Dottorato in Scienze e Ingegneria dell'Ambiente, delle Costruzioni e dell'Energia - XXIX ciclo

Overview of a PhD Experience

Performance and tracking optimisation studies with the upgraded ATLAS Inner Detector and applications to early analyses at the LHC Run-II at √s=13 TeV

November 26th 2015

UNIVERSITA DELLA CALABRIA

UNICAL Tutor:
Marco SCHIOPPA

CERN

CERN Tutor:
Andrea DELL'ACQUA

Valentina Maria Martina Cairo

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What is the link?
Let's take a look at the next slides…

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A step back…

- **Bachelor Degree in Physics in December 2011**
  - **Thesis Title: "Studies of calibration and Data Quality for the Muon Spectrometer of the ATLAS Experiment"**
- **CERN Summer Student from July to October 2013**
  (Thanks to Prof. Schioppa and to the already existing and well established link between UNICAL and CERN)
- **Master Degree in Nuclear and Subnuclear Physics in December 2013**
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Federazione Nazionale dei Cavalieri del Lavoro

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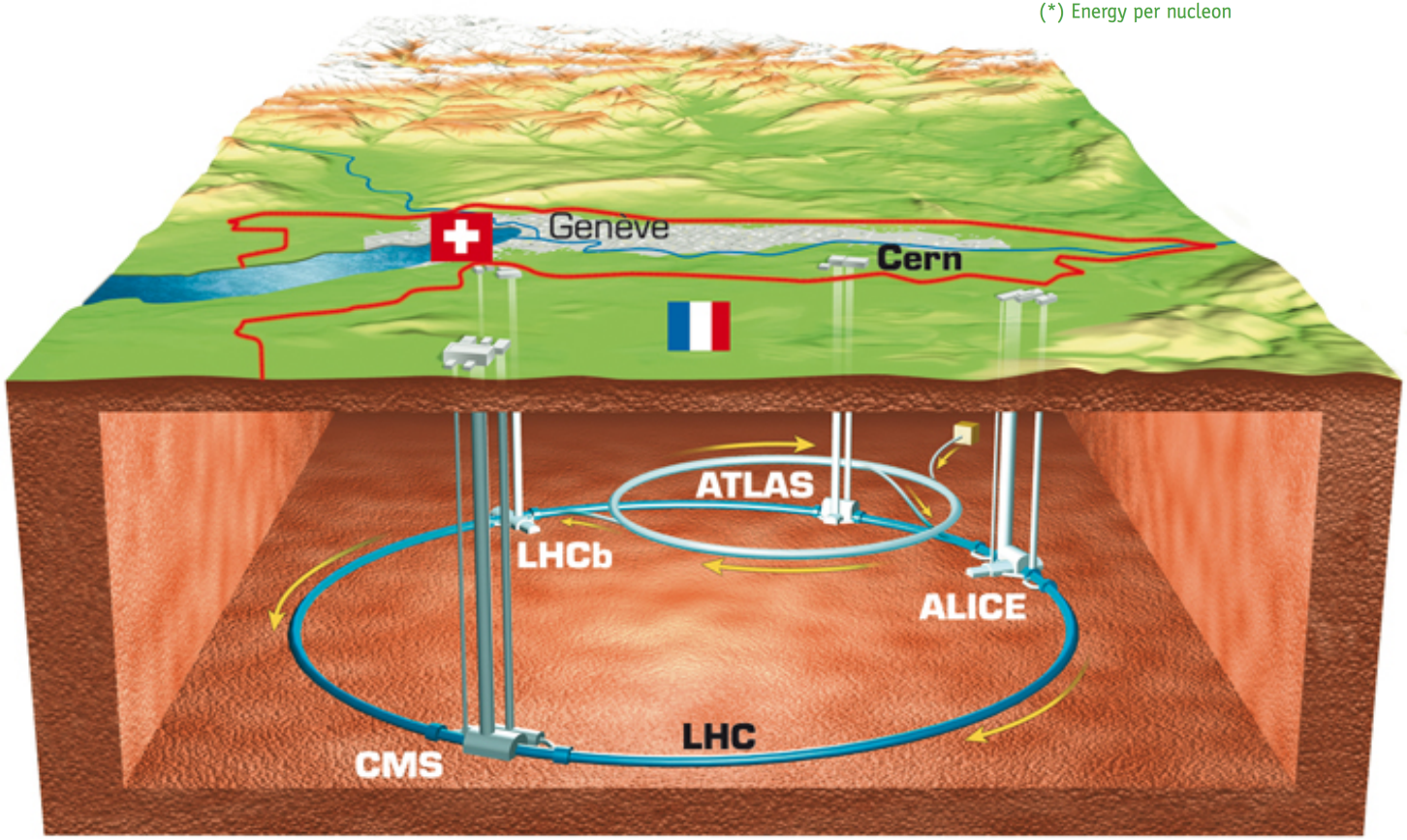
Large Hadron Collider

- The largest particle accelerator ever built -> 27 km long
- Located on the French-Swiss border
- 4 main interaction points and experimental areas:
  ATLAS, CMS, ALICE, LHCb

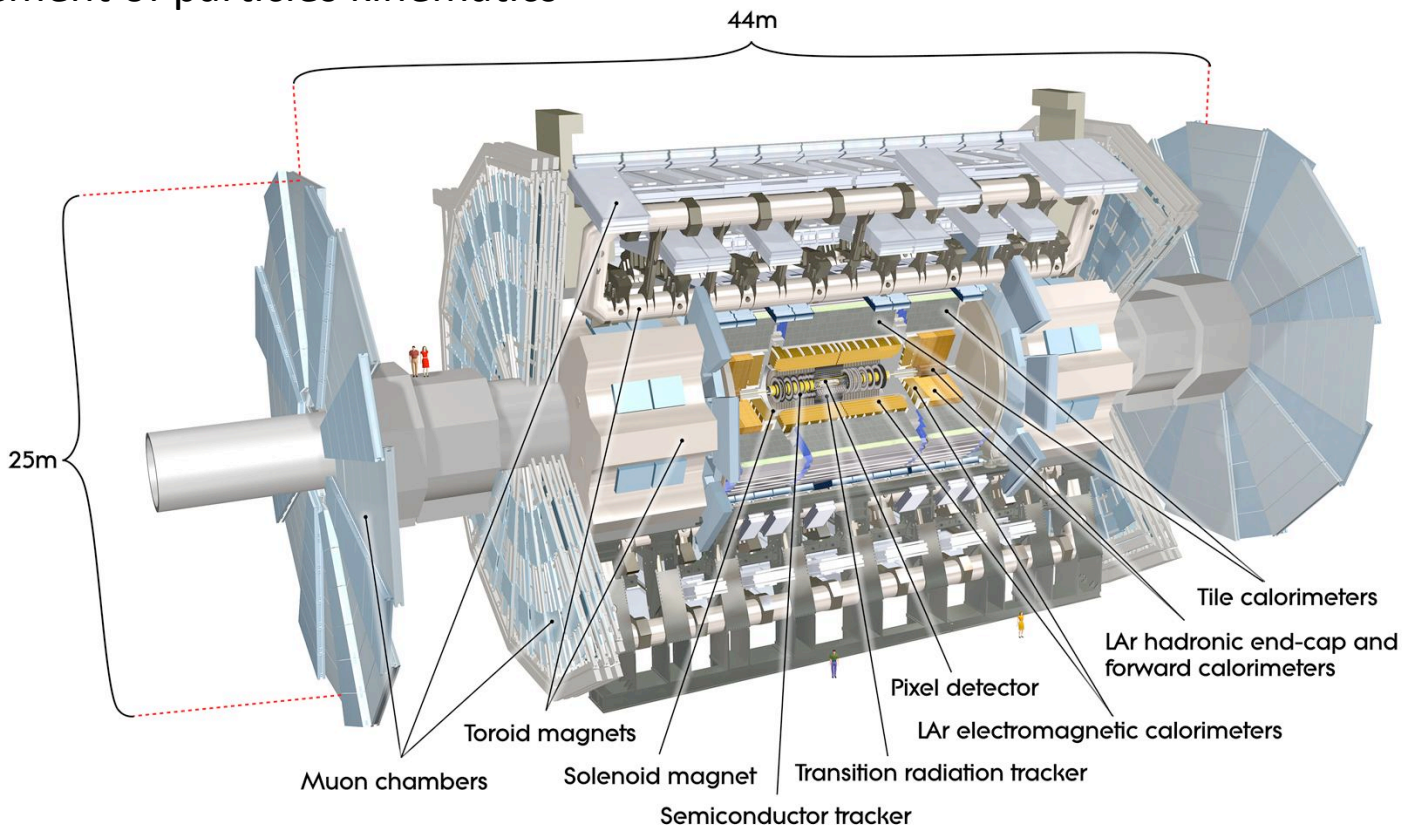
Quantity	number
Circumference	26 659 m
Dipole operating temperature	1.9 K (-271.3°C)
Number of magnets	9593
Number of main dipoles	1232
Number of main quadrupoles	392
Number of RF cavities	8 per beam
Nominal energy, protons	7 TeV
Nominal energy, ions	2.76 TeV/u (*)
Peak magnetic dipole field	8.33 T
Min. distance between bunches	~7 m
Design luminosity	10^{34} cm^{-2} s^{-1}
No. of bunches per proton beam	2808
No. of protons per bunch (at start)	1.1×10^{11}
Number of turns per second	11 245
Number of collisions per second	600 million

(*) Energy per nucleon



ATLAS Experiment

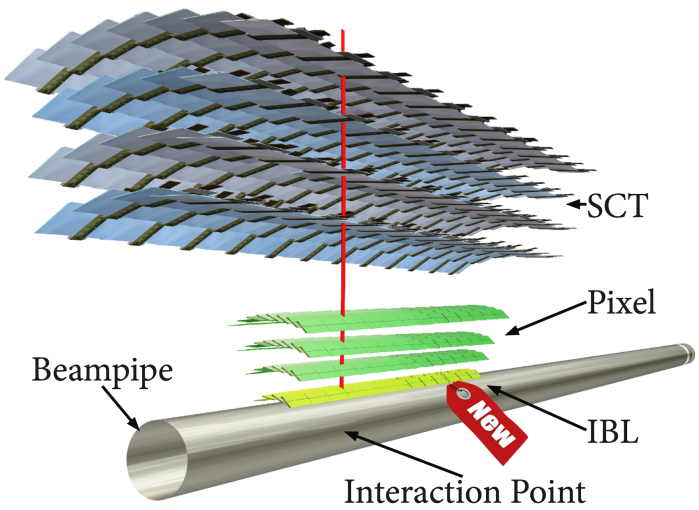
- The ATLAS detector is a multi-purpose detector with a tracking system ideal for the measurement of particles kinematics

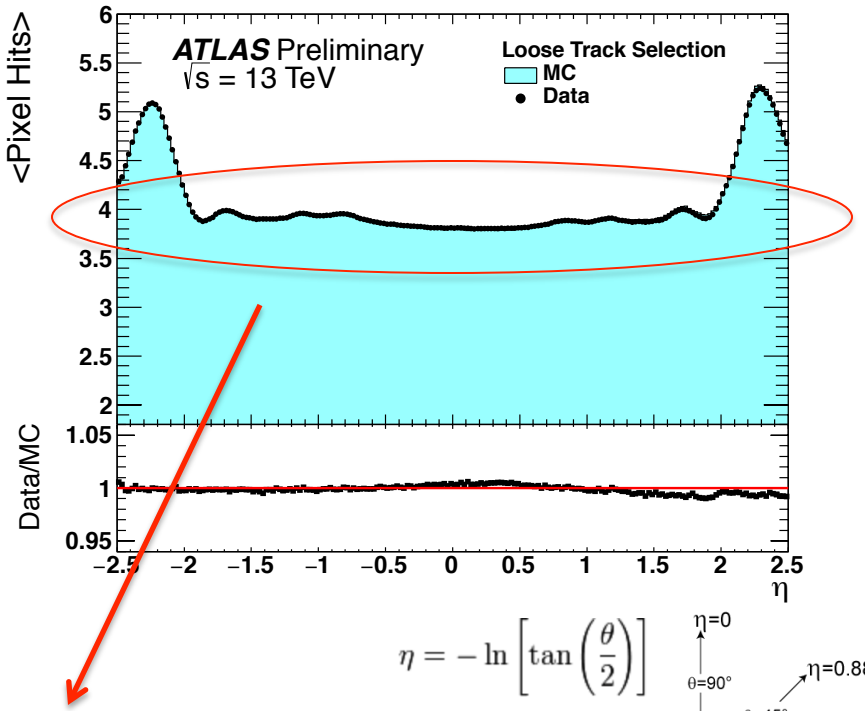


- After a 3-year data taking phase (Run-I, 2010-2012) and a 2-year shutdown (LS1, 2013-2014) for repairing and upgrade, the ATLAS Detector is again operational at the LHC Run-II at $\sqrt{s}$=13TeV

Inner Detector Performance

- The ATLAS Inner Detector, optimized for Run-I, consists of 3 different, concentric detectors:
  - Pixel
  - SCT (Silicon Tracker)
  - TRT (Transition Radiation Tracker)
- A new Pixel layer, the **Insertable B-Layer** (**IBL**) added to the tracking system during Long Shutdown 1
- Detector Performance carefully re-optimized for Run-II





4 measurement points to reconstruct the track!

Current Student's Profile

- **Based at CERN full time**
  (with the unanimous approval of the SIACE Academic Council)

- **Main Academic Activities:**

  - **CERN-Fermilab Hadron Collider Physics Summer School** (24 June-3 July 2015)
  - **CERN School Of Computing** (14-25 September 2015)
    - Selected as lecturer for the Inverted CERN School of Computing which will be held on 29February-2March 2016
  - **~ 35 Seminars and Colloquia** attended at CERN
  - **10 International Conferences and Workshops** attended

- **Main Contributions to International Conferences:**
  - **Frontier Detectors for Frontier Physics, 13th International Pisa Meeting on Advanced Detectors**, La Biodola, Isola d'Elba, 24-30 May 2015
  - **QCD@LHC-2015 International Conference**, Queen Mary University Of London, 1-5 September 2015

Current Student's Profile

- **Main Research Activities:**
  - **Muon Detector:**
    - New Small Wheel Simulation (Geant4-based)
    - Micromegas Performance
    - Online Monitoring during the Muon Spectrometer Operation
  - **Inner Detector:**
    - Tracking Optimization and Material Studies at the LHC RUN-II
  - **Data Analysis**
    - Charged Particle Multiplicity (or Minimum Bias Events) at 13 TeV
    - W boson cross section measurements at 13 TeV
  - **Outreach**
    - CERN Guide

- **Qualified Member** of the **ATLAS Collaboration** since **February 2015**
  - **Author of ~70 papers**
  - **Editor of 4 PubNotes (main editor of 2 of them), 3 ConfNotes and 3 Papers** (to be submitted to international journals)
  - **Reviewer of the Supporting Note** of the Minimum Bias Paper at 8 TeV

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THE AIM OF THIS TALK IS NOT TO GO INTO DETAILS ABOUT MY RESEARCH RESULTS (if you are interested, please contact me directly) BUT TO GIVE AN EXAMPLE OF A PhD EXPERIENCE

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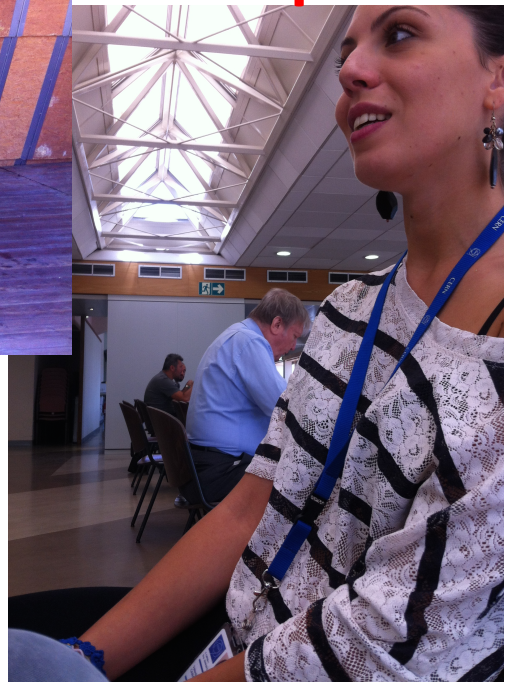
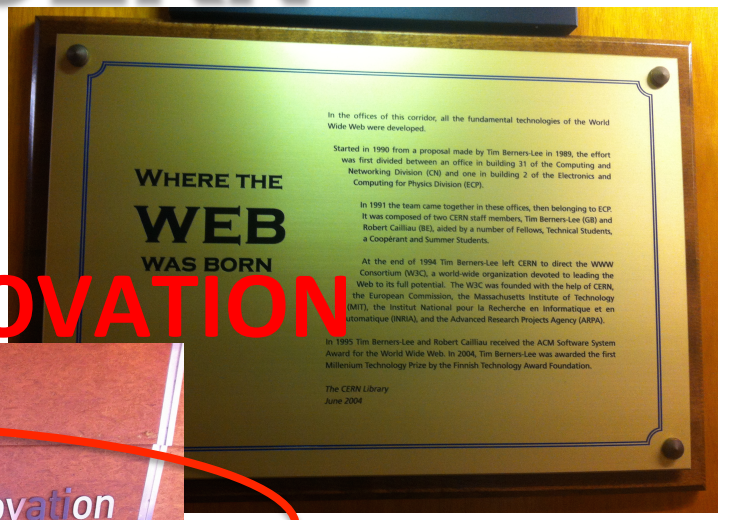
Working at CERN

Experimental facilities

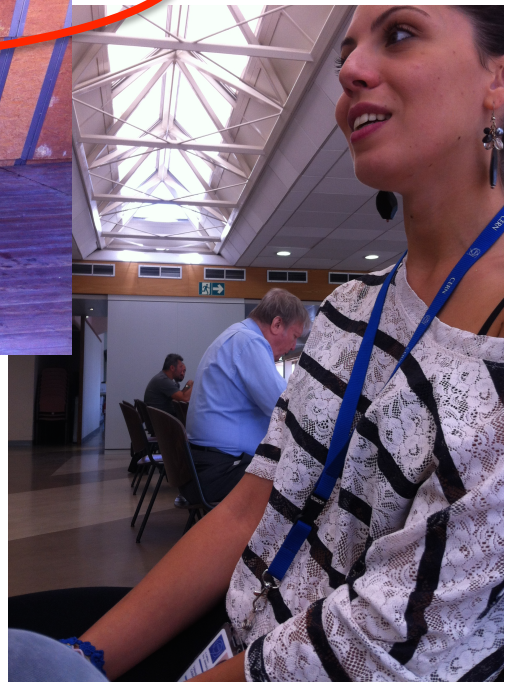
Expertise



Working at CERN



SCIENCE AND INNOVATION



Working at CERN

- Multinational and multicultural environment
  - Working with people from all over the World
  - Learning a new language
    (not only English, already considered as baseline knowledge)
    - French is necessary to talk with technicians,
      to do shopping, to live in France!
  - Living in a foreign country
    - Rent an apartment
    - Different lunch-time (different lunch!)

- Cutting-edge technology
  - Access to modern laboratories
  - New detector technologies
  - Advanced computing facilities and techniques

- Very exciting and stimulating context
  - Where one's abilities are boosted greatly!

- But also…
  - Working long hours (often 7 days a week)
  - Night shifts
  - Traveling like crazy! (Good? Bad?)

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CERN-UNICAL Link

ATL-COM-PHYS-2015-1383

Early Inner Detector Tracking Performance in the 2015 data at $\sqrt{s}$ = 13 TeV

Cairo, Valentina (INFN Gruppo Collegato di Cosenza and Universita' della Calabria, Dipartimento di Fisica) ; Styles, Nicholas Adam (DESY, Hamburg and Zeuthen) ; Bruckman de Renstrom, Pawel (Institute of Nuclear Physics Polish Academy of Sciences, Krakow) ; Henkelmann, Steffen (Department of Physics, University of British Columbia) ; Yamaguchi, Daiki (Tokyo Institute of Technology) ; Clark, Michael Ryan (Columbia University (US)) ; Mansour, Jason Dhia (Institute of High Energy Physics, Chinese Academy of Sciences) ; Gray, Heather (European Laboratory for Particle Physics, CERN) ; Hsu, Shih-Chieh (Department of Physics, University of Washington, Seattle)

16 Nov 2015. - mult. p.

Particle Physics - Experiment

CERN LHC ; ATLAS

Tracking CP Recommendations ; TRACKING

This note summarises the combined performance recommendations for ATLAS Inner Det
proton collisions at the LHC. The track reconstruction efficiency, fake rate, and related sy
selections, along with the impact parameter resolution and the alignment weak mode s
Inner Detector tracks in Run 2 data.

- Even if I am working at CERN, I am still associated to UNICAL!
- Any paper I sign, any conference I attend, I do it with the UNICAL label
- **I feel that I represent UNICAL at CERN**

SIACE keywords

Scienze e Ingegneria dell'Ambiente, delle Costruzioni e dell'Energia

=

SCIENCE AND INNOVATION!

- **Multidisciplinary PhD school → Science and Innovation are multidisciplinary by definition:**
  - **Physics**
  - **Chemistry**
  - **Engineering**
  - **Natural Sciences**
  - **Material Sciences**

- **Nice opportunity of sharing knowledge:**
  - **Poster sessions**
  - **End-Of-Year presentations**

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