



DT Science-Techno Tea



DT News

CJ



'Cast Experiment'

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DT Personnel

- New technician (LD contract) for bondlab & QART lab recruited: Florentina Manolescu. She is currently project associate. Supervisor Alan Honma.
- Job opened for Tech. Engineer or Engineer (CP D or C). Operation and upgrade of irradiation facilities.
- Diego Perini will leave group on 1 July and move to EN/MME. Deputy group leader, in charge of the MME design office.
 - Antti Onnela becomes section leader of DT/EM1
 - A LD position for a mechanical engineer has been published. Full time for ALICE technical support and upgrade.
 - Solution for engineering support of AEGIS not yet settled. In discussion with department. Hope for the right decisions in the CERN Council meeting of tomorrow.
- Stefan Haider will increase activity in AEGIS (gradually to ~100%).
- Roberto Guida will become project leader of the gas project. Transition plan worked out. Official information to LHC experiments in July.

DT Personnel

- Summer students have arrived
 - *Sarah Wiegele (D), supervisor Matthieu Heller*
 - *László Oláh (H), supervisor Michael Moll*
 - *Jaakko Laaksonen (FIN), supervisor Antti Onnela*
 - *Yoshiki Tanaka (JP), supervisor Thierry Gys (arrives in July)*
- Stagiare
 - Maxence Curdy 1.4. – 1.7.2011, works with Francois Xavier Nuiry on ATLAS IBL project.



Other DT activities

EIROforum school of Instrumentation

Grenoble, 15-22 May 2011

50 students across Europe, ESA, ESO,
ESRF, ILL, CERN...
3 from DT: Francois Xavier Nuiry, Matthieu
Heller, Markus Gabrysch

4 DT lecturers...



Matthieu won a price for the best student poster



AX-PET, A Demonstrator for an Axial PET Camera with WLS Strips and G-APD Readout

The AX-PET collaboration: INFN Bari, Ohio State University, CERNS, University of Michigan, University of Guelph, INFN Roma, University of Valencia, RWTH Aachen, ETH Zurich

From standard PET scanners to AX-PET

Conventional PET devices: Radial arrangement of scintillating crystals

- Find compromise between resolution R and detection efficiency ϵ :
- R related to parallax error, $\delta p = L \sin \theta$
- ϵ related to absorption length, $\epsilon = 1 - e^{-L/\lambda}$
- Long radial crystals: high ϵ but poor R
- Short radial crystals: high R but poor ϵ

Solution:

- Long crystals axially oriented for photopeak detection and (x, y) coordinates
- small radial dimension for better R
- several crystal layers for better ϵ
- Wave Length Shifter (WLS) strips for z coordinate

The AX-PET principle

Axial arrangement of long thin scintillator crystals → transverse coordinates xy

- Full 3-D reconstruction of the impact point of the incoming 511 keV γ
- Potential to identify and reconstruct Compton events (enter Crystal Scatterer) → increased sensitivity
- Spatial resolution independent on the depth of interaction (No parallax error)
- Uncorrelated sensitivity and spatial resolution in detector
- Silicon Photo Multipliers (MPPCs) readout of the LYSO and WLS
- combined PET/MRI possible

In-vivo functional imaging technique

- a biologically active compound labeled with a proton rich isotope (e.g. ^{18}F , ^{11}C , ^{10}B , ^{15}N) is injected into the body
- detection of the coincidence of two back to back photons
- imaging reconstruction software → 3D image of the radiotracer concentration in the body

The AX-PET Module

Six layers in each module, each layer composed of:

- Crystal and strip matrix:
- 8 LYSO crystals in axial direction
- 26 WLS strips orthogonal to LYSOs
- a thin carbon fiber plate to optically separate each layer
- Photo detectors: **Geiger mode Avalanche Photo Diodes (G-APD)** from Hamamatsu (MPPCs)
- Readout electronics:
 - signals from MPPCs → fast amplifiers → charge integrating readout ASIC
 - readout in sparse mode → channels above the threshold only
 - Self triggering or external trigger possible

Energy calibration and resolution

To calibrate the energy and to correct for the small non-linearity introduced by the MPPC saturation, two different data sets are used:

- Self-triggering mode: peaks of the ^{232}Th decay spectrum at 202 and 307 keV (natural radioactivity of LYSO) and the Lutetium K_α escape line at 63 keV
- External triggering mode: ^{22}Na source; photoelectric peak at 511 keV

→ The average energy resolution of a crystal is 11.6% (FWHM) at 511 keV
→ The sum resolution is 12.2%

Simulation

In order to estimate the performance of the entire system, the AX-PET demonstrator has been fully simulated using GEANT4 and GATE

- For image reconstruction, a dedicated Maximum-Likelihood Expectation Maximization (MLEM) algorithm has been implemented
- The simulation predicts that inter-crystal scatter events can be identified and reconstructed with an efficiency of at least 70%.

The experimental setup

Two modules placed on a rotating gantry. One module is fixed, the other one can rotate around the center of the system. A rotating support is placed at the center of the system. On this support, depending on the needs one can insert:

- a point like source (^{22}Na)
- any FDG filled phantom

AX-PET demonstrator axial resolution

The Data was taken with the two modules at a distance of 150 mm and the ^{22}Na point source placed in the middle, with a coincidence trigger. Only events with only one LYSO hit (photopeak) per module are selected. The colored lines are the connections between the detected (x,y,z)-positions of 511 keV photons in the two modules for the first 100 coincidence events. The Gaussian fit indicates a resolution of $\sigma_x = 0.64$ mm (1.51 mm FWHM).

Tomographic scan

Gate visualization of the AX-PET demonstrator

Extended field of view scan (EFOV)

DT MARS 2011

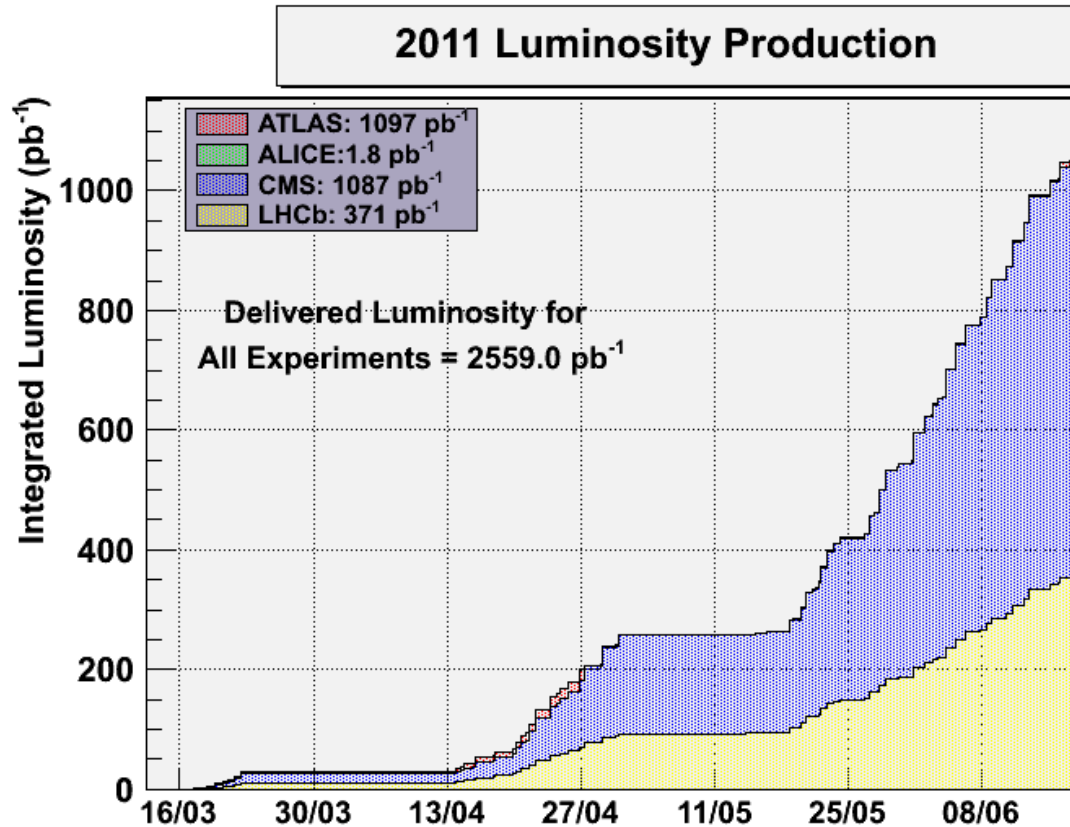
Expect to receive notification letters still this week.

Rumour, i.e. not official:

All SB and CP change proposals were considered favourably.

LHC and the experiments work VERY well.
Peak luminosity beyond $1 \cdot 10^{33} / \text{cm}^2 \cdot \text{s}$

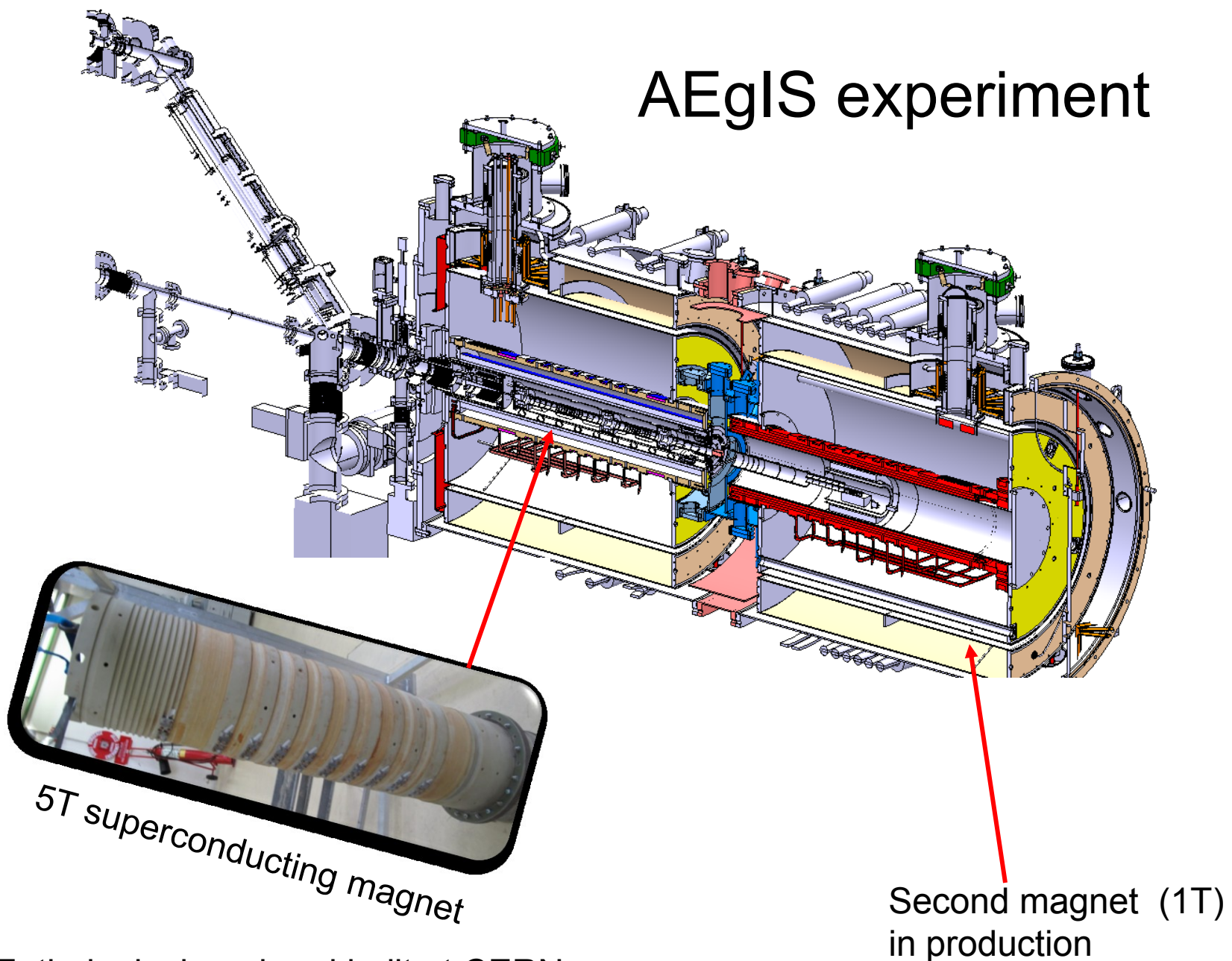
This week Physics with 1092 bunches and 1236.



For comparison: in 2010 the two large experiments collected $\sim 50 \text{ pb}^{-1}$

The same amount of data can now be collected on a single good day.

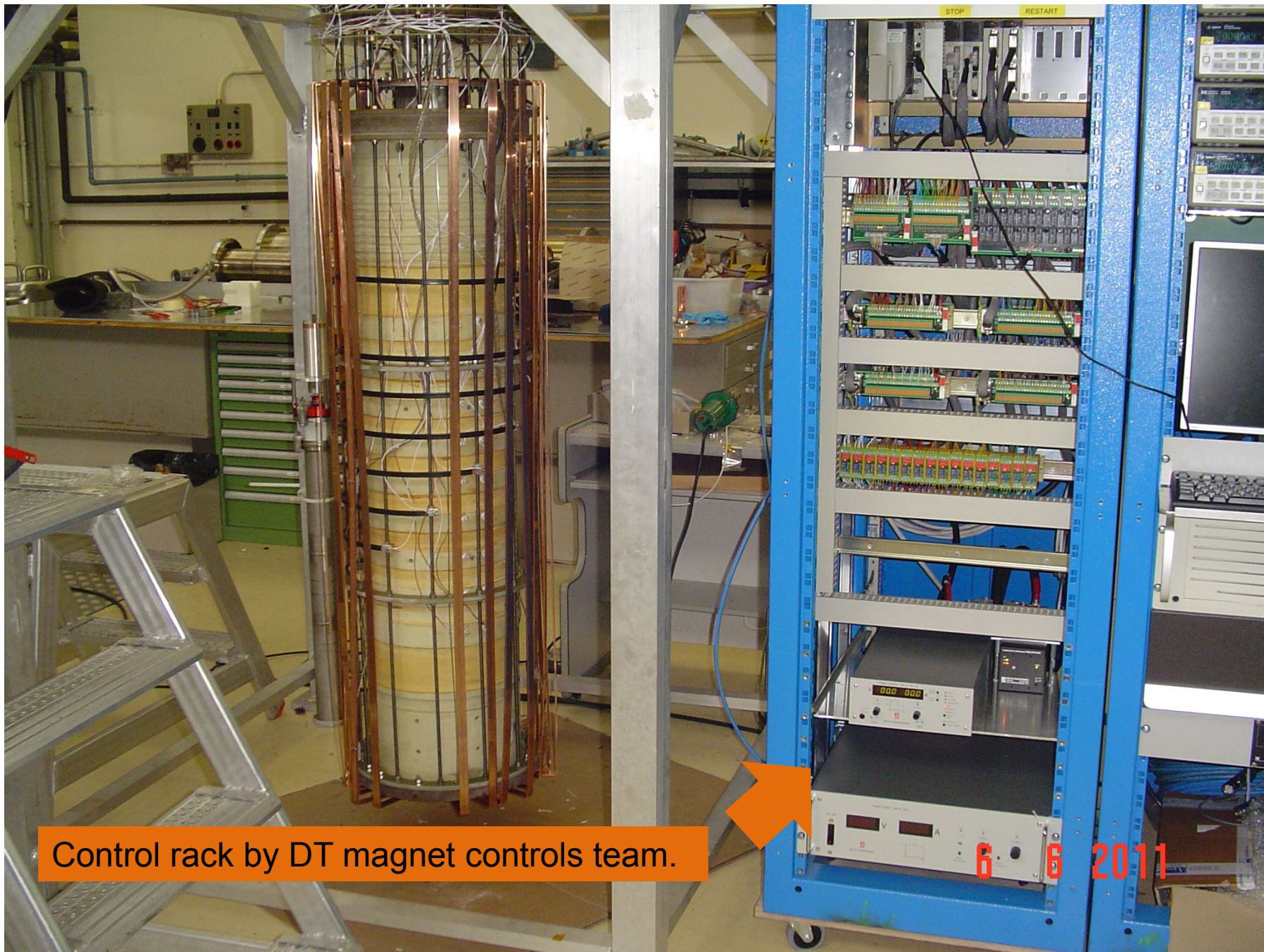
AEGIS experiment



5T superconducting magnet

Second magnet (1T)
in production

Entirely designed and built at CERN
A. Dudarev (ATLAS), D. Perini, P.-A. Giudici, F. Garnier



Control rack by DT magnet controls team.

6 6 2011

Test in Cryolab

Magnet achieved
design
performance
after 2 training
quenches.

Very nice
achievement!

