



NUSTAR Project Status

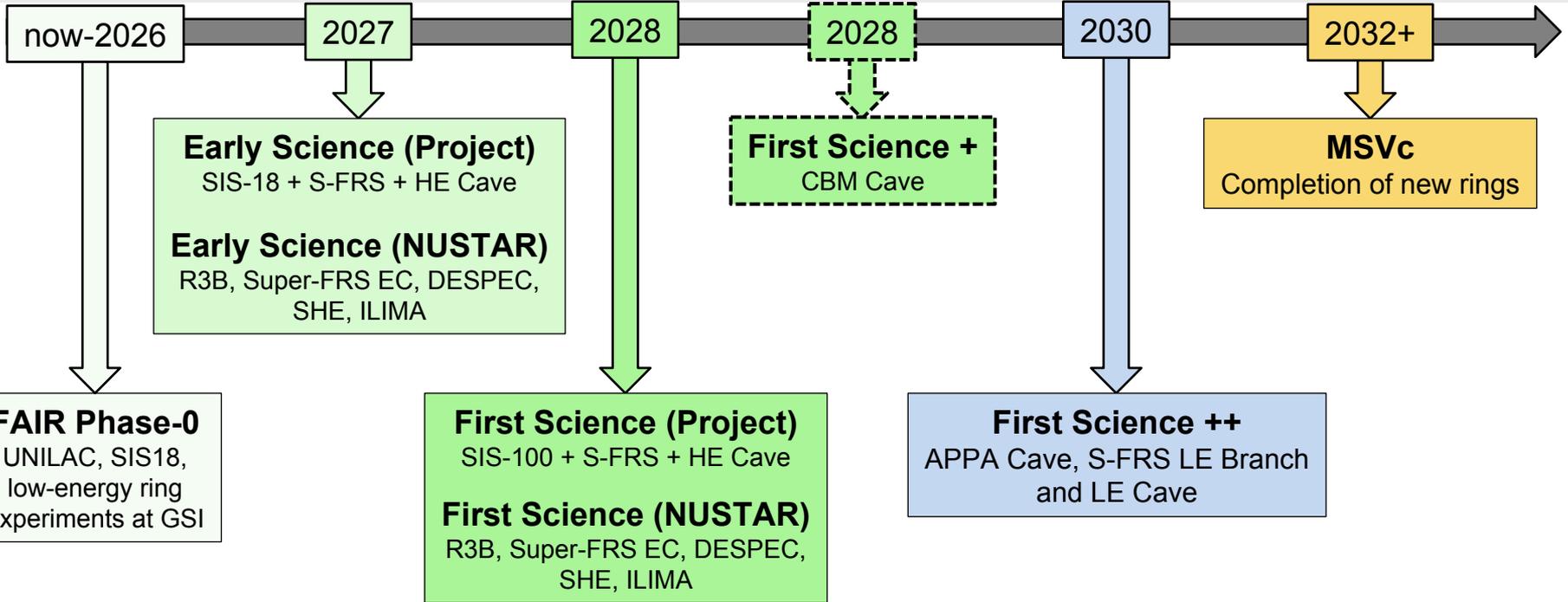
NUSTAR Week 2024, GSI Darmstadt

9th October 2024

H.M. Albers



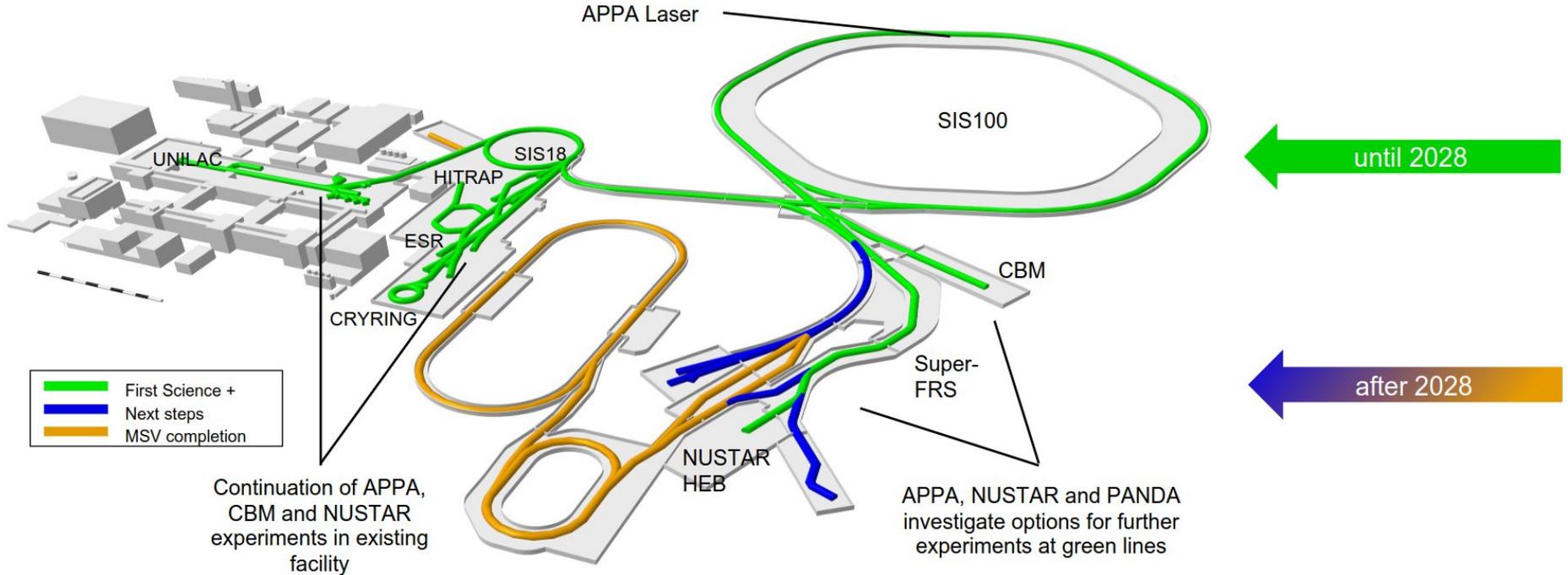
NUSTAR timeline: the 'simple' picture



Green: Budget available
Green: Budget decision expected soon
Blue: Civil construction complete
Orange: Significant additional investment required

– Timeline dependent on Council decisions and timely delivery of SIS100 quadrupoles
– Additional funding needed in 2026 for continuation of skilled workforce

FAIR in 2028

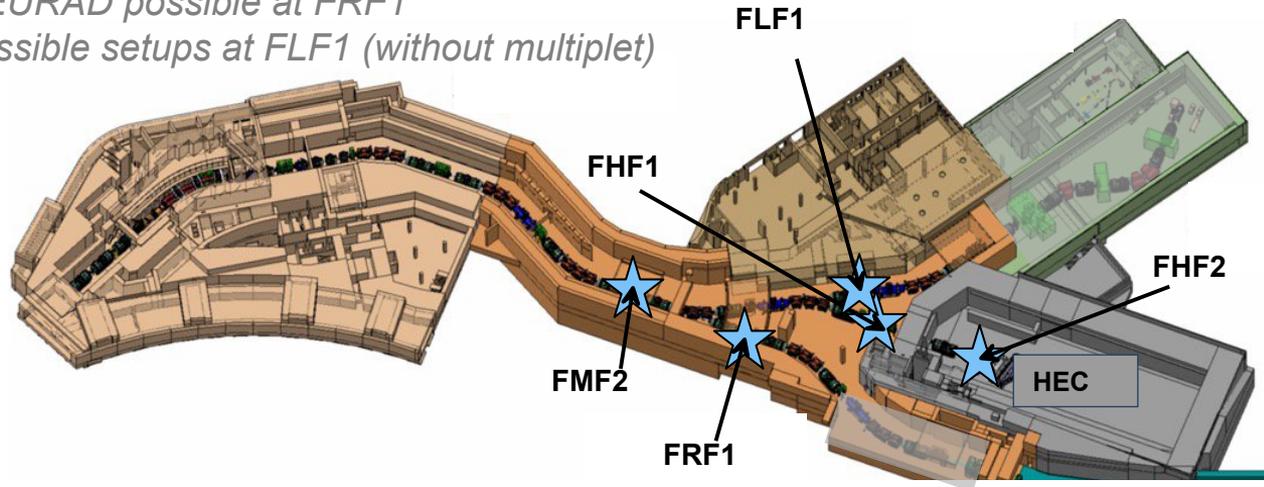


NUSTAR at the Super-FRS (**R³B**, **Super-FRS EC** and **DESPEC**) with SIS100 beams, plus **SHE** experiments at UNILAC and **ILIMA** at the low-energy rings

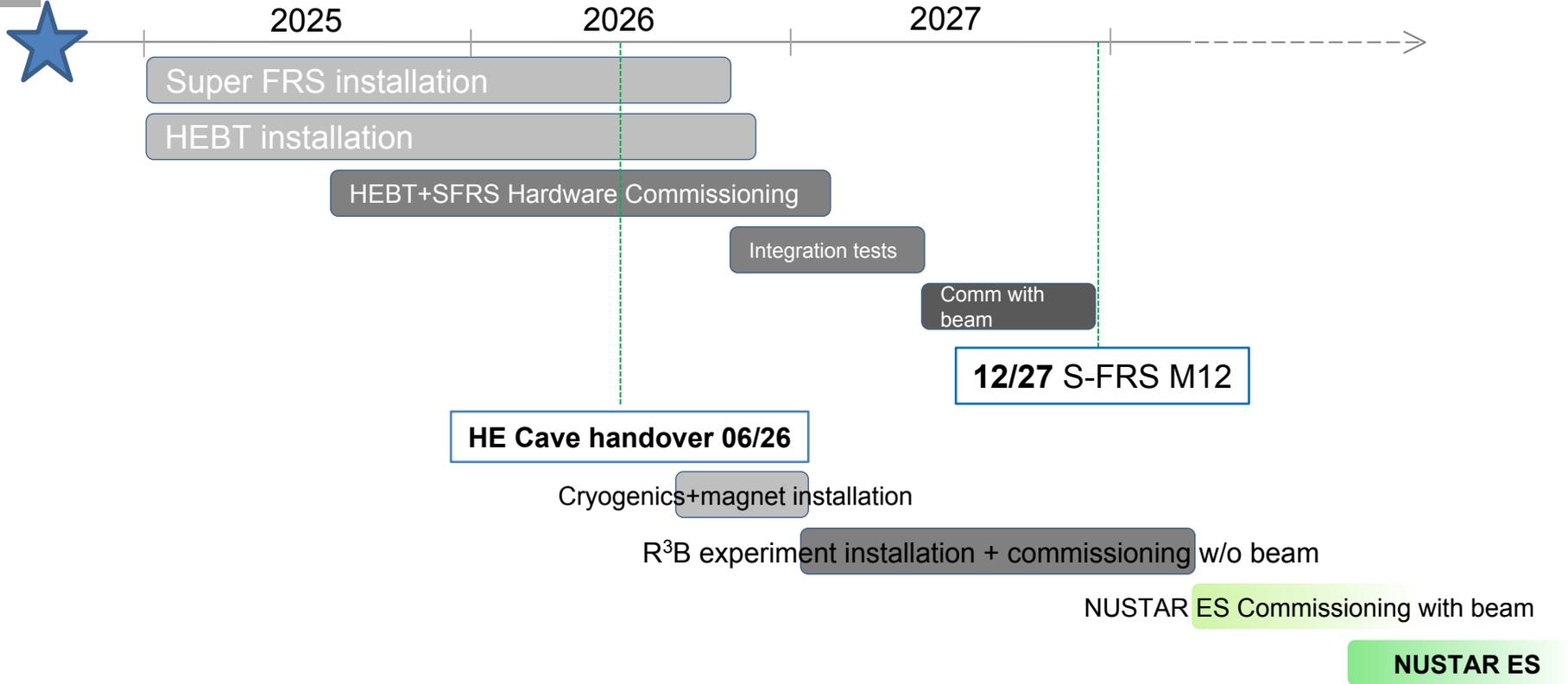
Overview of ES/FS at the S-FRS

Key focal planes of the S-FRS:

- **FMF2** mid-point of main separator
- **FHF1** (tunnel)
- and **FHF2** (HEC) along high-energy branch
- *Some basic infrastructure planned for LEC to supply HEC, but no full TBI/beamline*
- *No ring branch; possible BIOMAT setup at the beginning of the ring branch (See talk of R. Pleskac).*
- *EXPERT neutron detectors NEURAD possible at FRF1*
- *Ongoing discussions about possible setups at FLF1 (without multiplet)*

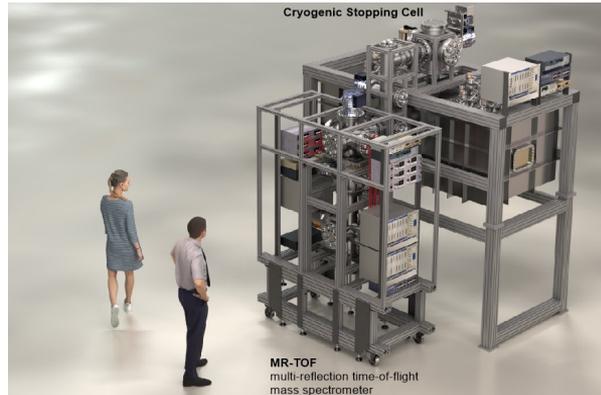
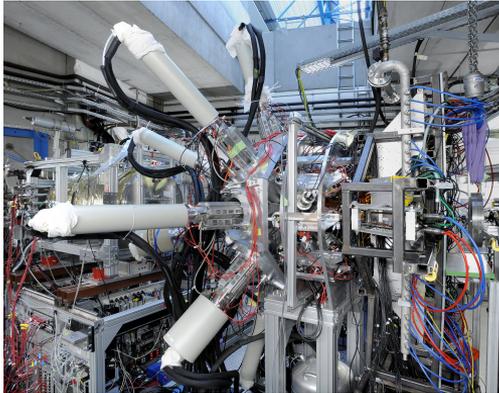


Installation and commissioning timeline

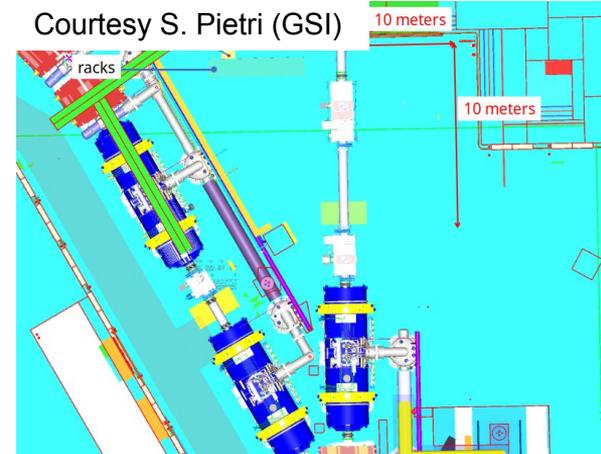


Status of NUSTAR Early Science Planning (1)

- **LCM (Lean Construction Management) Workshops for the High-Energy Cave** continue
 - more detailed breakdown of installation steps and parallelisation
- **NUSTAR+S-FRS+SiST Workshops** held in 2023 and 2024 on NUSTAR components to be installed at FHF1
 - Ion Catcher setup (Super-FRS Experiment Collaboration)
 - DESPEC setup (HISPEC/DESPEC Collaboration)

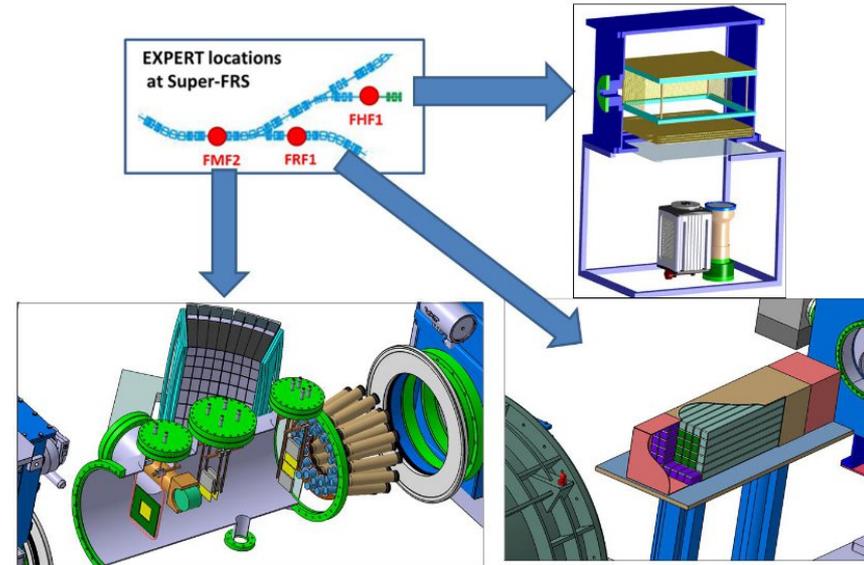


Courtesy S. Pietri (GSI)



Status of NUSTAR Early Science Planning (2)

- **Priority setups defined for FMF2 focal plane** (mid point of Super-FRS main separator)
 - EXPERT setup (Super-FRS Experiment Collaboration)
 - Ice Target and Tensor Force experiments (Super-FRS Experiment Collaboration)
- **Workshops for FMF2 setups** foreseen in 2025 to carry out detailed infrastructure checks
- Details of **commissioning requirements** for Early Science sub-collaborations under discussion
- Super-FRS (Pietri et al) to provide **LISE++ simulation file** for the Early Science focal planes for use by NUSTAR for experiment planning



Construction update – High Energy Cave



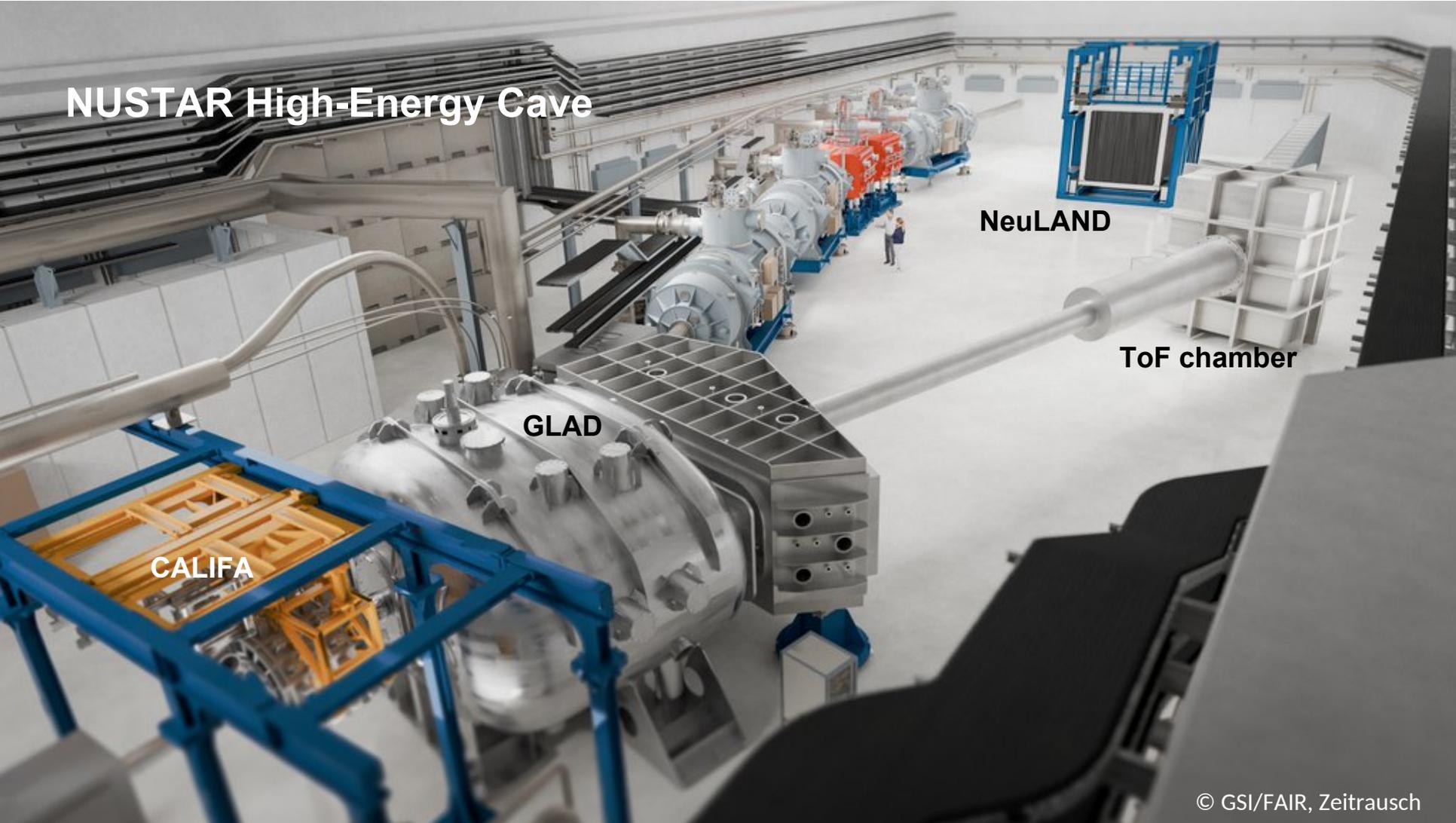
December 2022

NUSTAR High-Energy Cave



July 2024

NUSTAR High-Energy Cave



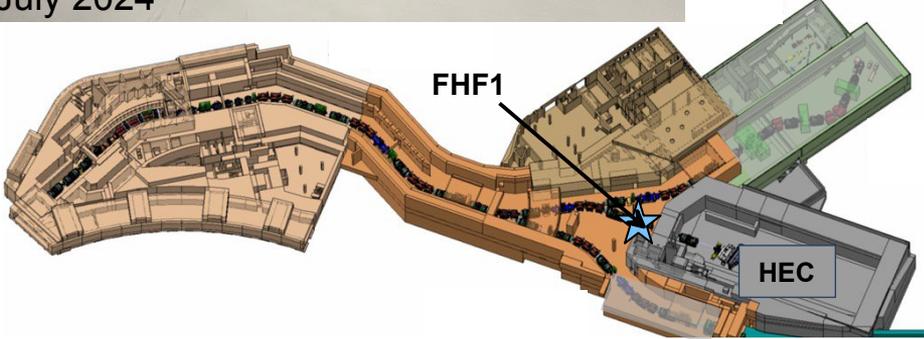
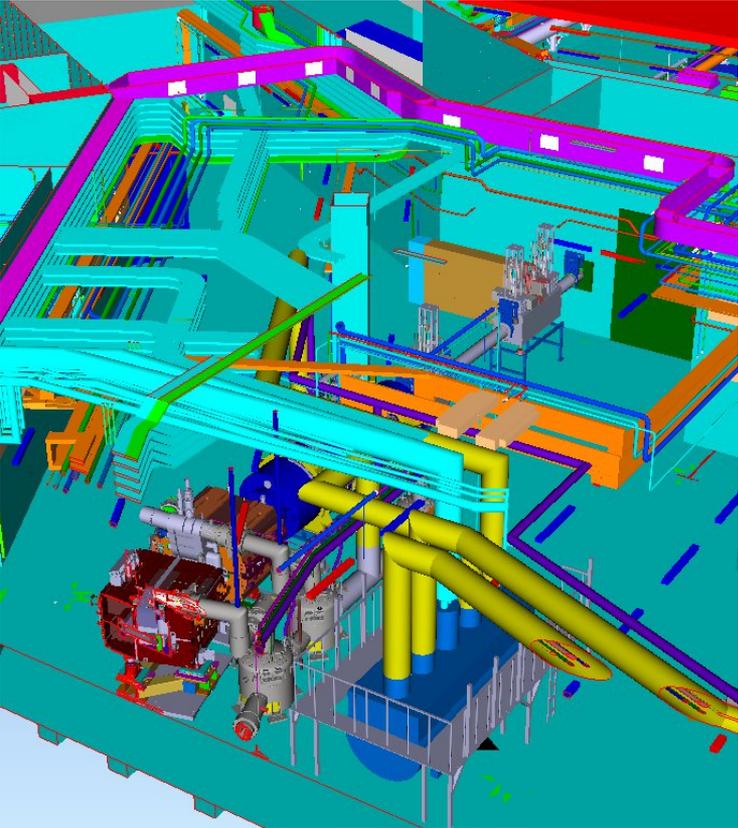
CALIFA

GLAD

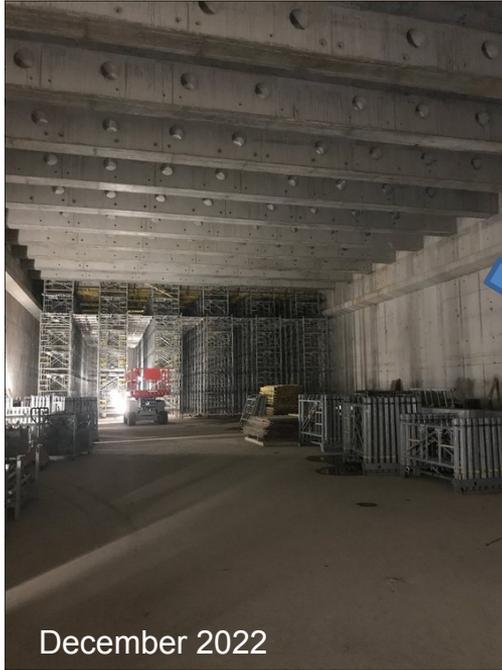
NeuLAND

ToF chamber

Construction update – FHF1



Construction update – Low-Energy Cave



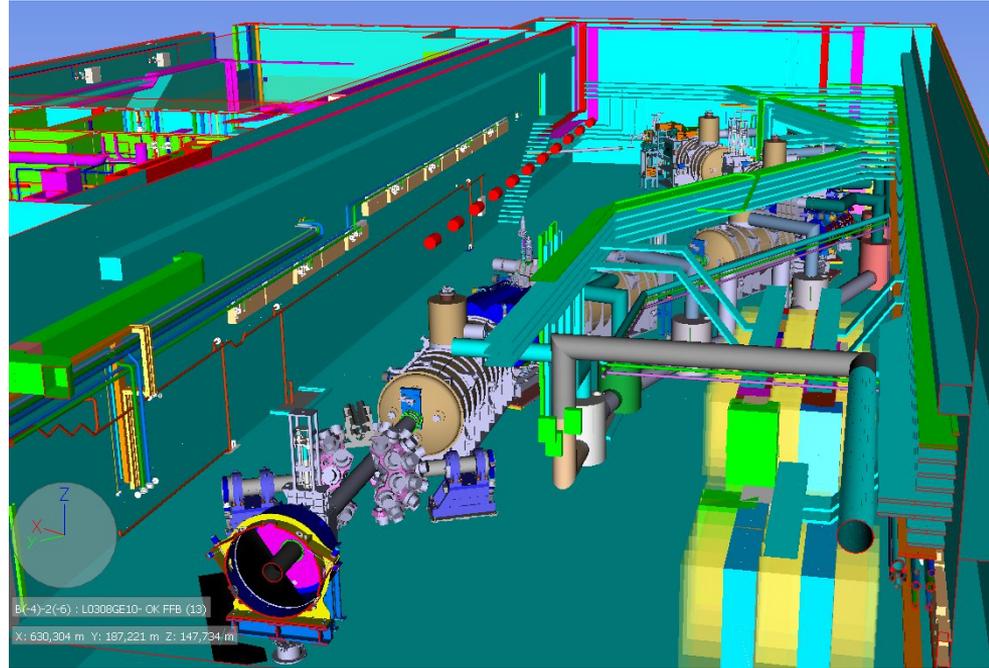
December 2022

NUSTAR Low-Energy Cave



July 2024

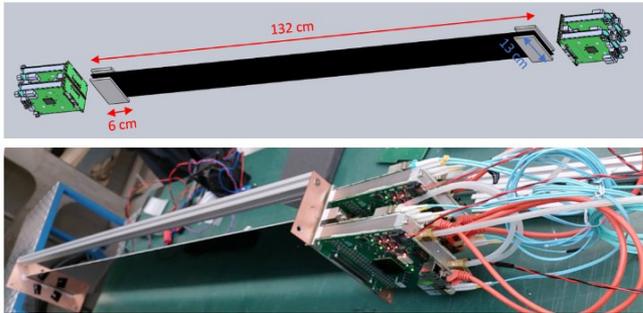
Low-Energy Cave visualisation



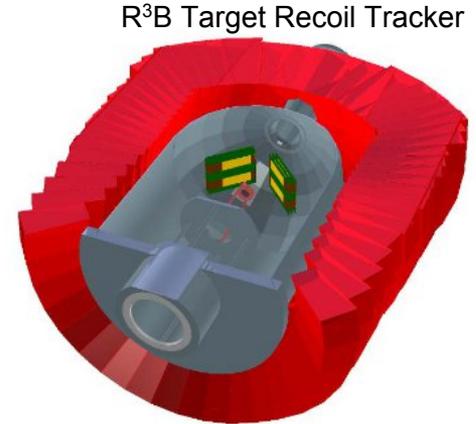
NUSTAR Low-Energy Cave

Status of Technical Design Reports (TDRs)

- R³B Target Recoil Tracker (TRT) TDR (former Si Tracker)
 - **approved in July 2024**
- Addendum to the R3B Tracking TDR
 - re-procurement of ex-Russian in-kind contribution
 - **TDR addendum approved in May 2024**



R³B Proton
Arm
Spectrometer
unit



R³B Target Recoil Tracker

Upcoming TDRs

- Super-FRS Experiment Collaboration Ice Target and Tensor Force
 - advanced draft available, expected to be submitted very soon
- gSPEC
 - work ongoing

NUSTAR TDR summary

28	approved
0	submitted
2	expected
7	beyond "Day one"

NUSTAR Score card



Status: September 2024

	NUSTAR sub-system	TDR	Cost [k€ 2005]	Funding	Construction	Date completion	Test/Commissioning
	Early and First Science (ES / FS)						
ES / FS	Cave infrastr.		1,618			12/2026	
	HISPEC/DESPEC		11,153			11/2025	
	MATS		462			08/2024	
	LaSpec		67			06/2021	
	R3B		18,447			07/2026	
	ILIMA		424			06/2025	
	Super-FRS EC		568			12/2025	
		98.4% <i>value weighted</i>	32,739	95.4% <i>secured</i>	62.5% <i>value weighted</i>		56.9% <i>value weighted</i>

Since last reporting period:

- Funding status increased (CSC core system and gSPEC)
- R³B: TDR of TRT (former Si tracker) approved – now under construction
- MATS: RFQ construction completed

NUSTAR Score card



	NUSTAR sub-system	TDR	Cost [k€ 2005]	Funding	Construction	Date completion	Test/ Commissioning
First Science ++ LEB (FS++LEB)							
FS++LEB	Cave infrastr.	<div style="width: 100%; height: 15px; background-color: green;"></div>	352	<div style="width: 0%; height: 15px; background-color: yellow;"></div>		12/2028	
	MATS	<div style="width: 100%; height: 15px; background-color: green;"></div>	711	<div style="width: 68.6%; height: 15px; background-color: green;"></div>	<div style="width: 41.1%; height: 15px; background-color: green;"></div>	09/2026	<div style="width: 30.3%; height: 15px; background-color: gray;"></div>
	LaSpec	<div style="width: 100%; height: 15px; background-color: green;"></div>	186	<div style="width: 68.6%; height: 15px; background-color: green;"></div>	<div style="width: 41.1%; height: 15px; background-color: green;"></div>	05/2026	<div style="width: 30.3%; height: 15px; background-color: gray;"></div>
		100.0% <i>value weighted</i>	1,249	68.6% <i>secured</i>	41.1% <i>value weighted</i>		30.3% <i>value weighted</i>
Change since report 2024 I		+ 0.0%	+ 72.4	+ 1.9%	+ 1.8%		+ 0.1%

MATS: Isobar separator of MR-TOF system moved to FS++LEB

	Modularized Start Version Completion (MSVC)						
MSVC	ILIMA	<div style="width: 100%; height: 15px; background-color: green;"></div>	678	<div style="width: 58.5%; height: 15px; background-color: green;"></div>	<div style="width: 0%; height: 15px; background-color: yellow;"></div>		07/2030
		100.0% <i>value weighted</i>	678	58.5% <i>secured</i>	0.0% <i>value weighted</i>		0.0% <i>value weighted</i>
Change since report 2024 I		+ 0.0%	+ 0.0	+ 0.0%	+ 0.0%		+ 0.0%

Status: September 2024

NUSTAR Project Risks



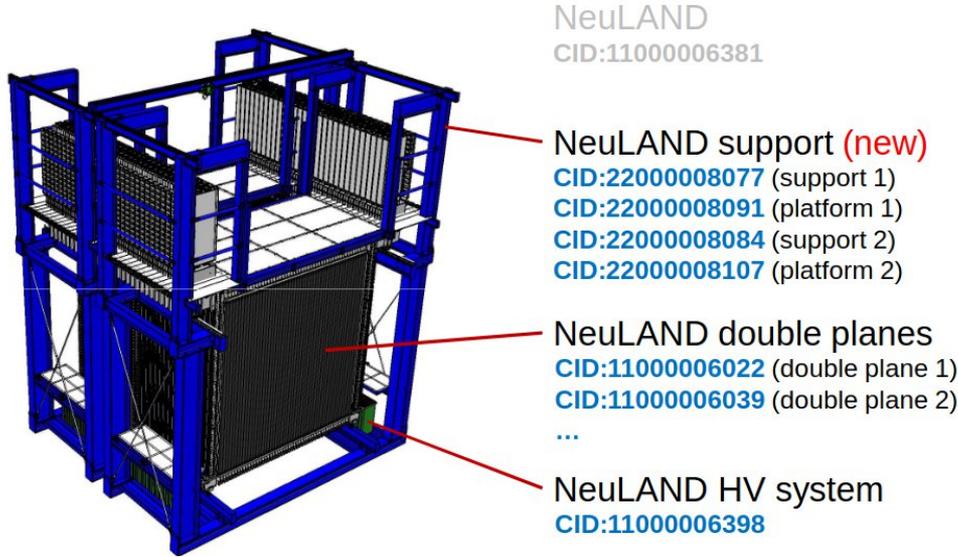
Risk ID	Scenario	Status	Description	Prob	Risk Score	Status/mitigating actions
867	ES	Mitigation planned	Required documentation is not completed on time to allow successful installation and operation of NUSTAR experiments.	50%	13	Risk to be mitigated through additional FTE available in early 2025.
173	ES	Mitigation ongoing	No budget approved for NUSTAR infrastructure	5%	8	It was agreed at the last meeting of the RRB that the signing procedure for the final version of the NUSTAR MoU should begin . The risk remains until sufficient signatures (and equivalent funds) are collected.
358	ES	Mitigation ongoing	Detection threshold of Si tracker far too high	10%	8	Mitigation: TDR approved , co-operation agreement (STFC-FAIR) and TRT implementation agreements now signed

NEW

Probability lowered

Risk to be closed?

- Two NUSTAR risks closed - #402 Energy resolution of CEPA scintillator and #187 Funding of AGATA



Example: NeuLAND CID breakdown, courtesy A. Herlert

- ‘**Technical Integration of NUSTAR components at FAIR**’ Workshop was held on Tuesday (7th Oct 2024)
- Focus on **Early Science** Work Packages
 - Detailed classification of components (Early Science and beyond)
 - Reasonable component breakdown (sub-components, sub-sub-components etc)
- All component classification and breakdown to be completed in **Q1 2025**

- **NUSTAR in 2028:** experiments at the Super-FRS (R³B, Super-FRS EC and DESPEC) with SIS100 beams, plus SHE and MATS experiments at UNILAC and ILIMA at the low-energy rings
- **Additional funding required** for realisation of **LE Branch** and **LE Cave**
- Planning for NUSTAR Early Science **progressing well**
- Technical Building Infrastructure (TBI) in NUSTAR areas **ongoing**
- Emphasis on **component classification/breakdown and documentation**

