LHCb collaboration

WELCOME

to

PNPI

Petersbourg Nuclear Physics Iinstitute

Russian Academy of Sciences

Research directions

- High energy physics
- Nuclear physics
- Solid state physics
- Molecular biophysics
- Theoretical physics
- Nuclear medicine

Institute structure

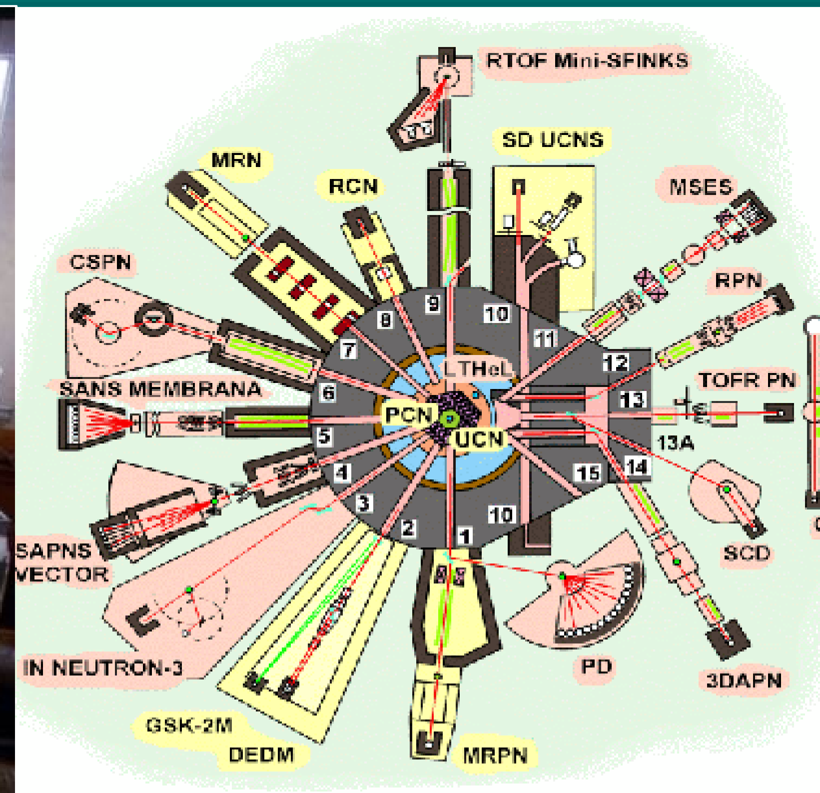
- High energy physics division
- Neutron research division
- Microbiology division
- Theoretical physics division
- Infrastructure

Main research facilities

- 18 MW research nuclear reactor;
- 100 MW research nuclear reactor (*to be completed in 2012*);
- 1 GeV proton accelerator.

Total staff 1600
Research workers and engineers 400

Research Nuclear Reactor
WWR-M 18 MW

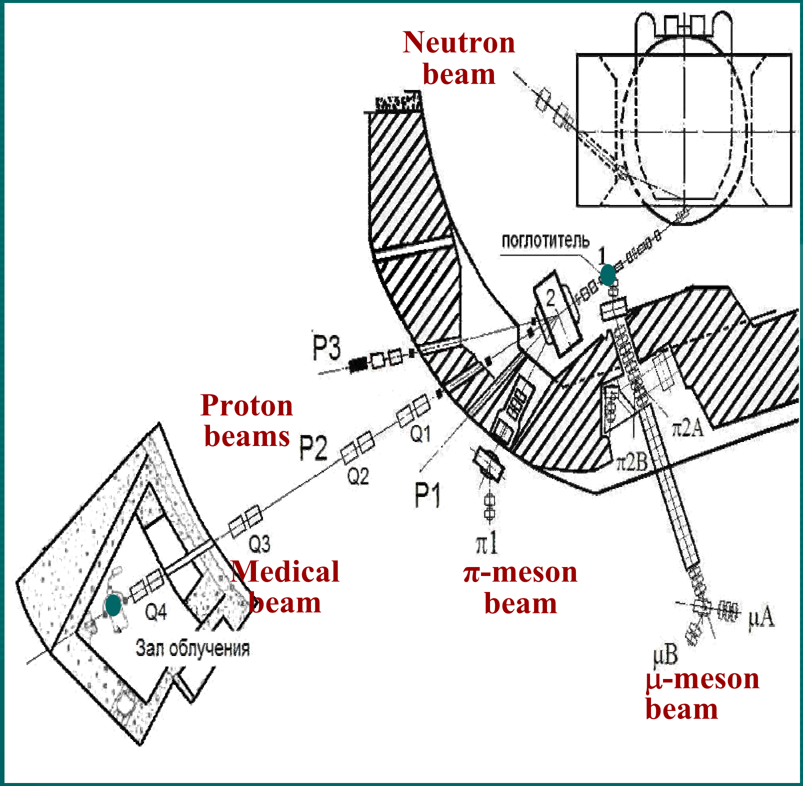


Solid state physics
Neutron life time
Neutron EDM

Research Nuclear Reactor PIK

Power: 100 MW
Thermal neutron flux: $5{\cdot}10^{15}$ n/cm^{2}sec
50 positions for neutron instruments

1 GeV proton synchrocyclotron

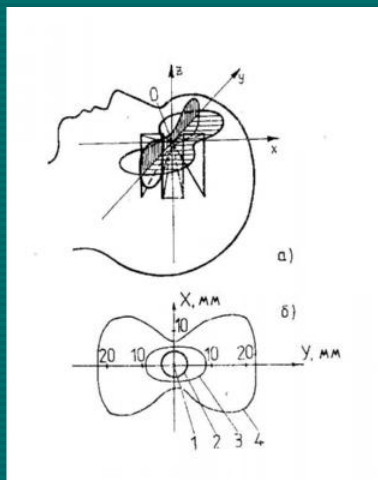


Nuclear physics
Radiation studies
Proton therapy
Test beams

Beams: protons, neutrons, π-mesons, μ-mesons

Proton therapy

1 GeV proton beam



1327 patients

clinical remission 85-100%

Pituitary adenoma

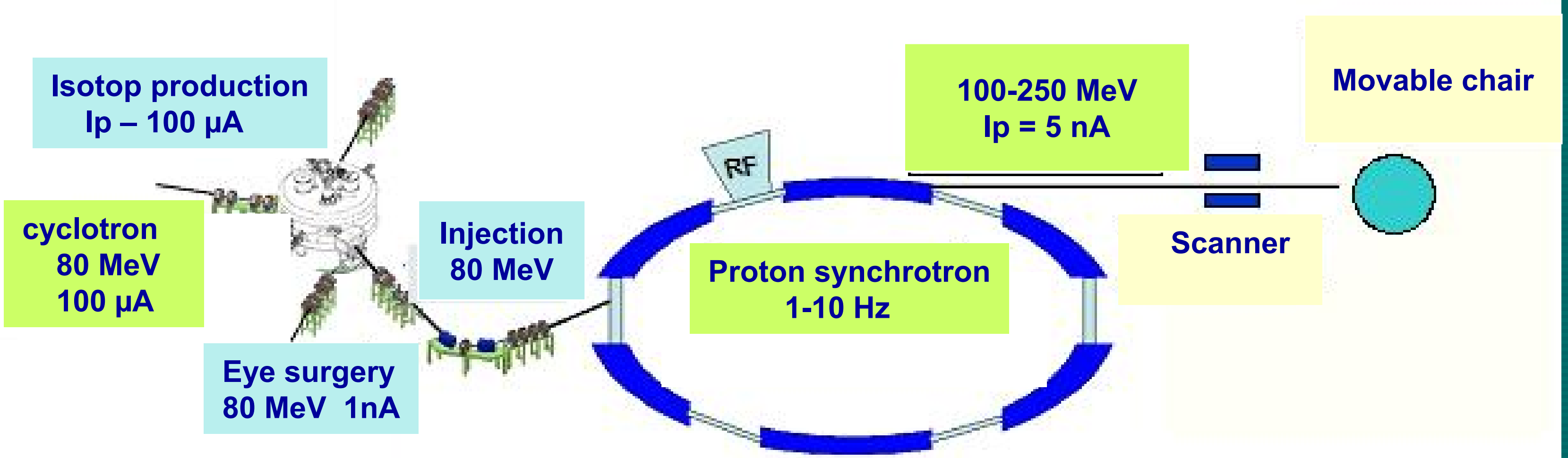
Asteriovenous malformation

Arterial anevrisma

PNPI centre of nuclear medicine *project*

Isotope production and 4D (x,y,z,t) proton therapy

High current cyclotron,80 MeV & fast cycling synchrotron, 100-250 MeV



Experiments outside PNPI

- FNAL – E715, E761, E7181, DØ
- BNL – PHENIX
- PSI – μCF, MuCap
- DESY – HERMES
- GSI – exotic nucl. FAIR
- Juelich – ANKE
- Mainz – γp
- Bonn – γp
- Jyvaskyla – ISOL
- ITEP – πp

- ILL (Grenoble) - τ_n
- CERN

ISOLDE, L3,

CMS, ATLAS,

ALICE, LHCb

Crystal collimation in LHC

The on-going experiments are in red

Support from engineering and electronics groups

This support helps to develop at PNPI
new experimental methods and
produce experimental equipment
thus allowing participation in the outside
experiments with important conceptual and
technical contributions

PNPI contribution to joint experiments

Experiment PHENIX (BNL)

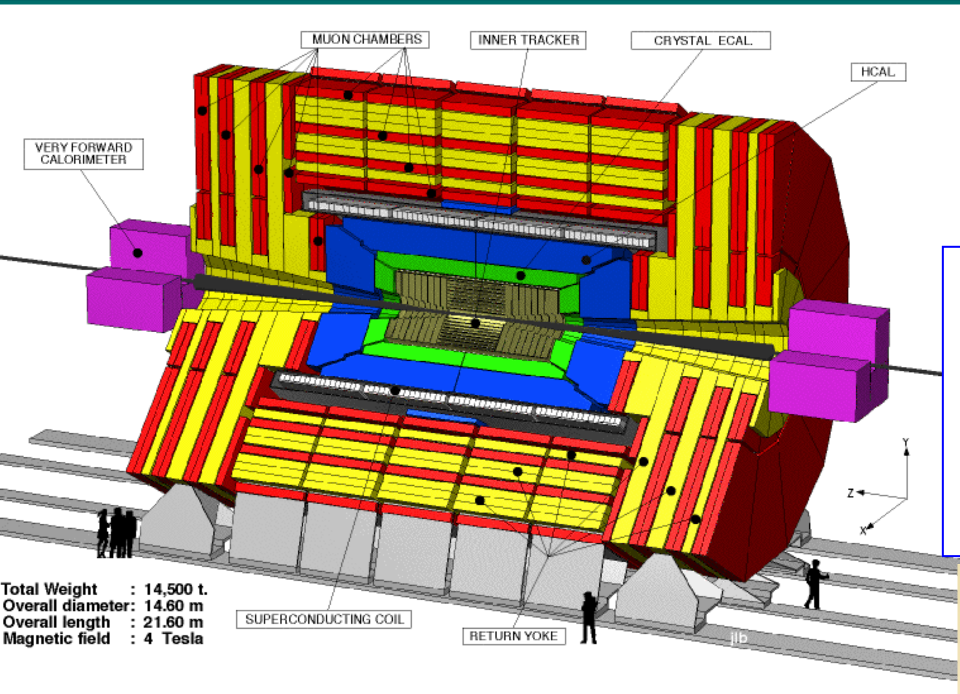
One of the two drift chambers for PHENIX central tracker designed and produced at PNPI

PHENIX magnet was fabricated in St.Petersburg under PNPI supervision

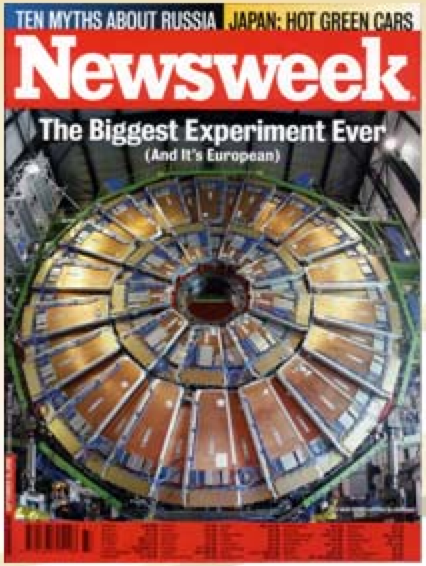
CMS

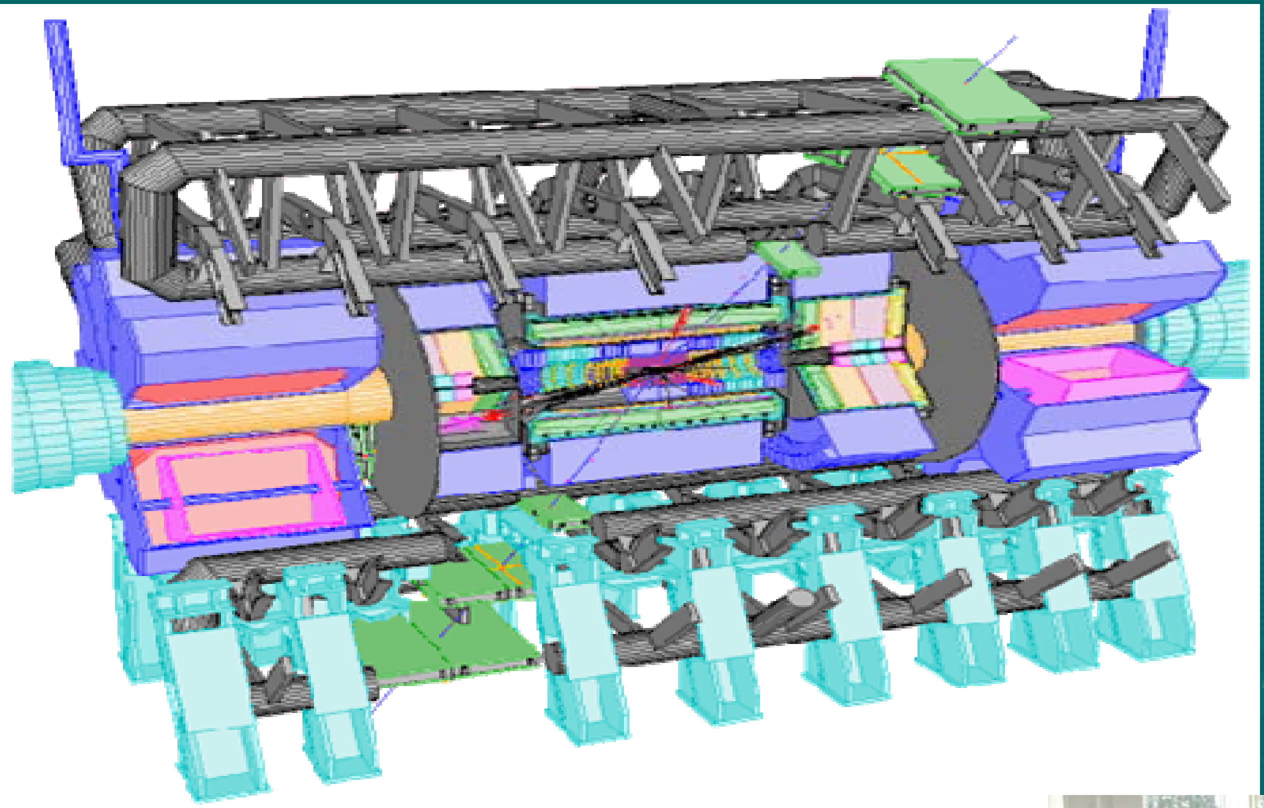
Endcap muon system

- 120 six-layers Cathode Strip Chambers (500 000 anode wires)
- 11000- channels HV system
- Track finder for L0 muon trigger
- Anode FE chips



PNPI CSC factory

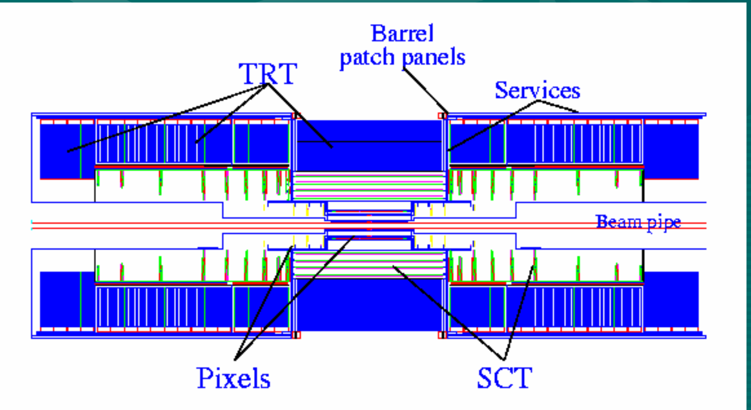


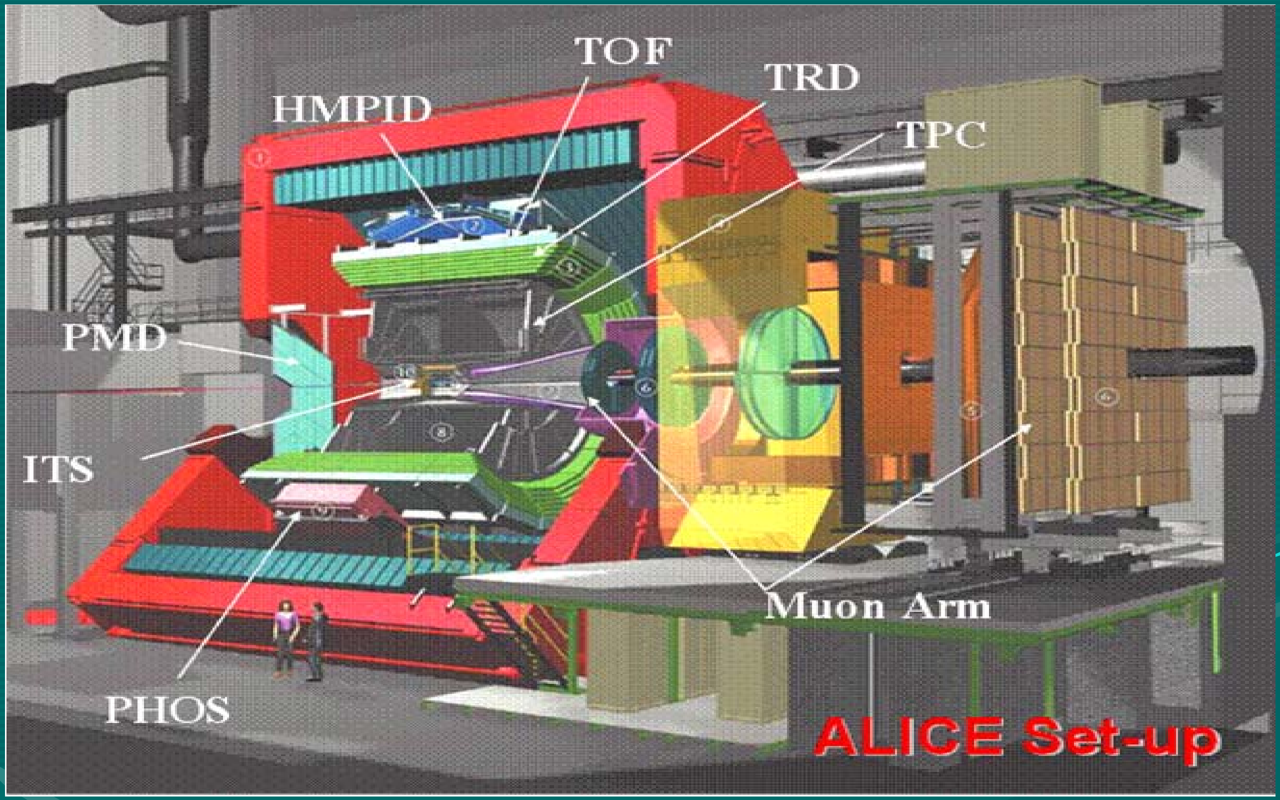


ATLAS

48 wheels with
150 000 straw-tubes
produced at PNPI

Endcap Transition Radiation Tracker

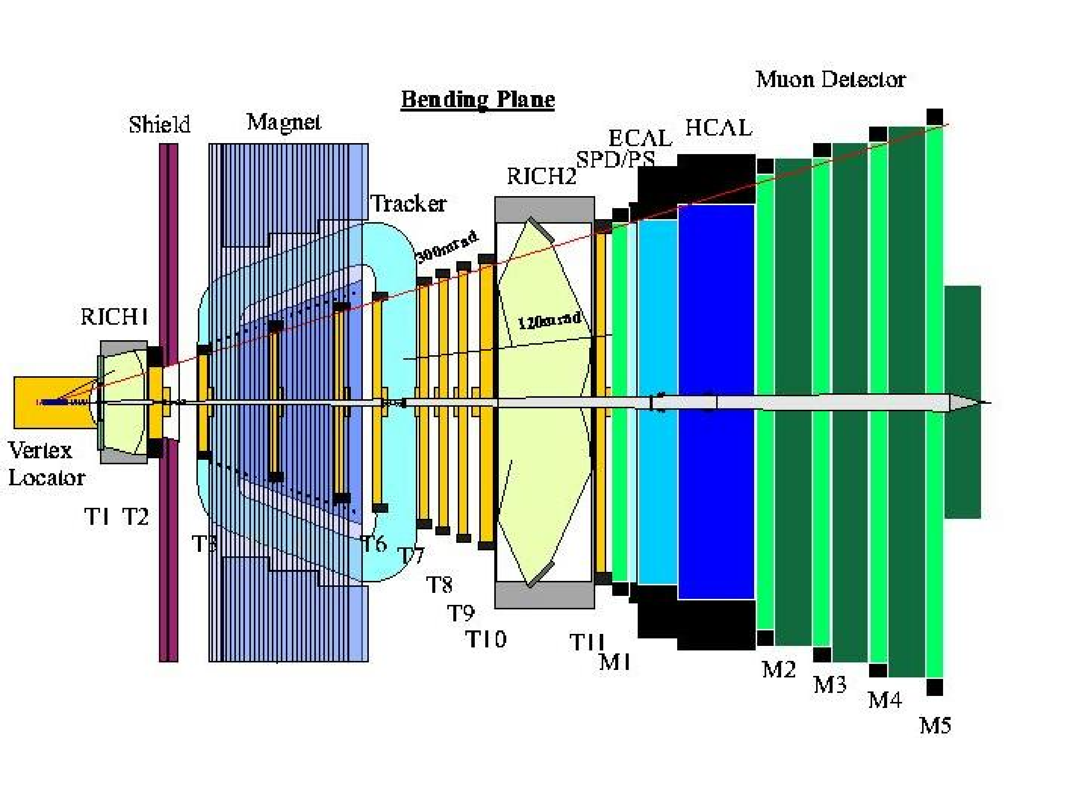




ALICE

38 Cathode Pad Chambers
for ALICE Muon system
produced at PNPI
25% of the total number

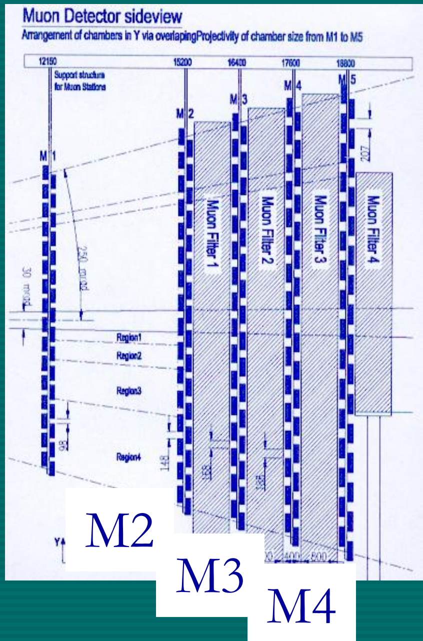
PNPI in LHCb project

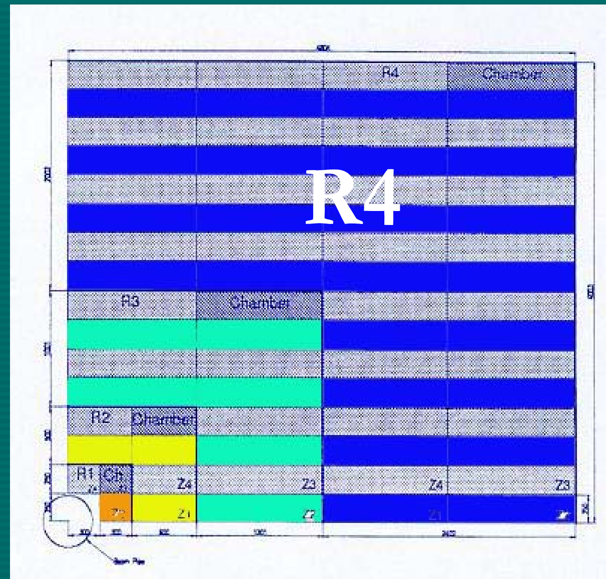


► **Transition from COBEX layout** (Large Quadrupole followed by small dipole) to the present layout (one large Dipole). Initiated by PNPI team.

► **Principles of operation of the LHCb muon system** (stand-alone trigger)
A.Borkovsky,A.Tsaregorodsev, and A.Vorobyov LHC-B97-007 TRIG,1997

► **Muon chamber technology** (fast operating wire chambers with wire /cathode pads)
Competition with two other technologies (thin-gap chambers and RPCs)





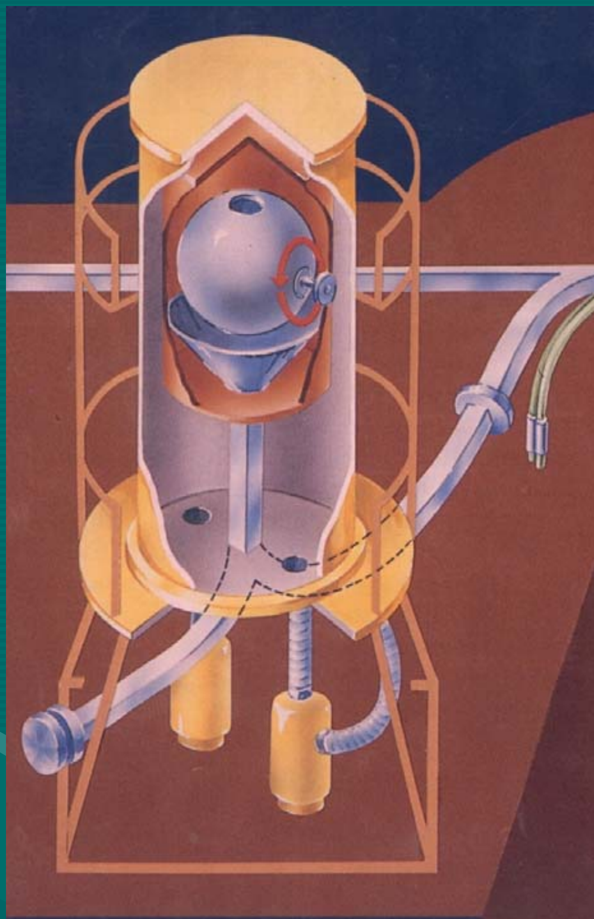
LHCb Muon system contains
5 muon stations
M1,M2,M3,M4,M5
1380 muon chambers in total

660 four-layers muon chambers are produced at PNPI for region R4 in stations M2,M3,M4.
(1.5 million of anode wires)

Also, 2000-channels HV system for LHCb muon system was designed and produced at PNPI

Some recent physics results related to our conference topics

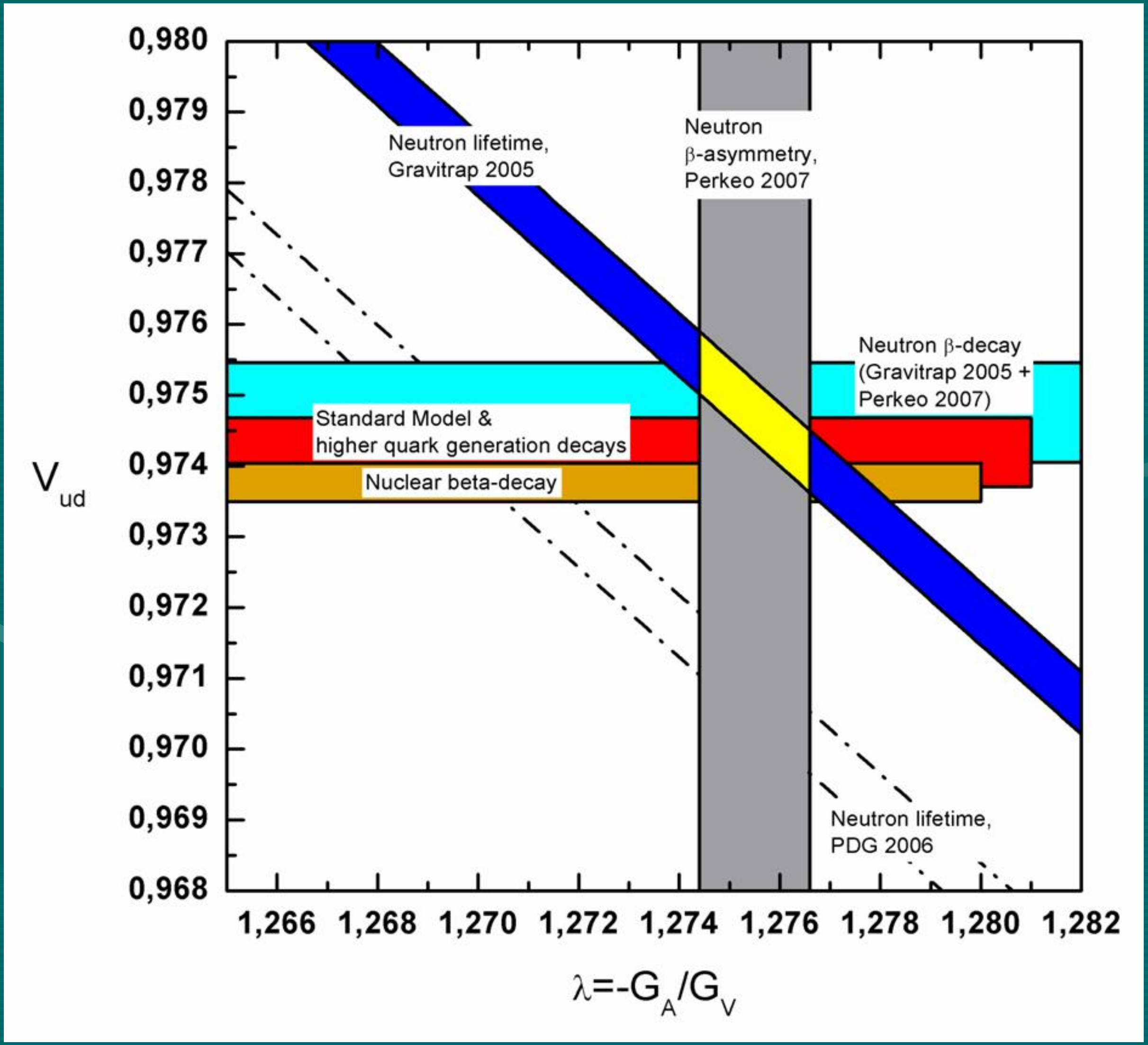
Neutron life time measurements with ultra cold neutrons



1986-1996 (ПИЯФ-ОИЯИ), реактор ВВР-М, Гатчина

2002-2004 (ПИЯФ-ОИЯИ-ILL), реактор ILL

V_{ud} and $\lambda = G_A/G_V$ from neutron decay



τ_n = 885.7(8)
(PDG data)

τ_n^{PNPI} = 878.5(8) s
PNPI data
A.Serebrov et al

Full consistency with SM

Neutron electric dipole moment
experiments with ultra-cold neutrons

Test for CP violation in barion system

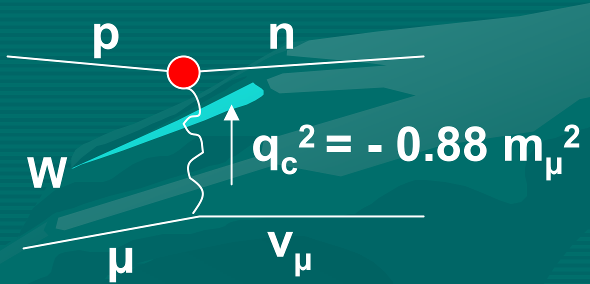
Standard Model prediction	~ 10^{-32} e·cm
SUSY	~ n· 10^{-27}
PNPI (1996)	< $1\cdot10^{-25}$
ILL (2006)	< $0.3\cdot10^{-25}$
PNPI project	~ 10^{-27}

Muon Capture on Proton

MuCAP experiment

$$\mu^- + p \rightarrow (\mu^- p)_{1S} \xrightarrow{\Lambda_S} \nu_\mu + n \qquad BR=0.16\%$$

Goal: to measure μp-capture rate Λ_S with ≤ 1% precision



$$V_\alpha = g_V(q^2)\,\gamma_\alpha + \frac{i\,g_M(q^2)}{2\,M_N}\,\sigma_{\alpha\beta}\,q^\beta$$

$$A_\alpha = g_A(q^2)\,\gamma_\alpha\,\gamma_5 + \frac{g_P(q^2)}{m_\mu}\,q_\alpha\,\gamma_5$$

$g_V = 0.9755(5)$

$g_M = 3.5821(25)$

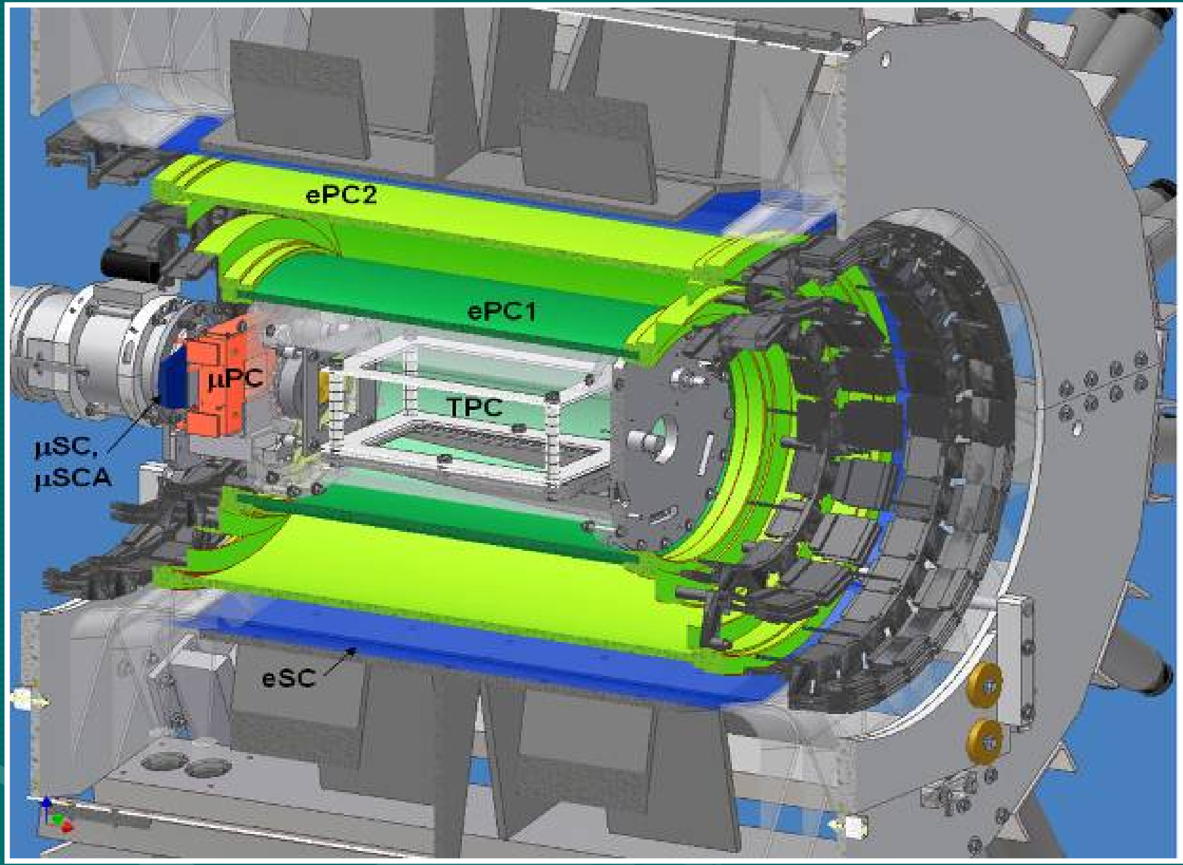
$g_A = 1.245(4)$

$g_P = ?$

g_P(theory) = 8.26 ±0.23

All form factors at $q_c^2 = - 0.88\ m_\mu^2$

Muon capture offers a unique possibility to measure $g_P(q_c^2)$



MuCAP experiment

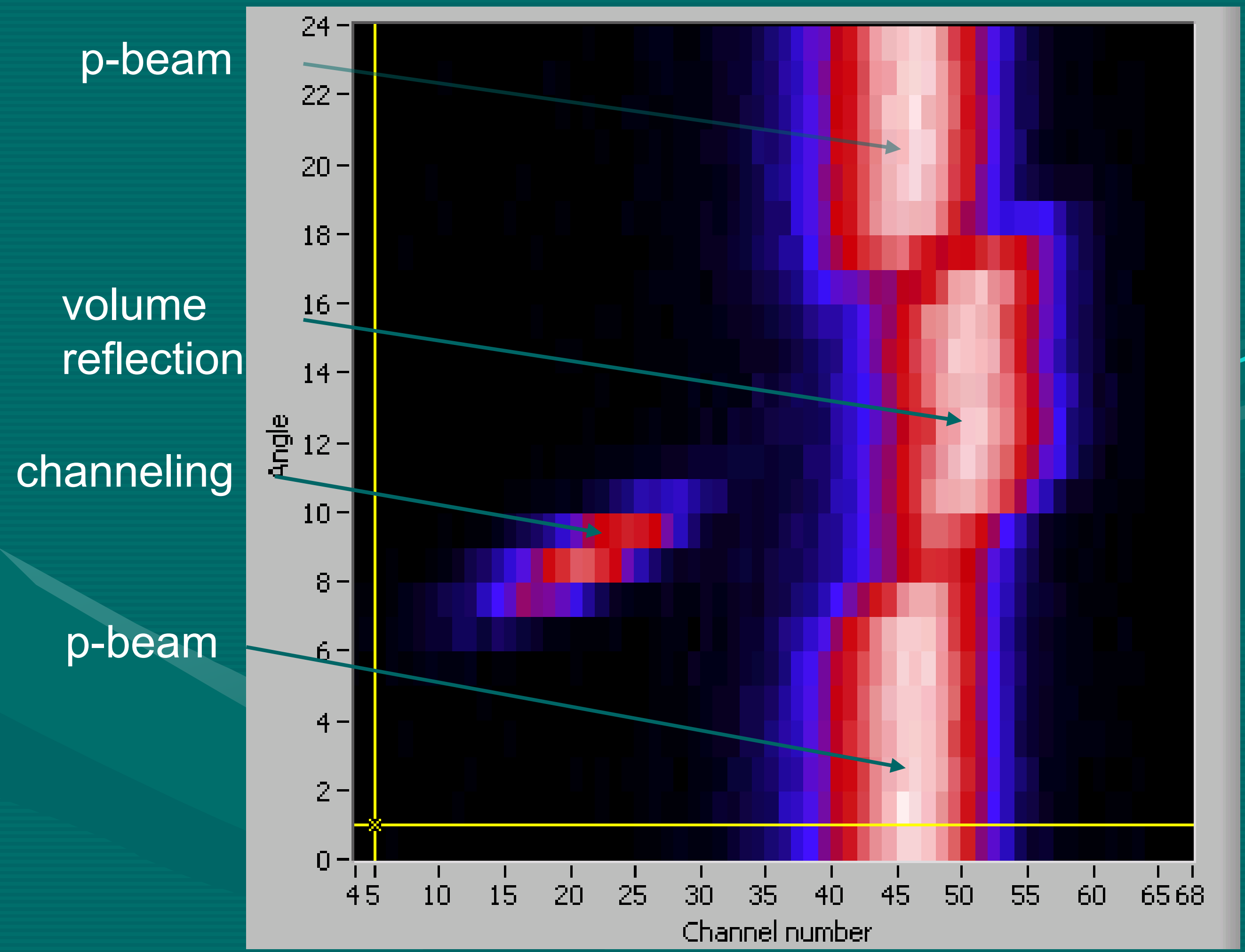
Hydrogen TPC develped at PNPI

	theory	prev. meas.	MuCap	
g_P	8.26 ±0.23	12 — 2	6.95 ± 1.09	(10% statistics analyzed)

So far, the MuCAP result is only 1σ from Standard Model prediction

Volume reflection from monocrystals

Experiment UA9 CERN 400 GeV protons



Volume reflection was observed first by PNPI&IHEP teams at 70 Gev at IHEP, then at 1Gev at PNPI, then at 400 GeV at CERN.

The final goal of UA9 is to reduce beam halo in LHC thus helping to increase LHC luminosity (replace the first collimator)

Thank you for your attention

and

our best wishes for success of the LHCb experiment