JINR and GSI / FAIR

NICA Days, WUT Warsaw, October 2019
GSI/FAIR-JINR cooperation

- Since 1980: Experimental collaboration in radiobiology and superheavy elements.
- Since 2000: Participation of JINR groups in the development of FAIR accelerators and experiments.

Quadrupole Magnets for SIS100

Test facility for superconducting magnets at JINR

Joint development of Silicon tracking detectors
- Reference laboratory for nuclear physics in Europe, one of the top heavy-ion accelerator facilities in the world
GSI Discoveries

- New chemical elements
- Hundreds of new isotopes
- New decay modes
GSI Discoveries

- Innovation in cancer therapy
FAIR: Facility for Antiproton and Ion Research – A World-Wide Unique Accelerator Facility

- ESFRI Landmark
- Top priority for European Nuclear Physics Community
- Driver for Innovation in Science and Technology
- 9 international FAIR Shareholders
- 1 Associated Partner (United Kingdom)
- 1 Aspirant Partner Czech Republic (Since 2018)
- Participation of 3,000 scientists from all continents
Status of FAIR Project: Civil Construction
Progress since official start on 4th of July 2017

before July 2017

July 4th 2017

August 2019
Status of FAIR: Accelerators: construction / procurement progress

~ 60 sc dipole SIS100 modules manufactured at BNG and 55 shipped to GSI and tested

SIS100 quadrupole units shipped from JINR to BNG for integration into FOS module

All 51 HEBT vacuum chambers of batch 1 delivered (BINP, Russia)

The series production of RF – debunchers

All HESR Dipoles are produced, in Jülich and 65% are delivered to FAIR

Delivery of 1st 6 series Power Converter from India, (ECIL, India)
The FAIR science: four pillars

atomic physics, biophysics, plasma physics, material research

APP A

nuclear- and quark-matter

CBM

nuclear structure and nuclear astrophysics

NuSTAR

hadron structure and dynamics

PANDA
Schedule for FAIR Science

- Working towards the completion of FAIR by 2025
- Major thrust is on construction of FAIR accelerators and experiments.
- At the same time *staged approach to FAIR science and progressive commissioning of accelerators and detectors*:
  - **FAIR phase 0**: start in 2018/2019
  - FAIR day 1 configurations/phase 1 experiments with FAIR accelerators progressively approaching design parameters → 2024/25 ...
  - Full FAIR operation 2025+
Russian partner institutes at FAIR leading players, with JINR in the frontline!
Collector ring being constructed at BINP

- 90% of CR specifications has been released
- The series production of RF – debunchers is ongoing
- CR Rest Contract with BINP (Russia) has been signed in June 2018
- Power amplifier prototype for Stochastic Cooling system has been produced and SAT successfully tested

FoS RF-debuncher

CR dipole design
FAIR Accelerator – Commons …

• All 51 HEBT vacuum chambers of batch 1 delivered (BINP, Russia)
• 21 of 51 HEBT Dipoles from serial production delivered (Efremov)
First of Series of SIS100 Quadrupole Magnets successfully cold-tested at JINR...

SIS100 quadrupole unit mounted in the test cryostat (blue) at JINR, Dubna

Cold-Test Facility at JINR, Dubna
Co-Operation with JINR in Forefront Technologies

- Cutting edge development of sophisticated super-conducting magnet technologies
FAIR experiments: detector R&D and construction well on track ...
Design fixed for 4 supracond. magnets by IHEP Protvino
INR, Moscow: CBM PSD

CBM Calorimeter modules setup for usage at BM@N
PNPI, Gatchina: CBM MUCH and RICH

CAD design of RICH mirror mount

Prototype of RICH mirror mount
PNPI, Gatchina: HV distribution system NeuLAND

Control board (2 out of 2 produced)

HV power supply module (distribution board)
About 60 out of 120 delivered
PNPI, Gatchina: ACTAF2

ACTAF2 technical drawing
PNPI, Gatchina: Proton arm spectrometer

HV Test of straw tubes @ PNPI
Series production in progress
Carbon fibre alveoles for EMC by IHEP Protvino
BINP, Novosibirsk: PANDA Solenoid

Extrusion test for SC cable prototype

Yoke production:
2 of the fully completed octants
Six cables for 3 coils were manufactured in December 2018 by Bochvar Institute, Moscow.

Photo of the cross section of the superconducting cable

Machining of yoke will start in November 2019.
JINR, Dubna: CBM STS

150 m² clean rooms, Solid State Section

Jig for sensor bonding

Mounted bare-die ASICs
JINR FLNR, Dubna: CALIFA forward endcap crystals

CsI Crystals

First batch delivered in June 2019
NICA and CBM@FAIR

Common physics program
Production and investigation of nuclear matter with densities like in the core of neutron stars. Search for phase transitions and the QCD critical point

Complementary approach
NICA Collider: high collision energies
CBM experiment at FAIR: high interaction rates
Silicon tracking systems and high-speed readout electronics

Silicon tracker for NICA

Prototype detector modules with micro-cables and readout electronics

Detector assembly in clean rooms at GSI and JINR

Joint detector workshop at JINR
EU project CREMLINplus

Science Cooperation between European Research Infrastructures and the Russian megascience projects (NICA, PIK, USSR, SCT and EXCELS)

Proposal (under evaluation): 4-year-project – starting end 2019, Total Budget: 25 M€

Consortium: 35 participants from 12 countries - 25 European laboratories 10 Russian laboratories
10 working packages (WPs), GSI/FAIR involvement in WP2 and WP7

WP2: Collaboration with NICA - Development of instrumentation for NICA and FAIR/CBM
Engineering and construction of fast detectors,
Development of high rate data acquisition chain and software packages for simulation and data analysis
Budget 4.61 M€
Participants: JINR (9 FTE), FAIR (8.5 FTE), U Tübingen (1 FTE), WUT Warsaw (2 FTE), Wigner Budapest (2 FTE), MEPhI (4 FTE), INR Moscow (1 FTE), NPI Prague (2 FTE)

WP7: Joint development of detector technologies
Develop a beyond state of the art CMOS pixel sensors (MAPS) for high-rate Silicon trackers for several particle physics and heavy-ion research communities in Europe and Russia for the potential upgrade of many experimental setups
Development of neutron detectors, detector school at BINP
Budget 1.8 M€
Participants: JINR (1 FTE), FAIR (1 FTE), DESY (1 FTE), U Frankfurt (1 FTE), IPHC Strasbourg (1 FTE), KINR Kiev (1 FTE), ESS (1FTE), PNPI (1 FTE), BINP
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German Russian scientific cooperation agreement (Roadmap)
Intended Workpackages for NICA

Implementation of the German-Russian 10 year roadmap with respect to NICA
German Contributions to JINR in the pillar I –
Cooperation in the area of large research infrastructure development

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Looking forward to many more years of intense cooperation between FAIR and JINR!
Accelerator and Experimental Facilities available for FAIR phase-0
First beam on miniCBM@SIS18

A glimpse of actual beam-ready miniCBM setup which received beam on target.

Data from individual read-out chains of the subsystems mSTS, mMUCH and mTOF is possible.

**mCBM@SIS18**

A CBM full system test-setup for high-rate nucleus-nucleus collisions at GSI/FAIR
- CBM prototype detector systems
- free streaming read-out and data transport to the mFLES
- up to 10 MHz collision rate
- first commissioning beam in December 2018