

Polish participation in the International Linear Collider Project

Dr hab. Aleksander Filip Żarnecki
Institute of Experimental Physics
Warsaw University

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Introduction

Polish institutes participate in the LC project since about 10 years.

Most activities related to TESLA project - superconducting technology.

Close collaboration with DESY, Hamburg.

Works intensified after technology decision in 2004

⇒ towards accelerator TDR and detector CDR in 2007

- new collaborations
- new projects

Overview of activities

Accelerator design

- superconducting cavity production
- cavity control and simulation
- accelerator alignment studies

Detector design

- high precision luminosity measurement
- vertex detector and flavour identification

Physics studies

- Physics case for Photon Collider
- Comparison of ILC physics potential with LHC and PC

Cracow group

Institutes

- AGH University of Science and Technology
- Institute of Nuclear Physics PAS
- Jagellonian University

Staff

full professors associate professors assistant professors	Ph. D.	Ph. D. students	other
6	3		3

Budget

(including personnel)

in k€	2003	2004
Institutes	37	57
National grants	20	24

Cracow group

Forward Detectors for ILC experiment:

- BeamCal - measurements of the beam parameters and fast beam monitoring
- **LumiCal - luminosity measurements**
- PhotoCal - measurements of the beam parameters from beamstrahlung photons

Main interests

R&D and construction of the **LumiCal**

for very precise $O(10^{-4})$ luminosity measurement using the Bhabha scattering process.

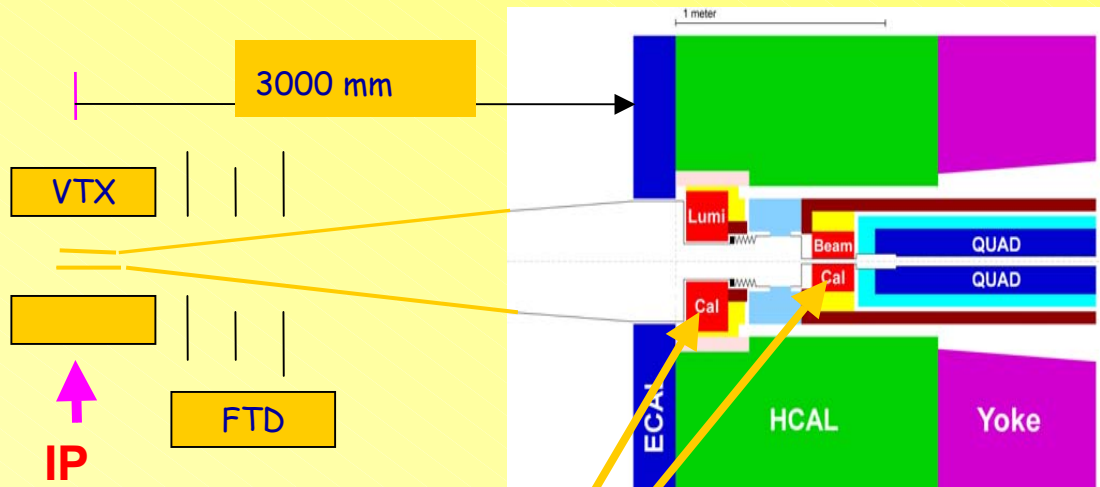
High precision is required from the physics program proposed for ILC.

Collaboration with:

NC PHEP Minsk, Tel Aviv Univ. DESY Zeuthen, Inst. of Physics Prague, JINR Dubna, IHEP Protvino, Univ. of Colorado - **Forward Calorimetry (FCAL) Collaboration**

Forward Detectors at a International e^-e^+ Linear Collider (ILC)

Starting with R&D of the Tesla project:



FORWARD CALORIMETERS:

LumiCal: $26 < \theta < 82$ mrad

BeamCal: $4 < \theta < 28$ mrad

PhotoCal: $100 < \theta < 400$ μ rad (downstream)

LumiCal



Two Si/W calorimeters
on both sides of the IP

Cracow groups concentrate on **LumiCal**:

- Extensive Monte Carlo studies
- Design of the mechanics and silicon sensors structure
- Development of the laser alignment method

Next steps :

the detailed design studies (background, x -angle), integration of calorimeter into ILC detector, technology choices, testbeam with prototypes, close collaboration with machine designers

Monitoring of the LumiCal Position – Laser Alignment Method

To achieve precision $\sim 10^{-4}$ in Lumi measurement, requirements for alignment are:

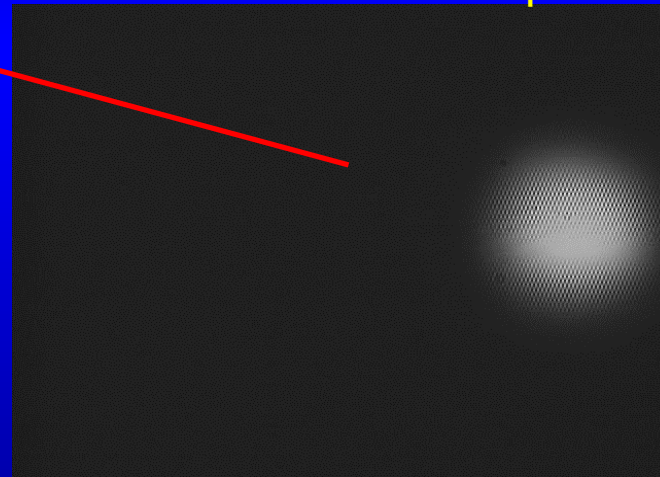
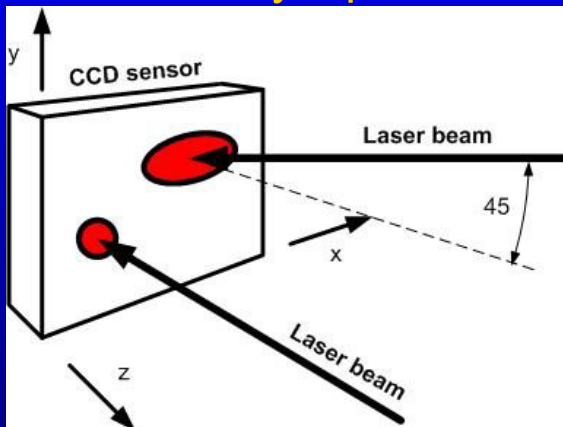
- inner radius of LumiCal $\sim 0.7 \mu\text{m}$,
- distance between LumiCals $\sim 60 \mu\text{m}$
- transversal (x,y) position $\sim 100 \mu\text{m}$

A method:

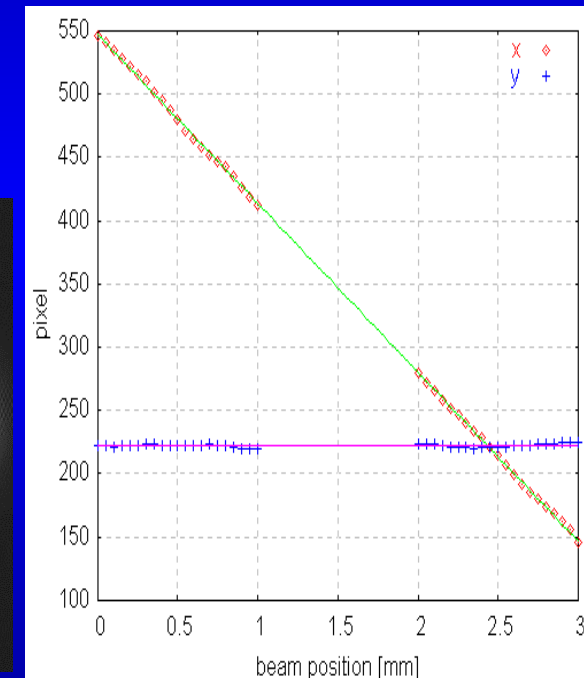
- Simple CCD camera
- He-Ne red laser
- Laser translated in 0.05 mm steps

Principle: reconstruction of the laser spot (x,y) position on CCD camera

Next steps :
two lasers - x,y,z position



First results:



Possible resolution of $\sim 1 \mu\text{m}$ if the center of the light spot is determined with accuracy better than 0.1 pixel

Cracow group

Current activities

- the extensive Monte Carlo simulation studies of the detector;
- the design of the mechanics and silicon sensors structure;
- the development of the laser method of the LumiCal alignment.

Plans (next 2 years)

- ⇒ continuation of MC studies of LumiCal for more realistic design, full simulation including all mechanical structures, electronics and digitization
- ⇒ detailed design studies for mechanical and silicon sensor structures
- ⇒ prototype for the laser alignment system, systematic studies of its performance
- ⇒ construct and test the first LumiCal prototype: Si sensors + tungsten absorber

Warsaw + Łódź group

Institutes

- Institute of Nuclear Studies, Warsaw
- Institute of Physics, University of Łódź
- Institute of Experimental Physics, Warsaw University
- Institute of Theoretical Physics, Warsaw University

Staff

full professors associate professors assistant professors	Ph. D.	Ph. D. students	other
4	2	2	2

Budget

in k€	2003	2004
Institutes	10	15
National grants	10	25

Warsaw + Łódź group

Main interests

- vertex detector for ILC experiment

collaboration with DESY, Hamburg University, Institut de Recherches Subatomiques (IReS) and Laboratoire d'Electronique et de Physique des Systemes Instrumentaux (LEPSI) in Strasbourg

- accelerator alignment methods

collaboration with DESY and Oxford University

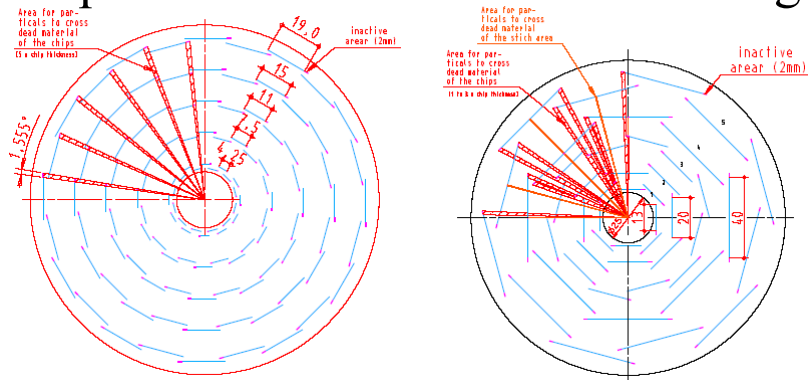
- Photon Collider project

within ECFA Study of Physics and Detectors for a Linear Collider

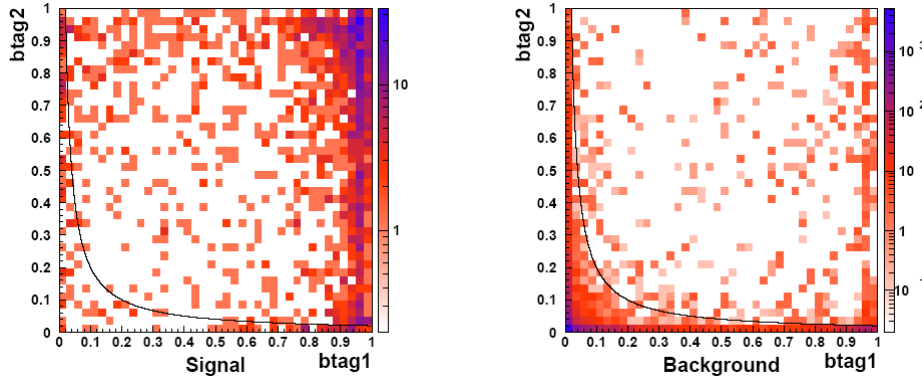
Vertex detector studies

Simulation studies

Comparison of different detector designs

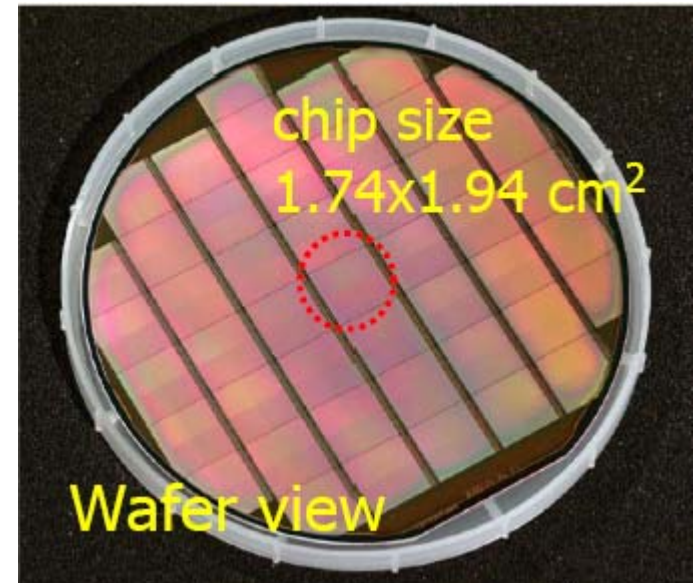
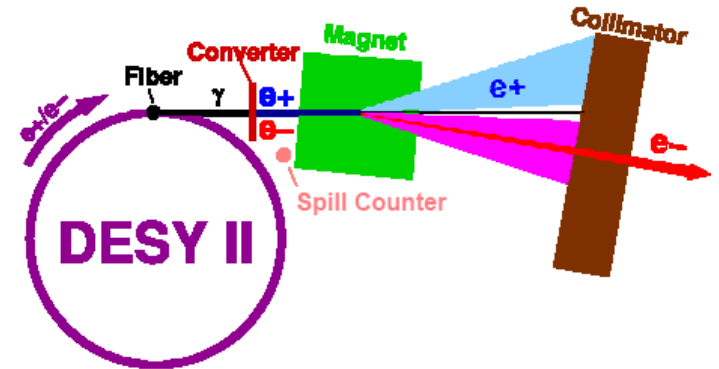


Simulation of $H \rightarrow b \bar{b}$ measurement



b -tagging for signal and background

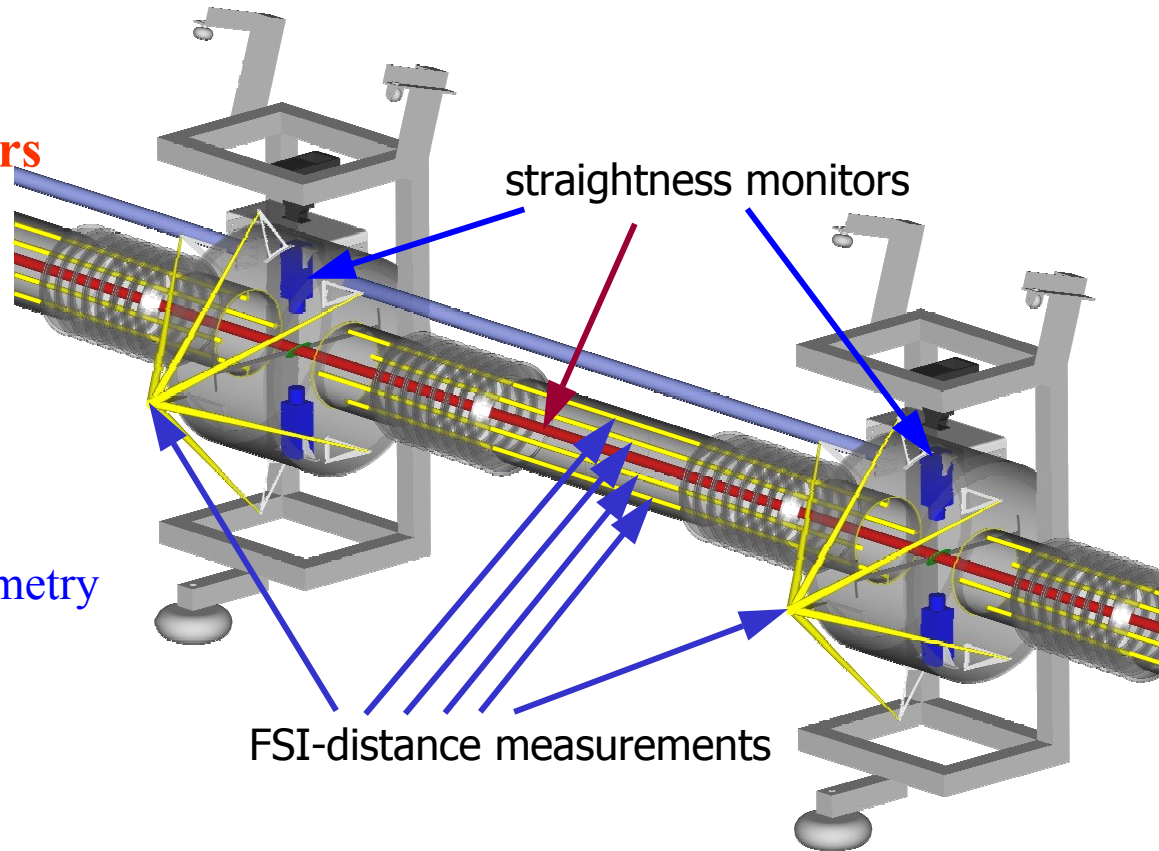
MAPS beam-tests at DESY



LiCAS = Linear Collider Alignment and Survey

TESLA Specification:

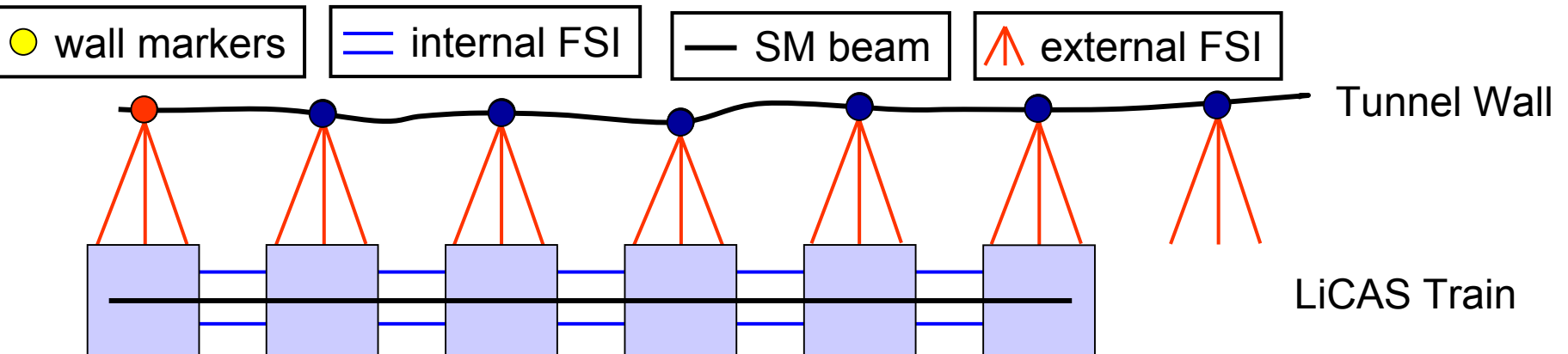
200 μm vertical over 600 meters
(=betatron wavelength)



New technology :

FSI – Frequency Scanning Interferometry
(distance measurement) and
Laser Straightness Monitors (LSM)

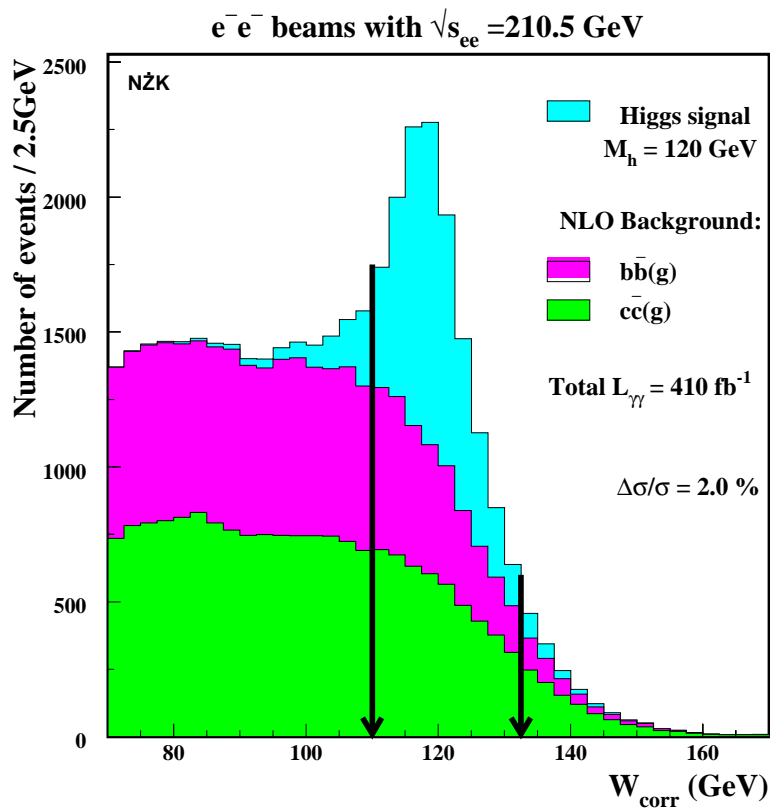
Survey Implementation



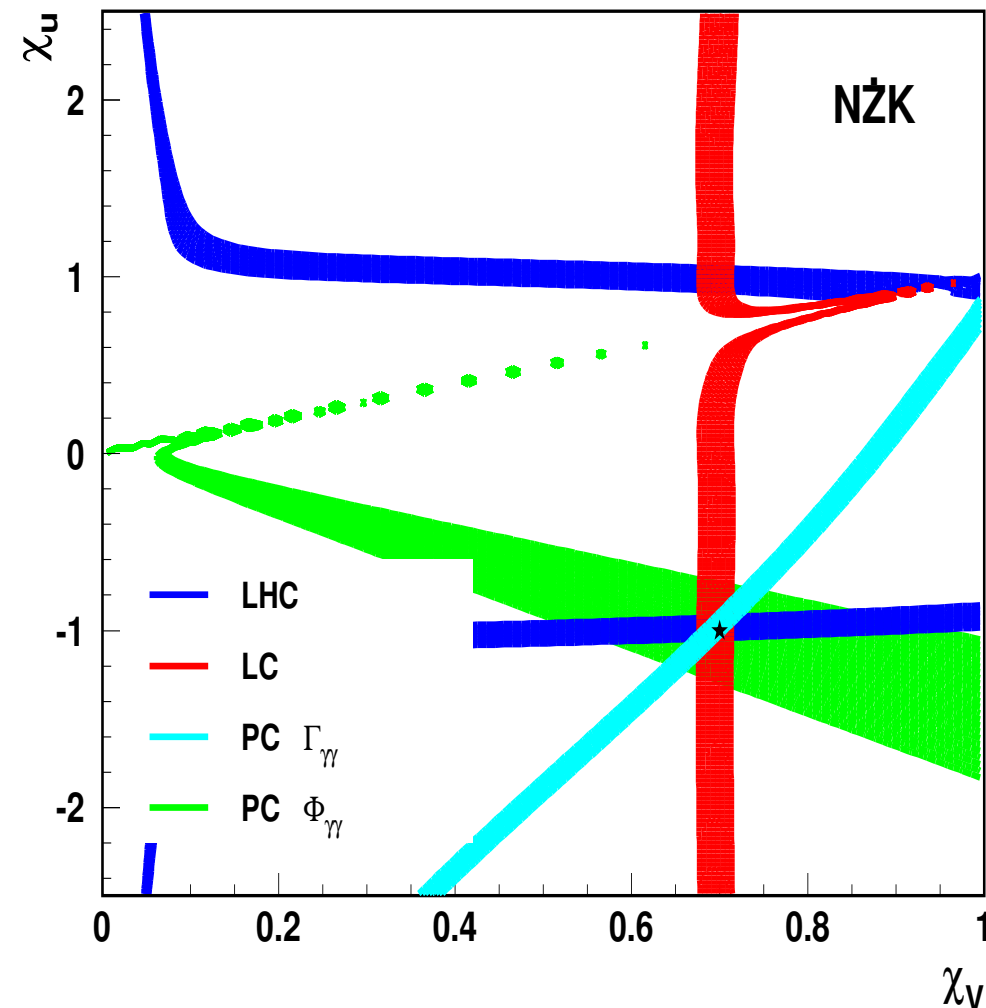
Physics case for the Photon Collider at ILC

Precise measurement of the Higgs boson production cross section at the Photon Collider

Measurements of Higgs boson couplings at LHC, ILC and Photon Collider are complementary.



Sensitive to "new physics" even at very large energy scales.



Warsaw + Łódź group

Current activities

- vertex detector design optimization based on physics simulations
- simulation studies of laser alignment methods for ILC
- realistic studies of the Higgs boson measurements at the Photon Collider
- comparison of the physics potential of LHC, ILC and PC

Plans (new activities)

- ⇒ beam tests of the MAPS sensors for the vertex detector (just started)
- ⇒ design and tests of the laser cavity for the Photon Collider at ILC (considered)
in collaboration with DESY-Zeuthen, KEK Japan

Institute for Nuclear Studies (IPJ), Świerk

Department of Plasma Physics and Technology

Staff

professors	Ph. D.	eng.	other
1	1	3	2

Budget

	k€ per year
National grants	40
EU funds	60

Main activities

Joint Research Activity within Coordinated Accelerator Research in Europe **CARE**

Thin Film Cavity Production

Development of a new method of superconducting cavity production:
Cu-cavities coated with a thin Nb-layer under ultra-high vacuum (UHV) conditions.

Close collaboration with INFN-Roma2, Rome, Italy

Thin Film Cavity Production

linear-arc discharge at the pressure of 4×10^{-10} mTr,
arc current of 40 A

General view of the UHV system

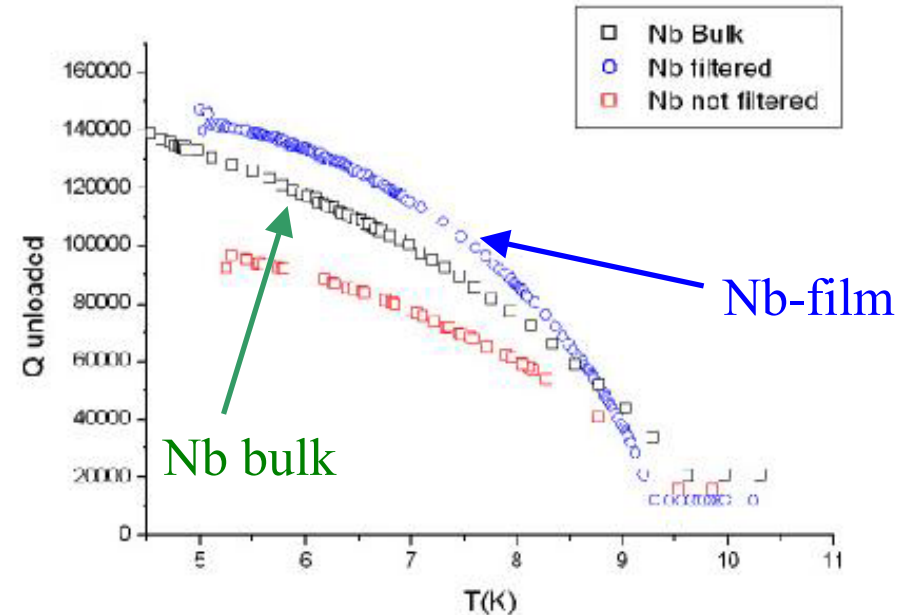


to achieve good superconducting film properties the partial pressures of water, nitrogen, oxygen, CO_2 , hydro-carbides etc., must remain well below 10^{-9} hPa

reliable and clean ignition technique required



Comparison of bulk Nb and Nb-film samples



Technical University of Łódź

Department of Microelectronics and Computer Science - DMCS

Staff

professors	Ph. D.	Ph. D. students	other
1	3	6	1

Budget: national grants: 35 k€ per year

Main activities

Joint Research Activity within Coordinated Accelerator Research in Europe **CARE**

Superconducting Radio Frequency (SRF) programme:

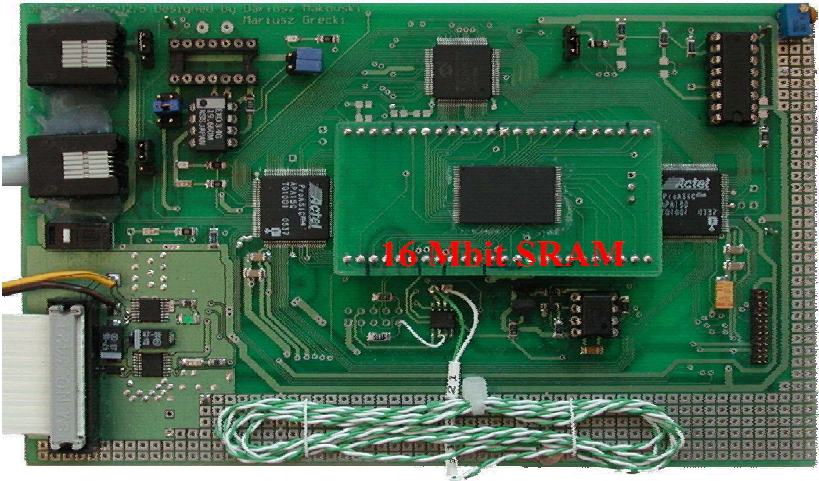
- R&D on magneto-strictive tuner for superconducting cavities
- Radiation damage studies on electronics
- Development of Finite State Machine to automate RF operation
(within Distributed Object Oriented Control System for the accelerator)

Radiation damage studies

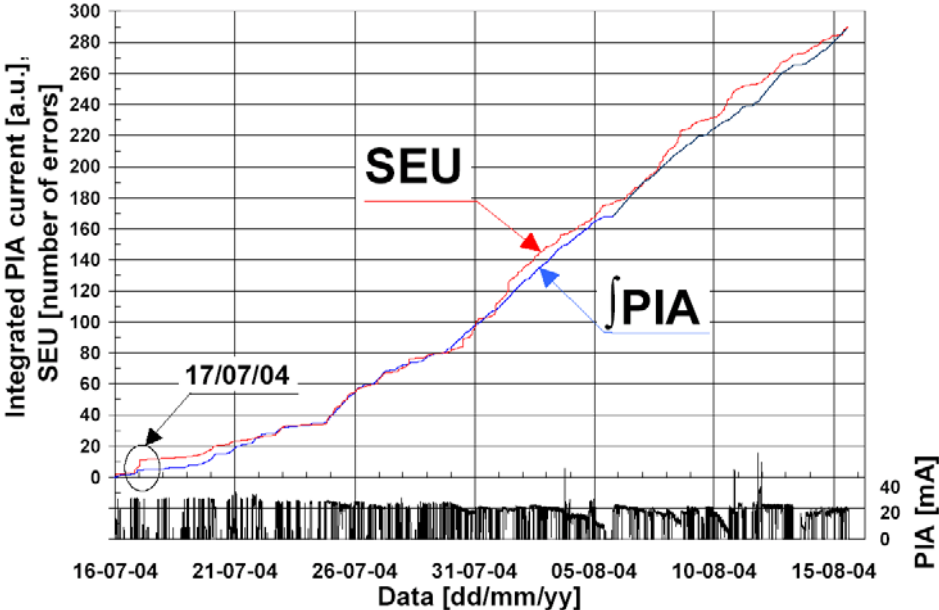
Investigations focus on application of SRAM memories for detection and measurement of radiation level

Prototype board

SRAM memory with two synchronously operating processors



Test results:
integrated neutron flux measurements



Technical University of Warsaw

Institute of Electronic Systems

Electronics for High Energy Physics Experiments group

Staff

professors	Ph. D.	Ph. D. students	other
1	2	6	4

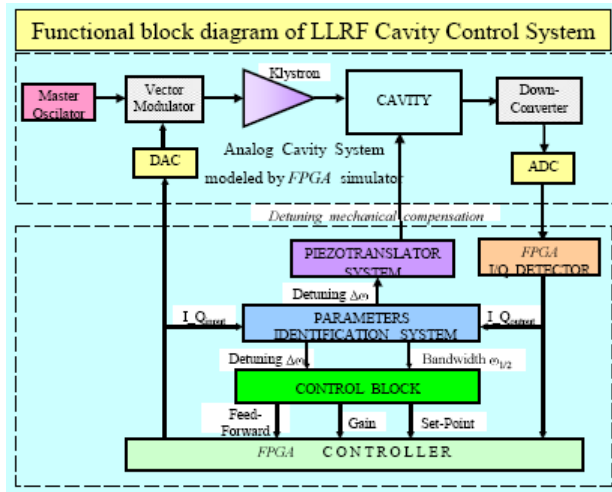
Main activities

Joint Research Activity within Coordinated Accelerator Research in Europe **CARE**

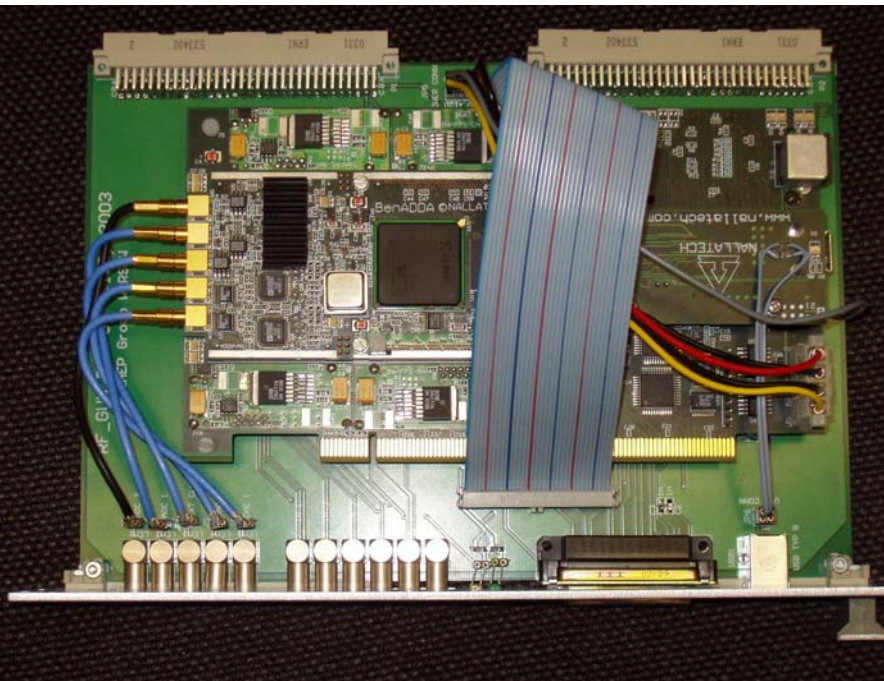
Superconducting Radio Frequency (SRF) programme:

- Cavity and RF gun controller
- Cavity and RF gun simulator
- Radiation tests

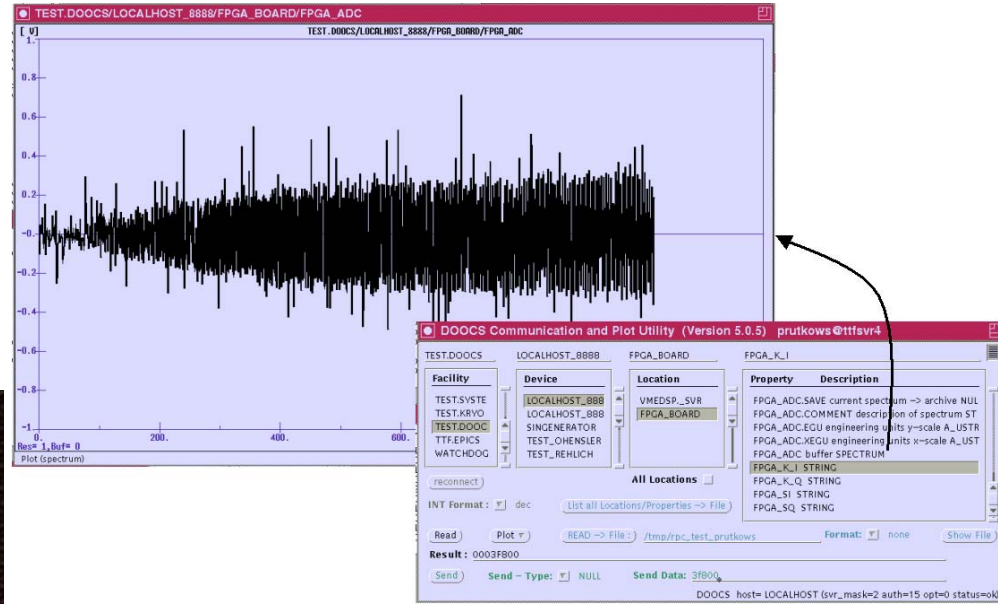
Cavity and RF gun controller



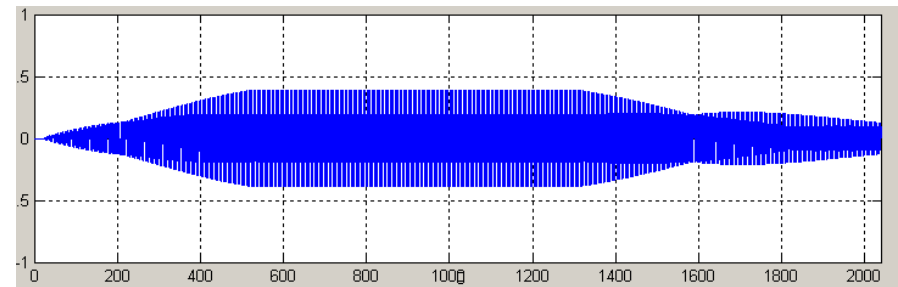
Prototype RF gun controller



Test results



Simulation results



Concluding remarks

Increasing participation of Polish groups in ILC project

in addition, many individuals working in collaborating institutes

Many diverse activities, new projects starting

Involvement limited by funds, but also laboratory space and manpower

International collaboration and support crucial