‘The strong interaction at the frontier of knowledge: fundamental research and applications’

WP12 NA1 - QCD Physics at GSI/FAIR (FAIRnet)

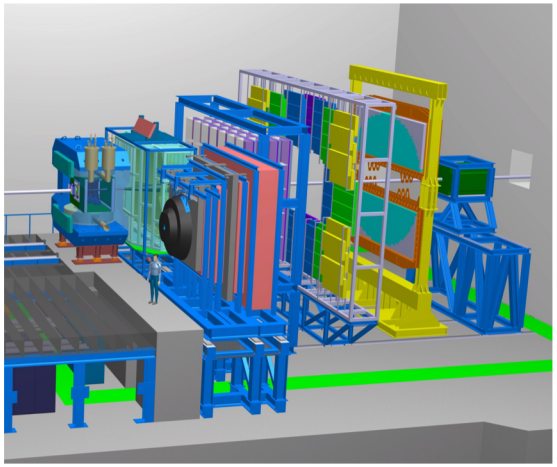
Fritz-Herbert Heinsius
Ruhr-Universität Bochum

STRONG-2020 Kick-off meeting

October 23-25, 2019

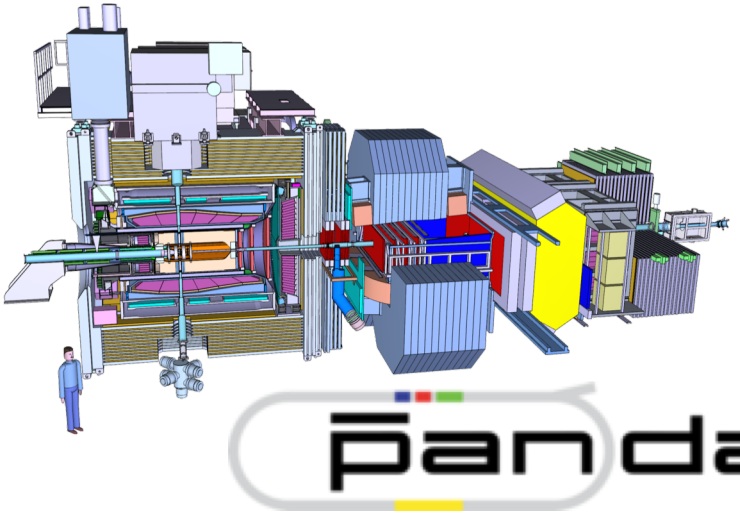
NA1 - QCD Physics at GSI/FAIR (FAIRnet)

WP12 Objectives



Antiproton Annihilation at Darmstadt
Investigate the nature of the strong force at the quark level

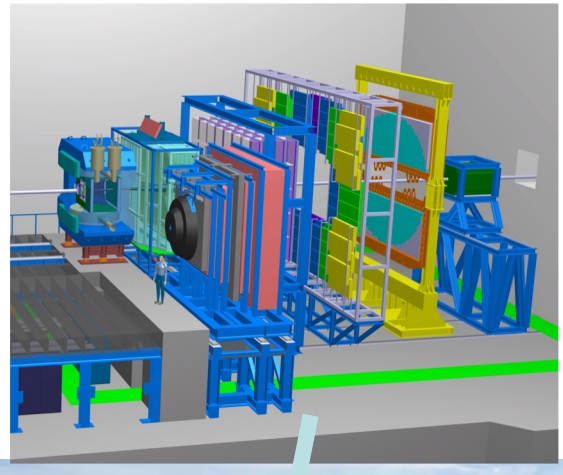
Compressed Baryonic Matter
Explore properties of strongly interacting matter under extreme conditions



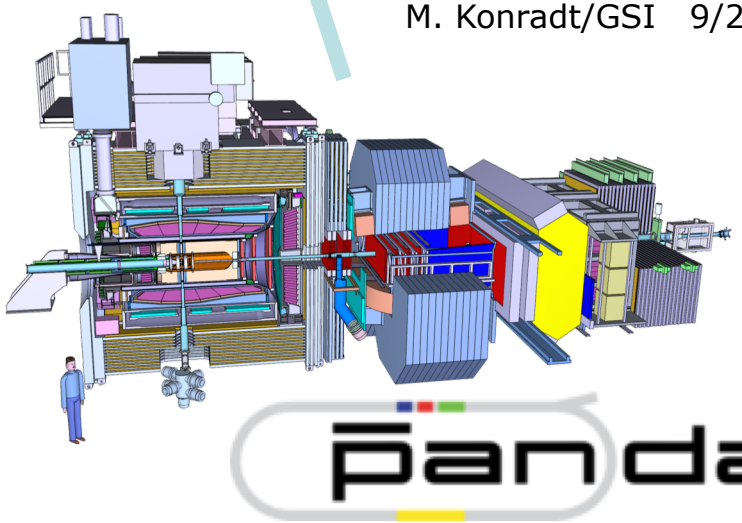
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824093.

NA1 - QCD Physics at GSI/FAIR (FAIRnet)

WP12 Objectives



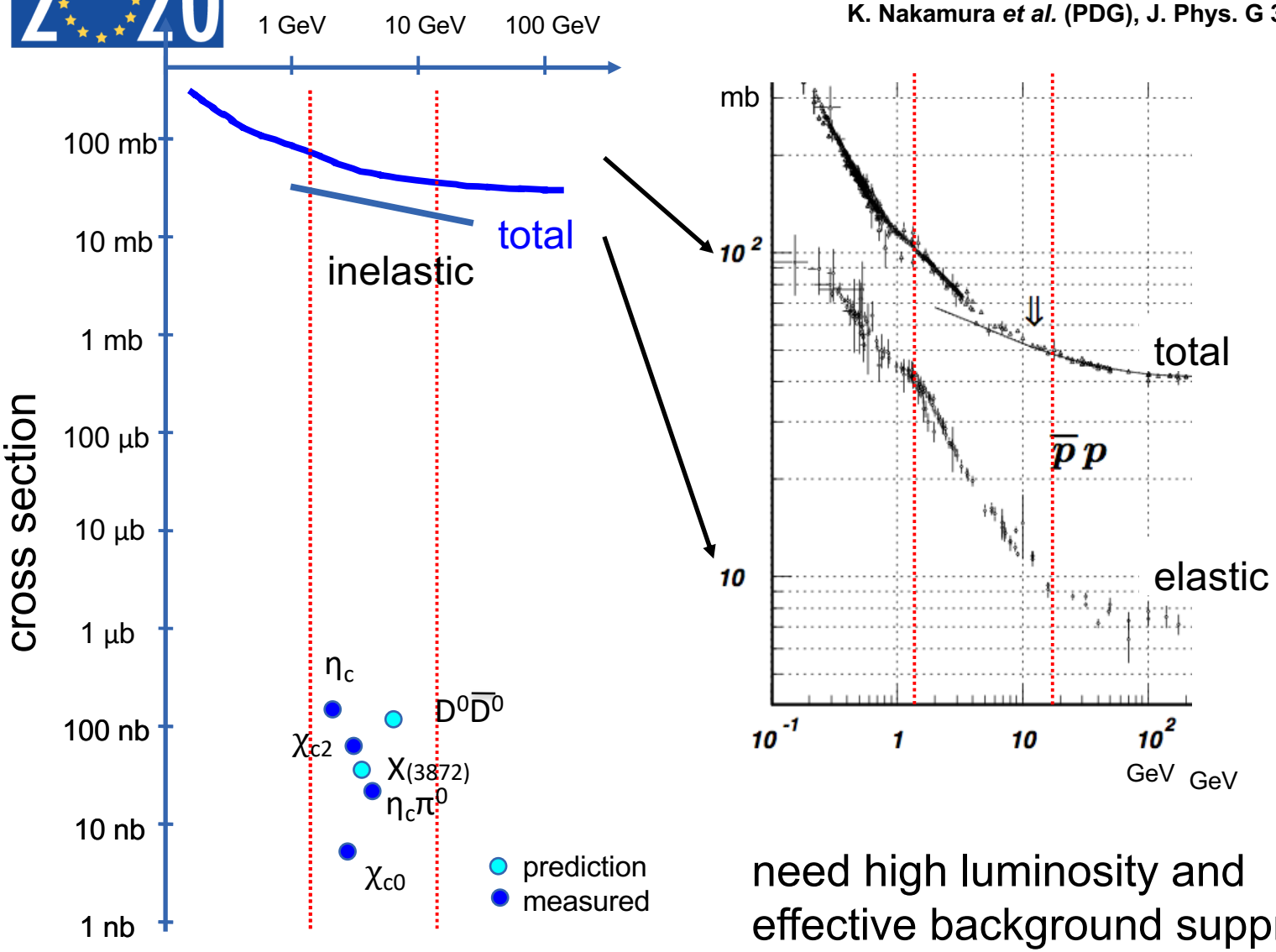
M. Konradt/GSI 9/2019



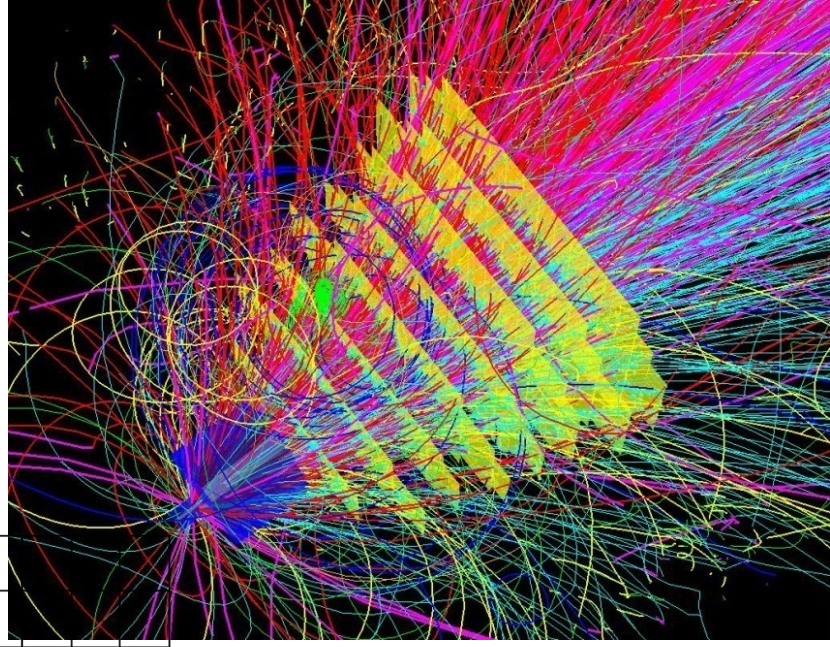
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824093.

$\bar{p}p$ cross sections

K. Nakamura *et al.* (PDG), J. Phys. G 37, 075021 (2010)

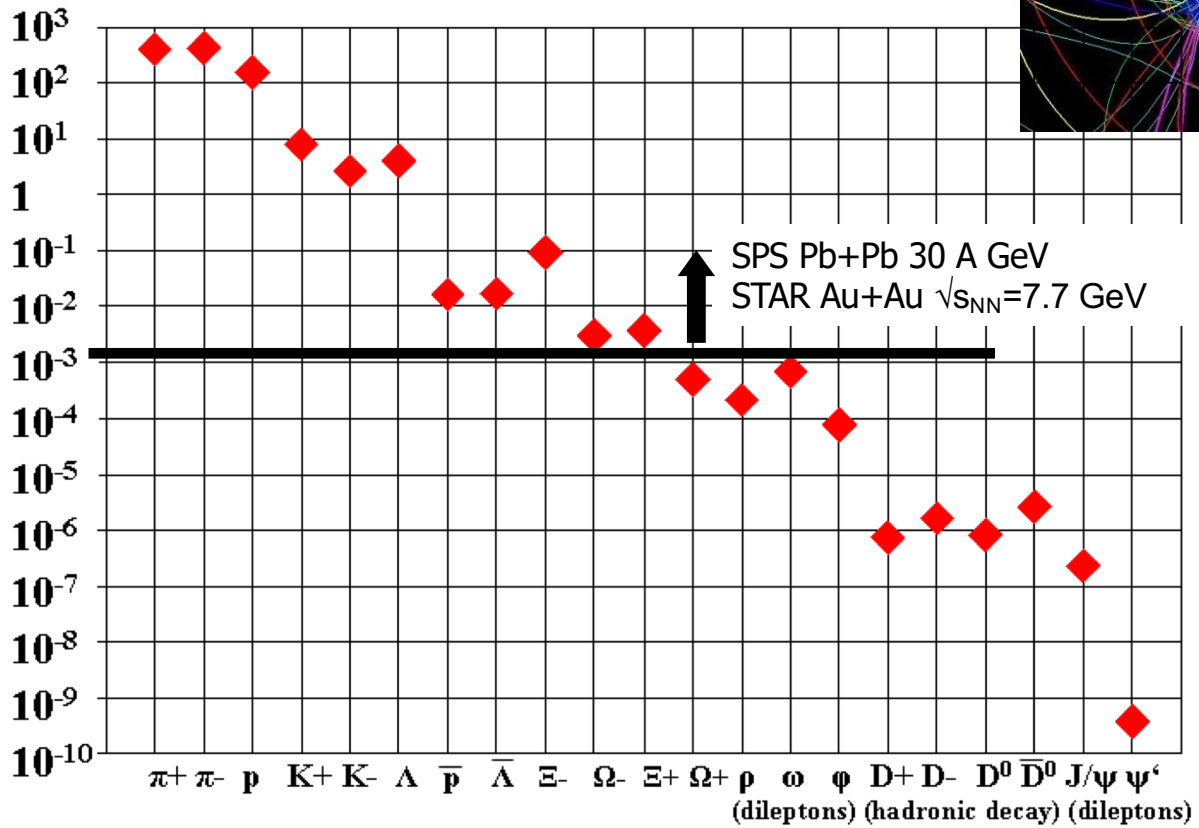


need high luminosity and
effective background suppression



Min. bias Au+Au collisions at 25 A GeV
(from HSD and thermal model)

Particle multiplicity x branching ratio



NA1 FAIRnet: Institutions

Australia
Univ. Sidney

Austria
SMI Vienna

Belarus
RINP Minsk

China
Tsinghua Univ. Beijing
IHEP Beijing
IMP CAS Lanzhou
USTC Hefei
CCNU Wuhan
CTGU Yichang

Czech Republic
CAS Rez
Tech. Univ. Prague
Univ. Prague

France
IPN Orsay
CEA Saclay
IPHC Strasbourg

Germany
ZIB Berlin
Univ. Bochum
Univ. Bonn
FAIR
GSI Darmstadt
TU Darmstadt
Univ. Erlangen
FIAS/Univ. Frankfurt
Univ. Gießen
Univ. Heidelberg
FH Südwestfalen
FZ Jülich
KIT Karlsruhe
HIM/Univ. Mainz
Univ. Münster
HZ Rossendorf
Univ. Tübingen
Univ. Wuppertal

Hungary
Eötvös Univ. Budapest
KFKI Budapest
Wigner RCP

India
Aligarh Muslim Univ.
IOP Bhubaneswar
Panjab Univ.
PIAS Changa
BIT&S Goa
Gauhati Univ.
IIT Indore
Univ. Rajasthan Jaipur
Univ. Jammu
IIT Kharagpur
Univ. Calcutta Kolkata
Kolkata Bose Inst.
VECC Kolkata
BARC Mumbai
Santiniketan
Univ. Kashmir Srinagar
Univ. Surat
Univ. Vallabh Vidynagar
B.H. Univ. Varanasii

Italy
Ferrara Univ. & INFN
LNF Frascati
INFN Genova
Pavia Univ. & INFN
Torino Univ. & INFN
Torino Politecnico

Poland
Jagiellonski Univ.
AGH Krakow
Krakow Univ.
IFJ Cracow
NCBJ Warsaw
Warsaw Univ. Tech.
Univ. Warsaw

Romania
IFIN-HH Bucharest
NIPNE Bucharest
Univ. Bucharest

Russia
JINR Dubna
ITEP Moscow
MEPHI Moscow
Kurchatov Inst. Moscow
SINP Moscow State Univ.
NSU Novosibirsk
BINP Novosibirsk
IHEP Protvino
PNPI St. Petersburg
INR Troitzk

South Korea
Pusan National Univ.

Spain
Univ. Valencia

Sweden
Lund Univ.
Stockholm Univ.
Uppsala Univ.

Switzerland
Basel Univ.

Thailand
Suranee Univ. of Tech.

The Netherlands
KVI-CART U. Groningen

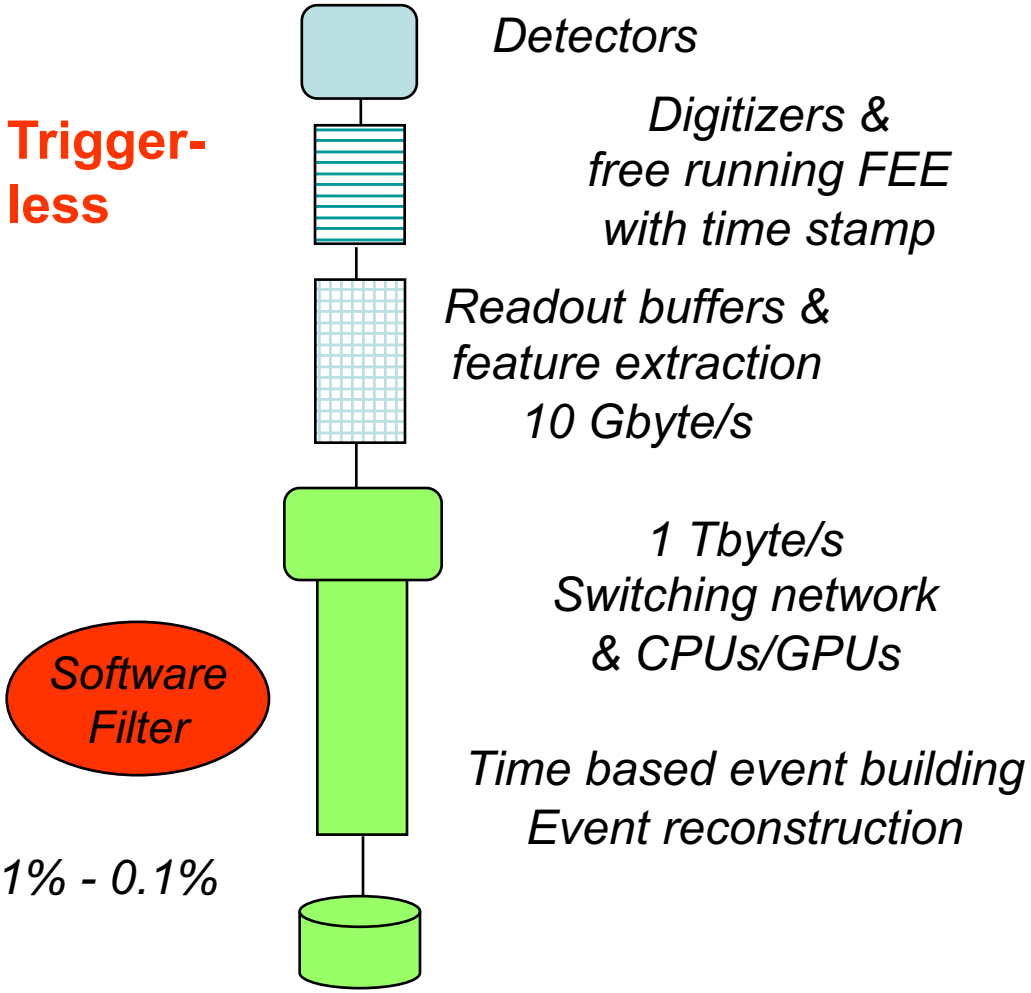
Ukraine
INR Kiev
Shevchenko Univ. Kiev

USA
NW Univ. Evanston

UK
Edinburgh Univ.
Glasgow Univ.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824093.

NA1 - QCD Physics at GSI/FAIR (FAIRnet)
WP12 Task 1: Frontend, DAQ and Online



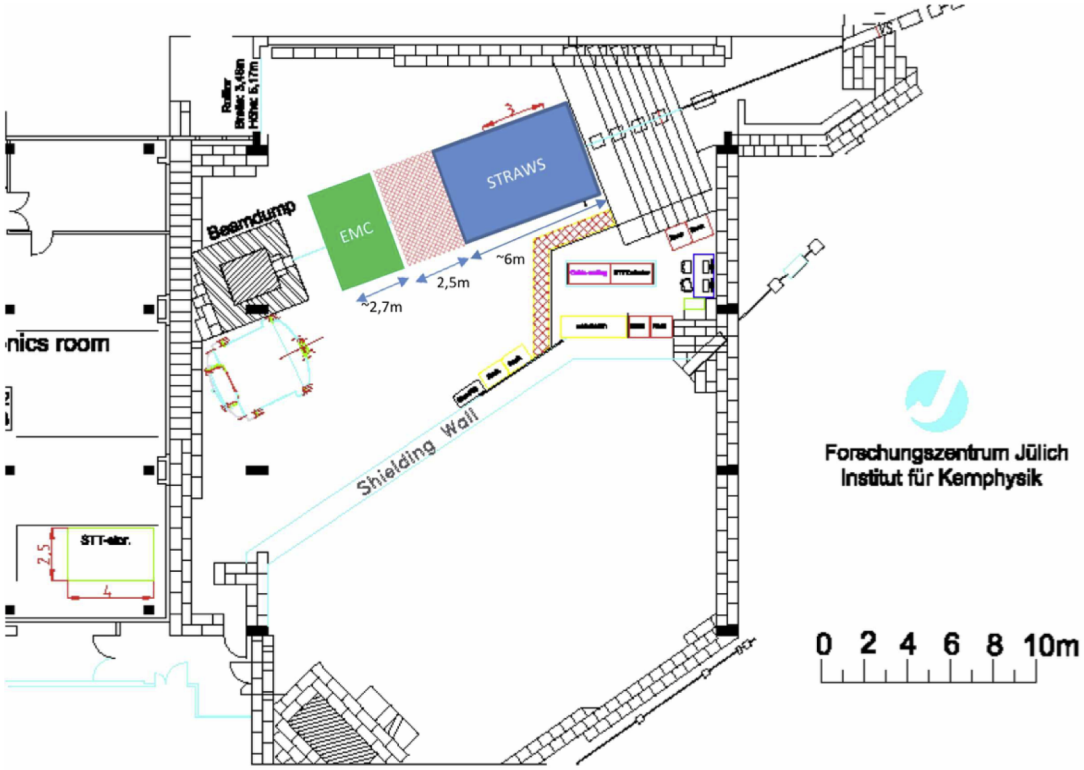
- Dead time free frontend electronics
  - Feature extraction on FPGAs
- Data switching network
  - FPGA based concentrator boards
  - Time distribution system with sub ns precision
- Data reduction and first level event selection
  - Compute nodes
  - Multicore CPUs
  - Vector processing units
  - Develop common tools

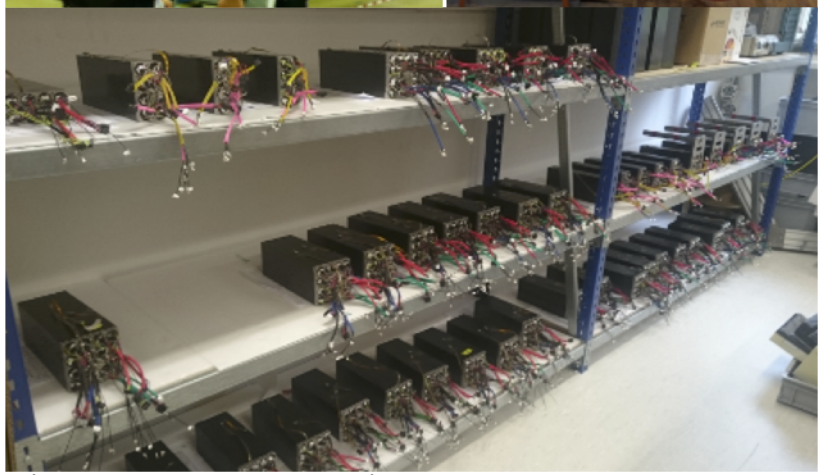
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824093.

NA1 - QCD Physics at GSI/FAIR (FAIRnet)

WP12 Task 2: Demonstrator

- Setup verification & test environment
  - Demonstrator at FZ Jülich (TA1)

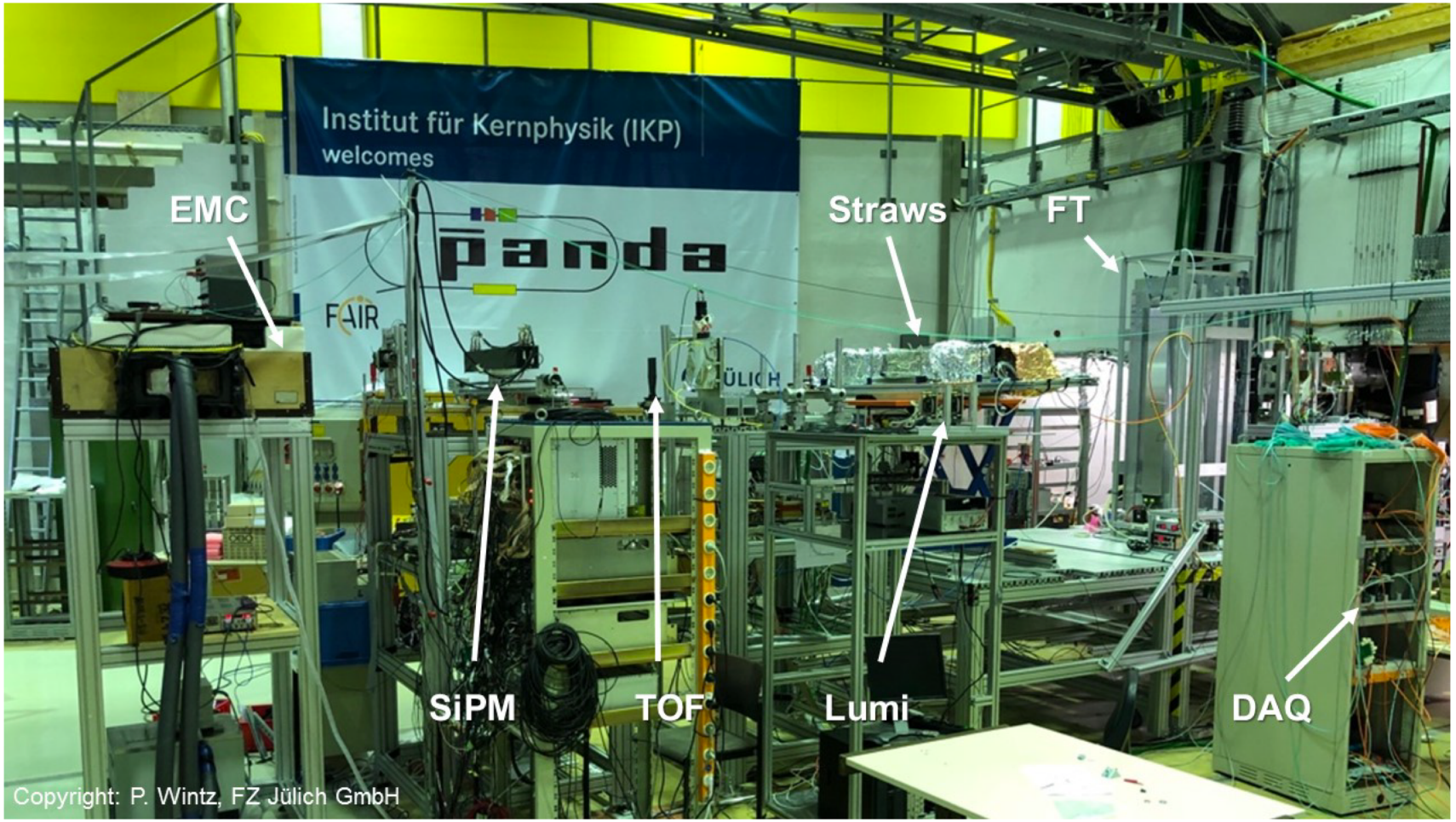




This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824093.

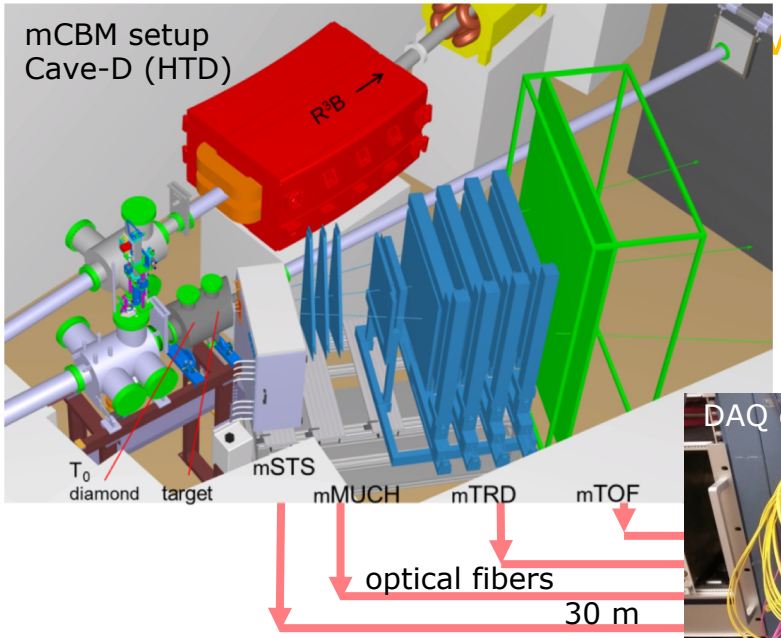
NA1 - QCD Physics at GSI/FAIR (FAIRnet)

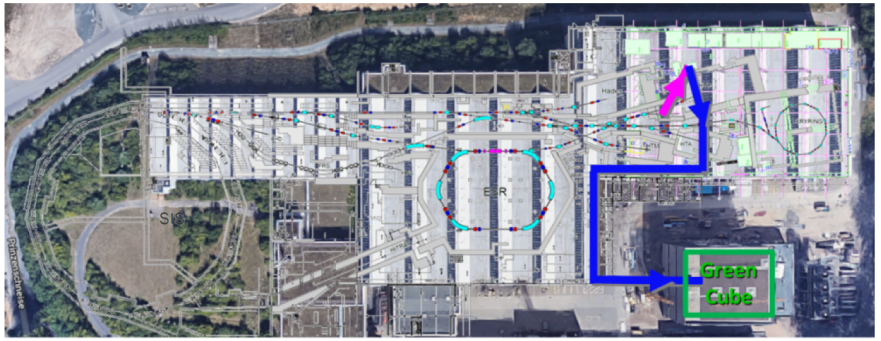
WP12 Task 2: Demonstrator FZJ

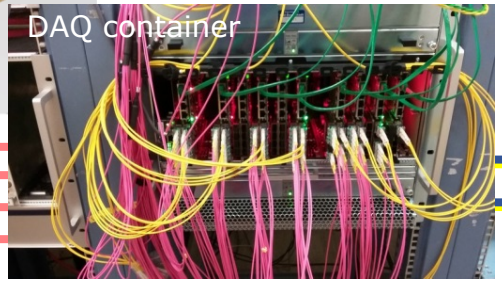


This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824093.

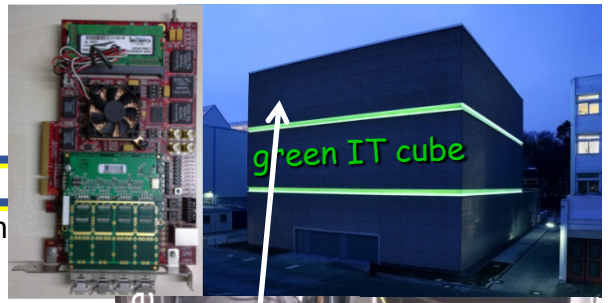
NA1 - QCD Physics at GSI/FAIR (FAIRnet)
WP12 Task 2: Demonstrator GSI (TA5)







optical fibers
300 m



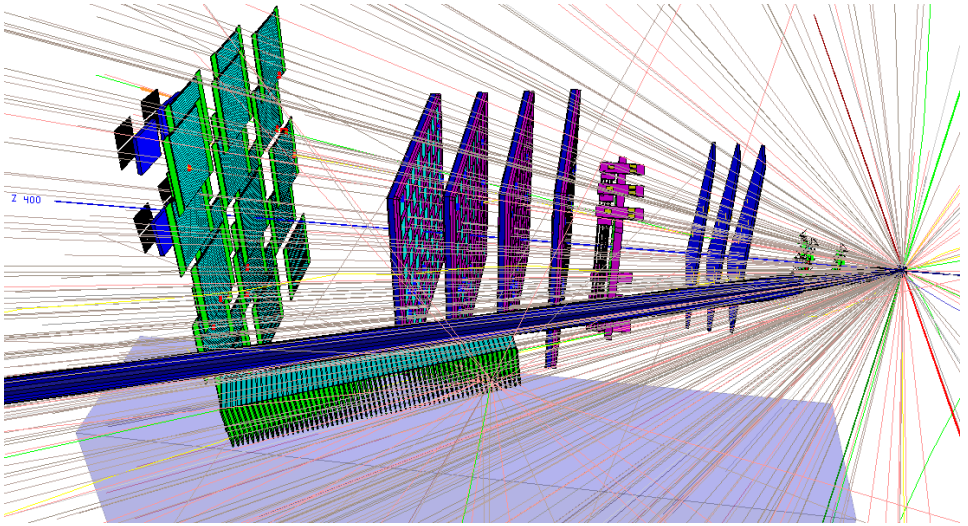
mCBM@SIS18

A CBM full system test-setup
for high-rate nucleus-nucleus collisions at GSI/FAIR

This project has received funding from the European Union's Horizon 2020 research and innovation programme

NA1 - QCD Physics at GSI/FAIR (FAIRnet)
WP12 Task 3: Data Analysis Challenge

- Sophisticated physics analysis methods
  - Partial wave analysis (PWA) tools
  - Multi-particle correlations
- Develop standards and general framework
  - Common software library
  - FairRoot software framework
  - Distributed computing

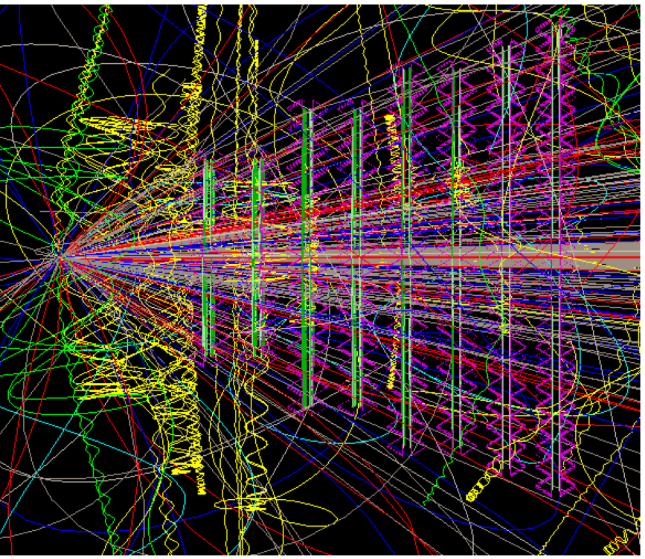


This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824093.

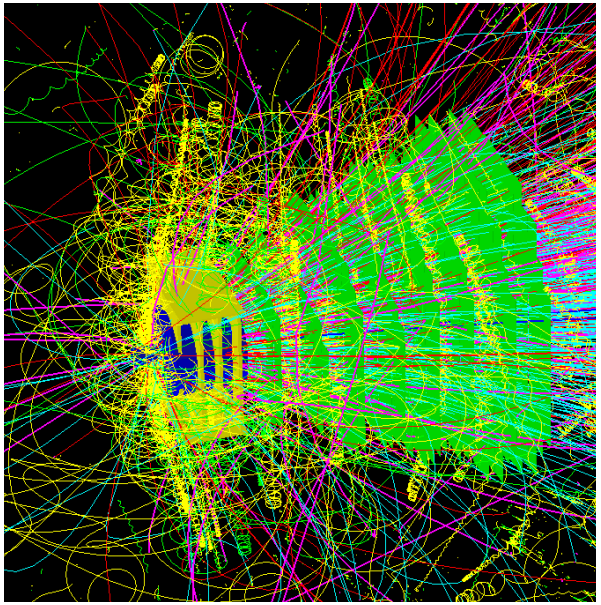
NA1 - QCD Physics at GSI/FAIR (FAIRnet)
WP12 Task 3: Data Analysis Challenge

4D track and event reconstruction

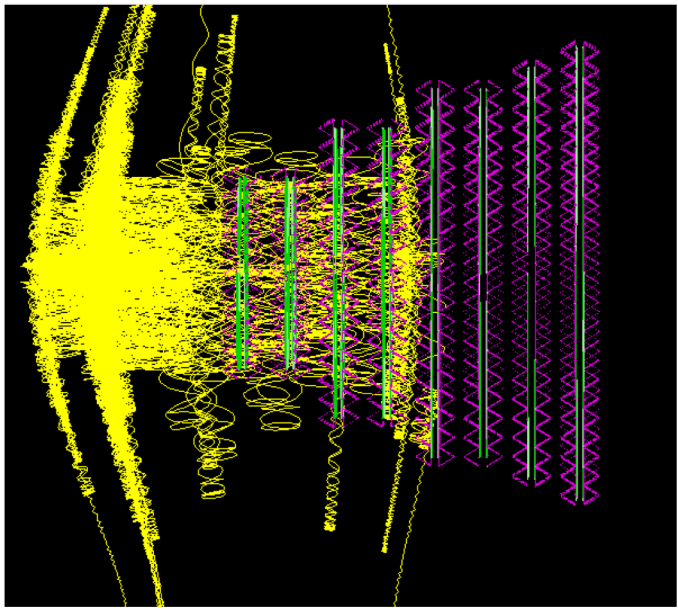
Au+Au 8 A GeV
peripheral collision
UrQMD + GEANT3



Au+Au 8 A GeV
central collision
UrQMD + GEANT3



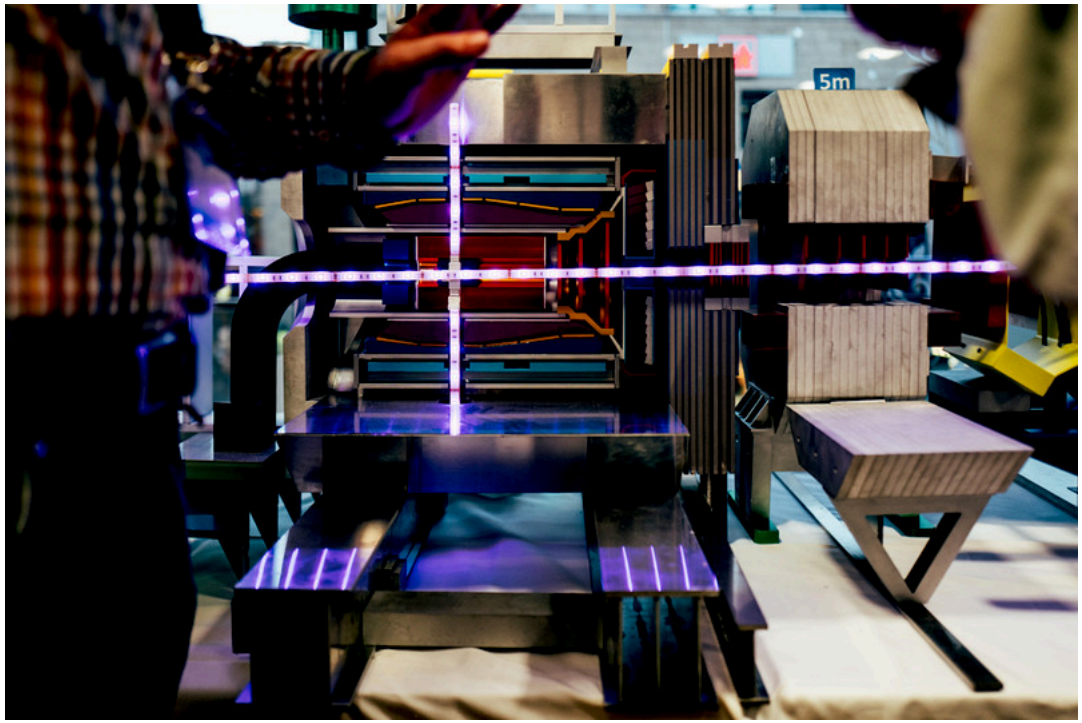
Au beam 8 A GeV
one single ion
passing the target
FairIon + GEANT3



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824093.

NA1 - QCD Physics at GSI/FAIR (FAIRnet)
WP12 Task 4: Education and Outreach

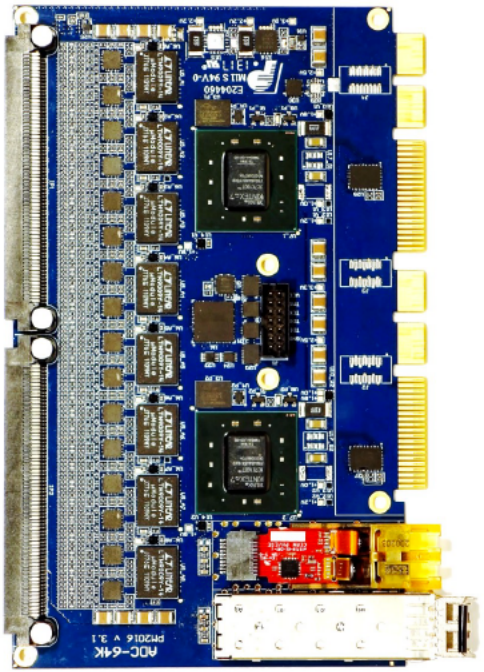
- Communication and education
  - Schools for PhDs and young researchers
  - Exchange of people between institutes in different countries
  - Workshops
- Outreach activities
  - Public talks and presentations
  - High school students at university labs



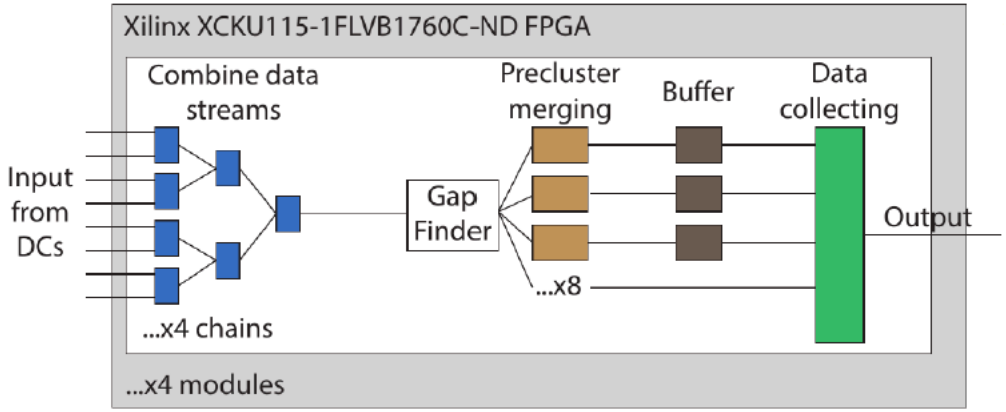
© RUB, Kramer

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824093.

NA1 FAIRnet: Update on Progress
Task 1: Frontend, DAQ and Online



Electromagnetic calorimeter clustering

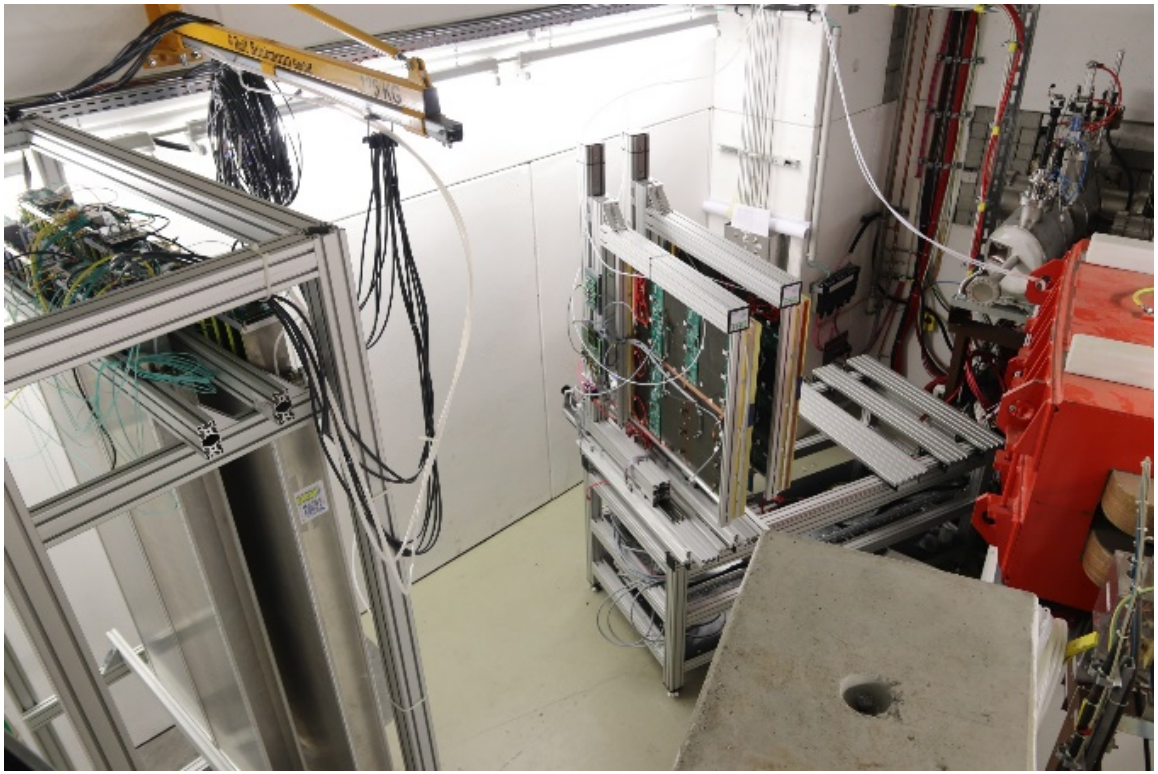


- PANDA DAQ technical design report close to final version

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824093.

NA1 FAIRnet: Update on Progress
Task 2: Demonstrator

mCBM installed and operational at GSI cave



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824093.

NA1 FAIRnet: Update on Progress

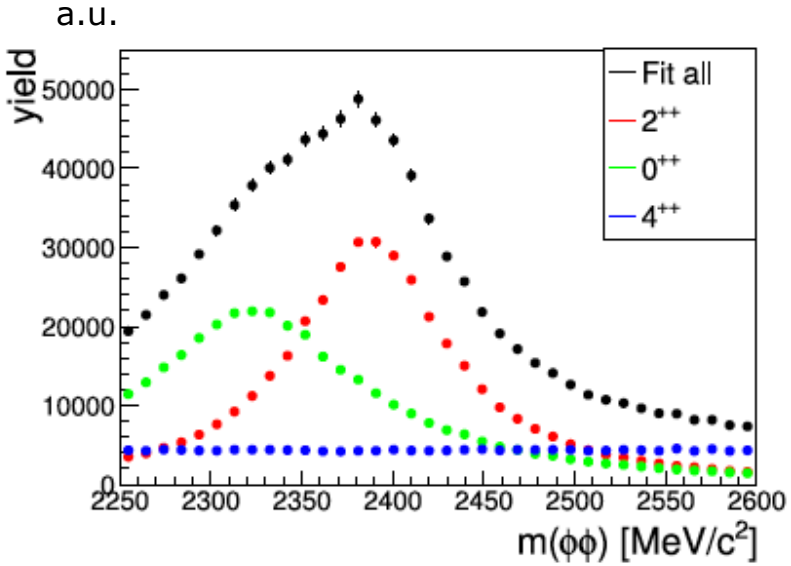
Task 3: Data Analysis Challenge

Simulation study for $\bar{P}ANDA$:

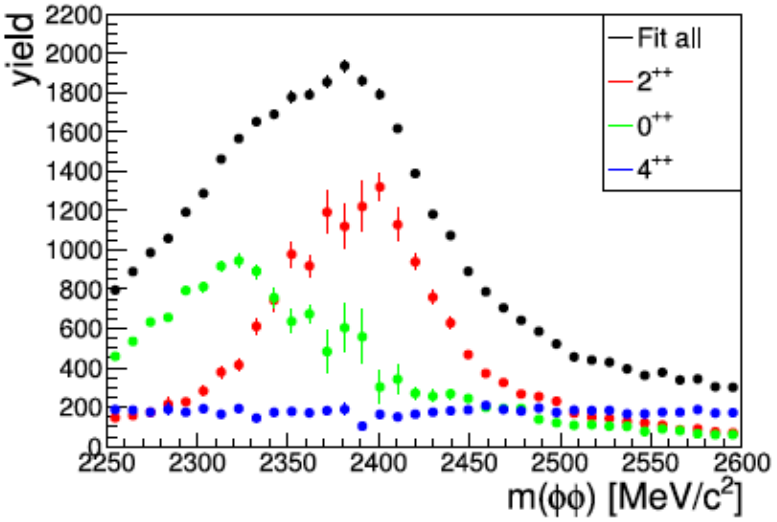
Partial Wave Analysis $p\bar{p} \rightarrow \phi\phi$

2^{++} glueball scenario with overlapping resonances

Generated contributions



Extracted contributions



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824093.

NA1 FAIRnet: Update on Progress

Task 4: Education and outreach

Public presentation of FAIR and PANDA for one week in September at “Highlights der Physik” Bonn, Germany

C. Schmidt, U. Bonn

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 824093.

NA1 FAIRnet: Milestones

- MS10 has to be achieved in M18

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS10	Repository of soft¬ware components and analysis tools	11 - RUB	18	Software released

- Well progressing
- Expected delivery date: November 2020

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 824093.