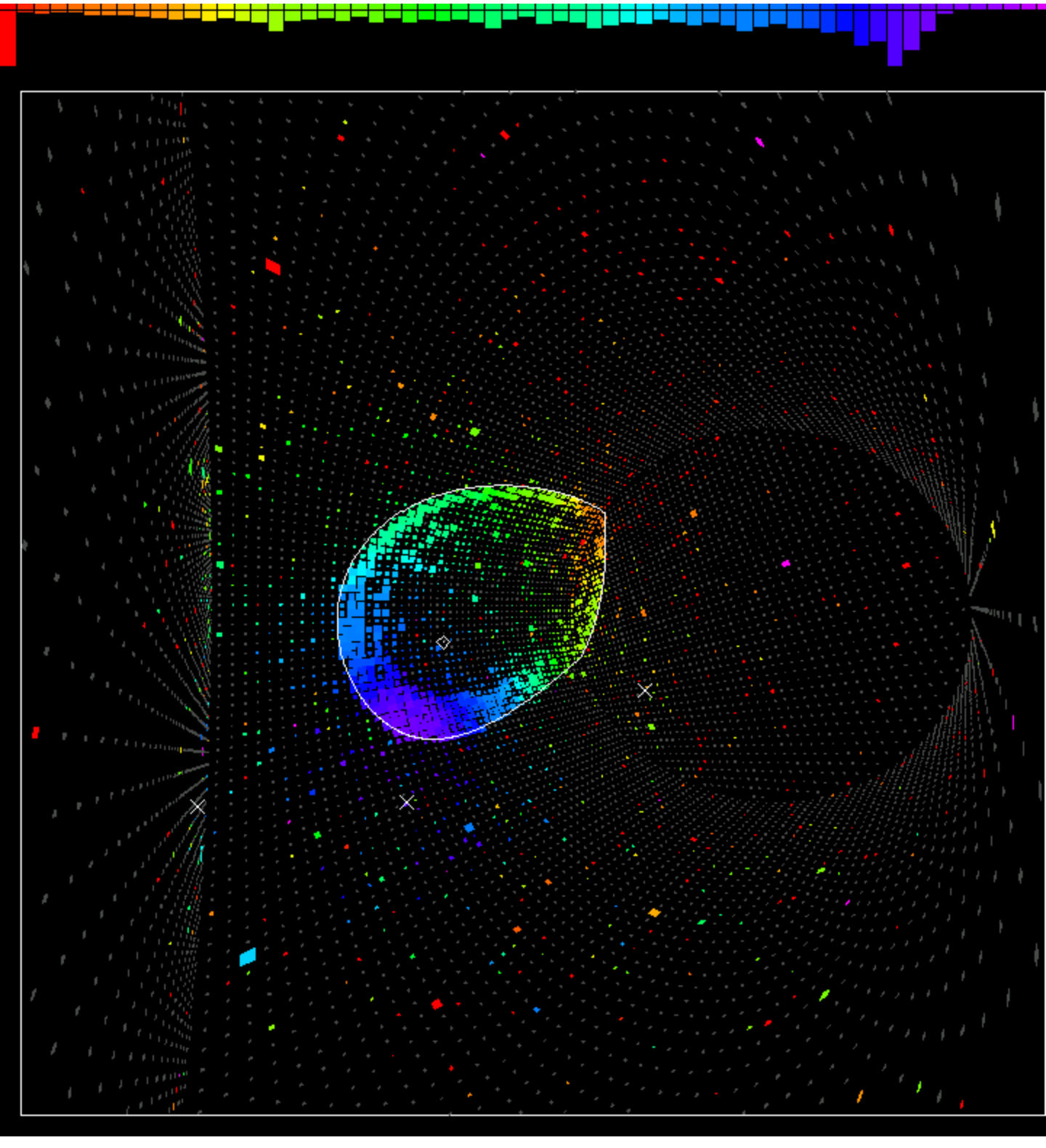
Higgs→ZZ→4μ

A Cherenkov detector:

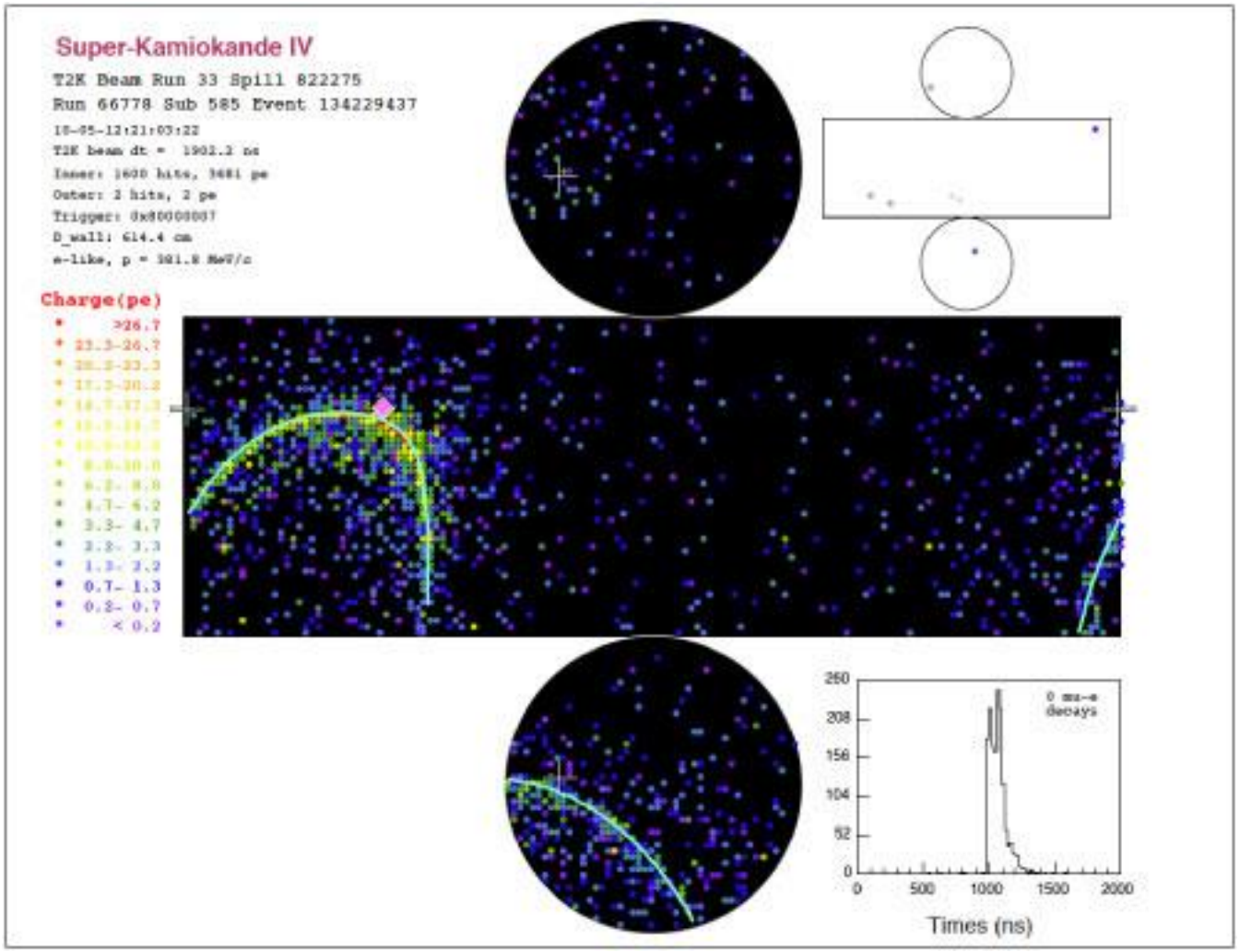
SuperKamiokande

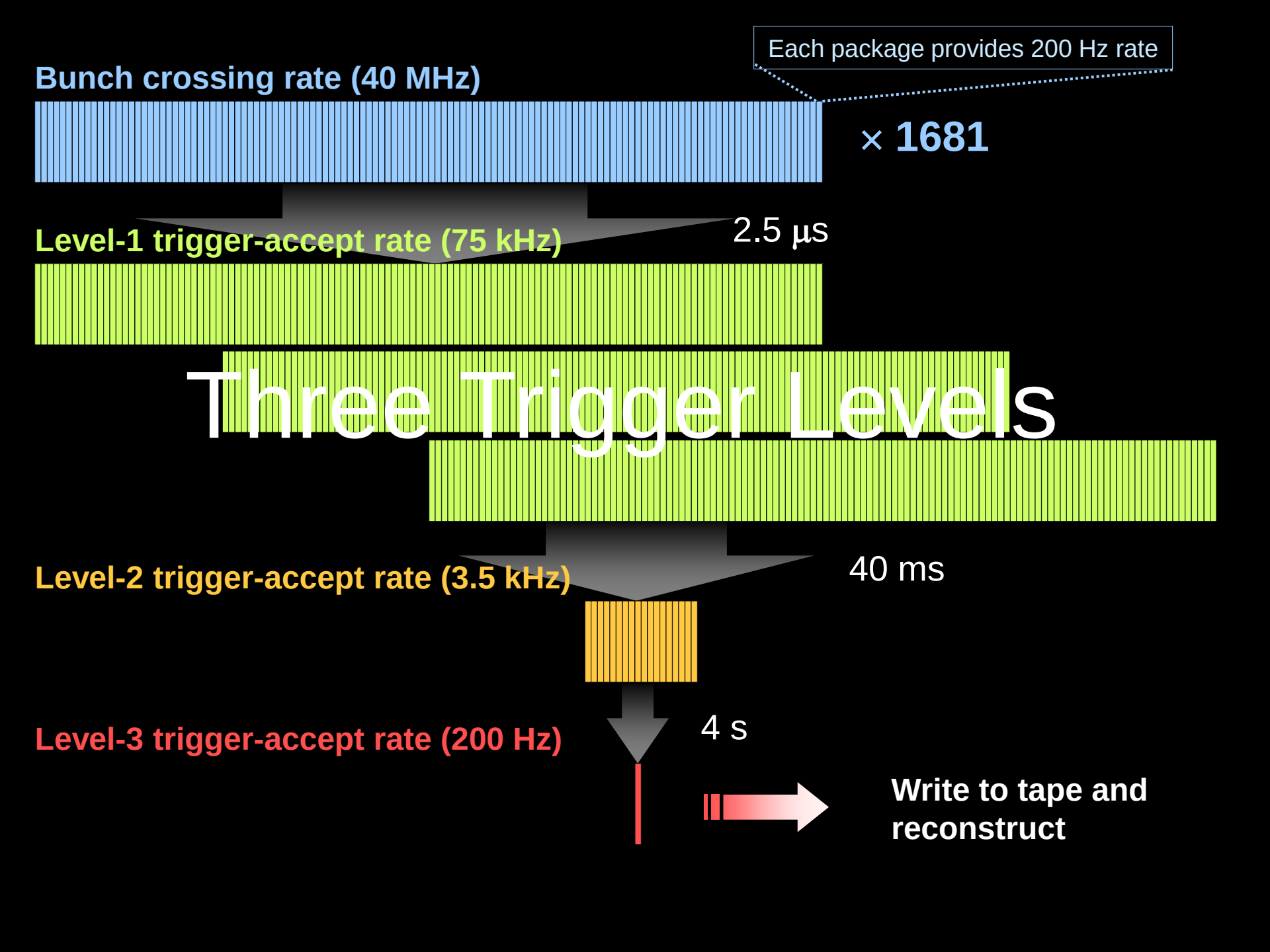


Muon neutrino produces muon that produces Cherenkov ring



One of six $\nu_\mu \rightarrow \nu_e$ candidates in T2K




Each package provides 200 Hz rate
Bunch crossing rate (40 MHz)
× 1681
Level-1 trigger-accept rate (75 kHz)
2.5 μs
Three Trigger Levels
Level-2 trigger-accept rate (3.5 kHz)
40 ms
Level-3 trigger-accept rate (200 Hz)
4 s
Write to tape and reconstruct

$H \rightarrow \tau\tau$ candidate