Mid-Term Report of CERN Member States

Hungary

On behalf of the Hungarian CERN Committee and the Hungarian HEP Community:

Péter Lévai, MTA Wigner RCP, Budapest

PECFA Meeting

19 July 2018, Barcelona, Spain

Hungary in 2018:

Citizens: 10 M persons
GDP: 135 +- 5 Mrd CHF

CERN Users: 70 +- 5 (40 FTE)
Personal: 600 kCHF/Y
Fund: 300 kCHF/Y

CERN Membership:
0.62 % of CERN budget
6.8 M CHF
(Payed by June, last 4 Y)

CMS M&O: 10 persons, 110 kCHF/Y
+ 1 MCHF for CMS Upgrade

ALICE M&O: 5 persons, 55 kCHF/Y
+ 300 kCHF for ALICE Upgr.

Main CERN participant institutes in Hungary:

Wigner
MTA atomki DEBRECEN
UNIVERSITAS BUDAPESTINENSIS DE ROLANDO EÖTVÖS NOMINATA
University of Debrecen
Debreceni Egyetem
ANNO 1774
ESZTERHÁZY KÁROLY UNIVERSITY

Global return coefficient

HUNGARY →

Country	2014-2017 CHF Amount	2014-2017 Return Coeff.	2017 CHF Amount	2017 Return Coeff.
AT	12,799,790	0.43	3,451,516	0.43
BE	11,694,296	0.31	3,272,121	0.32
BG	4,490,651	1.14	2,178,523	2.02
CH	294,868,731	5.60	80,980,001	5.63
CY	16,624	0.03	16,624	0.05
CZ	11,987,525	0.89	2,559,472	0.74
DE	146,918,870	0.53	41,990,650	0.56
DK	37,812,104	1.57	8,778,100	1.35
ES	110,964,073	1.07	32,742,414	1.23
FI	6,793,120	0.36	2,034,404	0.41
FR	372,154,509	1.84	96,825,807	1.84
GB	95,654,156	0.49	25,385,746	0.46
GR	6,643,680	0.35	2,267,840	0.51
HU	18,750,548	2.22	7,211,436	3.26
IL	3,189,292	0.17	802,846	0.15
IN	365,474	0.10	365,474	0.10
IT	147,218,172	0.98	29,624,906	0.76
NL	35,439,058	0.56	10,987,693	0.63
NO	7,980,043	0.21	2,104,943	0.20
PK	578,296	0.53	277,804	0.57
PL	28,168,105	0.75	12,035,875	1.16
PT	5,033,468	0.32	1,179,887	0.29
RO	4,642,860	0.40	2,069,950	0.57
RS	852,000	0.52	365,847	0.58
SE	10,249,690	0.28	2,353,826	0.23
SI	10,209	0.07	10,209	0.06
SK	3,342,766	0.50	2,040,622	1.15
TR	1,269,712	0.31	842,572	0.54
UA	61,464	0.15	61,464	0.19
Total	**1,379,949,283**	**1**	**374,818,571**	**1**

← **3.26 (II. !!)**

RECFA visit in Hungary: 4-5 October 2013, Budapest, MTA Wigner RCP

Recommendations:

--- Financal resources for the CMS and ALICE upgrade program should be secured;

--- Synergies between groups should be strengthened;

--- Phenomenological (and TH) support of experimental projects should be strenghened;

--- The future of the Innovative Detector Group (Lendület Grant) should be secured;

--- CERN TIER-0 computing center should be maintained at high level;

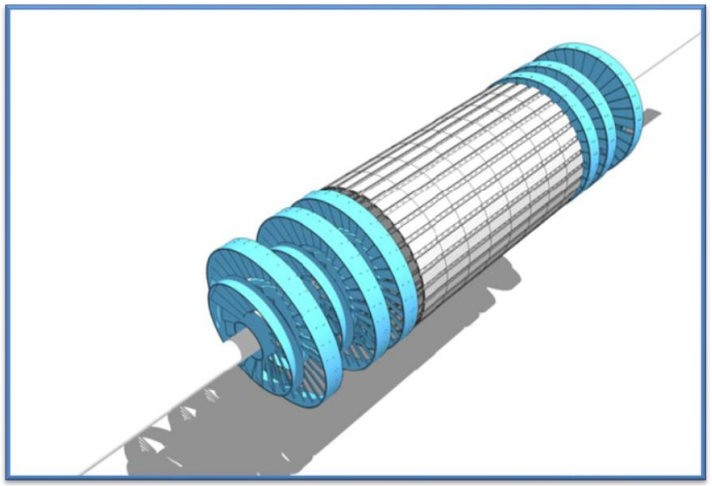
--- Hungarian CERN Tier-2 should be improved, financing should be increased;

--- Increasing support at the Universities for HEP related researches

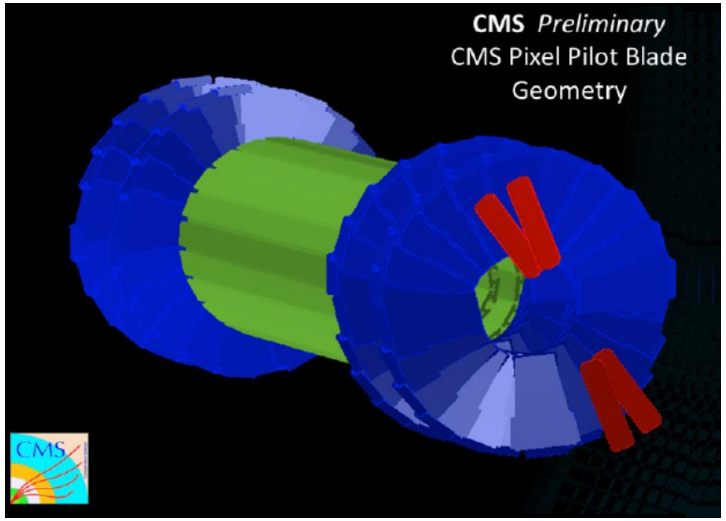
--- Starting a detailed discussion on the HU-HEP strategy for the forthcoming years.

LHC CMS Experiment - PIXEL Detector Upgrades

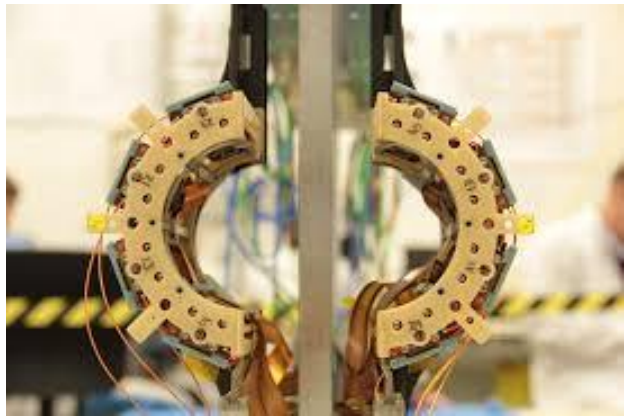
HL-LHC: FIRST PRIORITY



PIXEL Detector (operation) --- Upgrade accomplished & ongoing
PHASE-0: radiation effects are investigated, calibration
PHASE-1: DAQ, read-out electronics
PHASE-2: Chip testing of the Outer Tracker

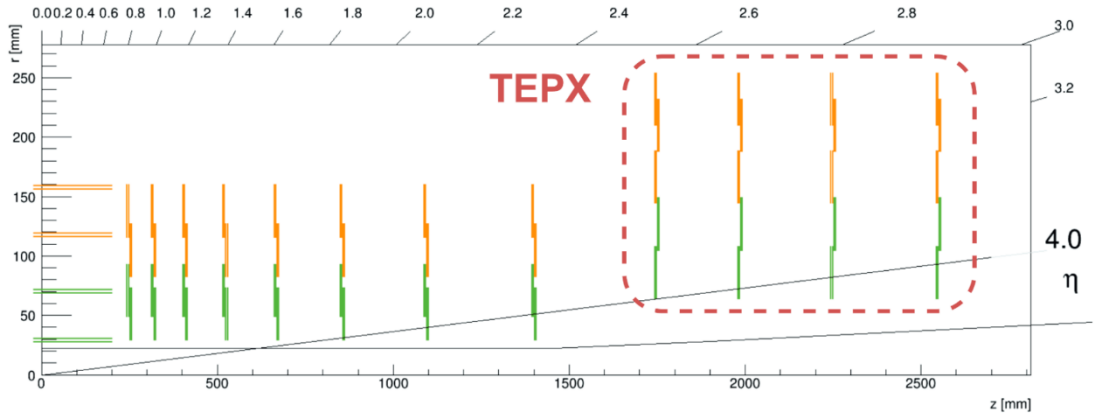


Pile-up problem at HI-LU LHC:
Muon detector upgr.& Timing Detector



PIXEL Luminosity Telescope (operation)

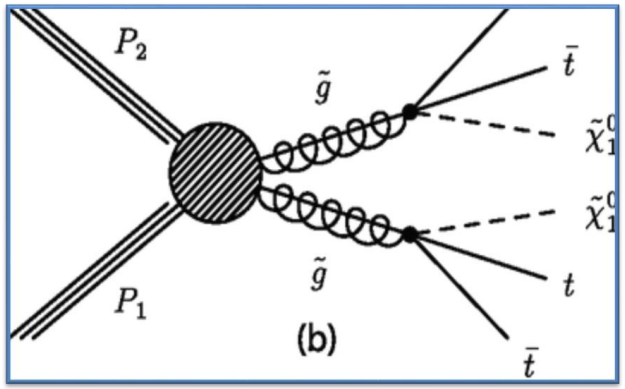
PHASE-2: High-performance
beam test setups
for studying sensors

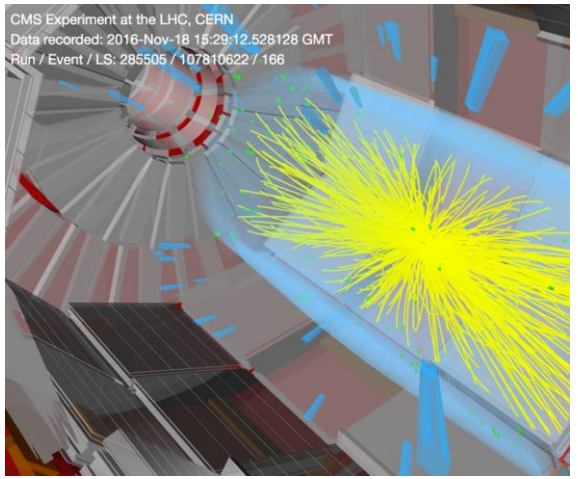


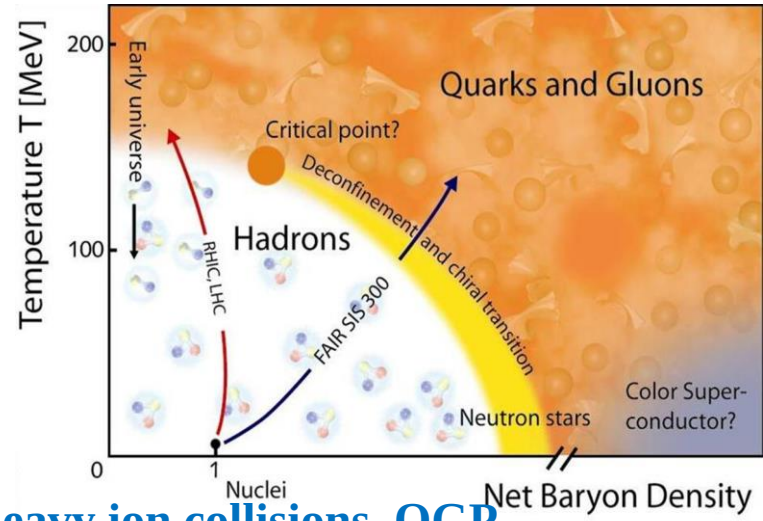
Tracker Endcap
Pixel Extension
for PHASE-2

Read-out test system
Will be created at ELTE

LHC CMS Analysis

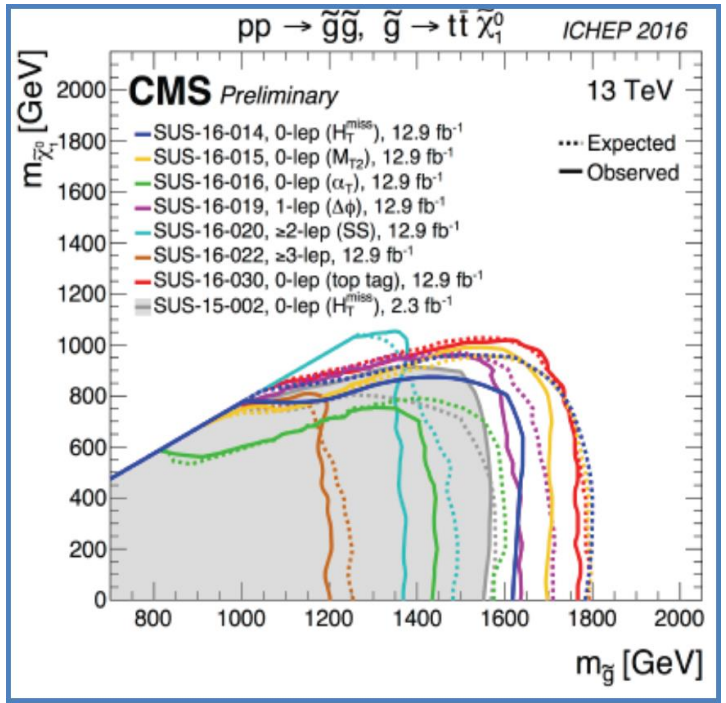


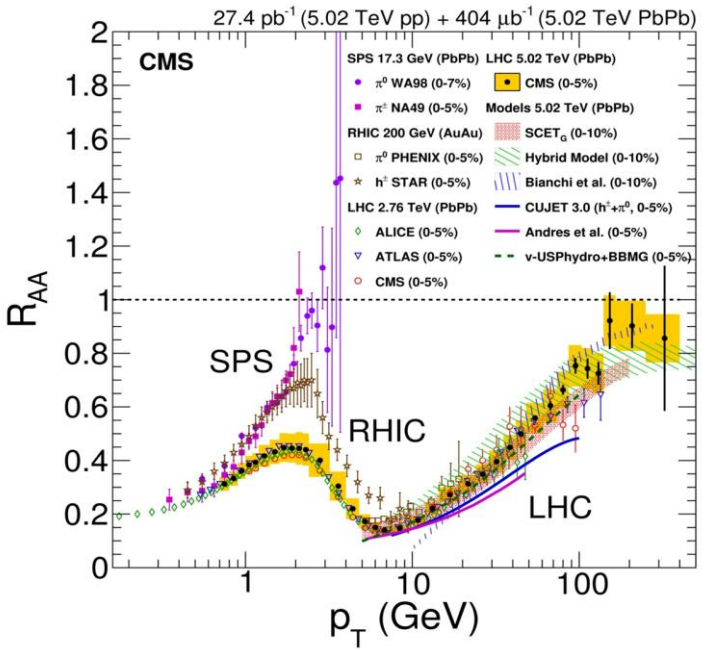


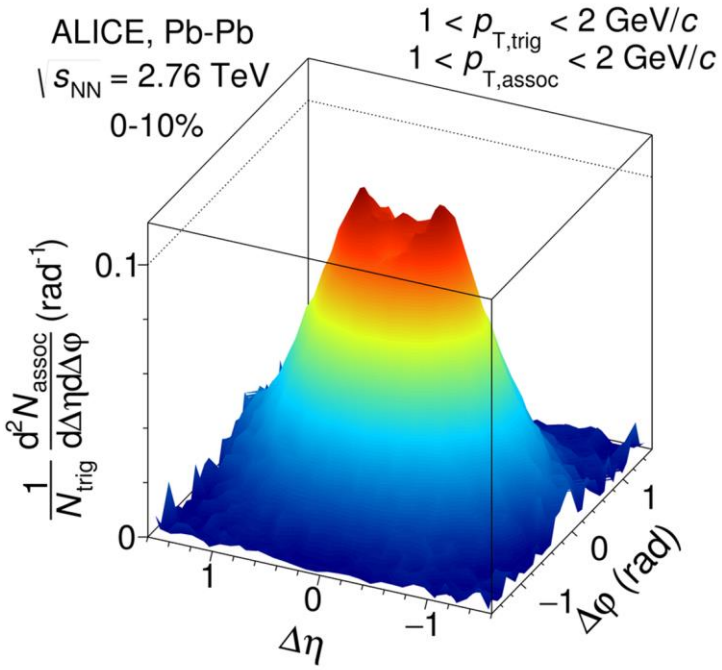


Gluino → Top-quark decay
Search for SUSY-particles

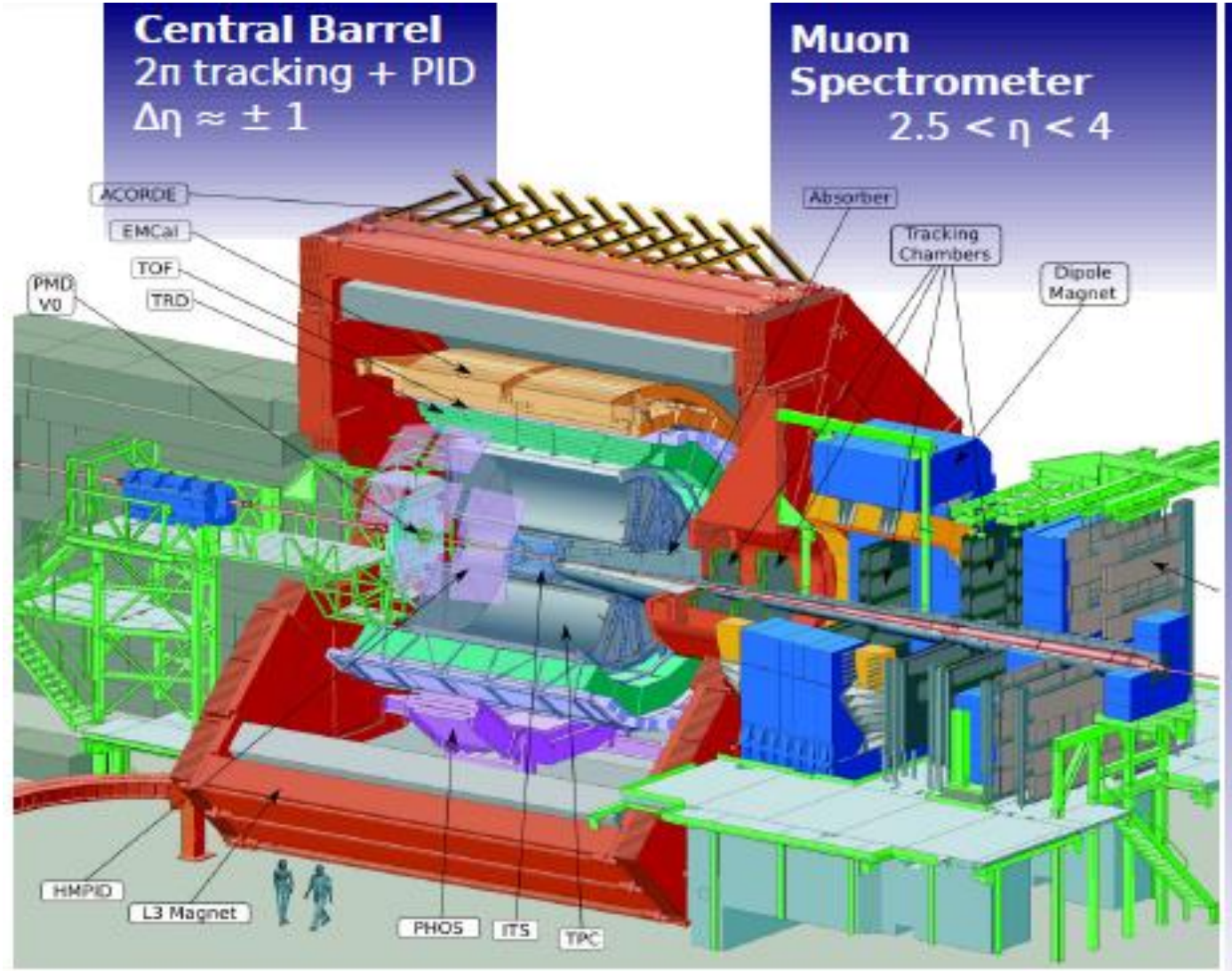
Strongly interacting matter, heavy ion collisions, QGP
Study of jet quenching, correlations, properties of QGP → ALICE







Participation in CERN ALICE collaboration: HMPID & TPC



ITS:
PID: dE/dx
low pt tracking

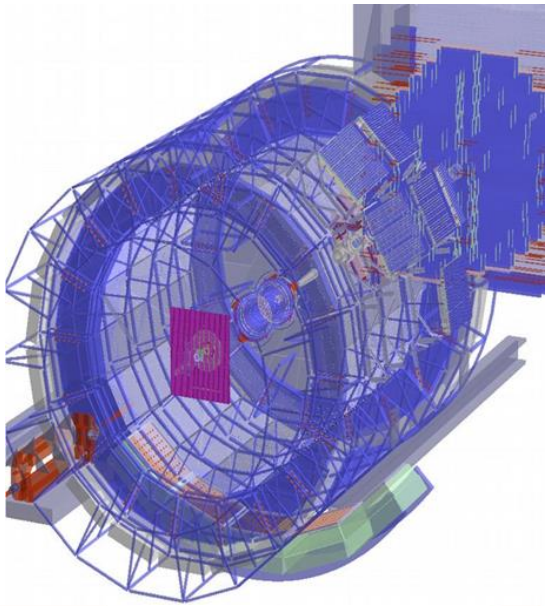
TPC:
· PID: dE/dx
· Global tracking

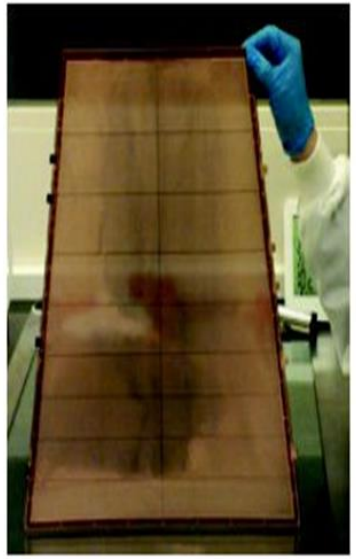
TOF:
· PID: ToF
· PID + TPC matching

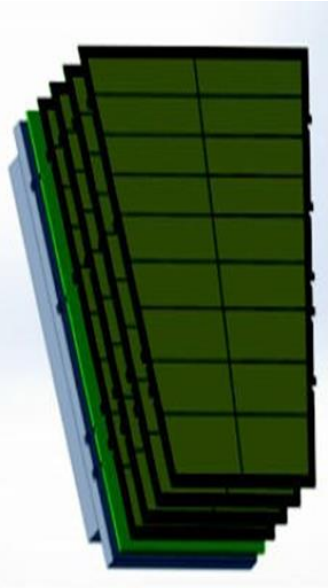
TRD:
· PID: transition rad.
· e / π separation

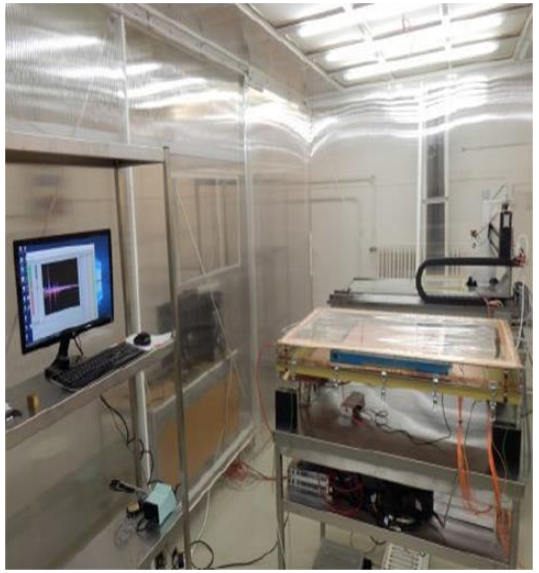
HMPID:
· PID: Cherenkov
· π/K/p

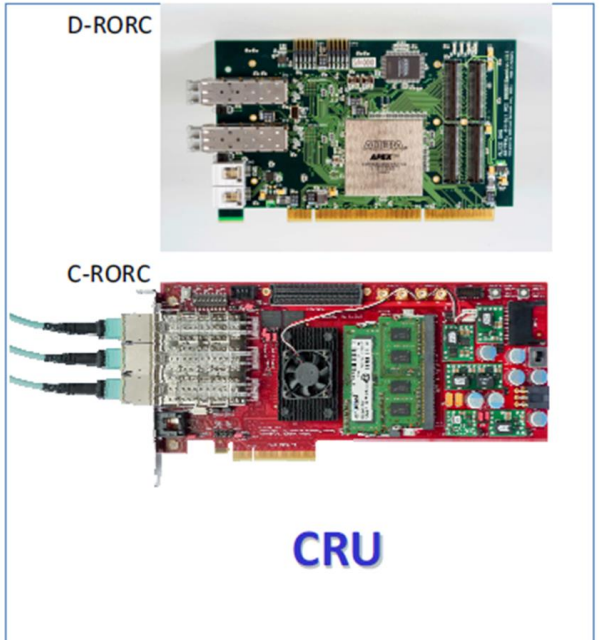
ALICE HW Upgrades: TPC Upgrade, GEM-monitoring and commission & DAQ



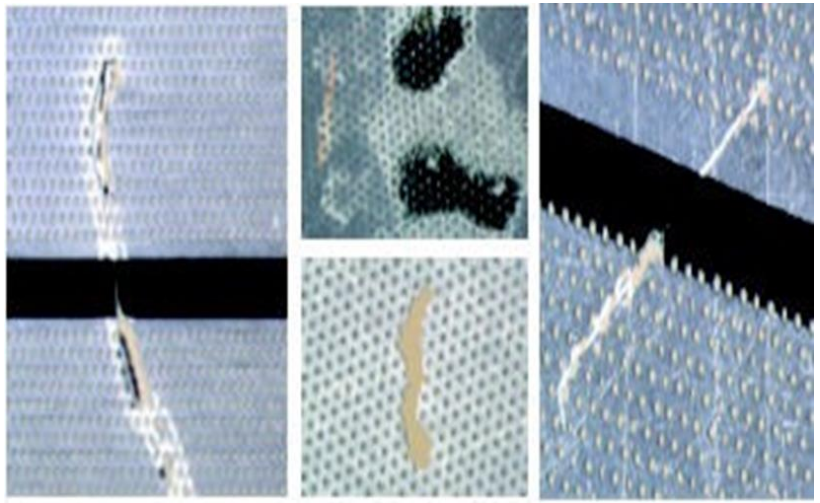






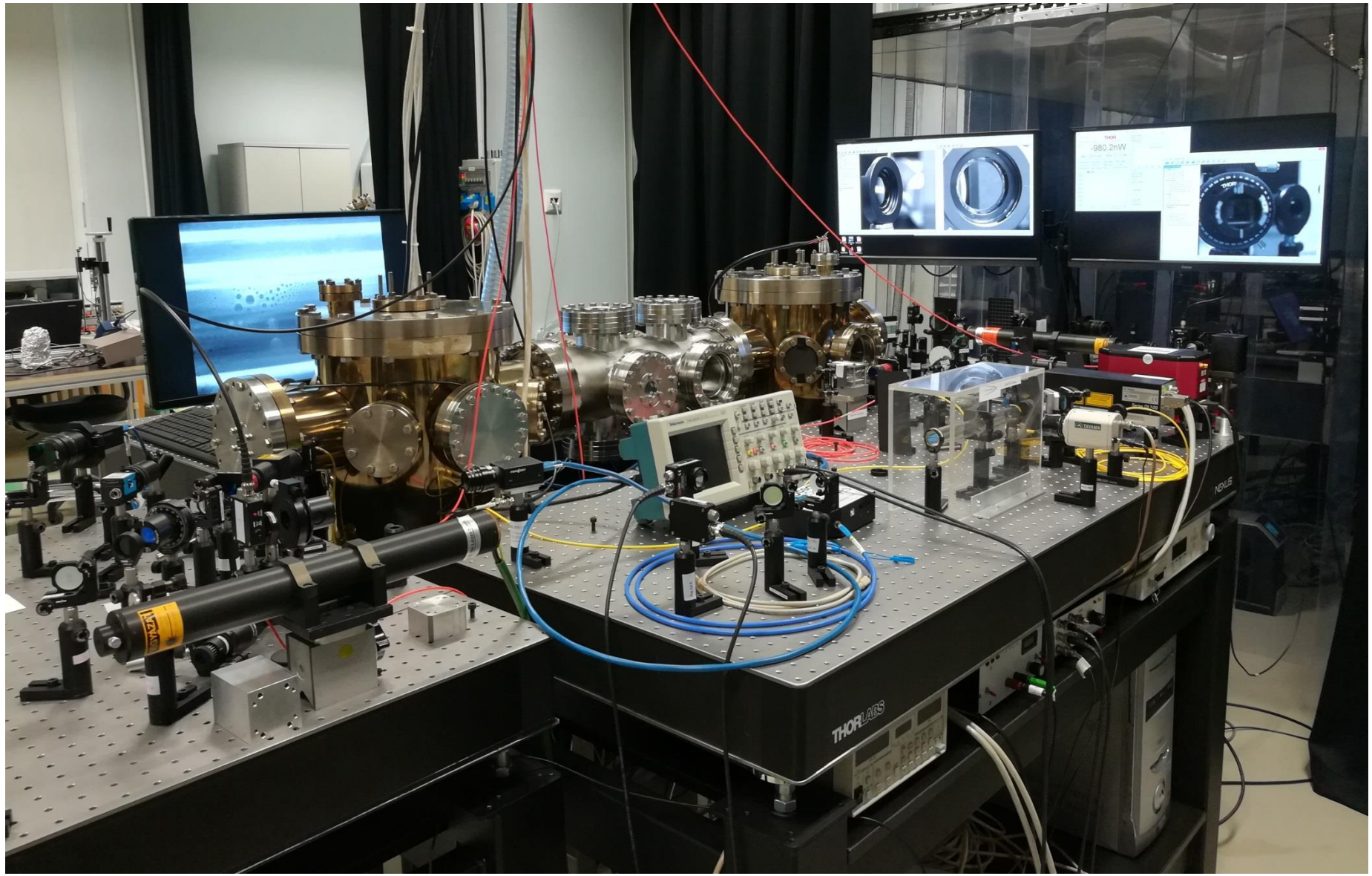


- Run1:
- 2.125 Gb/s custom DDL & D-RORC
- Run2:
- 4.25 Gb/s custom DDL2 & C-RORC
- Run3:
- Common Read-out Units (CRUs) as common detector, an trigger, and control interface

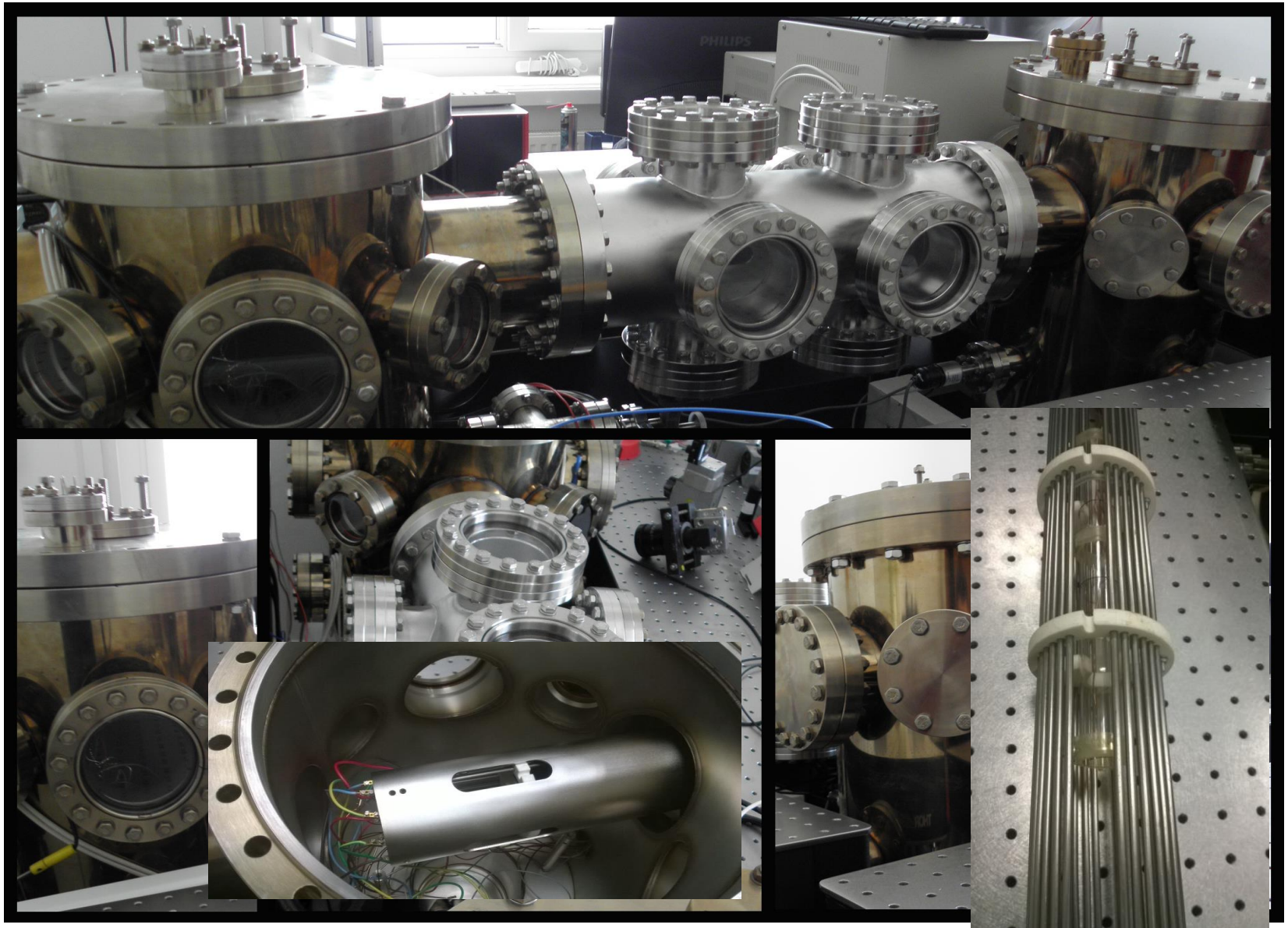


AWAKE Experiment, Associated Membership (2017-)

Laser plasma laboratory at Wigner Research Center for Physics (2015-)

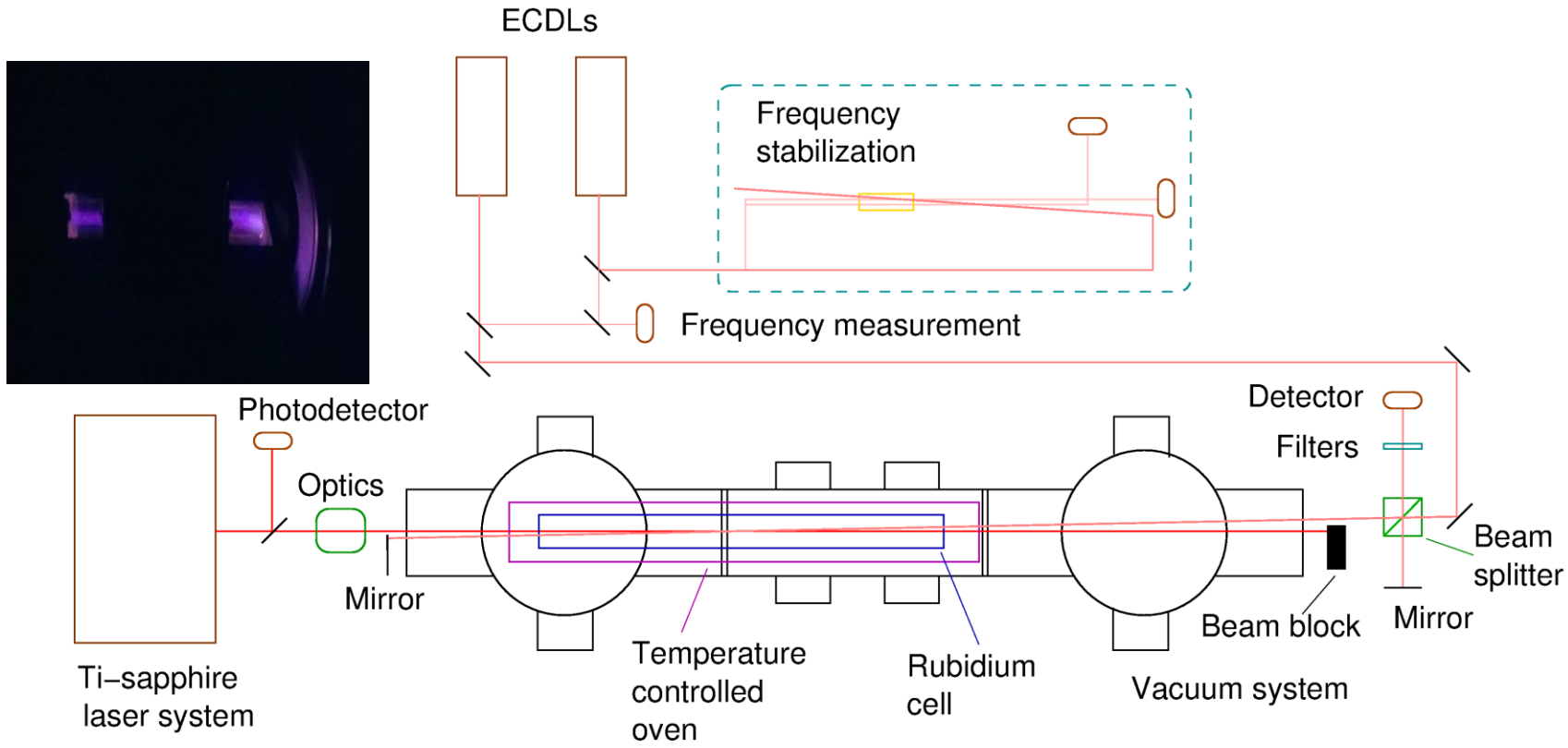


Experimental setup for laser plasma generation at MTA Wigner Research Center for Physics - an associated membership in the AWAKE Collaboration



Plasma density measurements using longitudinal interferometry

Experimental arrangement



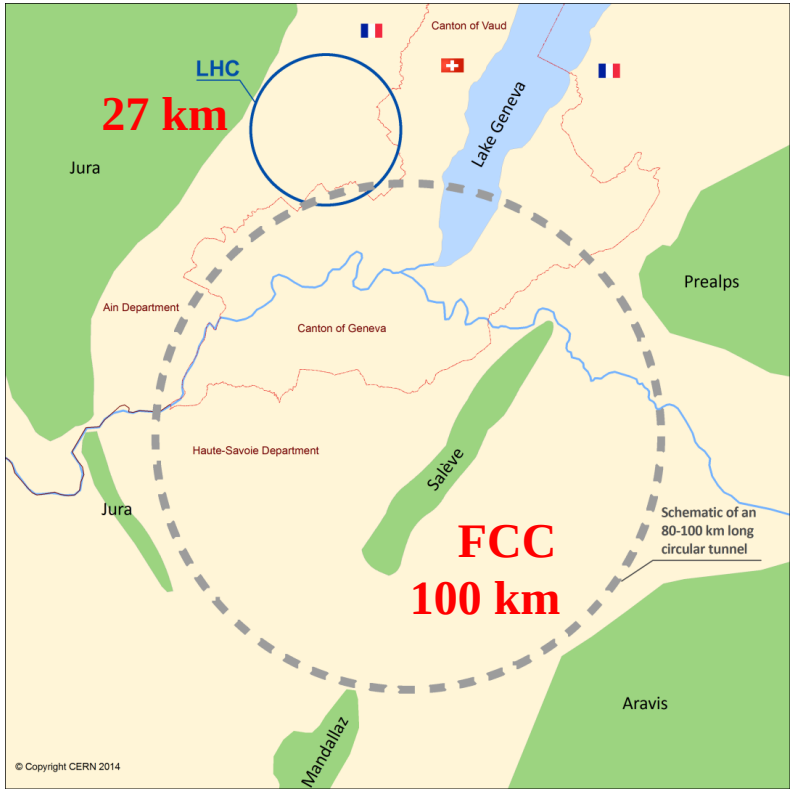
G.P. Djotyan et al, Real-time interferometric diagnostics of rubidium plasma Nucl. Instr. and Meth. in Phys. Res. A, A 884 : 25–30 (2018),

Measured parameters: relative phase, recombination constants, density of plasma

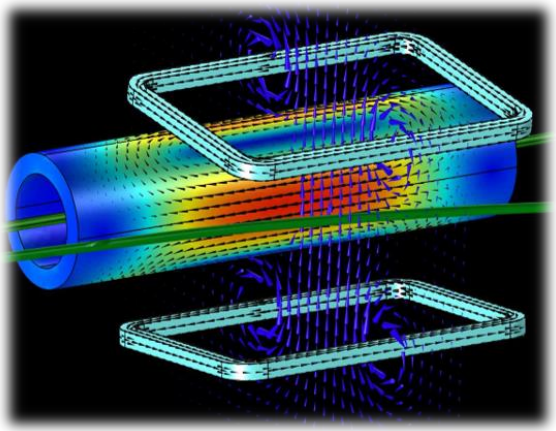
Temperature Vapor density	Detuning: 4GHz Maximum induced relative phase Relaxation time Plasma density (ionization percentage)	Detuning: 3.2 GHz Maximum induced relative phase Relaxation time Plasma density(ionization percentage)
T = 120 °C $\varphi_1^{(0)}$ N = 2.0 x 10^{13} cm^{-3}	Φ= 18.3 rad τ = 2.28 μs ΔN= 1.0 x 10^{12} cm^{-3} (8.5 %)	Φ= 24.8 rad τ = 2.31 μs ΔN= 1.1 x 10^{12} cm^{-3} (10.6 %)
T = 95 °C N = 4.3 x 10^{12} cm^{-3}	Φ= 3.59 rad τ = 1.08 μs ΔN= 2.0 x 10^{11} cm^{-3} (7.8 %)	Φ= 5.41 rad τ = 1.07 μs ΔN= 2.4 x 10^{11} cm^{-3} (10.8 %)

G.P. Djotyan et al, Real-time interferometric diagnostics of rubidium plasma Nucl. Instr. and Meth. in Phys. Res. A, A 884 : 25–30 (2018),

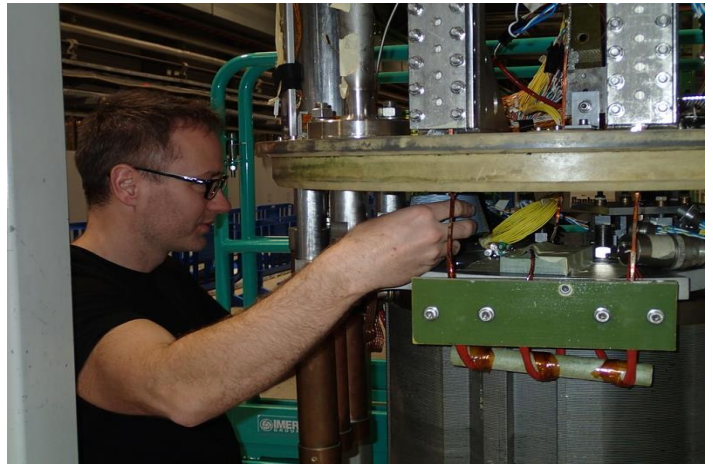
FCC Technology: criotechnology and connected test-facilities at liquid-helium temperature (SUSHI: CERN-WIGNER Collab.)



Large Hadroncollider (LHC)
Future Circulare Collider (FCC)
→ Many thousands superconducting dipol cooled down by liquid He
→ Fast Kick-off magnets (SUSHI)



Visualization of the SUSHI magnet



Installing a test-bed at CERN
Dániel Barna (Wigner RCP)
Head of the SUSHI project

The test facility at CERN for superconducting structures and LHC magnets installed inside

IT-Technology contribution form HEP (knowledge transfer, TechTrans)

WIGNER Datacenter -- Csillebérc, MTA WIGNER RCP [4 MW]

2013/01/01: Start of the CERN TIER-0 extension [1300 km 3x100 Gbit/s]

2016/07/01: Academy Cloud + Wigner Cloud (+ Integrated GPU)

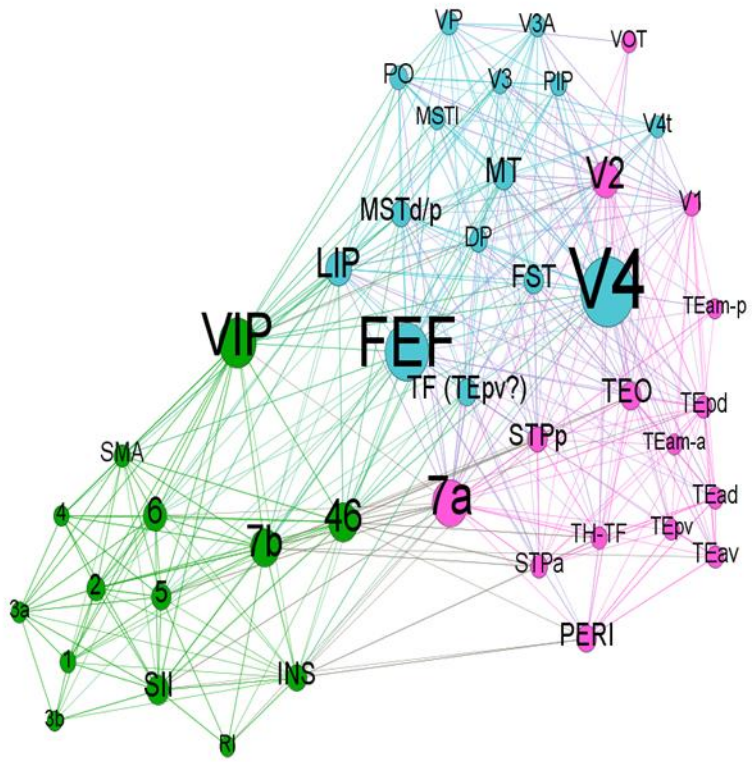
Tier-0: 80 000 CPU-kernel, 90 PB HD, 240 TB RAM (+ GPU Club, CERN AIME events)

Academy Cloud: 2300 CPU-kernel, 2 PB HD, 15 TB RAM, 1.6 PB tape (+ 32 TFLOP GPU)

►►►► **Pilot Project: TIER-2 Service on Cloud**

New Methods in Data Analysis: Big Data, Machine learning, AI, Visual. Changing paradigm in HEP & Knowledge transfer to other fields

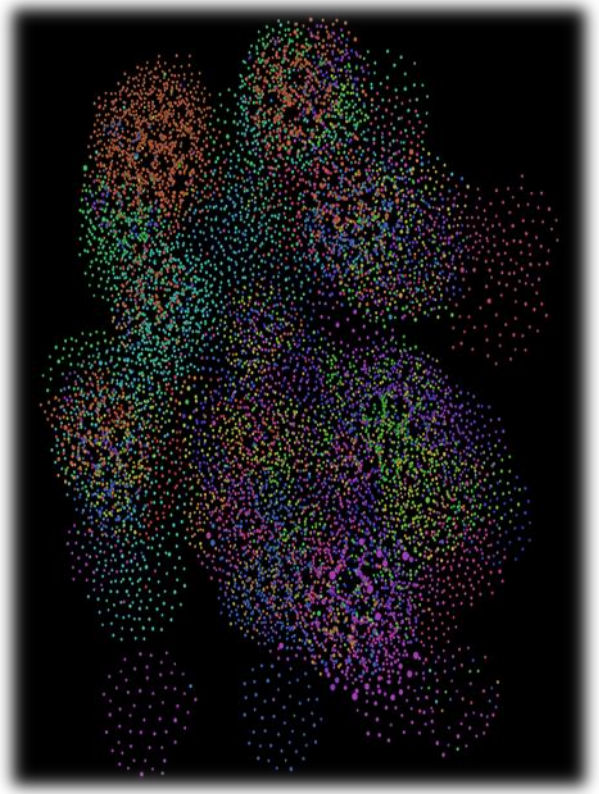
►►►► SPOTTING Collaboration (CERN& Wigner RCP & BME)[10p] Application of Clouds and Integrated GPU units [2018]



Second order line graph visualization of a Network by CollSpot

← **G0 level: 3 cluster**
G2 level: 21 cluster →
(paper is submitted)

+1 example:
Analysis of ERASMUS database

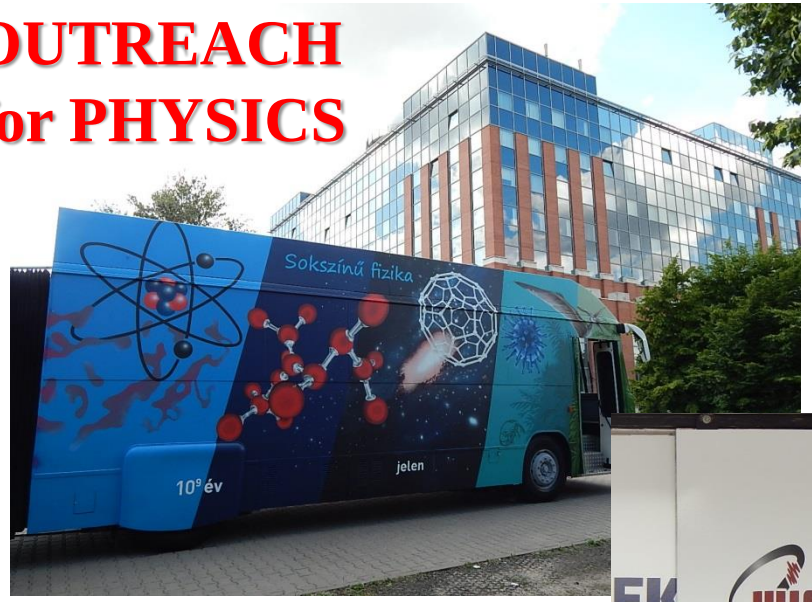


OUTREACH
for HEP

Intern. Masterclass (IPPOG)
2005 – 2018 (March) [SW]
Budapest & Debrecen
2 locations, 1 + 1 day

CERN@WIGNER [HW + IT]
2013/09 : 60th anniversary of CERN
2018/09 : 6th event at Wigner RCP

OUTREACH for PHYSICS



All Colors of Physics Bus
National Physics RoadShow

Inauguration: April 2014
Rolf Heuer CERN DG

New Education Methods in HEP fields and in Science

Teacher Training at CERN in August (13th training, one week) > 400 teachers

HU-network of CERN-trained teachers

Teacher Research Laboratory at Wigner RCP

Leading teacher + 2 assistant teacher + 12-15 students

Preparation for BL4S application (Beam Line for Students)

PhD for School Teachers – collaboration with ELTE PhD School

Student Summer Camp at CERN – HUN pilot in May 2017

22 HUN students in HEP topics (great success!)

Student Summer Camp at Wigner RCP – pilot in June 2018

14 students with excellence (not only HEP, but wider)

Extremely successful, wide support from other fields

Working against Brain Drain

New teachers want to apply for PhD; Student Camp in 2019; Summer Students

Recommendations → Activities in 2013-2018

--- Financal resources for the CMS and ALICE upgrade program should be secured;

→ Fair share was accomplished, LHC HI-LU detector upgr. was executed

--- Synergies between groups should be strengthened;

→ Other way: focusing on smaller number of target project, increasing efficiency

--- Phenomenological (and TH) support of experimental projects should be strenghened;

→ Phenomenology PhD-s are accomplished, ALICE, CMS TH-focus at ELTE strengthened

--- The future of the Innovative Detector Group (Lendület Grant) should be secured;

→ ALICE TPC, beam positioning, proton-therapy and other collaborations (wider scope)

--- CERN TIER-0 computing center should be maintained at high level;

→ 7th year contract is signed, collaboration and service is flawless

--- Hungarian CERN Tier-2 should be improved, financing should be increased;

→ Pilot project: virtual Tier-2 in a Scientific Cloud (how to use spare time slots)

--- Increasing support at the Universities for HEP related researches

→ New CMS Momentum Group has been established (PásztorG) + EKE (Gyöngyös)

--- Starting a detailed discussion on the HU-HEP strategy for the forthcoming years.

→ New accelerators using Laser-Plasma interaction (AWAKE@CERN + ELI exp.)

→ FCC kick-off magnet, SUSHI project, superconductivity technology at Wigner RCP

→ HU-discussions on connection between CERN LHC/FCC and EGO ET communities

→ New education methods (Bus, Summer Camp, Teacher Research Lab, Teacher PhD efforts)

→ New data analysis/visualisation methods, change in paradigm, open for other fields