

# ECFA Midterm Report for Poland

presented by

Jan Kalinowski  
University of Warsaw



Plenary ECFA Meeting, CERN, 26 November 2009

# Outline

## Outline

Basic facts

Education

HEP

Computing

Summary

- Basic facts about Poland
- Education
  - schools and students
  - teaching and research funding
- HEP in Poland
  - Organisation
  - Human resources
  - Research projects
- Computing
- Summary

# Basic facts about Poland



- Rzeczpospolita Polska – Republic of Poland
- Capital Warszawa - Warsaw
- Population 38.1 milion
- Area 312,679 km<sup>2</sup>
- GDP: 609 B\$, per capita 16 k\$ Source: OECD 2007
- Higher education exp. of GDP: 1.6% (=1.2%+0.4%)
- R&D expenditure of GDP: 0.57%
- 4.4 researchers for 1000 FTE
- Tertiary education: 18% of population 25-64 years of age  
28% of population 25-34 years of age
- CERN member state since July 1991, observer since 1963  
contribution to CERN budget 2.86%  
number of users: 195, fellows 21, staff 40 (Jan. '09)

# Education - schools

- 456 higher education institutions  
131 public and 325 non-public
- 1927762 students  
65.8% in public, 34.3% in non-public

Outline

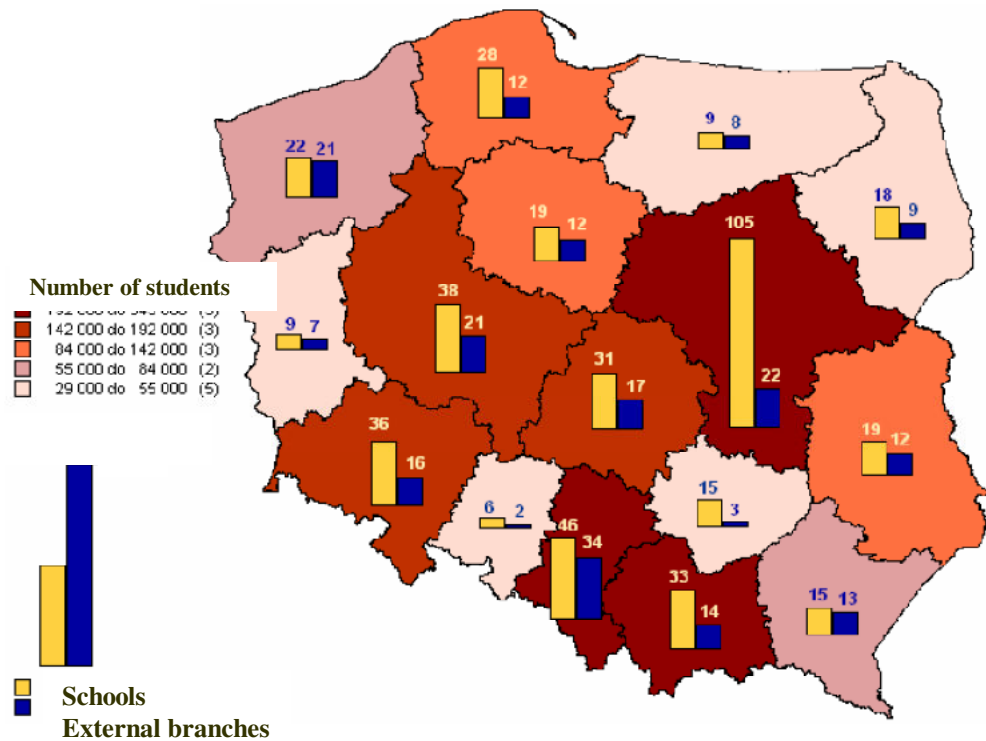
Basic facts

**Education**

HEP

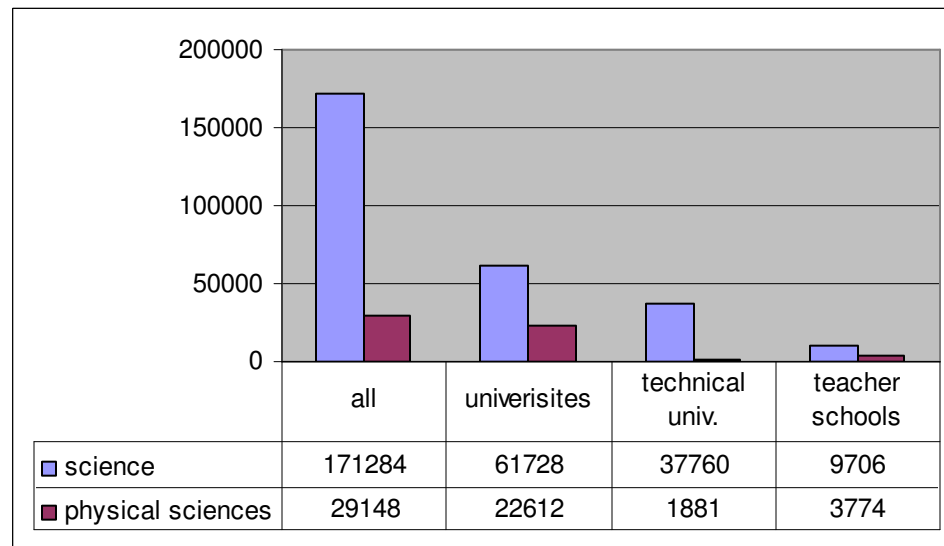
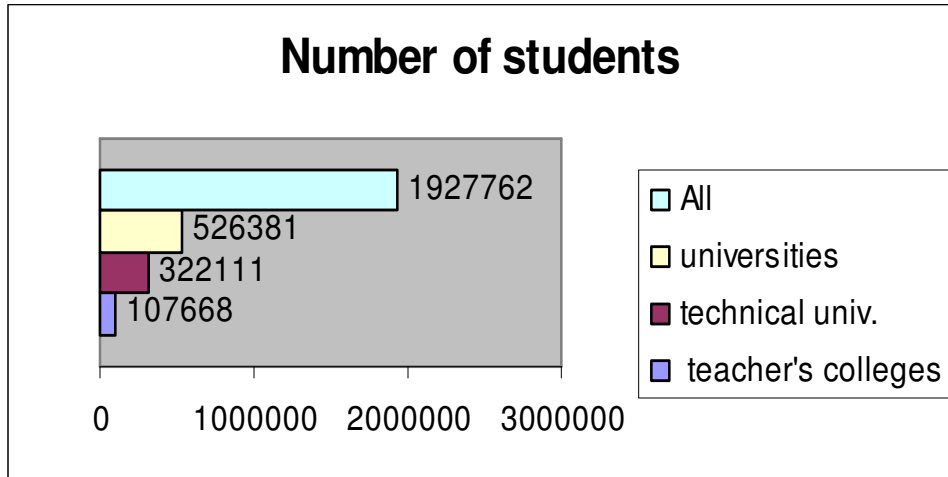
Computing

Summary



# Education - students

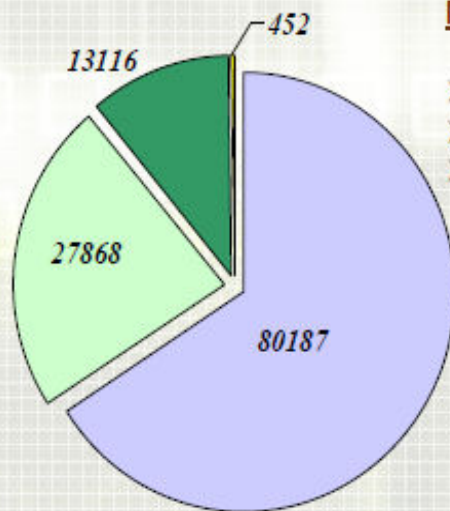
- 18 universities and 24 technical universities



PhD students:  
 32494 (all)  
 1066 in physical sciences  
 (397 females)

# Teaching and research

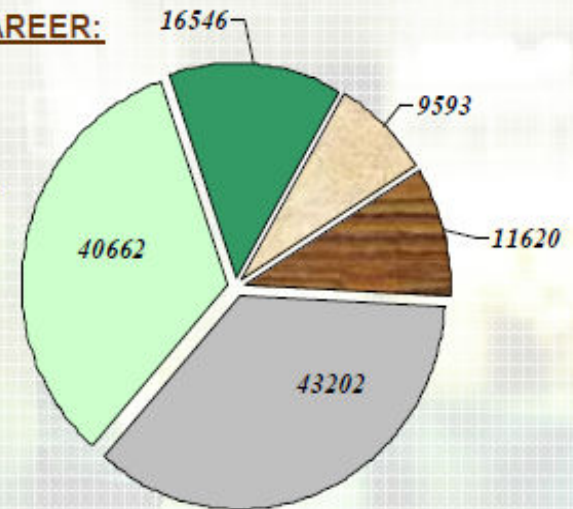
- Higher Education Institutions (Universities, Academies): **131 public**;
- Polish Academy of Sciences: **75 research units**  
59 institutes, 16 independent research departments;
- Branch R&D Units supervised by sector ministries: **180 units**  
128 institutes, 6 central laboratories, 45 R&D centres;
- Industrial R&D centres, units, laboratories: **aproximately 670 units**



■ Higher Education  
■ PAS and R&D units  
■ Business enterprises  
■ Other

## MODEL OF ACADEMIC CAREER:

- doctoral degree (Ph.D.)
- habilitated doctor
- academic professor title



■ professors  
■ habilitated doctors  
■ Ph.D.  
■ M.Sc. or equivalent  
■ others

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Anna Ostapczuk  
NCR&D,

Aspera Polish National Day NOV

Source: Science and Technology in Poland in 2007, Central Statistical Office, 2009

# Research funding in Poland

## Public funding:

- Ministry of Science and Higher Education
- The National Centre for Research and Development – funding agency for applied science (since July 2007)

## Private:

- Industry
- Foundations (The Foundation for Polish Science)

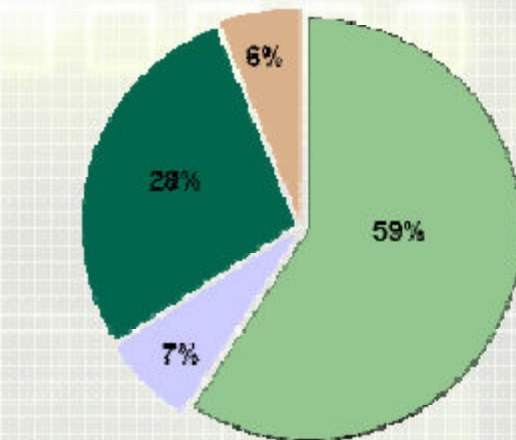
## EU Funding:

- Structural Funds: MSHE, The Foundation for Polish Science,...
- Framework Programmes

~1.4 B\$

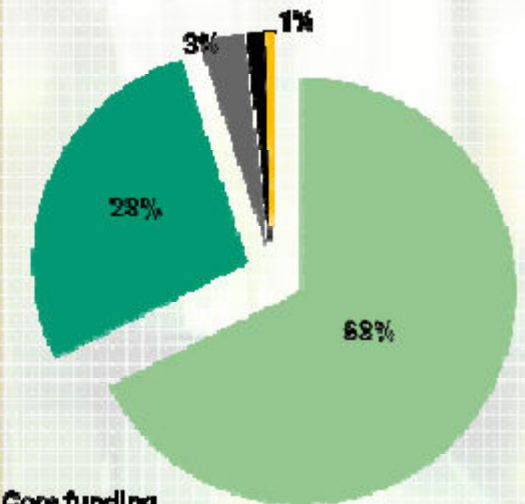
## Expenditures by sources of funds

~2.4B\$



■ budgetary  
■ from abroad  
■ enterprises  
■ other

## Budgetary: app. 3,9 bn PLN



■ Core funding  
■ R&D Targeted projects (competitive calls)  
■ International Cooperation  
■ Support activity  
■ Other

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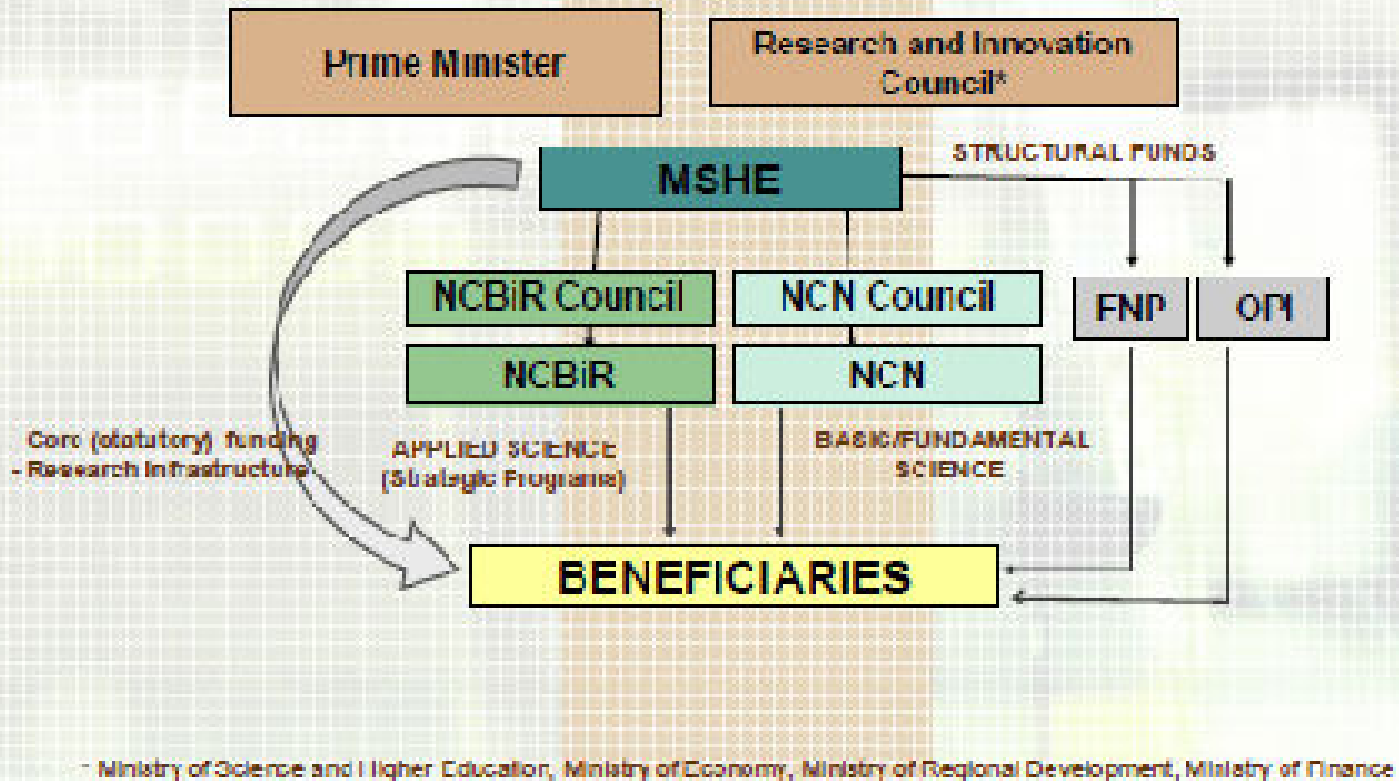
Summary

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NCR&D,

Aspera Polish National Day

# Reform of funding in Poland

## RECENT REFORM OF POLISH R&D SYSTEM



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# HEP in Poland – research centers

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## Warsaw:

University of Warsaw (UW)  
Warsaw University of Technology (PW)  
**Institute of Nuclear Studies (IPJ)**  
N. Copernicus Astronomical Centre (CAMK)  
Space Research Center (CBK)

## Cracow

**Institute of Nuclear Physics (IFJ)**  
AGH U. Science and Technology (AGH)  
Jagellonian University (UJ)

## Katowice

University of Silesia (UŚ)

## Wrocław

University of Wrocław (UWr)  
Wrocław University of Technology (PWr)

## Łódź

University of Łódź (UŁ)  
**Institute of Nuclear Studies (IPJ)**

## Kielce

Jan Kochanowski University (UJK)

## Toruń

N. Copernicus University (UMK)  
**N. Copernicus Astronomical Centre**

## Lublin

M. Curie-Skłodowska U. (UMCS)

## Szczecin

University of Szczecin (USz)

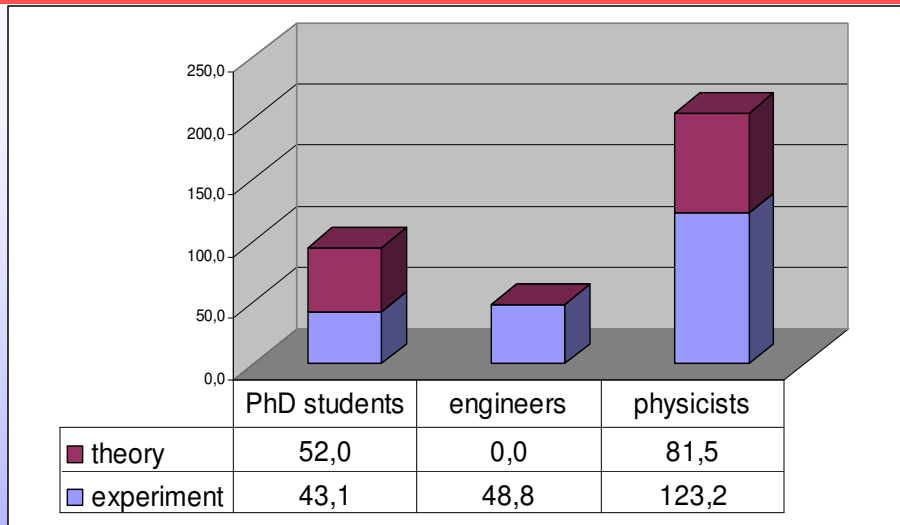
## Zielona Góra

University of Zielona Góra (UZG)

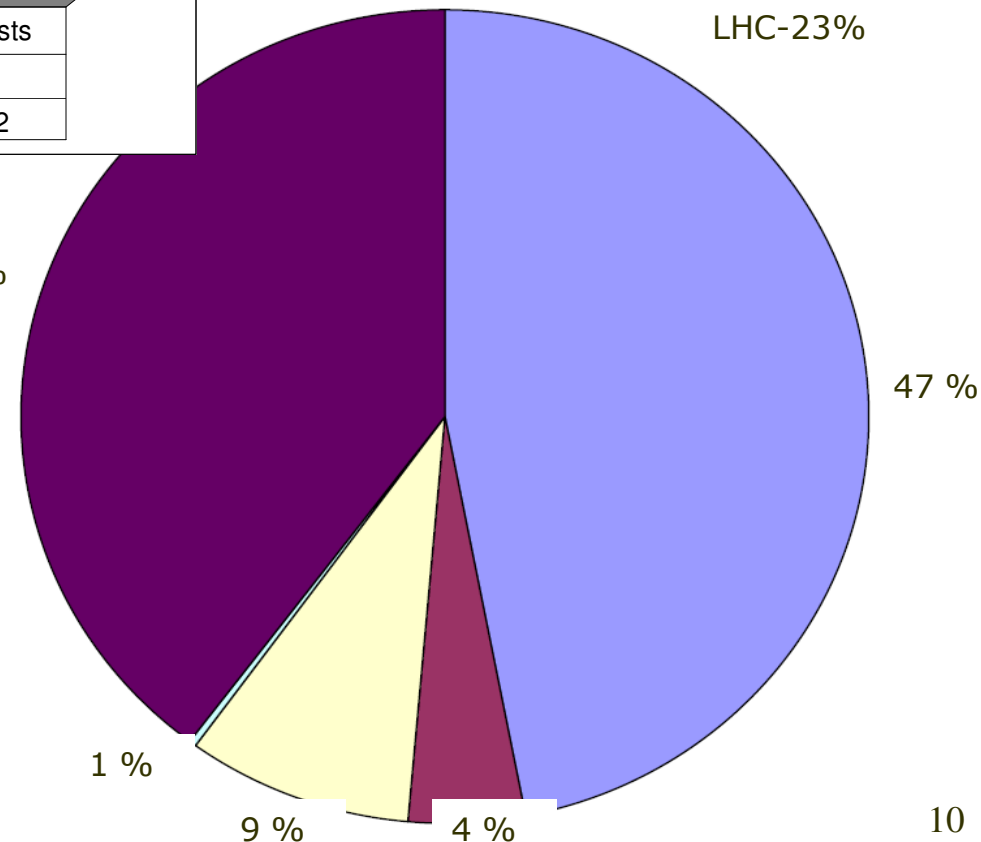
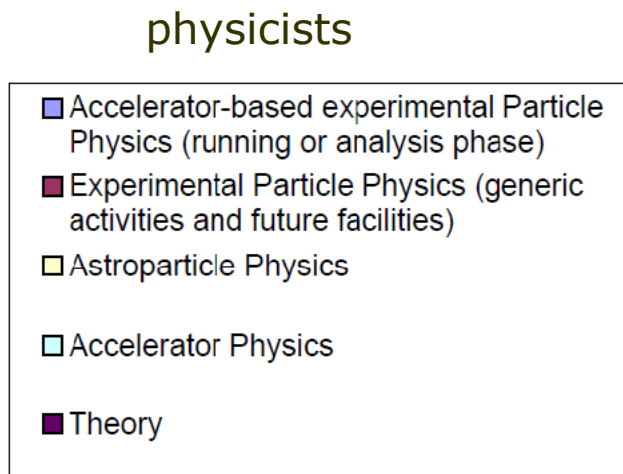


# HEP – human resources

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Source: ECFA Poll 2009



# HEP – experimental projects

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LHC experiments: ALICE, ATLAS, CMS, LHCb

SPS experiments: COMPASS, NA49, NA61

HERA experiments: ZEUS, H1

Experiments at BNL: STAR, PHOBOS, BRAHMS

Belle at KEK

Neutrino experiments: SK, T2K, ICARUS, BOREXINO

GERDA, MINOS

Dark matter: SK, WArP, ArDM, OSQAR, LAGUNA

Gamma ray bursts: Pi of the Sky

Cosmic rays: AUGER, JEM-EUSO

Gamma ray astronomy: H.E.S.S., MAGIC

# LHC experiments - ALICE

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## Polish Institutes:

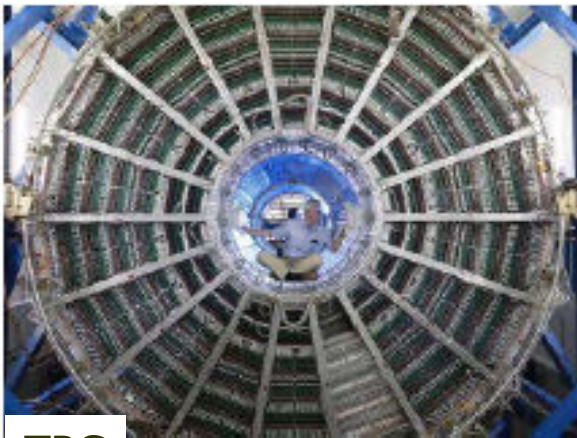
- Institute of Nuclear Physics, Cracow
  - ❖ 6 physicists, 4 engineers, 6 PhD
- Institute of Nuclear Studies, Warsaw
  - ❖ 3 physicists, 2 PhD students
- Warsaw University of Technology
  - ❖ 4 physicists, 2 PhD students

## Fields of interests of Polish Institutes:

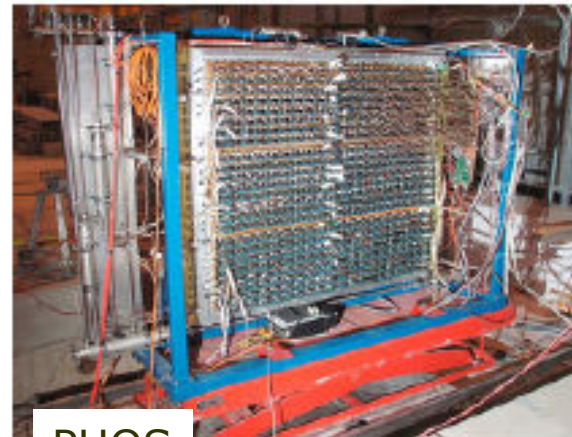
- strangeness production
- femtoscopy
- direct photons and diphotons
- heavy flavors

Polish Institutes were involved in the design, simulation and construction of two detectors: (1 MCHF)

- Time Projection Chamber (TPC) – the main tracking device
- Photon Spectrometer (PHOS) – high resolution electromagnetic calorimeter



TPC



PHOS

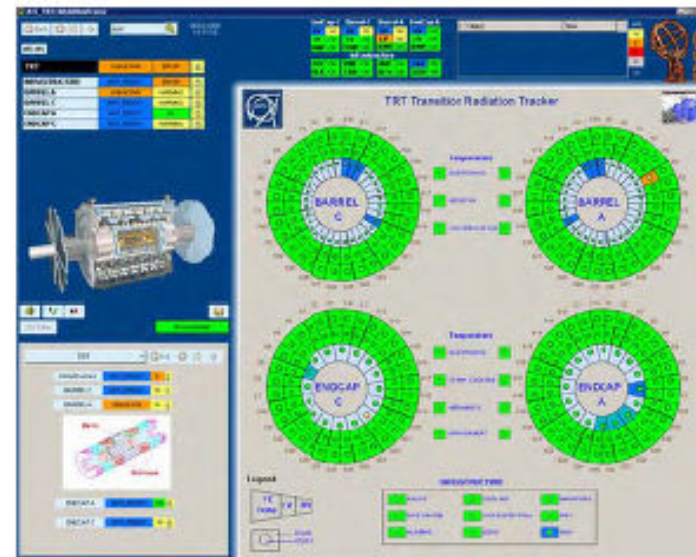
# LHC experiments - ATLAS

## Polish Institutes:

- Institute of Nuclear Physics, Cracow
  - ❖ 17 physicists, 4 engineers, 6 grads
- AGH U. of Science & Technology, Cracow
  - ❖ 6 physicists, 2 engineers, 2 grads

## Fields of interest of Polish institutions

- physics with taus: Higgs, SUSY
- track-based alignment of inner detector
- heavy ion physics: MC production, software analysis tools,..



TRT SERVICES SOFTWARE

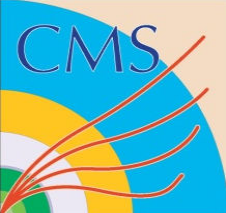
## Contribution to hardware

### SCT (SemiConductorTracker)

- Design of the ABCD3T readout chip
- Design, prototype and tests of HV PS
- Design of the crate's backplane
- Design of the crate controller
- Programming HV PS firmware
- Programming SCT DCS

### TRT (Transition Radiation Tracker)

- Design and implement the TRT
- Design, build and test GGSS
- Design of the LV & HV PS
- Integrate TRT DCS into global DCS



# LHC experiments - CMS

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## Polish Institutes:

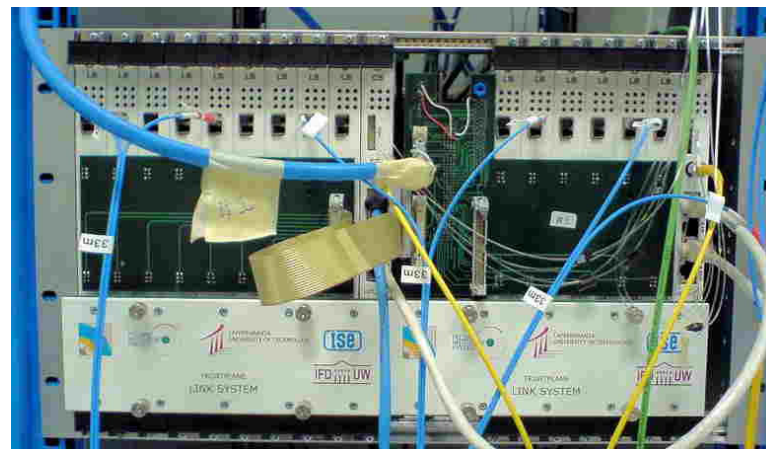
- University of Warsaw
- Inst of Nuclear Studies, Warsaw
- Warsaw U. of Technology
  - ❖ 25 physicists, engineers, PhD students and technicians

## Contribution to hardware

- Design, tests, production and integration of the L1 RPC Muon Trigger System PACT- electronics, firmware, on-line software, emulation off- line software
  - link system on the CMS detector UXC55 (1700 boards)
  - trigger electronics
- instalation of gas and water pipes (ZEC Wrocław)

## Fields of interest of Polish institutions

- long lived charged particles, like NLSP staus in SUSY
- nonpointing photond from neutralino decays
- WW and ZZ scattering at high energies
- KK states of extra dimensions, decays to muons
- reconstruction software



96 Link Board Boxes, 1700 boards

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## Polish Institutes:

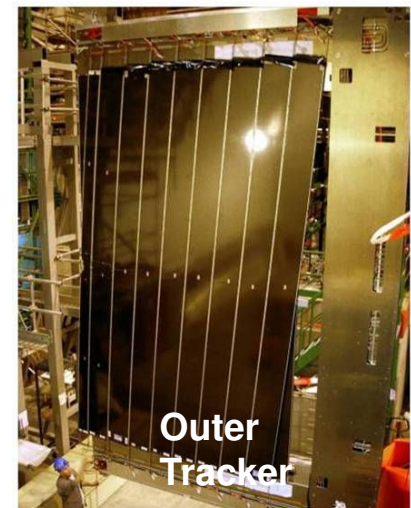
- Institute of Nuclear Physics, Cracow
- AGH University of Science and Technology, Cracow
- Inst of Nuclear Studies, Warsaw
  - ❖ 20 physicists and PhD

## Contribution to hardware

- Design and production of Outer Tracker
- A system for monitoring of OT layers position
- "Timing and Fast Control" for DAQ
- Development of trigger algorithms
- Simulation and reconstruction software
- Tools for data analysis

## Fields of interest of Polish Institutes:

- tools for data analysis: systematic effects and signal selection algorithms
- tools to control systematic effects
- CP violation in B decays to a pair of mesons
- new physics in rare decays, e.g  $B \rightarrow \mu^+ \mu^-$



# Experiments @ SPS



## COMPASS

### Polish Institutes:

- University of Warsaw
  - Warsaw University of Technology
  - Institute of Nuclear Problems, Warsaw
- ❖ in total 16 physicists and PhD students

### Hardware contributions:



- Two inclined SciFi planes
- Each plane 176 channels, 4 fibers/ch.
- $12.3 \times 12.3$  cm active area
- Efficiency  $\sim 97\%$  (standard)
- Gain  $\sim 5\%$  in  $D^0$  statistics at low  $Q^2$   
( $\equiv$  15 days of data taking in 2 years).

### Fields of interest/ responsibilities

- detector simulation and optimization
- detector alignment  $\sim 3$  years
- radiative corrections calculations
- open charm and high  $p_T \Rightarrow \Delta G$
- inclusive analysis  $\Rightarrow g_1$  at low  $Q^2$
- exclusive vector meson production
- participation in setting up upgrade for COMPASSII



# Experiments @ SPS



## Polish Institutes:

- Jan Kochanowski University, Kielce
- Institute of Nuclear Physics, Cracow
- Warsaw University of Technology
- University of Warsaw
- Jagellonian University, Cracow
- Institute of Nuclear Problems, Warsaw
- Jagellonian University, Cracow



39 physicists  
and PhD

21 physicists  
and PhD

Spokesperson: P. Seyboth  
MPI Munich & [JKU Kielce](#)

Spokesperson: M. Gaździcki  
IKF Frankfurt & [JKU Kielce](#)

## Hardware contribution:

- low voltage supplies for TPC
- slow control electronics
- instalation

## Hardware contribution:

- gas system for TPC
- beam position detectors
- detector control system
- charge detector for ion beam
- projectile spectator detector

## Contribution to analyses:

- charged hadron prod. in pp and AA
- transverse characteristics
- long-range correlations
- multiplicity fluctuations
- elliptic flow of strange particles
- event-by-event fluctuations in AA

## Contribution to analyses:

- search for critical point of QCD
- study of onset of deconfinement
- hadron production at high pT
- hadron production in p-C for T2K and cosmic-ray physics

for

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# Experiments @ HERA

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## Polish Institutes:

- Institute of Nuclear Physics, Cracow
  - AGH U. of Science and Technology, Cracow
  - University of Warsaw
  - Jagellonian University
  - Institute of Nuclear Problems, Warsaw
- ❖ 30 physicists and 9 PhD students

### Current fields of interest

- diffractive production
- exclusive VM production



## Polish Institutes:

- Institute of Nuclear Physics, Cracow
- ❖ 7 physicists and PhD students

### Current fields of interest

- small x
- strangeness prod.
- search for instantons
- T-odd processes

# Experiments @ BNL

The logo for the PHOBOS experiment, featuring the word "PHOBOS" in a stylized, colorful font with a blue and yellow color scheme.

## Polish Institutes:

- Ins. of Nuclear Physics, Cracow  
5 physicists and 1 grad  
12 engineers and technicians

## Polish Institutes:

- Warsaw U. of Technology  
4 physicists, 2 PhD and 5 grads

## Hardware contribution:

- design and construction of mechanical support structures
- design and construction of cooling system for Si detectors

## Hardware & software contrib:

- silicon strip detectors
- file catalog

## Contribution to analyses:

- studies of space-time development of particle emission process
- hidden charm ( $J/\psi$ ) as a signature of the phase transition to the state of Quark-Gluon Plasma

## Contribution to analyses:

- software analysis tools
- detector geometry description
- MC production
- particle prod. at low  $p_T$
- study of collective flow
- fluctuations and correlations in multi-particle final states

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## Polish Institutes:

- Institute of Nuclear Physics, Cracow
- ❖ 5 physicists and 3 engineers and 3 PhD student

## Hardware contribution:

- Silicon vertex detector SVD
- HALNY readout modules for SVD1
- master and repeater boards for SVD2
- readout electronics for SVD3 (SuperBelle)
- SVD calibration and alignment



**HALNY – readout module for SVD1**



$$e^+e^- \rightarrow \Upsilon(4S) \rightarrow \bar{B}B$$

$$L_{\text{peak}} = 1.7 \times 10^{34} / \text{cm}^2 / \text{s}$$

$$> 1 \text{ million } \bar{B}B\text{-pairs/day}$$

$$L_{\text{int}} = 895 \text{ fb}^{-1} \text{ (as of April 2009)}$$

## Contribution to analyses:

- hadronic B decays with  $b \rightarrow s$
- semileptonic B decays  $b \rightarrow c\tau\nu_\tau$
- first observation of semitauonic in exclusive mode  $B^0 \rightarrow D^* \tau^+ \nu_\tau$
- charm spectroscopy
- discovery of csbar system

$D_{sJ}(2700)$

# SK, K2K and T2K

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## Polish Institutes:

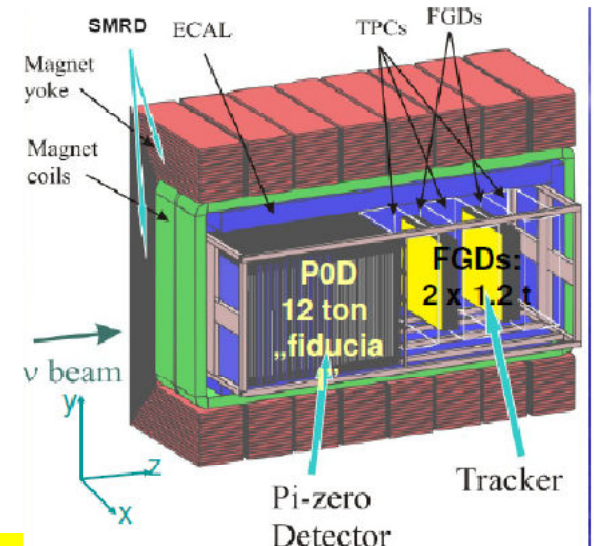
- Institute of Nuclear Studies, Warsaw
- University of Warsaw
- Warsaw University of Technology
- Institute of Nuclear Physics, Cracow
- University of Silesia, Katowice
- University of Wrocław

❖ 14 physicists and 10 PhD student

## Hardware contribution to T2K:

- design and construction and mounting of side muon range detector SMRD of near detector ND280
- construction of automatic tester of silicon photomultipliers MPPC for ND280
- purchase TFB and scintillator counters

## ND280 (off axis detector)



## Contribution to software/analyses:

- SMRD reconstruction program
- studies of GENIE and Neut MC generators
- CC muon neutrino background calculations
- cosmic muons vs. ND280 trigger
- uncertainties of background calc.

# other neutrino experiments

Outline

## ICARUS

14 physicists and 10 PhD students

Basic facts

**from:** Institute of Nuclear Physics, Cracow  
University of Warsaw  
Institute of Nuclear Studies, Warsaw  
University of Silesia, Katowice  
University of Wrocław

Education

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### Hardware contribution to ICARUS:

- participation in electronics modification installation and tests

## BOREXINO

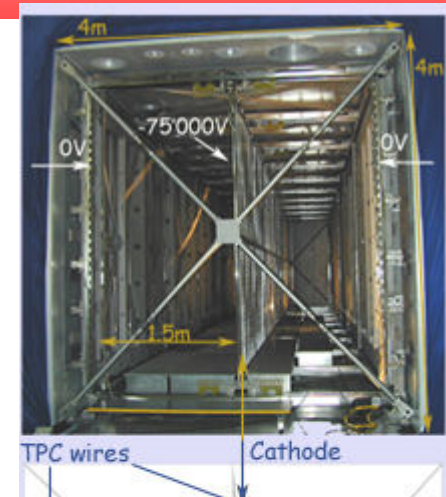
5 physicists from Jagellonian University

## GERDA

1 physicist from JU

## MINOS

1 physicist from UW joined in 2008



### Contribution to software/analyses:

- pi0 analysis on test data
- 3D reconstruction of electromagnetic cascades
- background calculations for Borexino
- Rn analysis in liquid N2 and Ar

# Dark matter searches

## Experiments with Polish participation

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Basic facts

### Super-Kamiokande

1 physicist + 1 PhD from U. Warsaw  
WIMP search with neutrinos from dispersed sources

Education

### WArP

1 physicist from INP, finished his PhD in 2009  
contribution to R&D and data analysis

HEP

Computing

### ArDM

1 physicist from Jagellonian University

Summary

### OSQAR

1 physicist from University of Warsaw, deputy spokesperson  
1 PhD student

# LAGUNA @ SUNLAB?

## Large Apparatus studying Grand Unification and Neutrino Astrophysics

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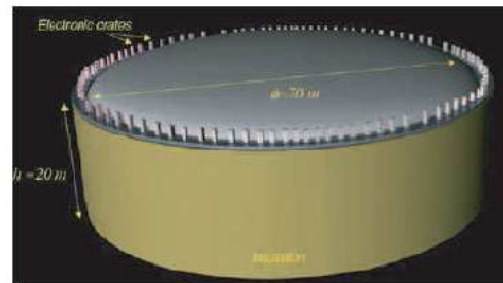
Computing

Summary

Institute of Nuclear Physics, Cracow  
Institute of Nuclear Studies, Warsaw  
University of Silesia, Katowice  
University of Wrocław  
Mineral and Energy Economy Research Institute  
KGHM CUPRUM Ltd Research and Development Centre

GLACIER: liquid argon = 150xICARUS

Construction: cylinder  
70m in diameter and 20 m  
high, total mass - 100 ktons  
of Liquid Argon, read out of  
the ionisation signal and two  
types of light signals  
(scintillations and Cherenkov  
light)



very low natural radioactivity in  
the cavern in salt layer

LAGUNA Coll. meeting 3.04.09



Jan Kalir

**SUNLAB - Sieroszowice  
Underground LABORatory**



## Observe gamma ray bursts

Prototype in operation since 2004

2 CCD cameras, 2000x2000 pixels, custom design

- custom shutter design  $\sim 10^7$  cycles
- localization: [ASAS](#) site, [Las Campanas Observatory](#)
- self-trigger - flash recognition in real time
- following Swift, Integral and Glast FoV
- reaction to other GCN alerts
- all sky survey - twice a night

Final system, start 2010:

- 2 x 12 CCD cameras, 2000x2000 pixels
- covers 1.5 sr of the sky
- the whole night sky stored for  $\sim 12$  hours
- automatic flash recognition in real time
- fast reaction to GCN triggers
- off-line analysis (next day)



## Collaboration:

- Institute of Nuclear Studies, Warsaw
- Center for Theoretical Physics
- University of Warsaw
- Warsaw University of Technology
- Space Research Center, Warsaw
- U.C.S. Wszyński, Warsaw

# Cosmic rays

## AUGER



### Polish Institutes:

- University of Łódź
- Institute of Nuclear Physics, Cracow

11 physicists and 1 PhD student

### Hardware contribution:

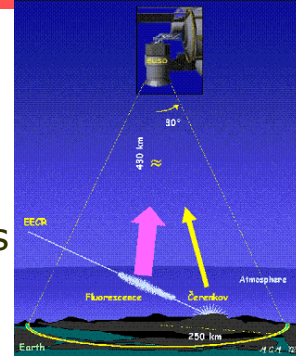
- to telescopes of fluorescence detectors
- design and prototype construction of electronic system for the trigger

### Contribution to analyses:

- designed description of optical image of an air shower
- introduced local monthly models of the atmosphere
- demonstrated need for balloon radiosounding of the atmosphere
- fluorescence signal from a shower

## JEM-EUSO

use earth's atmosphere as a detector of the most energetic particles in the Universe



### Polish Institutes:

- Institute of Nuclear Studies, Łódź and Warsaw
- Jan Kochanowski University, Kielce
- Jagellonian University, Cracow
- Space Research Center, Warsaw  
~ 11 physicists

### Contribution to analyses:

- simulations of air showers
- monitoring of the atmosphere
- data analyses

# Gamma ray astronomy

## H.E.S.S.

### Polish Institutes:

- N. Copernicus Astro. Centre
  - N. Copernicus U, Toruń
  - Institute of Nuclear Physics
  - Jagellonian University
- 11 physicists and 1 PhD

### Hardware contribution:

- 0.5 MEUR hardware to H.E.S.S.II

## MAGIC

### Polish Institutes:

- University of Łódź
- 2 physicists

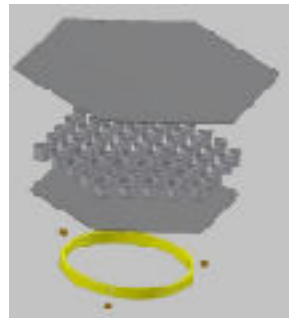
## Cherenkov Telescope Array

### Polish Institutes:

- N. Copernicus U, Toruń
- Jagellonian University
- University of Warsaw
- N. Copernicus Astronomical Centre
- Institute of Nuclear Physics, Cracow
- University of Łódź
- Space Research Center

### Polish contribution:

- mirrors design in Space Res. C.
- prototype manufacturing in Inst. Nuclear Physics
- climatic chamber
- modelling of mirror deformation
- MC simulations



# HEP – theory

## Strong theory groups in Cracow and Warsaw

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### Cracow: Standard Model, QCD

**Jagellonian University:** QCD at higher order, nonperturbative methods, matrix models, strong-coupling methods AdS/CFT

**Institute of Nuclear Physics, Cracow:** SM: EW and QCD at higher order, modeling of generalized parton distributions, tau physics, neutrino physics, flavor, Monte Carlo developments

### Warsaw: physics beyond the Standard Model

**University of Warsaw:** SM, and beyond: 2HDM, SUSY, extra dimensions, strings, dark matter, neutrino physics, heavy flavor, models of inflation, baryogenesis, perturbations in homogeneous universe, cosmology, LHC and ILC phenomenology, QCD bound states, spin SF

**Institute of Nuclear Studies, Warsaw:** statistical methods, reggeized QCD, neutrino physics, cosmology,

# HEP – theory

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smaller groups in several other centers

University of Silesia, Katowice: neutrino physics, LR models, top physics, radiative return methods, Monte Carlo developments

University of Łódź: cosmic ray physics, formal QFT

University of Wrocław: QFT, SUSY, quark-gluon plasma, neutrino physics

Jan Kochanowski U., Kielce: quark-gluon plasma, non-perturbative QCD

# New developments: networks

Outline

Particles-Astrophysics-Cosmology (C-A-K):  
theory network

Basic facts

UW, JU, INP, INS, UŁ, UŚ, UMK, UMCS, KUL, UZG,  
USz, UWM, UW<sub>r</sub>, CAMK

Education

**HEP**

Polish Network on Astroparticle Physics:

experimental

Computing

INP, INS, UŁ, UJ, UŚ, UMK, UMCS, JKU, USz, WUT, UW<sub>r</sub>,  
CAMK, CFT

Summary

Polish Neutrino Network (PGN):

theory and experiment

UW, JU, UW<sub>r</sub>, INP, INS, WUT, UŚ, UMCS,

Polish Network for Physics and Technology of High  
Energy Linear Accelerators (FiTAL)

theory and experiment

UW, JU, UW<sub>r</sub>, INP, INS, ŁUT, AGH-UST, UŚ

# Conferences, outreach

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## Conferences:

Planck conferences

Cracow Schools in Zakopane

Epiphany conferences in Cracow

Matter to the Deepest in Szczyrk

Karpacz Winter School, Wrocław

Max Born Symposium, Wrocław

ECFA-ILC 2008 conference

String Pheno 2009

EPS-HEPP 2009 conference

Cosmic Ray Conference 2009

- Festival of Science – every September since 1996
- Scientific Picnick – every June
- The Roland Maze Project
- Cosmic Ray detectors at Mobile LHC exhibitions
- Polish Teachers Programme at CERN
- Cracow-Warsaw LHC Workshop



Jan Kalinowski,

EC



# HEP Computing - GRID

Outline

Basic facts

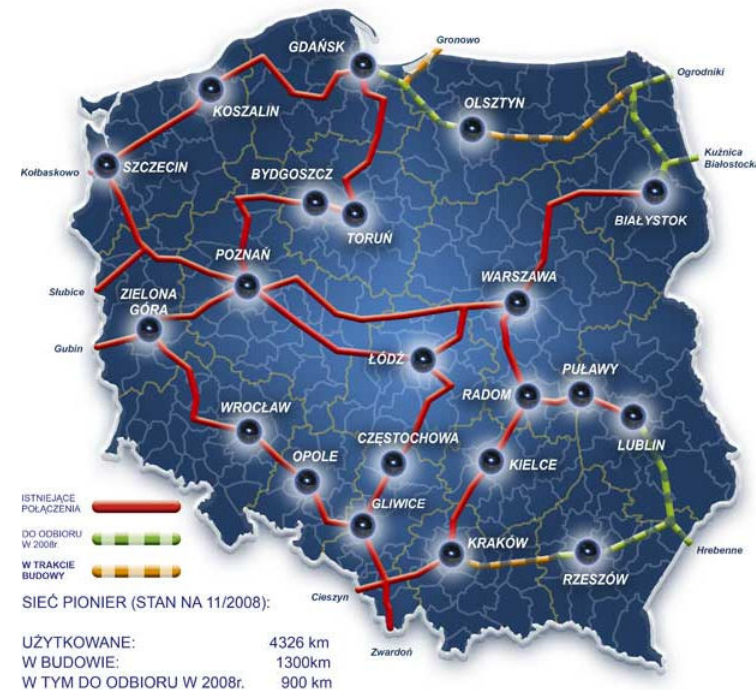
Education

HEP

Computing

Summary

- Active participation in setting-up and supporting grid since 2002
- 4 high-performance computing centres constitute **Polish Tier-2**:
  - Kraków (AGH)
  - Poznań (PAN)
  - Warszawa (UW)
  - Wrocław (PWr)
- Based on national optical network dedicated 2 Gb/s inside PL, high-performance link to Tier-1 in FZK (Karlsruhe)
- Currently PL delivers in total above 5 k 64-bit processors and a few hundred Tbytes





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Summary

- Operations centre: Kraków
- Helpdesk and end-user support: Warsaw
- Networking: Poznan
- Experiment-specific services located depending on experiment
  - CMS: Warsaw
  - ATLAS: Kraków
  - ALICE: Poznań
  - LHCb: scattered

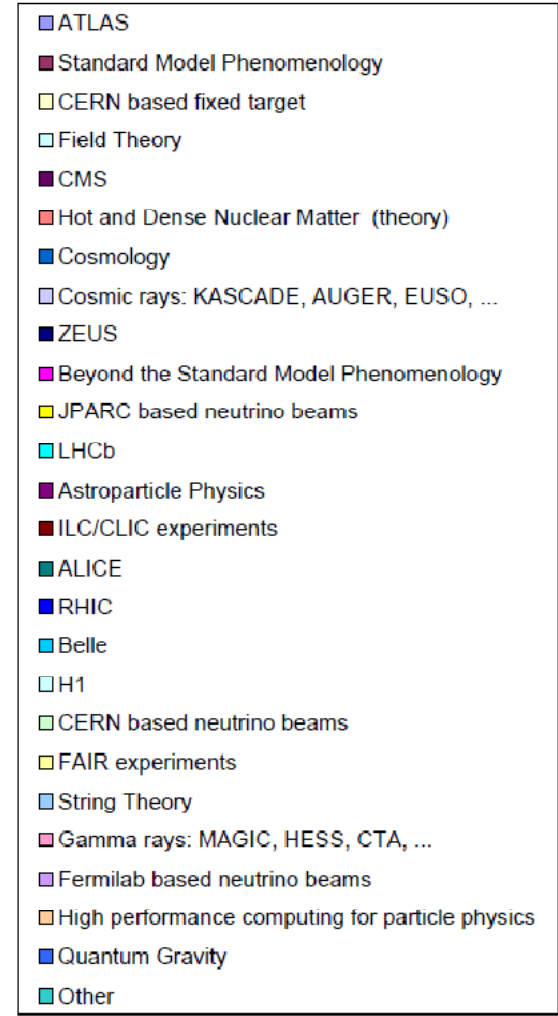
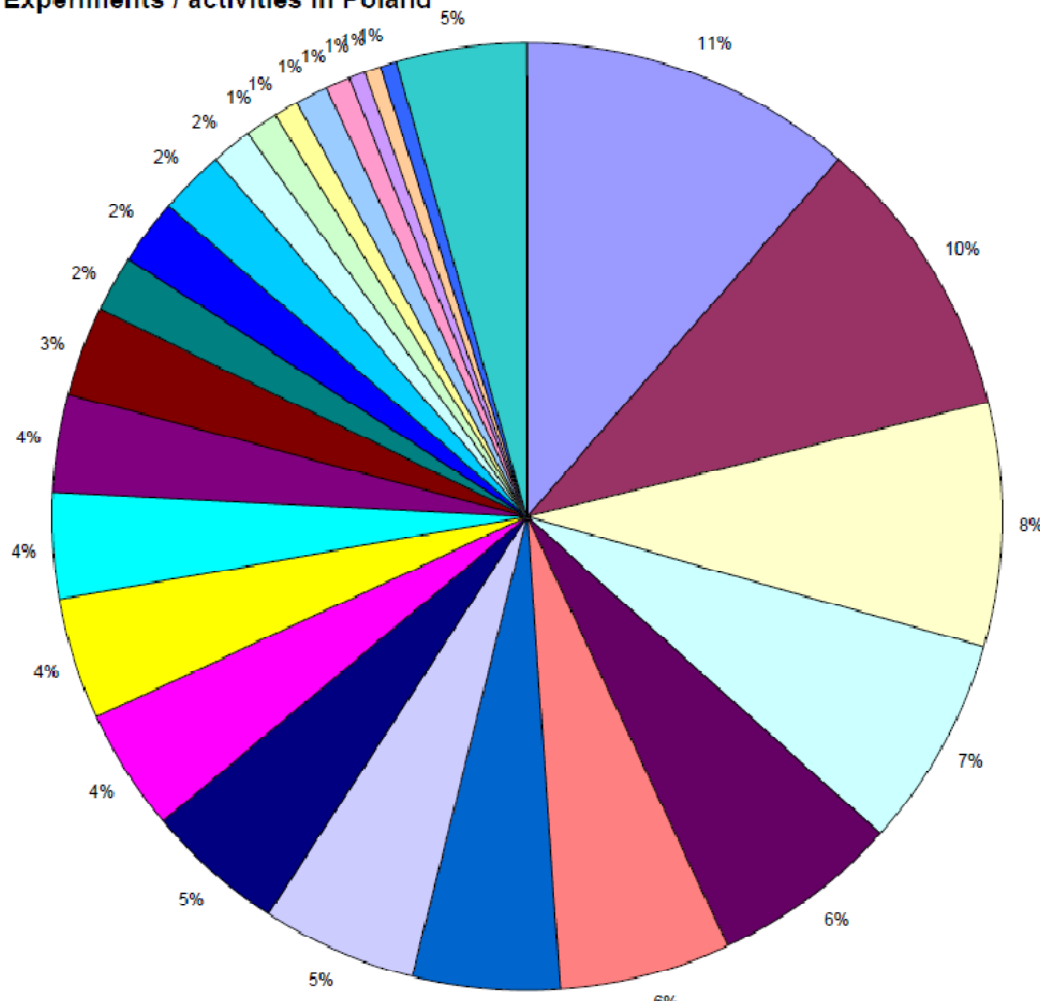
## Near future

- PI-Grid project funded by Polish government
- 20 MEuro for 3 years: 2009-2011
- 5 centres taking part: 4 old players + Gdansk
- Substantial upgrade of computing infrastructure in 2010;  
good timing in view of upcoming LHC production

# Summary

Source: ECFA Survey 2009

Experiments / activities in Poland



Process of consolidation in progress

- Outline
- Basic facts
- Education
- HEP
- Computing
- Summary**

# backups

# Polish share in European activity

Outline

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HEP

Computing

Conclusions

