

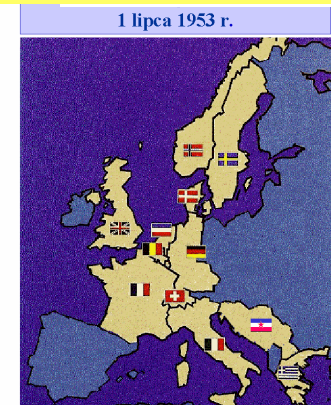
Symposium  
„Physics of Elementary Interactions in the LHC Era”  
April 21-22, 2008

# Poland at CERN

Jan Paweł Nassalski  
Soltan Institute for Nuclear Studies

## Road to CERN

**1954:** CERN established → 12 Member States  
ratify the CERN Convention



**1959:** Marian Danysz (Warsaw) and Marian Mięslowicz (Cracow) obtained several scholarships for young Polish physicists at CERN. It soon developed into wider collaboration.

**1963:** On the initiative of M. Danysz and CERN DG V. Veisskopf, Poland was granted status of observer state, as the only country from „behind the iron curtain”. Initiatives of a full membership were blocked by the Soviet Union.

**1991:** **Poland becomes 16<sup>th</sup> member state of CERN** as the first country from „behind the iron curtain”. The formal agreement between government of Poland and CERN was ratified by the President Lech Wałęsa on May 13, 1991.



# Poland at CERN



**CERN is our laboratory from July 1, 1991.**

## Poland at CERN



**The Polish Deputy Minister of Energy and Nuclear Power, J. Felicki, presented the Directors General with a bust of Maria Skłodowska-Curie on behalf of physicists of Poland, 1979.**

**→ Main Building, 1st floor**



## Poland at CERN



**H.H.Pope John-Paul II**

16 June 1982



**H.E. Tadeusz Mazowiecki,  
prime minister of the Republic of Poland**

16 Jun 1990

Warsaw, 21.4.2008

J.P. Nassalski

## Poland at CERN



**Prof. Andrzej Wiszniewski,  
Minister of Science**  
9 October 2000



**Prof. Michal Kleiber,  
Minister of Science**  
17 October 2003

Warsaw, 21.4.2008

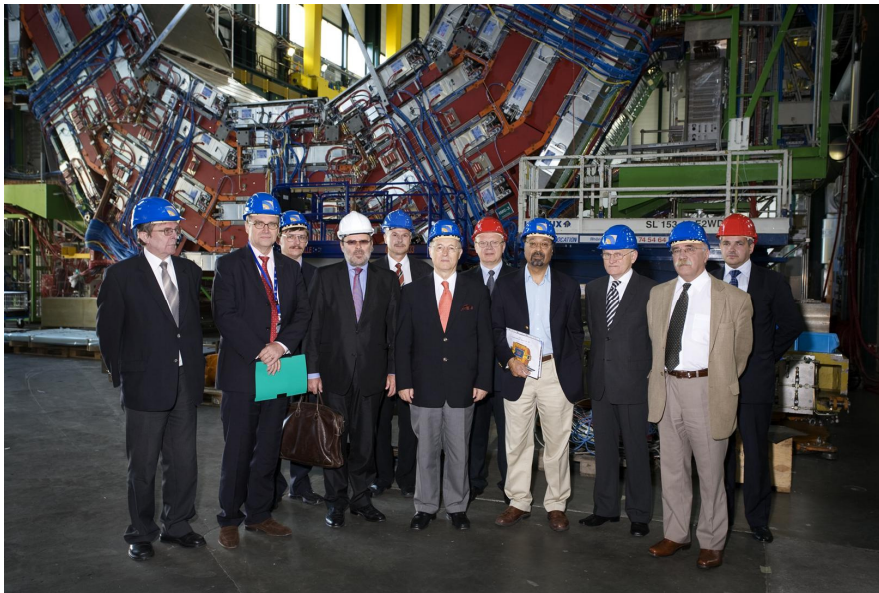
J.P. Nassalski



## Poland at CERN



**Prof. Krzysztof Kurzydłowski,  
Undersecretary of State,  
Ministry of Science and Education  
24 April 2006**



**Prof. Michał Seweryński,  
Minister of Science and Higher Education  
and Prof. Krzysztof Kurzydłowski,  
Undersecretary of State  
12 Jul 2007**

Warsaw, 21.4.2008

J.P. Nassalski

## Rights and duties

- We contribute to the CERN budget.

CERN budget in 2008: ~1,100M CHF.

Polish contribution: ~2.3% - proportion of our „Net National Income” to that of all member states.

- We have 2 representatives to the CERN governing body: the CERN Council;  
*prof. J.Niewodniczański, National Atomic Energy Agency – representing government,*  
*prof. J.Nassalski, Soltan Institute for Nuclear Studies – representing physicists.*

In the CERN Council votes of all member states have the same weight.

- We have access to the CERN infrastructure worthy billions of CHF;  
LHC (6,000M CHF), SPS, PS, AD, ISOLDE.



## Rights and duties

- Physicists, engineers, students can apply for temporary positions at CERN (associateships, fellowships, doctoral studies ...).  
Students and teachers – for the summer courses.

We can expect our share to be ~2-3%;  
several countries have an extra funding, e.g. for doctoral and summer students.

- We can apply for the permanent positions (staff).

- Polish industry has an access to the CERN market:  
supply of goods and services.

## People at CERN

January 2008

*paid by CERN*  
*partially paid*  
*unpaid*

■ Staff ( <i>permanent</i> ) .....	38	
■ Fellows ( <i>1 + 1 yrs. → staff</i> ) .....	19	~50% young engineers in Information Technology Department
■ Paid associates ( <i>1 yr.</i> ).....	2	
■ Project associates .....	43	teams from Cracow and Wroclaw in the LHC tunnel
■ Technical students ( <i>½ - 1 yr.</i> ) .....	9	
■ Doctoral students ( <i>1 – 3 yrs.</i> ) .....	3	
■ Summer students ( <i>2 – 3 mths.</i> )...	4	
■ Users.....	229	
	<hr/>	
	~ 350	

# High Energy Physics institutions in Poland

## Łódź:

Soltan Institute for Nuclear Studies  
University of Lodz

## Katowice:

University of Silesia

## Kielce

Świętokrzyska Academy

## Kraków:

AGH University of Science and Technology  
Niewodniczanski Institute of Nuclear Physics, PAS  
Jagiellonian University

## Warszawa:

Soltan Institute for Nuclear Studies  
Warsaw University of Technology  
University of Warsaw

## Wrocław:

University of Wroclaw



**6 centers, 10 institutions**

■ ~ 300 experimentalists and engineers,

■ ~ 100 theorists.

**Most of them collaborating  
with CERN.**

## Positions at CERN

- Vice-President of the CERN Council: **R. Sosnowski** (1991-2004)
- Head of ECP (Electronics and Computing for Physics) Division: **M. Turała** (1995-1997)

### Members of Committees selected *ad personam*

- Scientific Policy Council (SPC): **A. Wróblewski, K. Rybicki, A. Zalewska (at present)**
- LEP Experiments Committee (LEPCC): **S. Pokorski**
- SPS Committee (SPSC): **J. Nassalski, A. Zalewska, H. Białkowska**
- LHC Electronics Coordinating Committee (LECC): **M. Turała**
- Research Board (RB): **A. Zalewska**

### Some present positions of Staff Members

- **A. Charkiewicz** – Leader of the Assistance and Counselling Section, [HR Department](#)
- **T. Kurtyka**
  - Deputy Group Leader of TS-MME ([TS Department](#), Mechanical & Materials Engineering Group),
  - Adviser to the Director General for the Relations with Non-Member States.
- **A. Siemko**
  - Deputy Group Leader of AT-MEI ([AT Department](#), Magnet Electrical Systems and Instruments Group)
  - Section Leader of AT-MEI-TF (Test Facilities and Electrical Diagnostics)
  - Technology Transfer Officer for AT Department

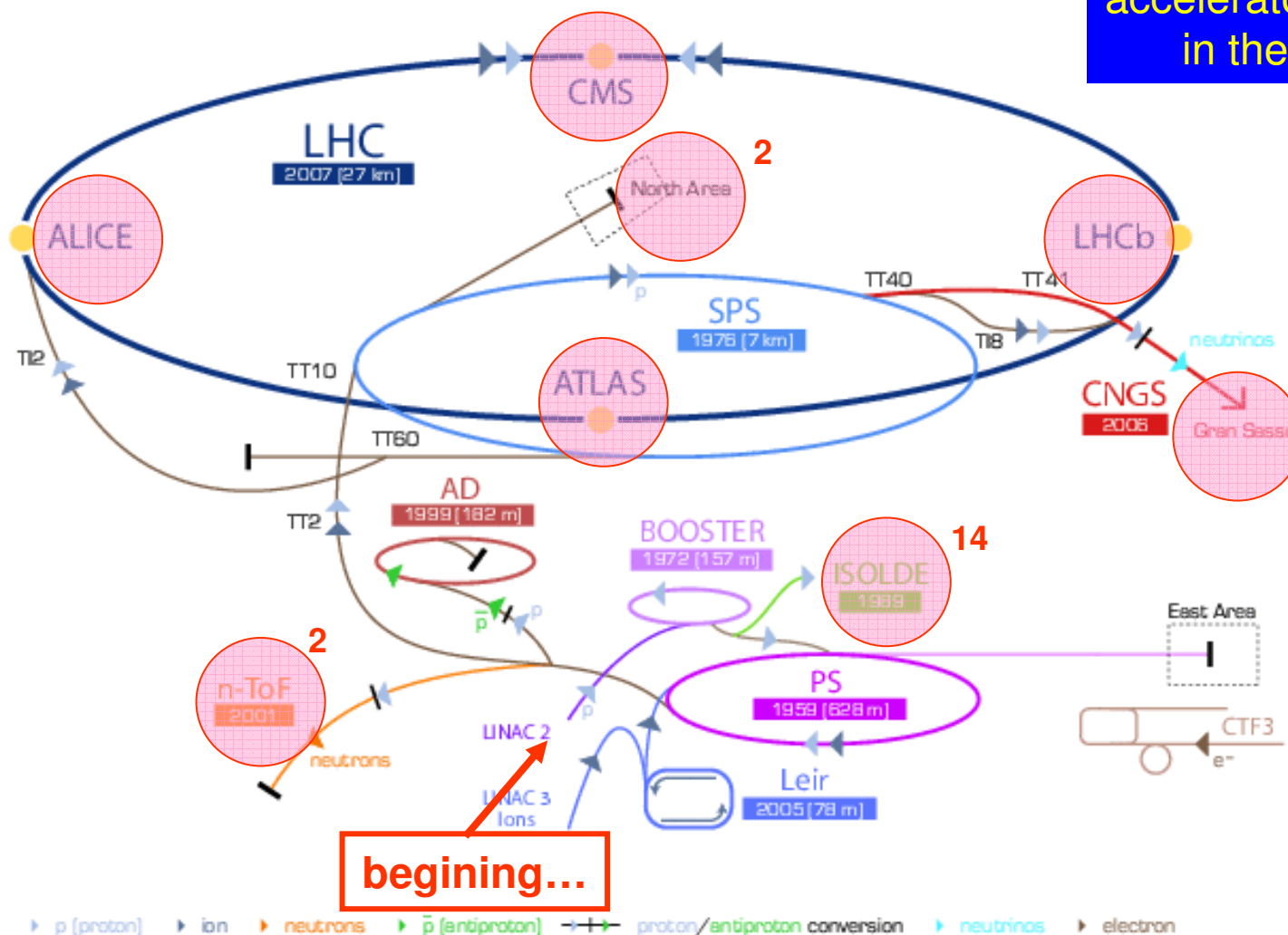


# Polish participation in experiments at CERN

We have participated in ~100 experiments at CERN.

Presently we are there:

The most complex  
accelerator system  
in the world



# Experiment at the SPS: COMPASS

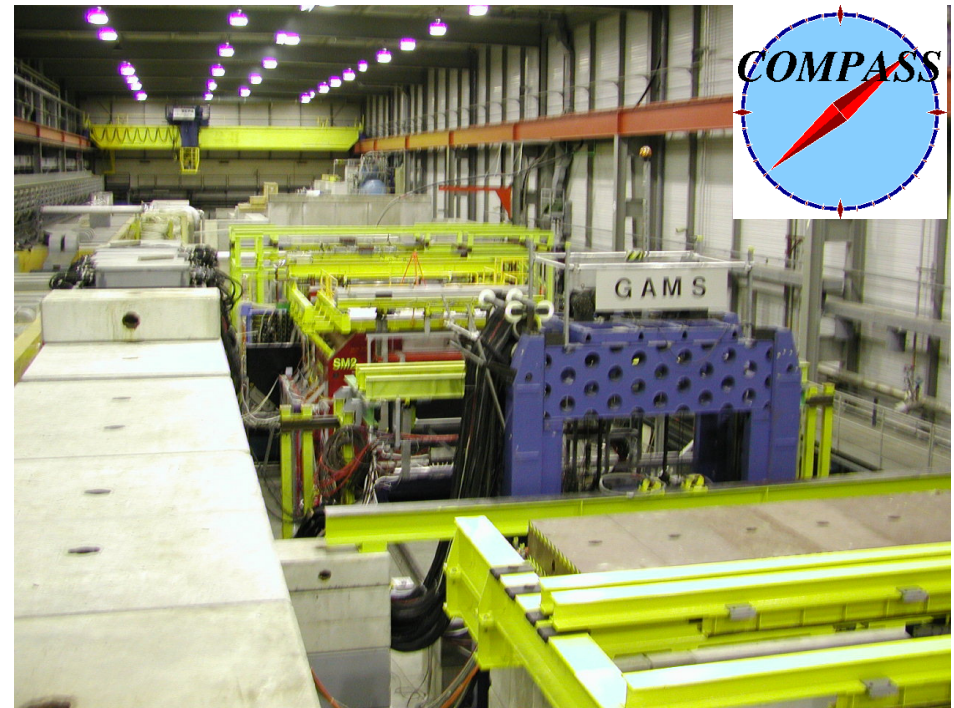
**COMPASS Collaboration:** 200 people from 30 institutions in 10 countries.

## From Poland – 15 people:

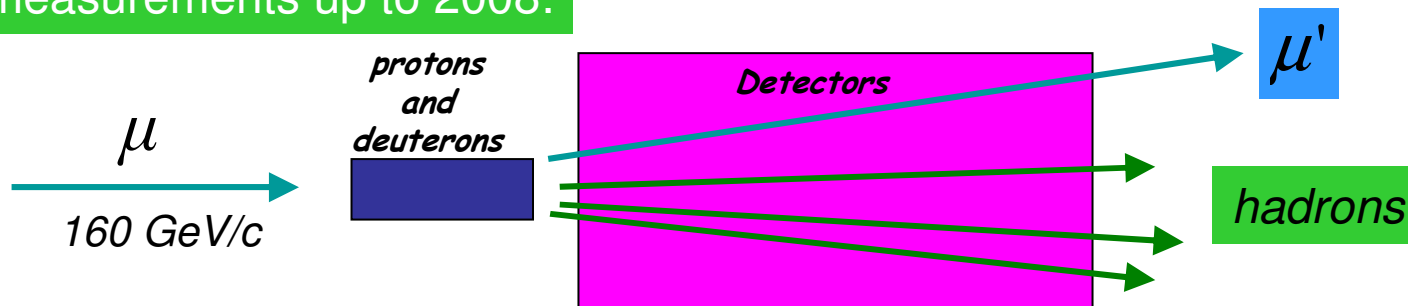
- Institute for Nuclear Studies, Warsaw
- University of Warsaw
- Warsaw University of Technology

## Polish contribution:

- SciFi tracking detector
- alignment of all detectors
- analysis (10 PhD students in total).



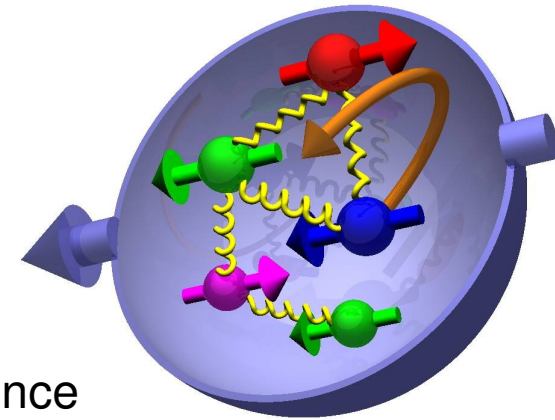
The measurements up to 2008:



## Experiment at the SPS: COMPASS

**Physics:** to understand the proton and neutron  
in terms of their constituents: quarks and gluons.

This subject has been investigated at CERN since early 70's and Polish physicists participated in all experiments since early 80's: **EMC** → **NMC** → **SMC** → **COMPASS**.

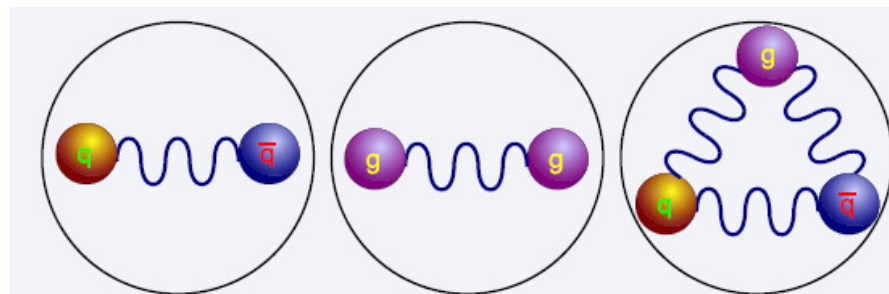


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**New physics program starting this year:** using hadron beams - to discover particles build by exotic combinations of quarks and gluons, predicted to exist by the theory of strong interactions, Quantum Chromodynamics:

known particle  
(meson)

unknown particles,  
predicted to exist

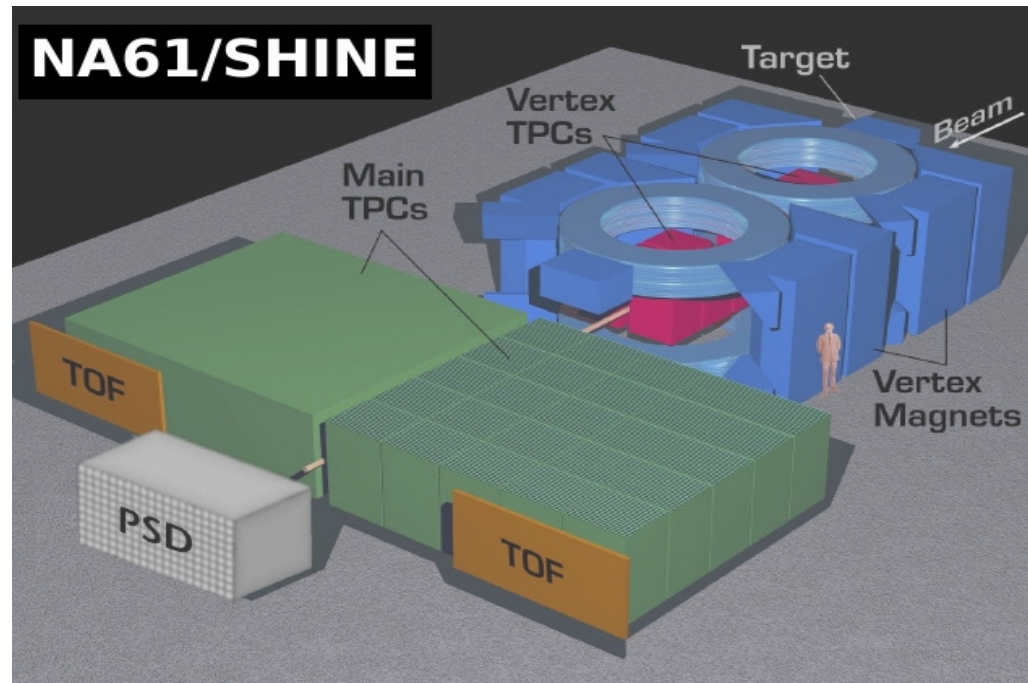


## Experiment at the SPS: SHINE

**SHINE Collaboration:** 114 people  
From 24 institutions in 14 countries.

### From Poland – 16 people:

- Jagiellonian University, Kraków
- Institute for Nuclear Studies  
Warszawa
- Świętokrzyska Academy, Kielce
- University of Warsaw
- Warsaw University of Technology.



### Polish contribution:

- beam position detectors
- gas system
- power supplies
- light guides for TOF detectors
- detector control system
- data base of experiment
- software coordination
- spokesperson: M. Gaździcki (Frankfurt/Kielce).



# Experiment at the SPS: SHINE

## Physics subjects:

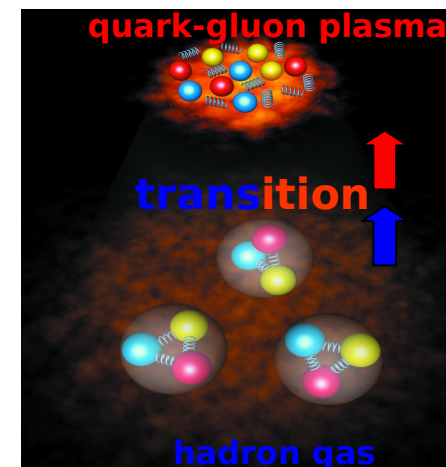
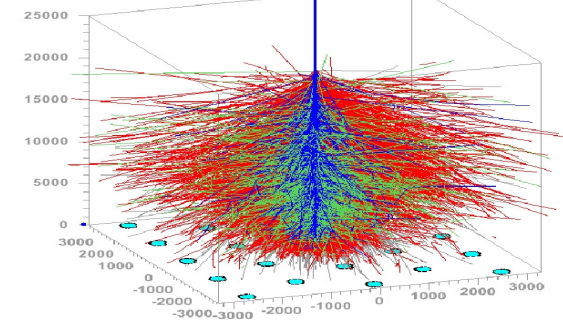
- Measure hadron production in hadron – hadron interactions, needed for **neutrino experiments** (Super-Kamiokande, T2K) ....
- ... and also for **cosmic-ray experiments** (Pierre Auger, KASCADE):
- Study of nucleus-nucleus collisions in search of a transition from nucleon-gas to **quark-gluon plasma**:

**Good synergy:** Polish groups are also involved in **neutrino, cosmic-ray and higher energy nucleus-nucleus interaction** experiments (STAR, ALICE).

**COMPASS and SHINE → E. Rondio presentation**



## Extensive air shower



# Construction of the LHC

**From 2004, more than 100 engineers and technicians from ...**

- Institute of Nuclear Physics, PAS; Kraków
- AGH University of Science and Technology; Kraków
- Cracow University of Technology; Kraków
- Wroclaw University of Technology; Wrocław

**About 1000 man-months  
until the end of 2007**

**... were testing and working on:**

- **Electric connections of magnets**
- **Mechanic, cryogenic and vacuum connections in the tunnel**
- **Superconducting cables**
- **Quench protection system**
- **Cooling system and air-conditioning**
- ....

**→ G. Polok presentation**



Polish engineer testing electric connections

Warsaw, 21.4.2008

J.P. Nassalski

# ALICE



**ALICE detector** build by 1000 people from 86 institutions in 26 countries.

**From Poland - about 22 people:**

- Institute of Nuclear Physics, PAS; Kraków
- Institute for Nuclear Studies, Warszawa
- Warsaw University of Technology

- **ALICE detector** is a „vehicle” to travel back in time to the Universe at  $10^{-6}$  s after the Big Bang, believed to be composed of hot and dense Quark-Gluon Plasma (QGP).
- Attempt to produce QGP will be made by colliding head-on lead ions accelerated in the LHC; in the most central collisions available energy will be 1'150'000 GeV.
- QGP will be detected by identifying emitted „messenger particles”. It will be very difficult task because up to 20'000 particles will be created in the collisions.



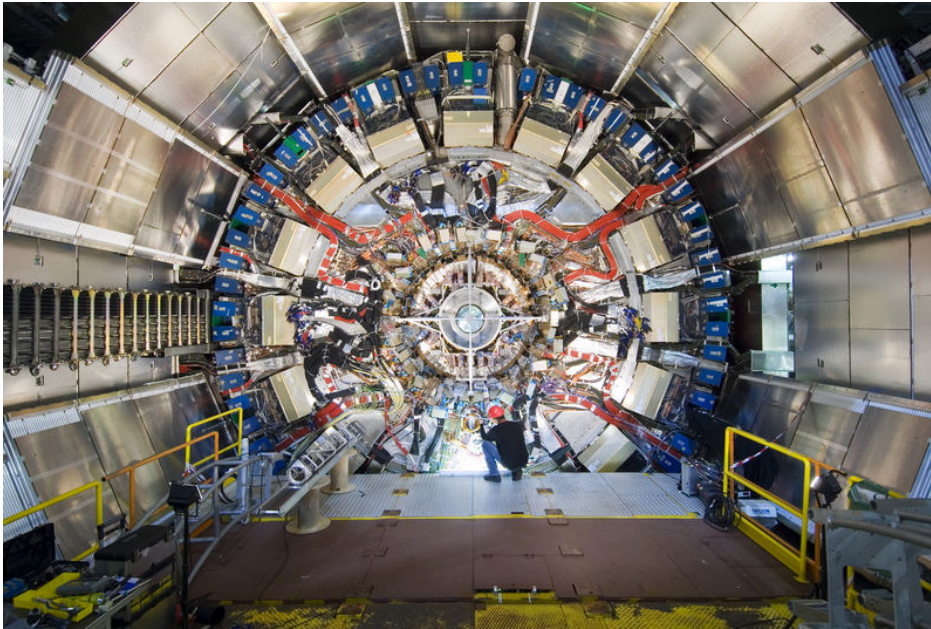


## Polish contribution:

- Time Projection Chamber – cylindrical detector of 5m length and diameter;  
contribution to the design, construction and tests.
- Photon detector (PHOS) composed of transparent PWO crystals 2cm x 2cm x 18cm;  
Poland supplied 1000 crystals, part of electronics, contributed to the construction and tests.
- Fast timing and trigger detector T0;  
contribution to the electronics.
- ... to the construction of the data-base.
- ... to the simulations of heavy ion interactions.



# ATLAS



**ATLAS detector** build by 2000 people from 167 institutions in 37 countries.

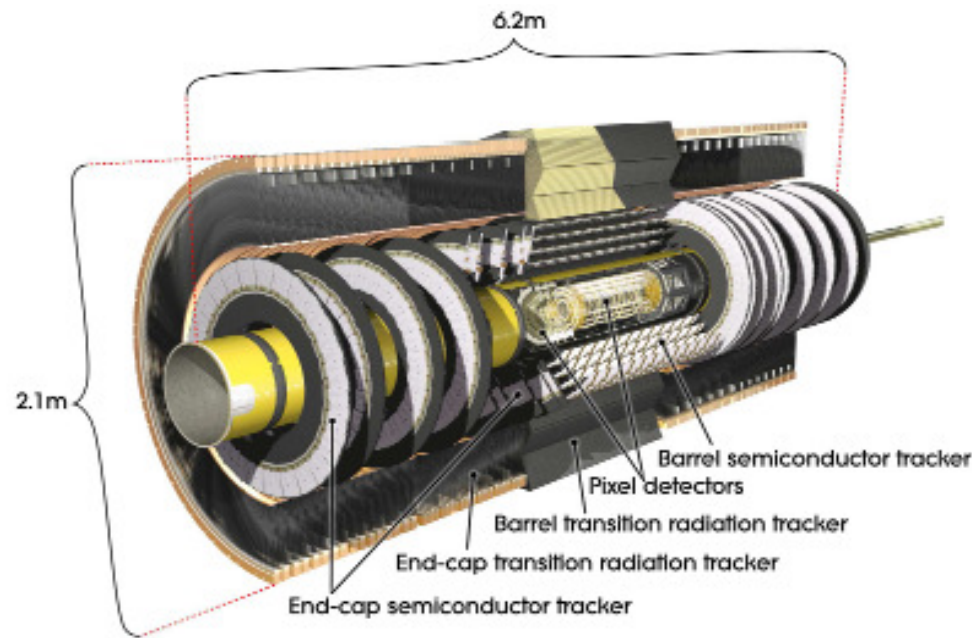
**From Poland - about 20 people:**

- AGH University of Science and Technology, Kraków
- Institute of Nuclear Physics, PAS; Kraków

■ With the **ATLAS detector** physicists will be searching for:

- the last missing piece of the Standard Model – **the Higgs particle**
- the physics beyond the Standard Model, in particular - **the supersymmetric particles**,
- and also exotic items like: **mini black holes, higher dimensions, ...**

# ATLAS



## ATLAS Inner Detector:

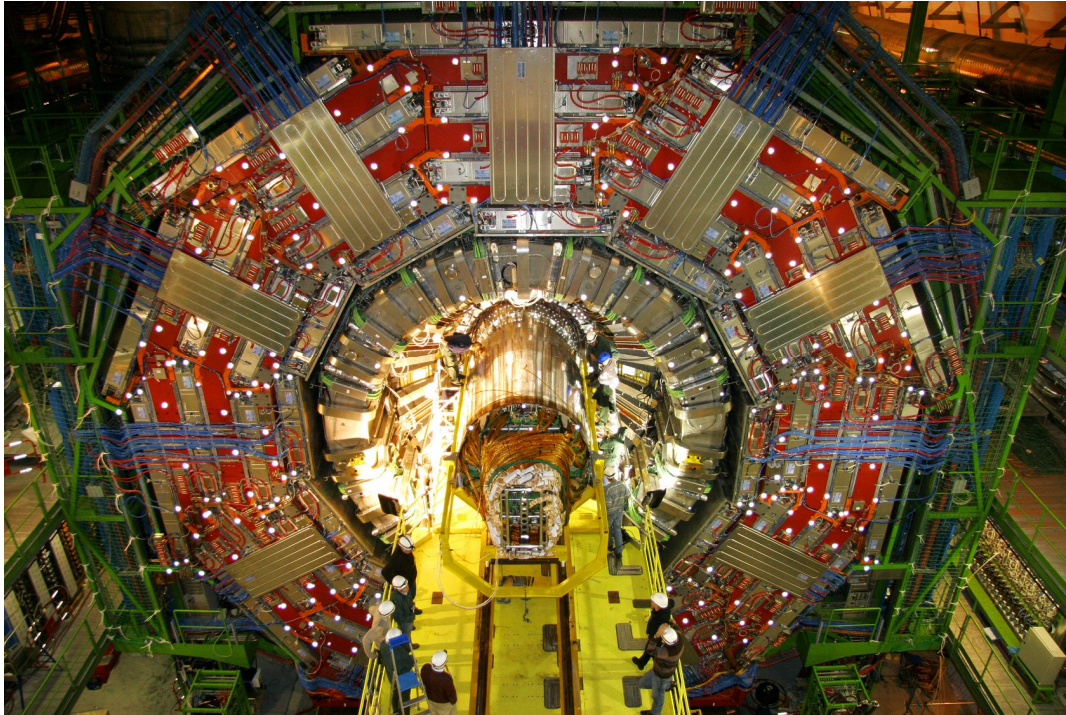
for precise determination of charged particle trajectories near the colliding protons using:

Silicon Pixel Detector  
+ Silicon Semi-Conductor Tracker  
+ Transition Radiation Tracker

## Polish contribution - to the Inner Detector:

- to the construction, installation and commissioning of the detector
- to the electronics: power supplies, read-out and steering
- to the simulations of proton interactions

# CMS



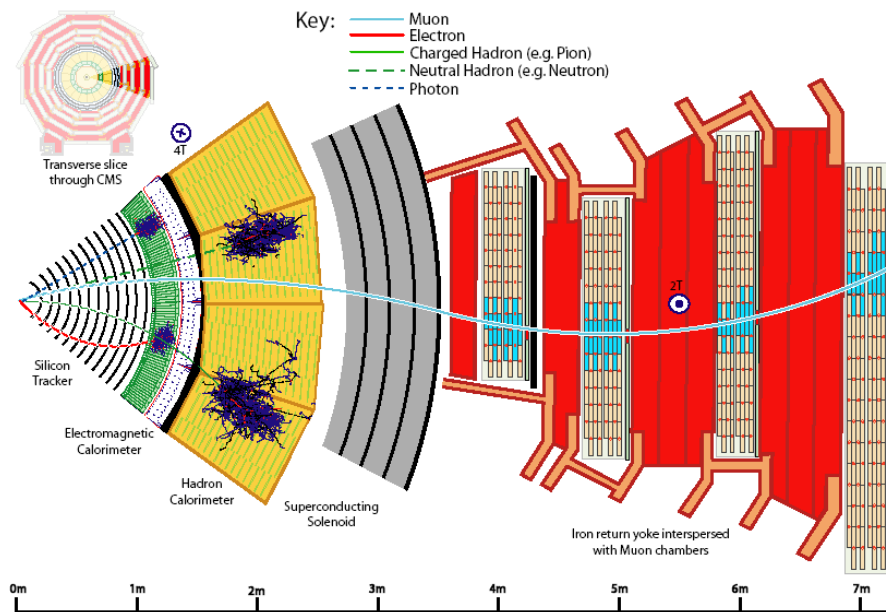
**CMS detector** build by 2300 people from 159 institutions in 36 countries.

**From Poland - about 20 people:**

- Institute for Nuclear Studies, Warszawa
- University of Warsaw

- Similarly as ATLAS, the **C**ompact **M**uon **S**olenoid (**CMS**) **d**etector is a multi-purpose detector dedicated to the search for higgs and the search of New Physics – beyond the Standard Model





## CMS Trigger:

uses high momentum muons produced at large angles to the colliding protons.

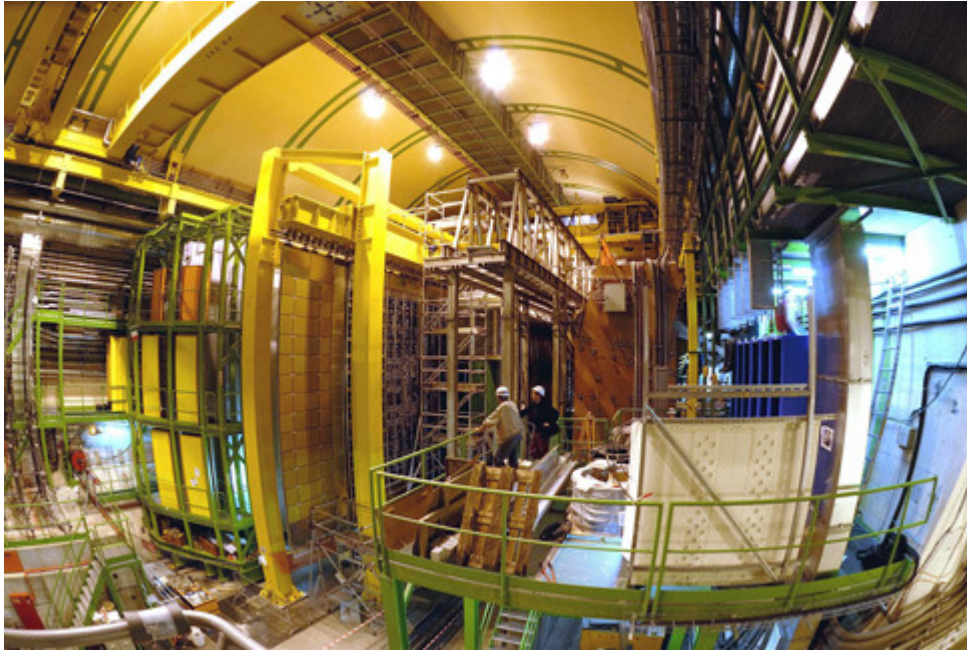
Muons penetrate the whole detector and are identified in the outer layers.

Trigger decisions: every 25 ns.

## Polish contribution – to the CMS trigger:

- design of all trigger electronics
- construction of about 3000 electronics modules
- installation, commissioning and responsibility for the whole system
- to the simulations of proton interactions.

# LHCb



**LHCb detector** build by 690 people from 48 institutions in 15 countries.

**From Poland - about 18 people:**

- AGH University of Science and Technology, Kraków
- Institute of Nuclear Physics, PAS; Kraków
- Institute for Nuclear Studies, Warszawa

- Experiment dedicated to study differences between particles and antiparticles; how is it possible that initial Universe, created with an equal number of particles and antiparticles, is presently dominated by matter?
- The study will be made with particles (and antiparticles) containing **quark b** (beauty), which is heavy and decays after  $10^{-12}$  s. During its lifetime it will travel a distance of about 1 cm.
- These particles have to be identified and the distance determined by reconstructing decay products in various tracking detectors





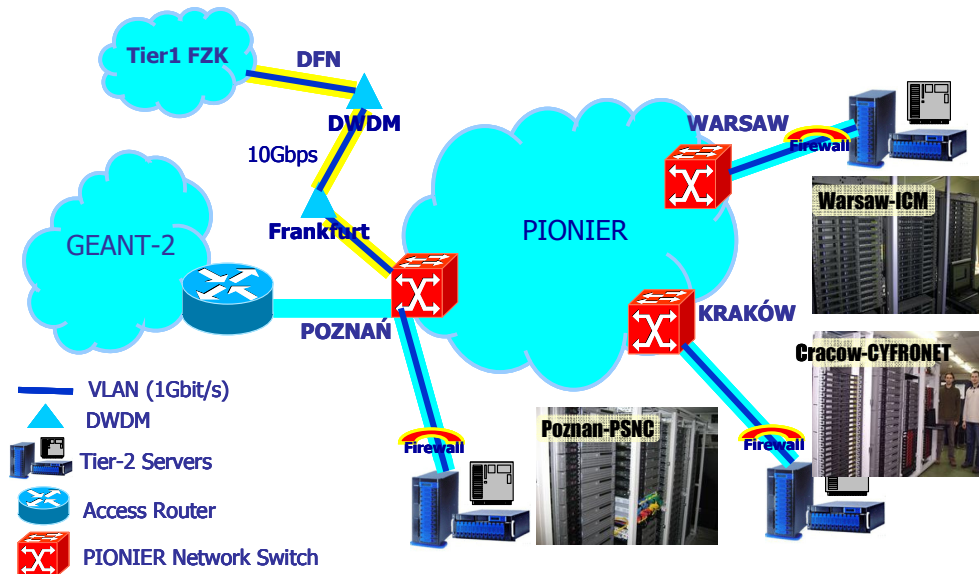
**Polish contribution:**  
**„straw tubes” - tracking detectors used**  
**In the Outer Detector.**

Straw tubes of 2.5 m long and 5 mm diameter are glued into layers. Two layers mounted on a panel form a module.

Production of a module in Warsaw

- Contribution to the design and construction of the prototype
- Production of all 2.5m straws (1/3 of the total 64'000)
- Alignment system for the Outer Detector
- Production of all pannels (400) needed for the construction of modules.

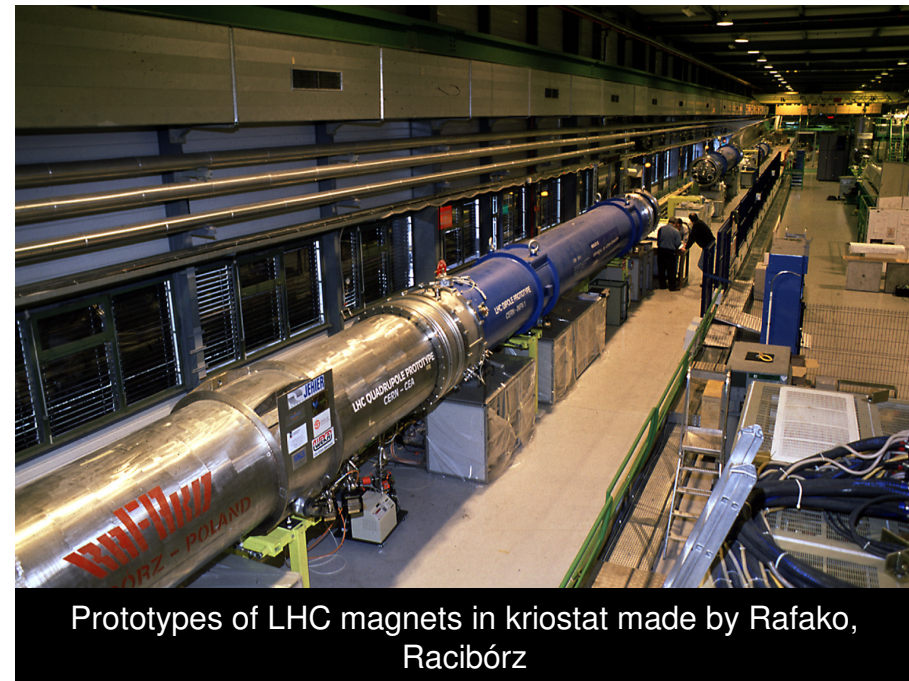
# LHC computing GRID



- During 1 yr. of data taking LHC will produce 15 PB of data to be analysed by 5000 physicists in 500 institutions around the world.
- A dedicated computing GRID (WLCG) was created to distribute the data from CERN and to share the computing power. There are 4 distribution levels: Tier0 (CERN) → Tier3.
- Physicists from Cracow and Warsaw, in collaboration with CYFRONET (Warsaw), ICM (Warsaw) and PCSS (Poznan), created Tier2 level in Poland. It uses computing net constructed with the Polish program PIONIER.

→ M. Turała presentation

## Polish industry



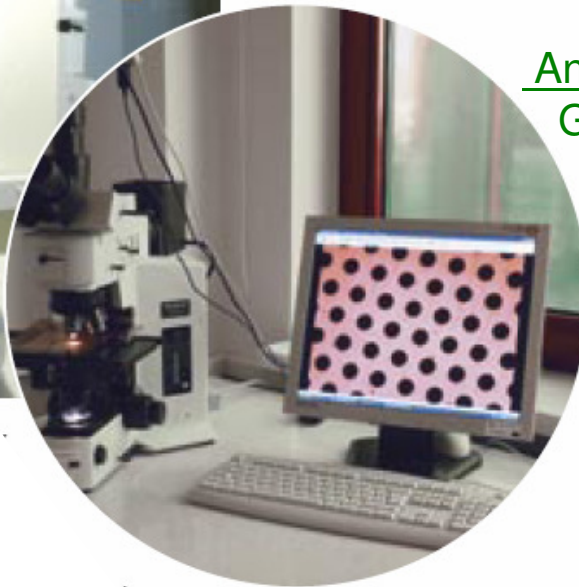
- Construction of the LHC created a market worthy 3-4 billions of CHF
- Poland got an access to this market in 1991, when it became the member state
- Since that time tens of Polish enterprises won contracts for supplies and services; e.g. ZEC Service, Wrocław – several contracts for a total of 10 million CHF and Rafako, Racibórz – kriostats for a prototype section of LHC magnets
- In the period 1991-2006 all the contracts amounted to 30 million CHF.  
Warsaw, 21.4.2008 J.P. Nassalski → **T. Lagrange and M. Chorowski presentations**



# Technology transfer



High energy physics needs very sophisticated instruments using novel technologies.  
CERN encourages transfer of technologies to the research laboratories and to the industry, to be used in our daily life.



## An example:

GEM detector invented at CERN and the technology transferred to TECHTRA (Wroclaw Technology Park).  
Awarded silver medal in the International Inventions Fair in Geneva, 2007.

**→ J.- M. Le Goff and  
W. Dąbrowski presentations**



# CERN National Teacher Programme

„TRAINING SCIENTISTS OF TOMORROW”

One week - secondary school physics teacher program in Polish – was launched at CERN at the beginning of 2007.



First evening of the first course, April 2007



Second course, May 2007

Up to now 5 courses were organised with the next in planned in June.

Nearly 200 teachers have already attended.

**A big success!**

# CERN National Teacher Programme

## Success in ...

- ability to mobilize local government funds to finance participation
- mobilizing **very large number of follow-up activities** after return to Poland



An example: conference organised for teachers by local educational office (*kuratorium*) and teachers – participants of NTP: „High Energy Physics in School Education”, Puławy, 29.2.-1.3.2008, with ~ 80 participants.

## Sources of success:

- liberation of teacher's activities by NTP (and by CERN!)
- support of local governments
- partial support in 2007 by Ministry of Education
- organisational support in Poland by CODN (National Teacher Training Center)
- excellent support from physicists in Poland and at CERN
- enthusiasm of Mick Storr from the Educational Group and invaluable support by Andrzej Siemko at CERN.

→ **R. Landua and  
H. Howaniec presentations**

Warsaw, 21.4.2008

J.P. Nassalski

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**CERN is essential for development of HEP in Poland**  
**and plays an important role in promoting science in the society.**

... very good evidence comes from the bus stop in Warsaw,  
where a new graffiti appeared a week ago:



Warsaw, 21.4.2008