

Status and perspectives at FAIR

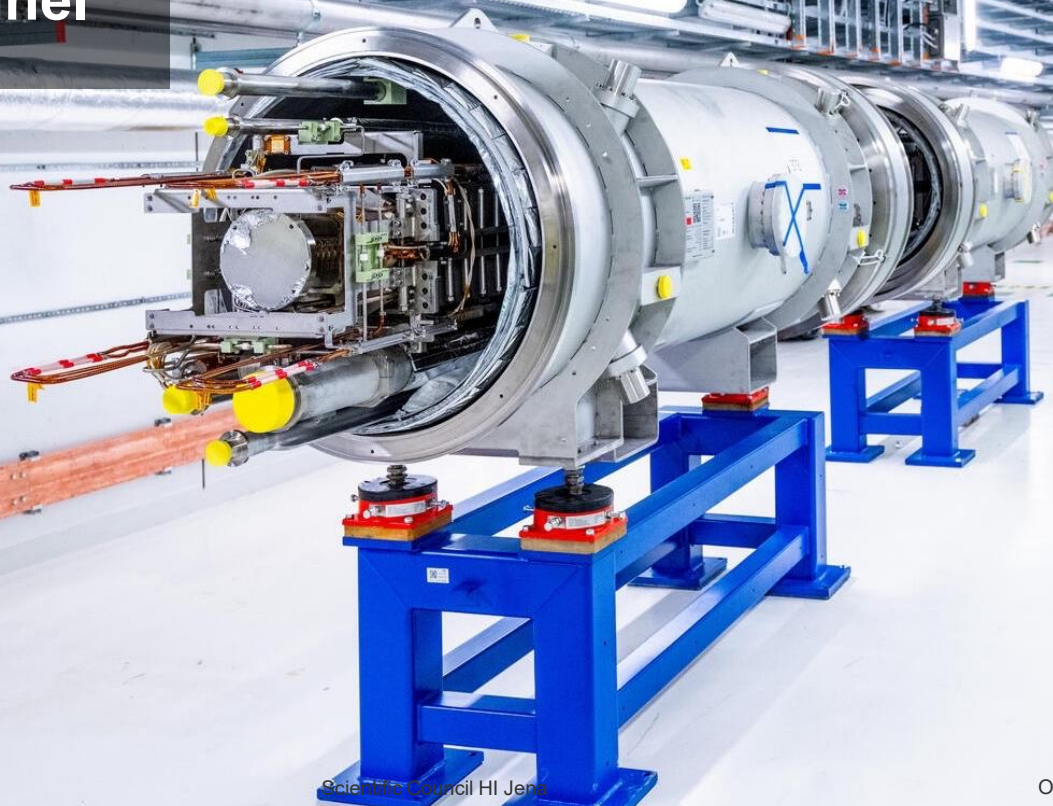
Jena Scientific Council
Yvonne Leifels (GSI/FAIR)

FAIR Project Progress – Civil Construction

- Central Transfer building



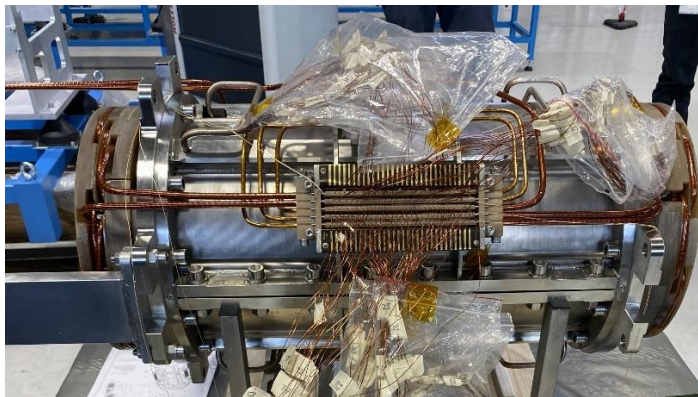
SIS100 tunnel



SIS100 installations



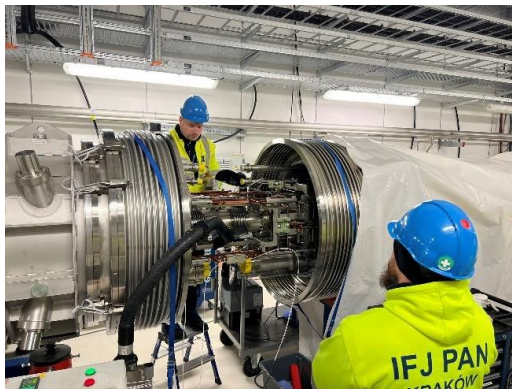
BNET36 industry prototype
quadrupole unit



SIS100 prototype multipole magnet



SIS100 - cavities



IFJ PAN brazes the
busbars to the
SIS100 module
interconnections



Feedline Box at
Kriosystem in
Breslau

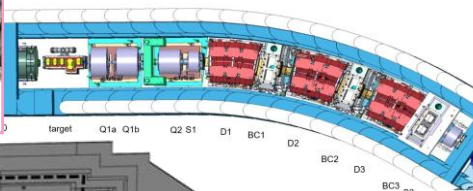
Super-FRS SC Magnet



Super-FRS

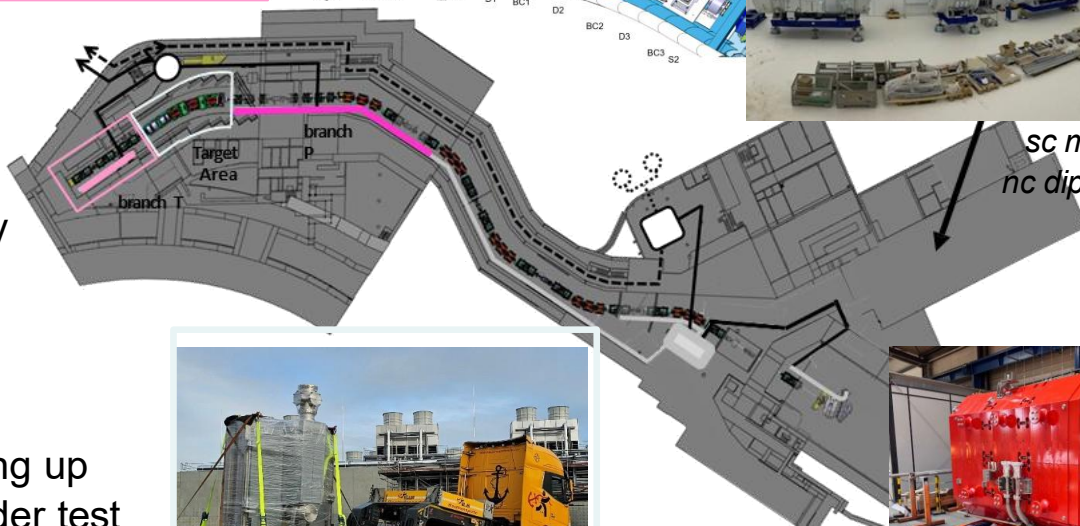
Pre-Target-Area

Installation completed for magnets and cryogenics, insulation vacuum tested



Target Area

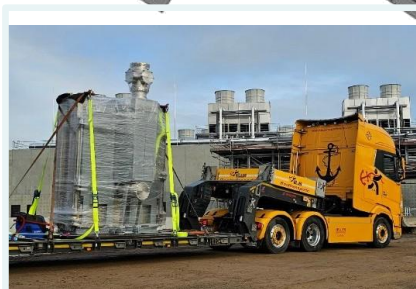
All components produced, mostly delivered. Pre-assembly ongoing, installation starting



sc multiplane and nc dipoles at FAIR

After Target Area

- all sc multiplane produced
- sc dipoles production ramping up
- branch-P delivered, FoS under test
- all D, Q power converters delivered
- all focal-plane chambers produced



target chamber transported to tunnel



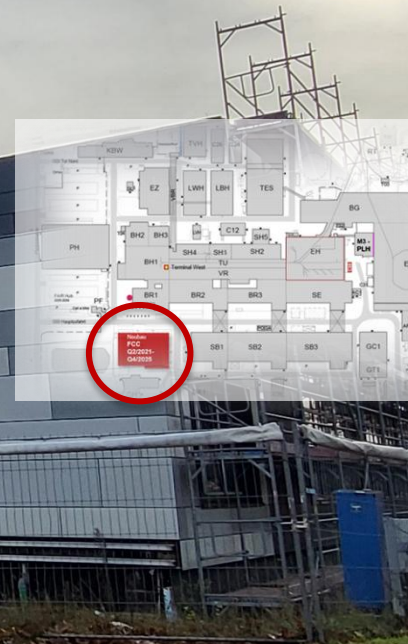
nc dipole

Commissioning Cryoplant

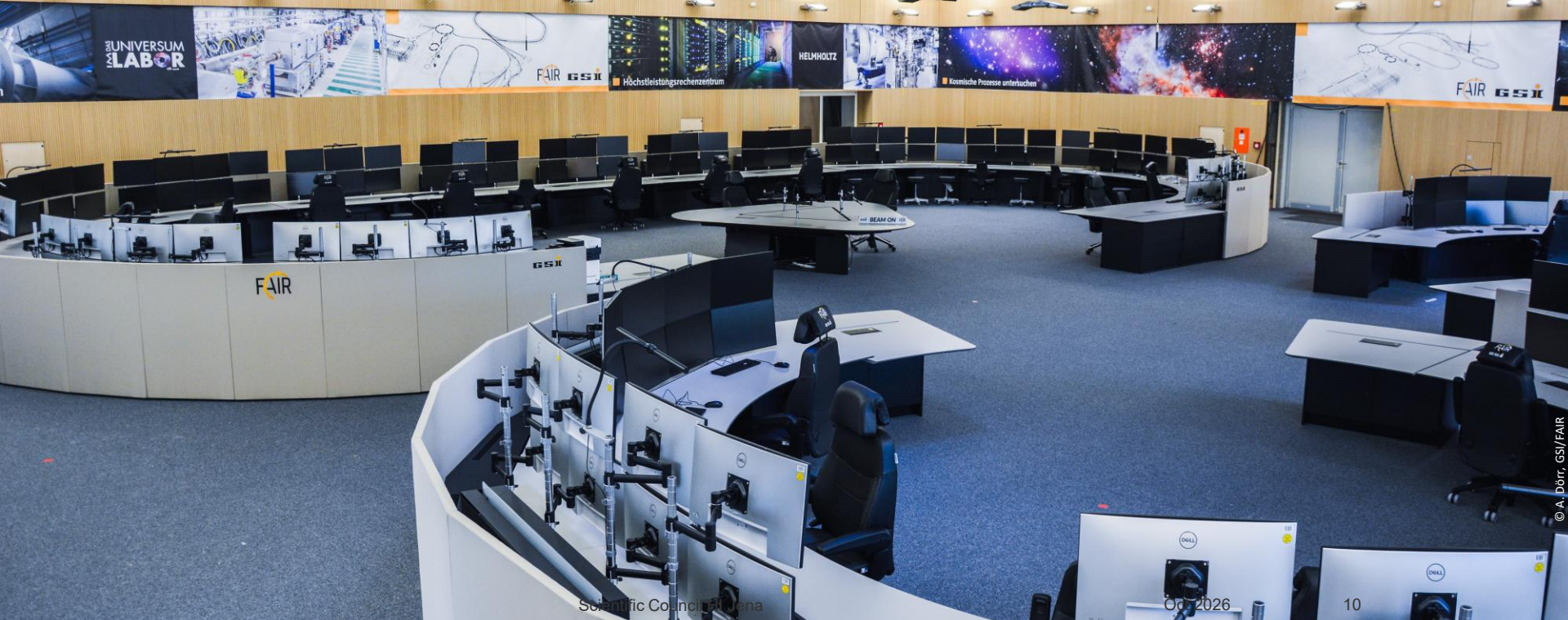


Das neue FAIR Control Center (FCC)

- Hauptkontrollraum GSI- und FAIR-Beschleuniger
- 5 Ebenen
- 206 Büroarbeitsplätze
- Konferenzräume



Inside the FAIR Control Center (FCC)



CBM – Compressed Baryonic Matter Latest Developments

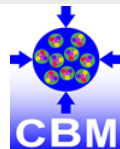


**TGA for CBM cave approved by
FAIR Council in a meeting, August 31st**

Major Experiment Highlights

■ CBM

- Technical Building Infrastructure for CBM approved
- STS: all modules assembled, first half-unit assembly
- Magnet: FAT of the power supply
- New CBM physics performance paper:
<https://arxiv.org/pdf/2606.16395>



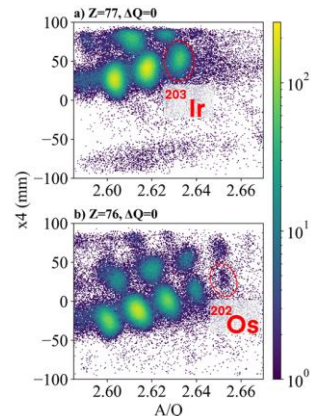
■ APPA

- Artemis-II Moon mission used a camera that had previously been tested at GSI Cave A by the BIO group
- BIOMAT setups at the SFRS (ES/FS) and in the CBM cave (FS+) have been approved by the FAIR Council



■ NUSTAR

- Start of experiment infrastructure installation (e.g. vertical storage system in HEC)
- Results of investigations on structure of semi-magic ^{203}Ir and ^{202}Os nuclei using DEGAS array published (G. Bertram et. al., Phys. Lett. B 2026)



■ PANDA

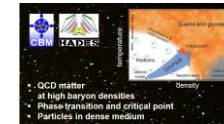
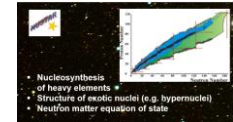
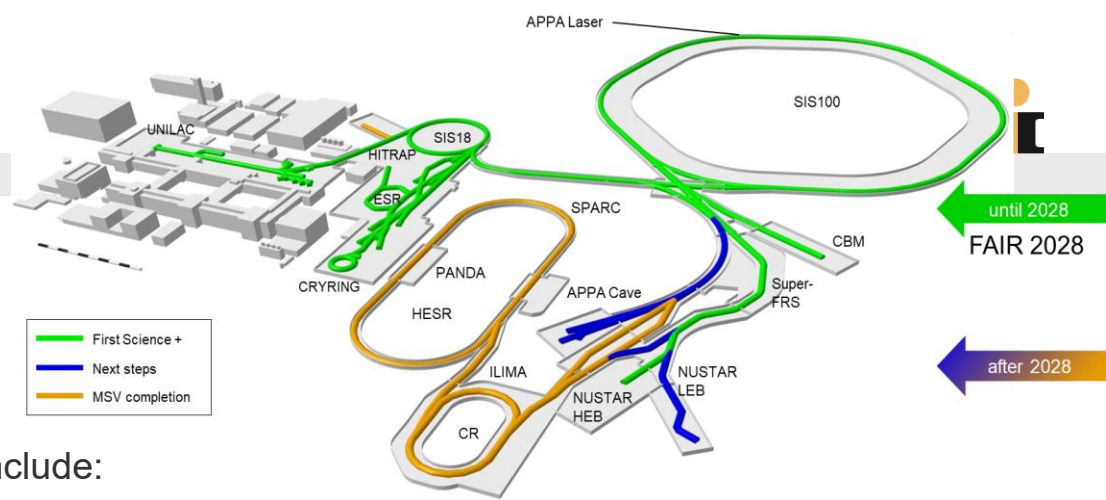
- Preparations: INSIGHT at ELSA and KOALA at GSI



Scientific goal: FAIR 2028

FAIR in 2028 will feature the most valuable science program which can be hosted in the FS(+) infrastructure.

- The "FAIR 2028" science program will include:
 - APPA experiments *at the low-energy rings, at SIS100*, at the *caves at SIS18 and UNILAC* with and at *PHELIX* and a limited set of experiments which could be hosted at all the *caves served by SIS100*
 - NUSTAR at the *Super FRS with SIS100 beams*, plus *SHE experiments at UNILAC* and *ILIMA at the low-energy rings*
 - CBM at the *new cave with SIS100 beams*, and *HADES at SIS18*
 - PANDA is developing a hadron physics program to be carried as bridge towards the program with antiprotons, when possible *using the caves and beams available at GSI/FAIR* and synergies with other experiments.



Incident on the GSI Campus

0

Injuries to persons

No

Hazardous substances
detected

200

Emergency personnel
deployed

~ 30 hrs

Total duration from ignition
to complete excitation

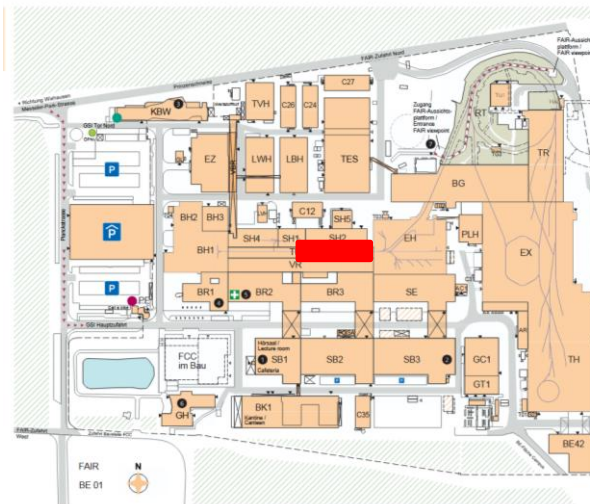


Date & Time

February 5, 2026;
~6:00 AM

Origin

Radiofrequency (RF) supply
area for the UNILAC linear
accelerator

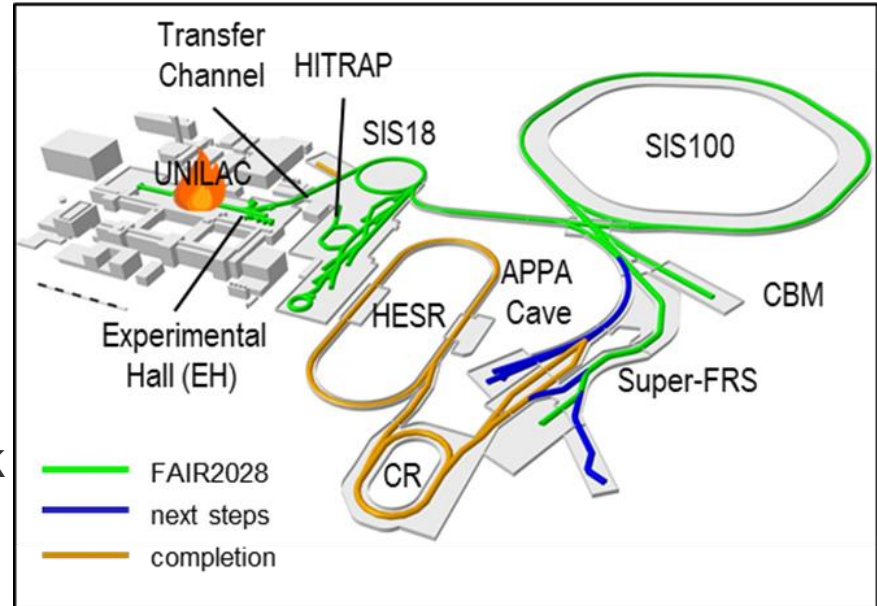


Affected systems:

- UNILAC HV supplies and controls
- HF gallery
- Connection building VR
- Laboratories and experimental setups in EH and SE

Consequences of the fire incident

- **UNILAC currently not operational**
- Many experimental and infrastructure areas at GSI **were not (directly) affected**, including:
 - **SIS18 synchrotron** and its associated **experimental facilities** (ESR, FRS, CRYRING, HITRAP, HADES, R3B...)
 - **PHELIX high-power laser** and the **GreenIT Cube**
 - The **FAIR construction site** was not affected.
- The overarching objective is to rapidly **commence solutions for the continuation of research** in close collaboration with the scientific community. Objectives:
 - **Beams for FAIR commissioning by Q4 2027**
 - **Intermediate injector for FAIR2028 by Q4 2028**
 - **Restoring UNILAC injector capability by 2030/2031**
- **Necessary funding secured by the BMFTR / HMWK**
- Funding for supporting phd and postdocs projects, which are affected by the fire provided by the HMWK



Interim solutions

(A) PARTIH – (B) InterLAC



To SIS-18 and FAIR

(A) PARTIH beam Q4 2027

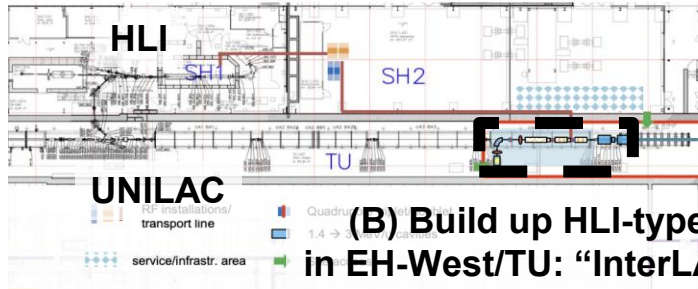
Relocation HiTRAP

15 meter device in TK

Beam for SIS-18 and FAIR

(A) HITRAP@TK
“PARTIH”

HITRAP



(B) Build up HLI-type
in EH-West/TU: “InterLAC”



The Path to FAIR Operation

From Commissioning to FAIR Science



	Current activities (2026)	Commissioning (2027 – 2028)	Intermediate Science (2028 - 2030/31)	Full Operation (2030/31 – 2032+)
Science & Milestones	• Cryo-plant & cooling start • FCC Main Control Room takeover	Hardware Commissioning ▪ Technical beam commissioning of HEBT and Super-FRS ▪ Detector Commissioning & Experiments R3B	FAIR Adapted Program ▪ NUSTAR @ Super-FRS SIS100 commissioning ▪ CBM & BIO (GCR)	Full Physics Program ▪ With HELIAC full GSI/FAIR capabilities ▪ Super-heavy elements & Materials Research
Beam Parameters		p to C low intensity, $1e7$-$e8$/spill up to 1.5 GeV/u	upto Xe medium intensity	p to U high intensity, short puls
Infrastructure & Injectors		PARTI HITRAP relocated to Transfer Channel (15 m device)	InterLAC Build-up HLI-type setup in EH-West / TU (~10m + ion source)	Full UNILAC Restoration (2030/31)

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Research perspectives: Stepwise Approach to FULL FAIR/GSI Science



 Physics-1 NUSTAR utilising S-FRS, Biophysics, Detector tests with beams up to C

 Physics-2 NUSTAR, APPA, HADES with beams up to Xe

 Physics-3 CBM, NUSTAR and APPA utilising SIS100

 Physics-4 heavy ion campaigns (Au-beams for CBM, U-beam for NUSTAR)

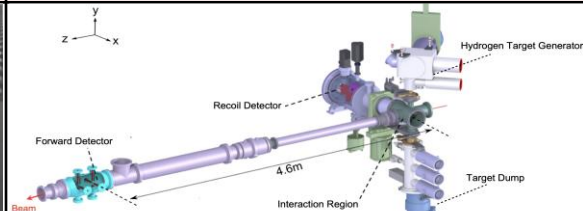
 Physics-5 restart of SHE and MAT with long-pulse operation

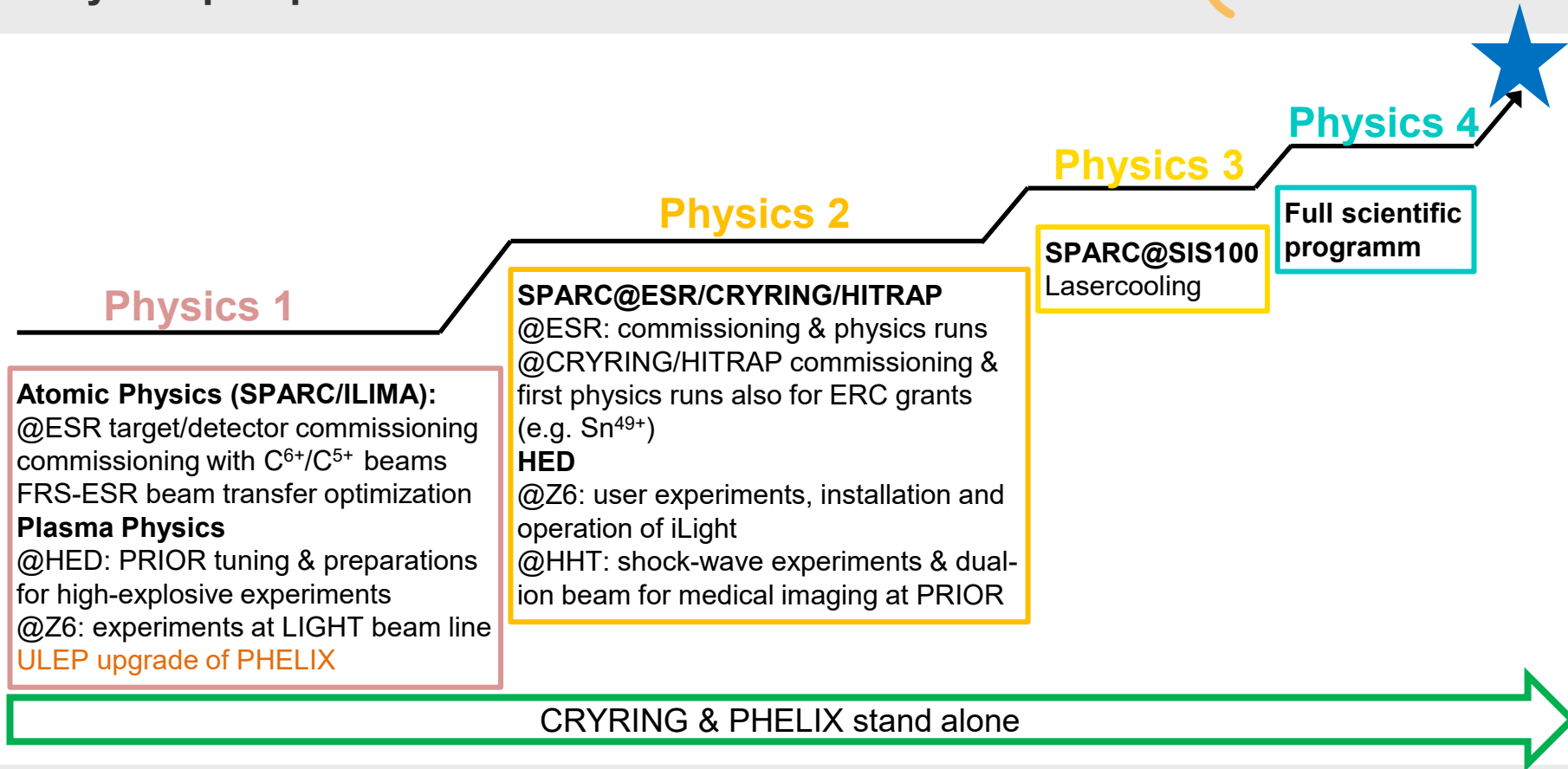
 Full FAIR

under discussion and evaluation

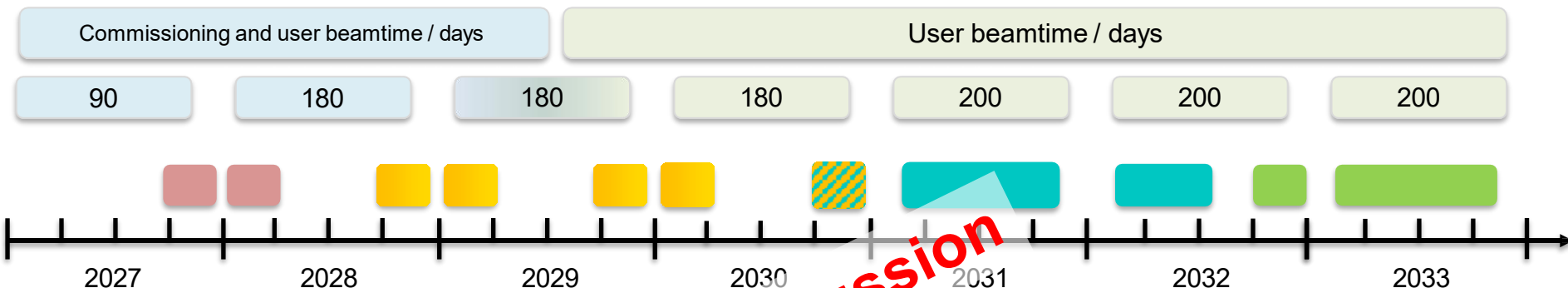


Physics-1 (light beams upto carbon)

APPA	PHELIX & CRYRING Operation	NUSTAR	CBM&HADES
Atomic Physics (SPARC/ILIMA): ESR target commissioning with C^{6+}/C^{5+} beams NECTAR-detector commissioning (ERC) FRS-ESR beam transfer optimization		R3B: Commissioning with p and ^{12}C	CBM@SIS18: Detector/system level tests in HTD cave
Biophysics Bio-PAC Bio-PAC (cancer therapy) experiments		Matter radius of hyperhalo candidate ^3H from interaction cross-sections	HADES@SIS18: d+ IH_2 (CH_2) Di-baryon Beam Energy Scan (BES) Bremsstrahlung (dilepton reference)
Materials Research (MAT) Commissioning of new components for High-Pressure Research platform in HTA		Other proposals suggested	Koala setup in Cave C Detector/system tests of gas jet targets
Plasma Physics (HED) PRIOR tuning and preparations for high-explosive experiments at HHT Experiments at the LIGHT beam line at Z6 ULEP upgrade of PHELIX			



Research perspectives: Expected Timeline



under discussion



HITRAP I PART I H

p – min. C beams, low intensity



InterLAC

p – min. C beams, medium intensity



UNILAC

p – U beams, high intensity (only short pulse operation)



UNILAC + HELIAC

full operation

Outlook & Perspectives



Summary and outlook

- CRYRING/HITRAP operational with local sources
 - allows for a limited scientific program
- PHELIX continues operation and the group will follow up the light project
 - option to inject laser accelerated protons into SIS18 under revision
- Intermediate solutions
 - important goal to start FAIR commissioning and operation
- PARTIH and InterLAC will sequentially expand the research program
 - heavier beams and higher intensities
- R3B will be the first experiment at FAIR
- Laser cooling@SPARC will start once SIS100 is in operation
- SPARC bridges the downtime with CRYRING experiments and later with beams from InterLAC
 - highly charged intermediate heavy ions
- HITRAP decelerator will be re-installed asap (new solid-state amplifiers)
- UNILAC completed 2030/31 enabling full science program

APPA cave at FAIR

