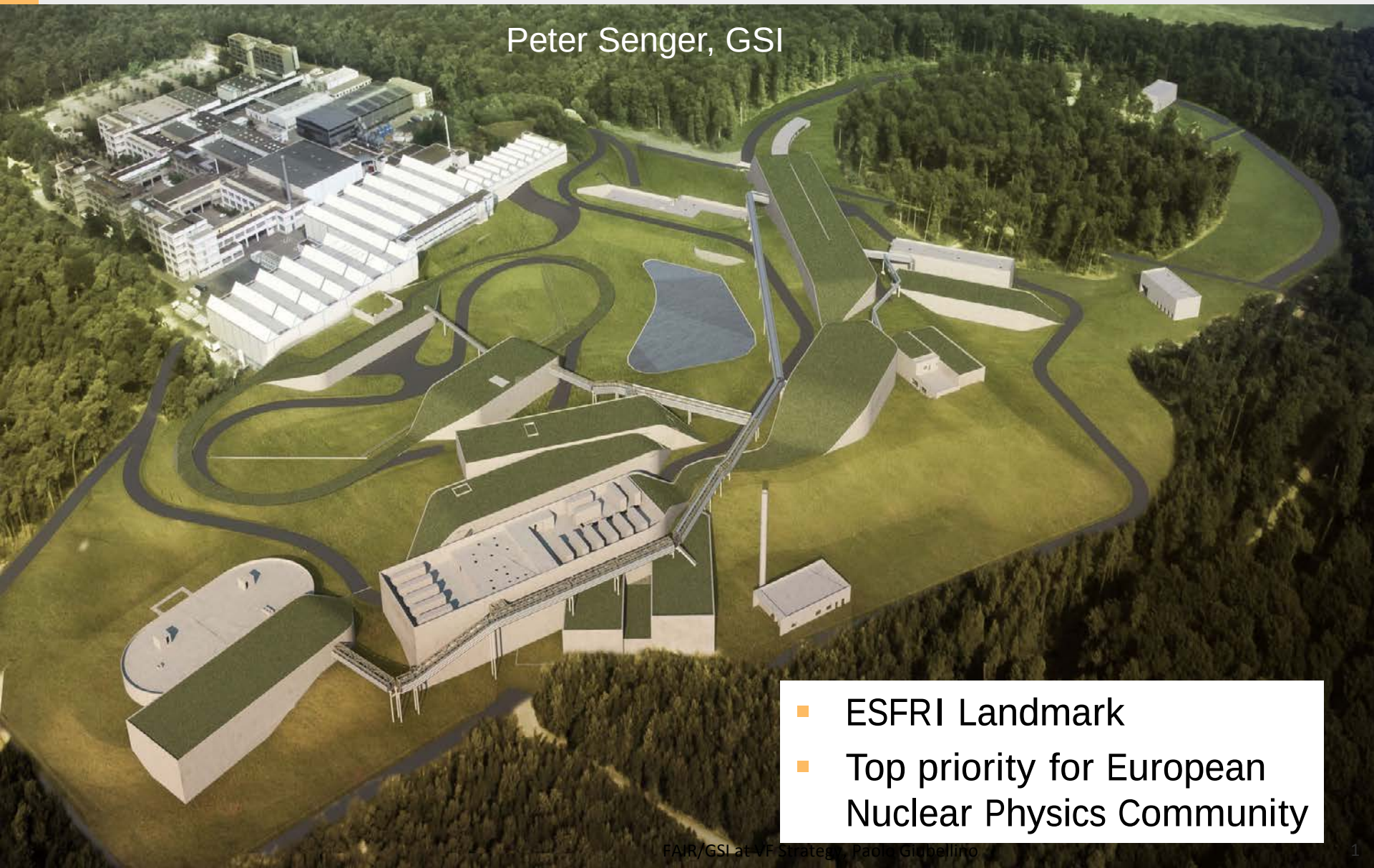
Facility for Antiproton & Ion Research
A World-Wide Unique Accelerator Lab

Peter Senger, GSI



- ESFRI Landmark
- Top priority for European Nuclear Physics Community

International Participation in FAIR

- FAIR governed by international convention
  - 9 shareholders + 1 assoc. partner (orange)
- Scientists from all over the world are engaged
  - More than 200 institutions from 53 countries are involved with their scientists (orange + blue) → FAIR community growing

Facility for Antiproton & Ion Research

Primary Beams

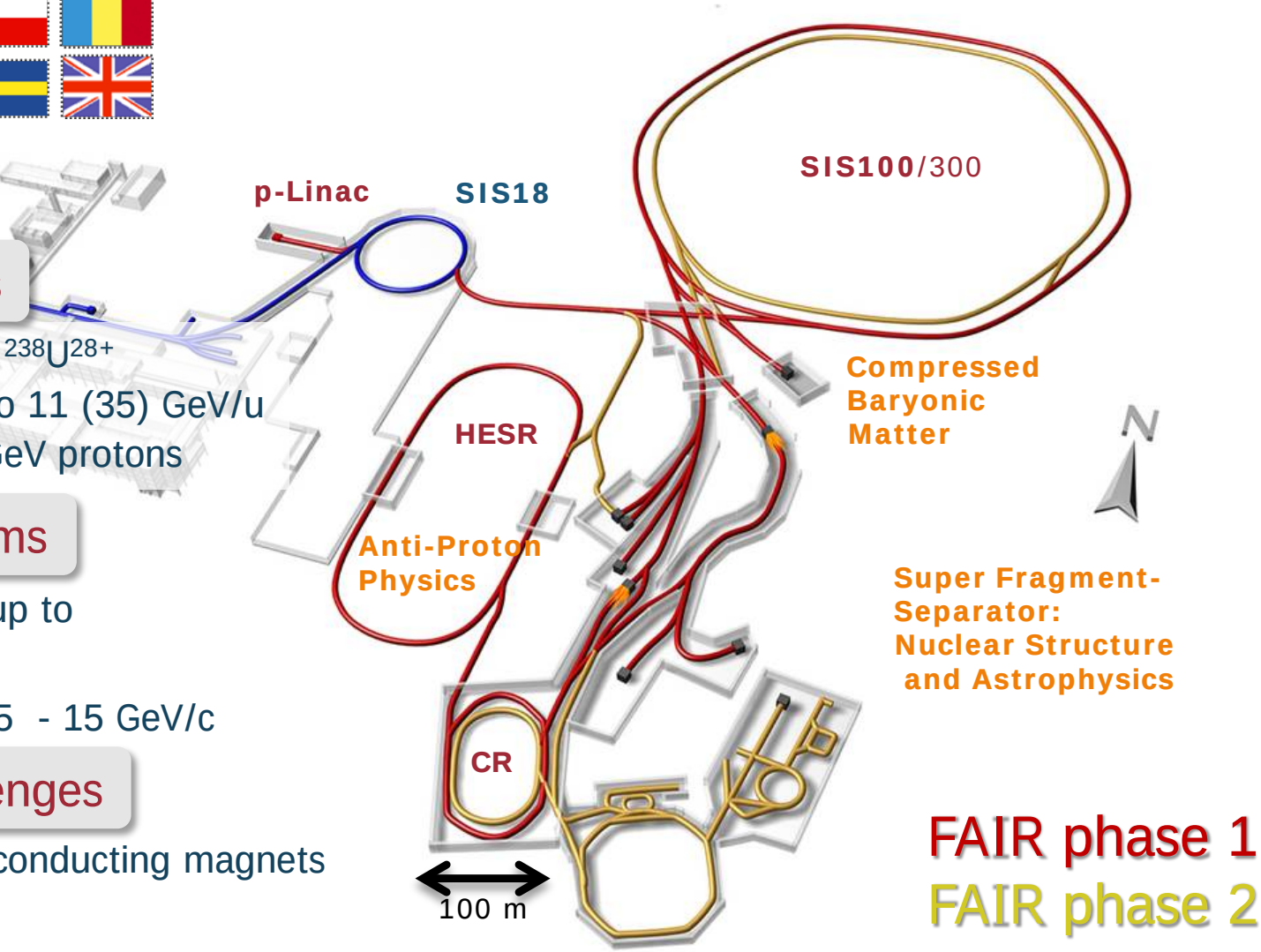
- 10^{12}/s; 1.5 GeV/u; $^{238}U^{28+}$
- 10^{10}/s $^{238}U^{92+}$ up to 11 (35) GeV/u
- 3x10^{13}/s 30 (90) GeV protons

Secondary Beams

- radioactive beams up to 1.5 - 2 GeV/u;
- 10^{11} antiprotons 1.5 - 15 GeV/c

Technical Challenges

- rapid cycling superconducting magnets
- dynamical vacuum



FAIR phase 1
FAIR phase 2

Facility for Antiproton & Ion Research

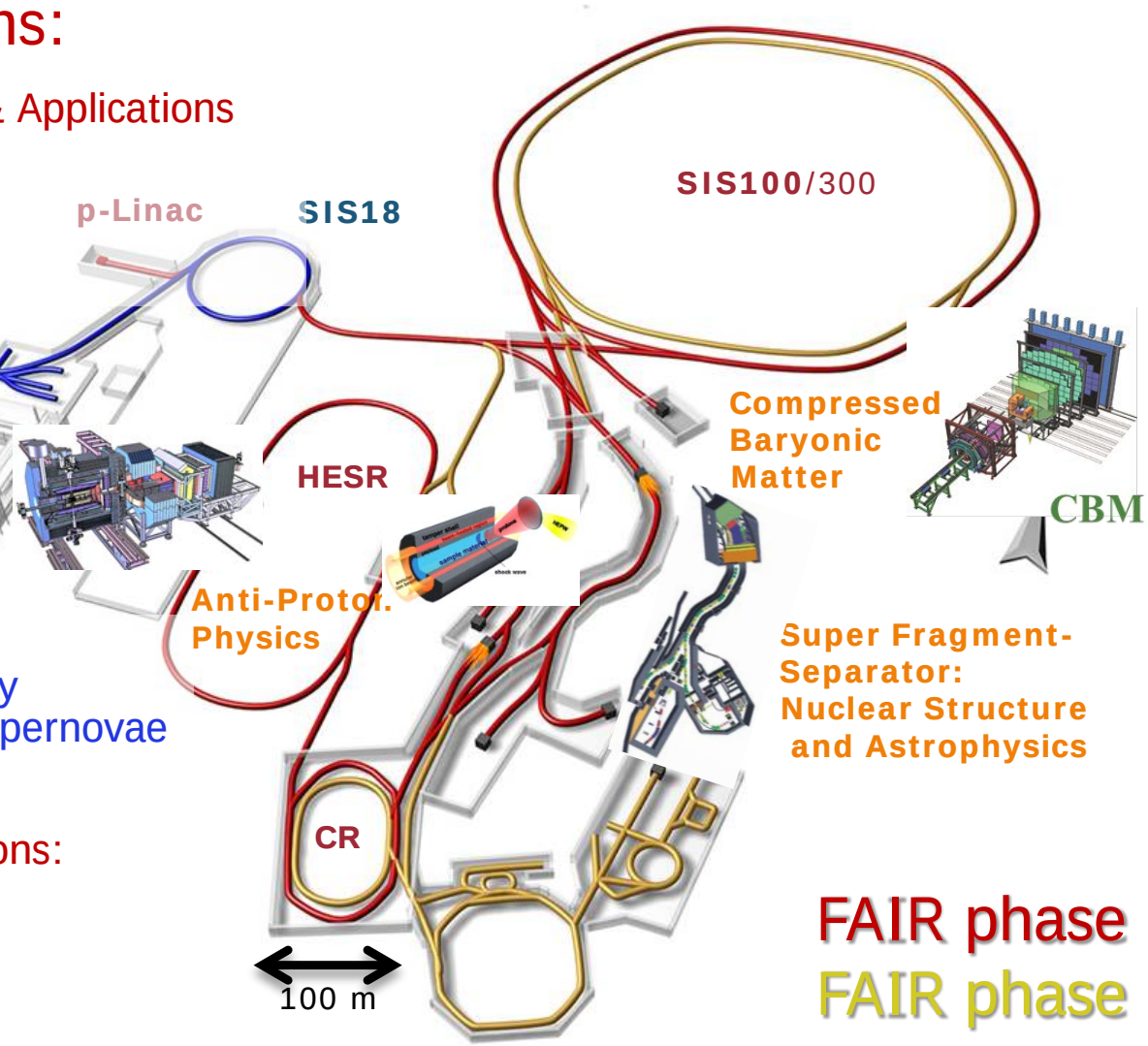
Experimental programs:

APPA: Atomic & Plasma Physics & Applications
- Highly charged atoms
- Plasma physics
- Radiobiology
- Material science

CBM: Nucleus-nucleus collisions
- Nuclear matter at neutron star core densities
- Phase transitions from hadrons to quarks

NUSTAR: Rare Isotope beams
- Nuclear structure far off stability
- Nucleosynthesis in stars and supernovae

PANDA: Antiproton-proton collisions:
- Charmed hadrons (XYZ)
- Gluonic matter and hybrids
- Hadron structure
- Double Lambda hypernuclei



FAIR phase 1
FAIR phase 2

Status of FAIR

On Sept. 13, 2016 BMBF gave green light and 203 M€ to start civil construction.

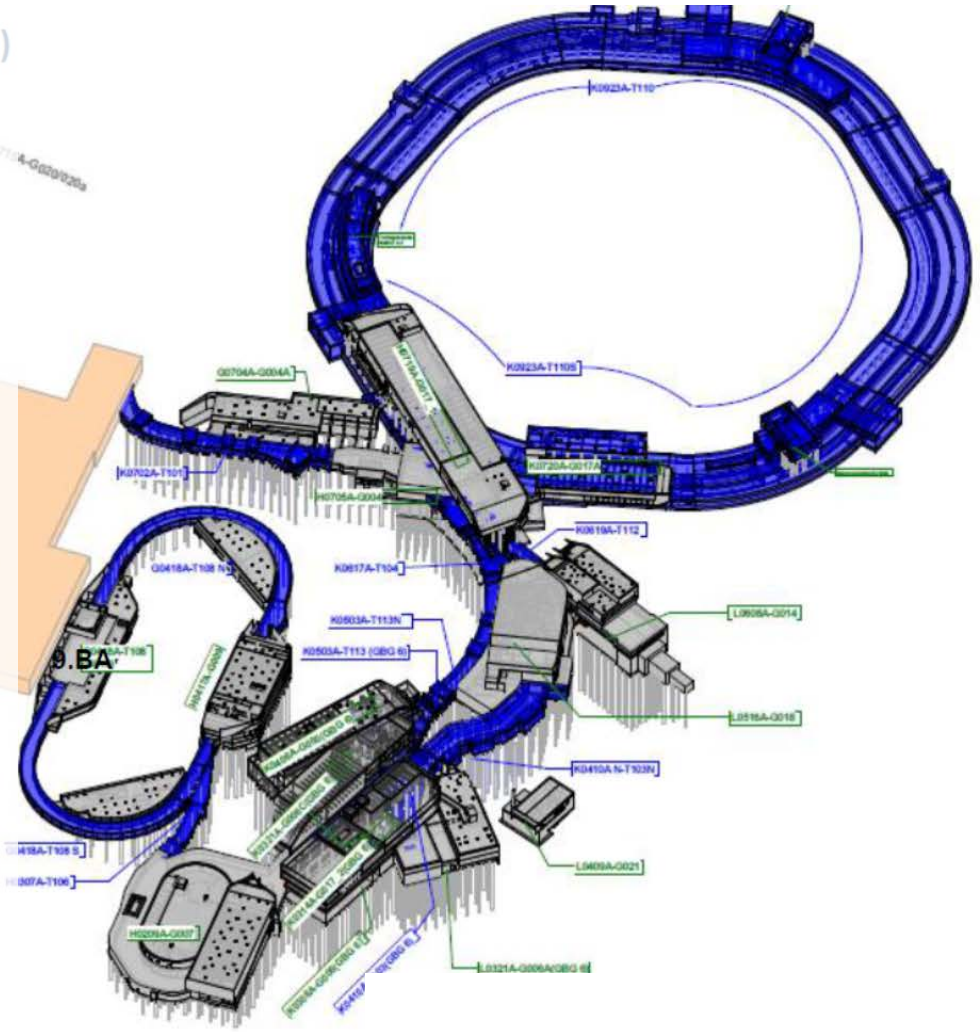
1st call for tender Sept. 26, 2016: water management and excavation

2nd call for tender Nov. 22, 2016: shell construction ‘north area’, includes SIS100 and CBM cave

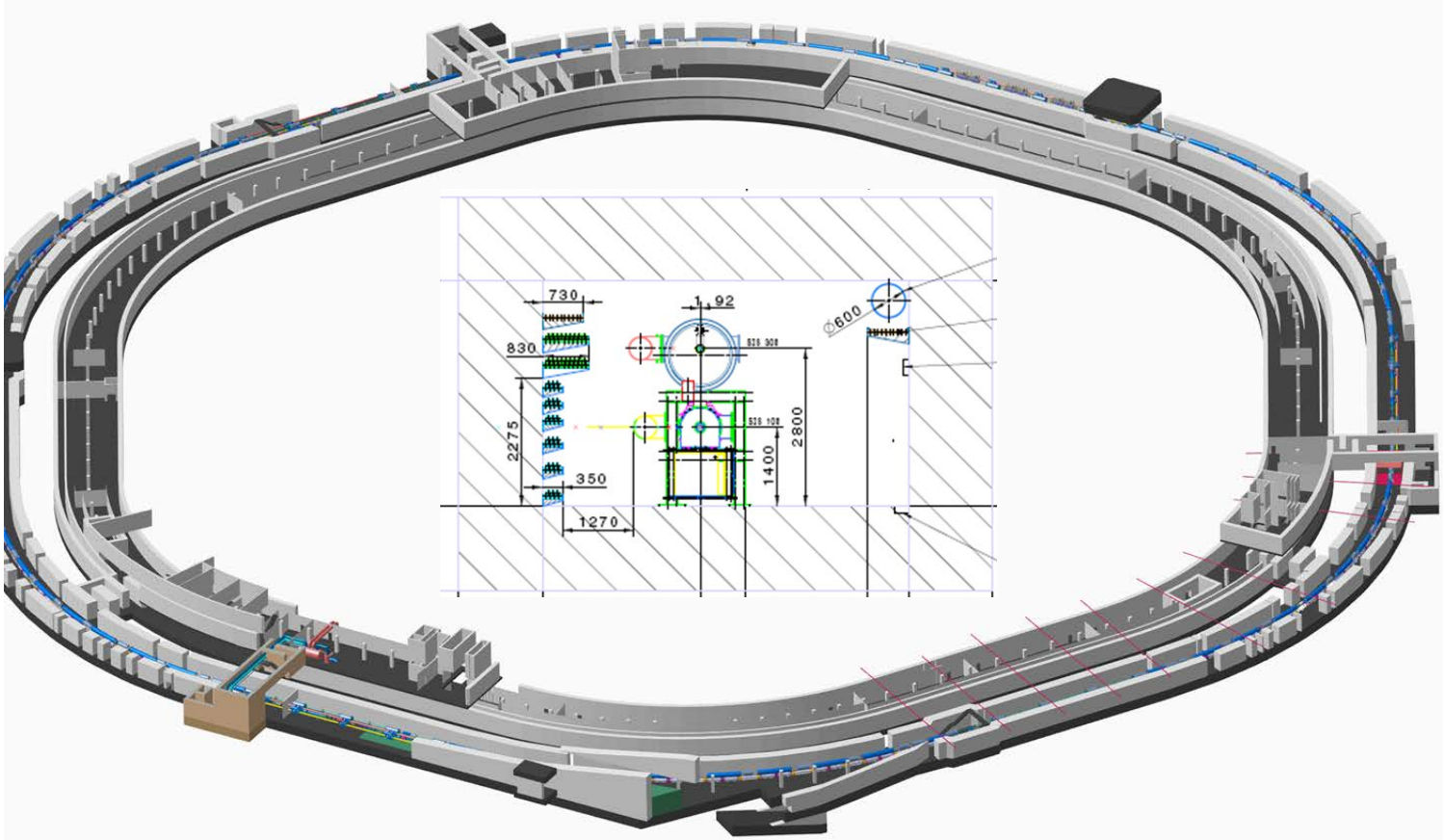
Start of construction mid of 2017

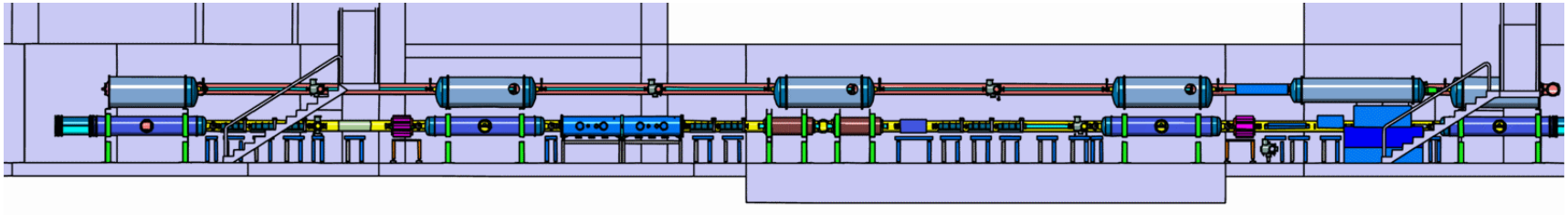
Installation incl. commissioning of the experiments is planned during 2021-2024

Full completion of FAIR by 2025

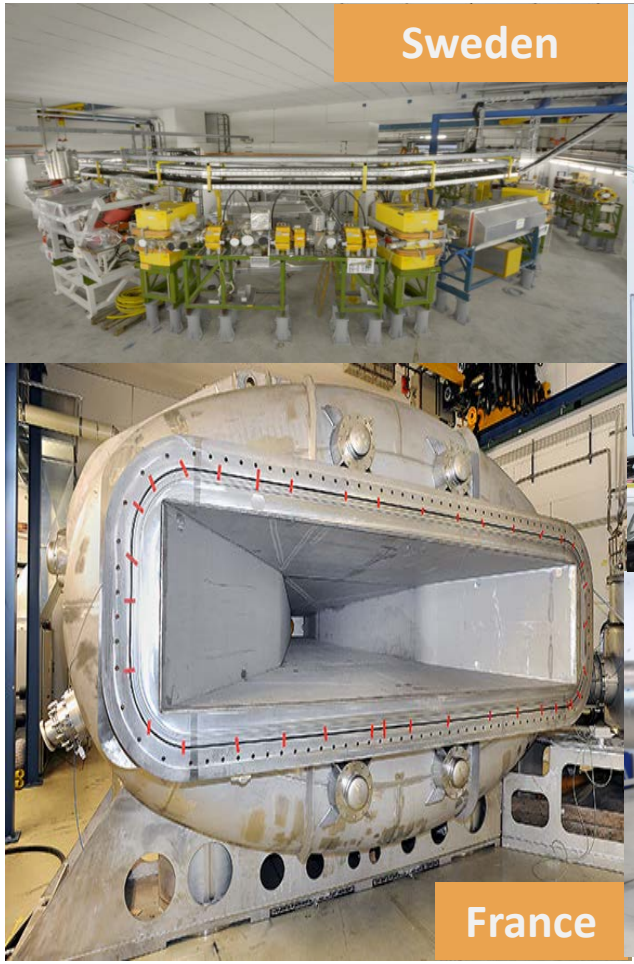


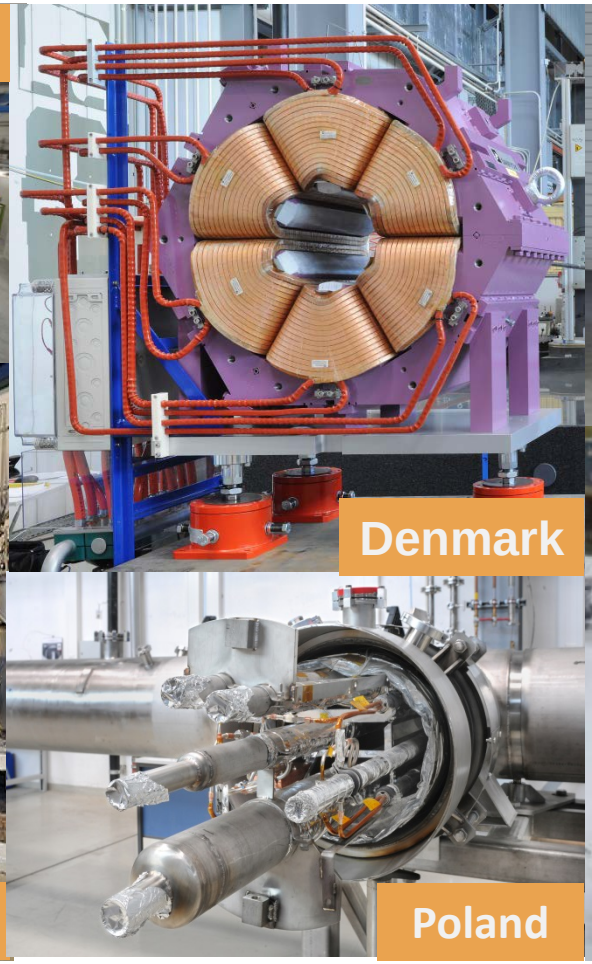
Tunnel for SIS100/300

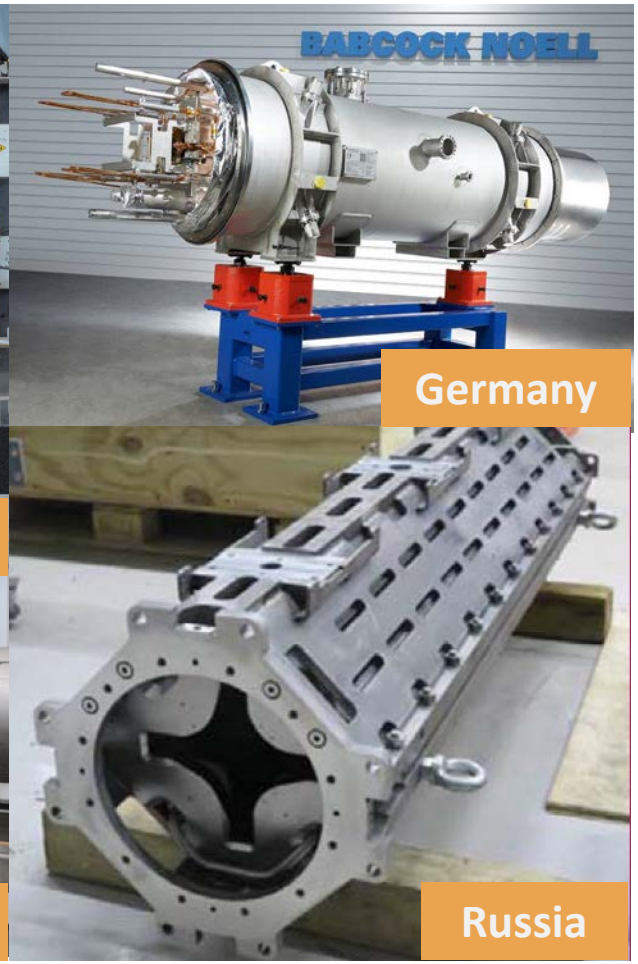




Procurement of FAIR components



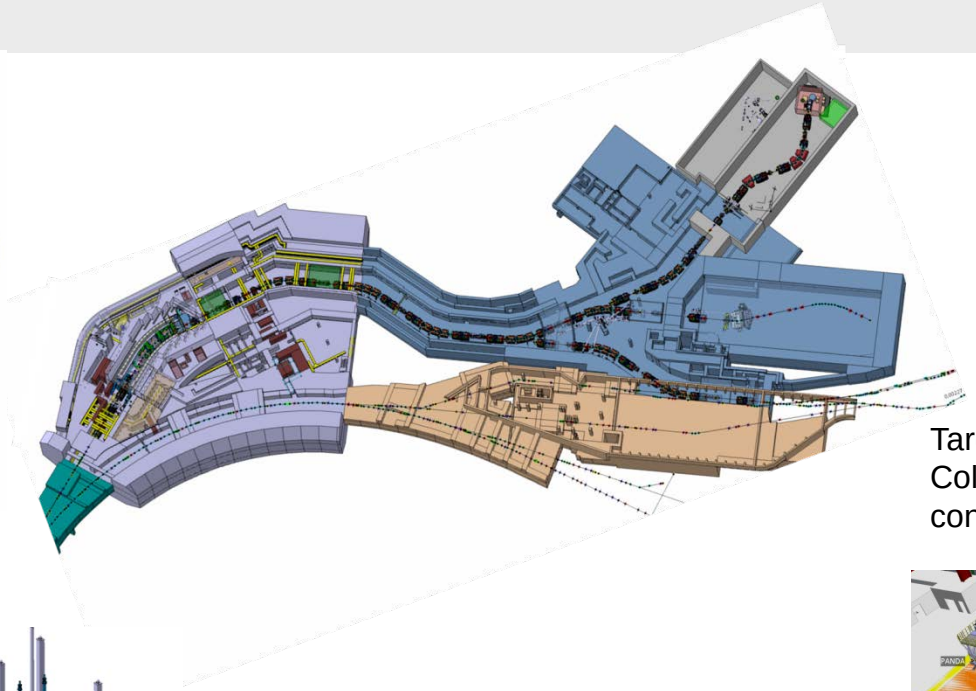


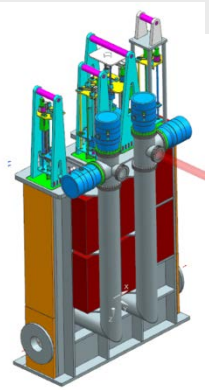


- Accelerator and detector contributions from many different partner institutions

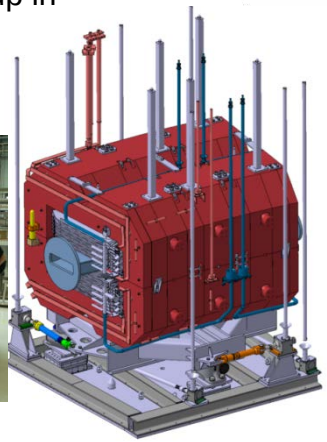
Procurement of Super-FRS components

FOS s.c multiplett: PDR approved in July. Steel and wire orderd. Coil mock-up in production (Italy).





Target chamber with plug ins. Collaboration and R&D contracts with KVI-CART (NL)



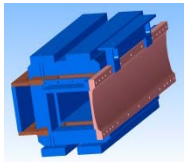
Radiation hard dipole. Prototype testing almost completed. Tendering on short term (Russia)

Collaboration agreement signed with CEA, including design and technical follow-up (France)

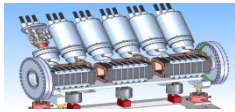
Set-up of test facility started at CERN, Commissioning of cryogenics system in 2016. First magnet end of 2017.

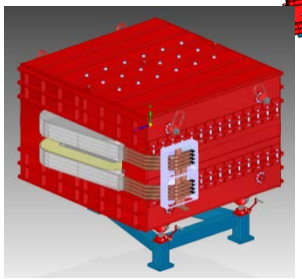
Procurement of Collector Ring

FOS debuncher cavity
SAT ongoing.

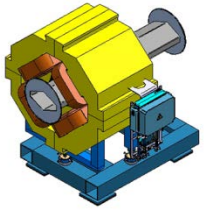


Prototype stochastic cooling tank at GSI

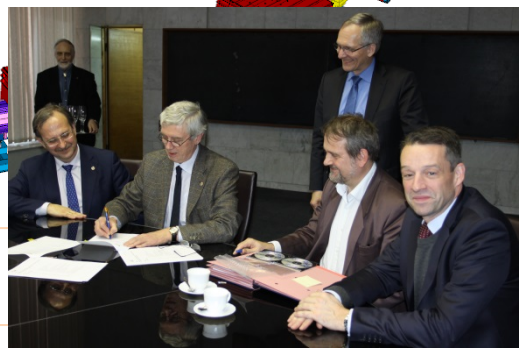




- The update of TDR (Annex) is ready and approved. Several spec. completed
- The full 3D model of CR system is ready (DMU model)
- MA debuncher cavity in SAT at GSI.
- Prototype of Stochastic cooling Pick–up under development.

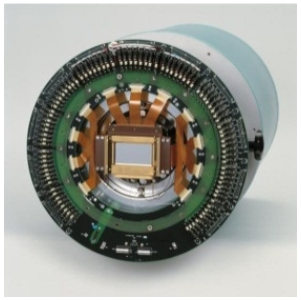


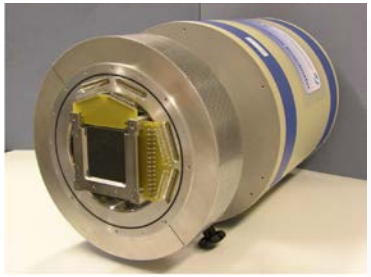
December 2016: Collaboration contract signed for the dipole magnets (production until 2021) with BINP

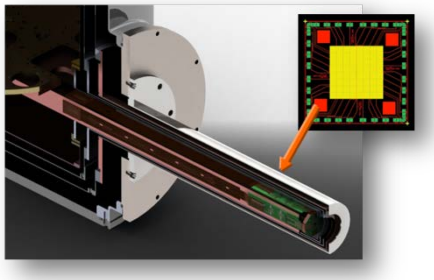


APPA – Detector Development

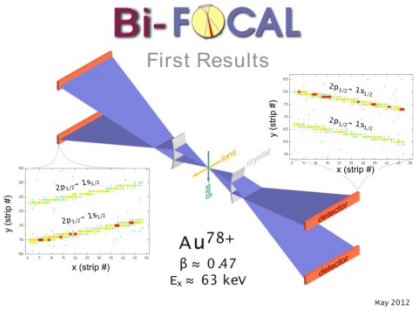
Targets



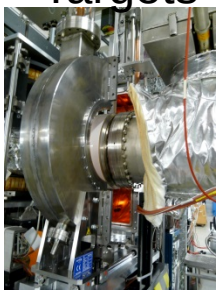


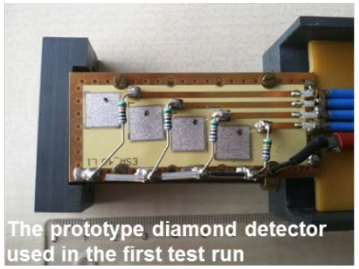


Position-sensitive solid-state detectors

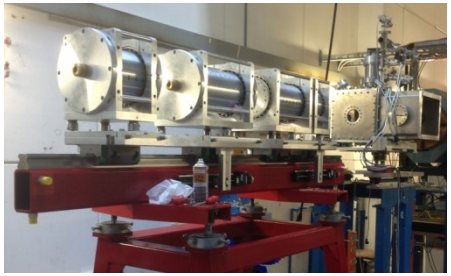


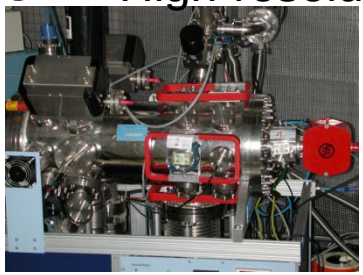
High-resolution spectrometers



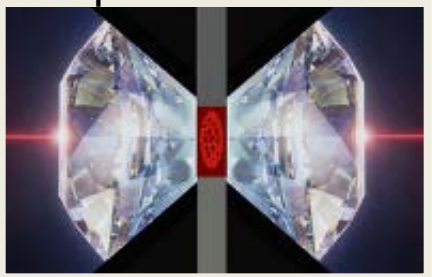


Particle detectors



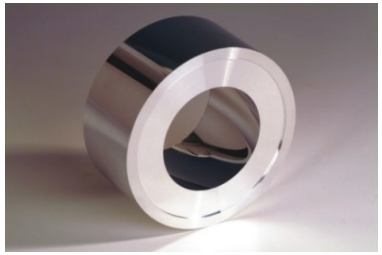


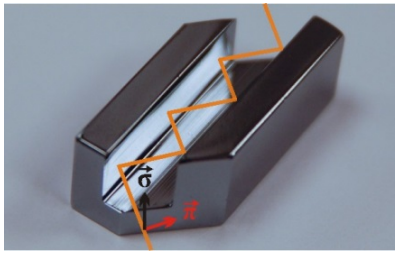
Particle spectrometers



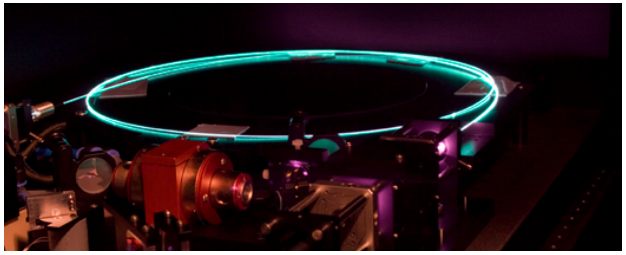
High pressure cell

Traps





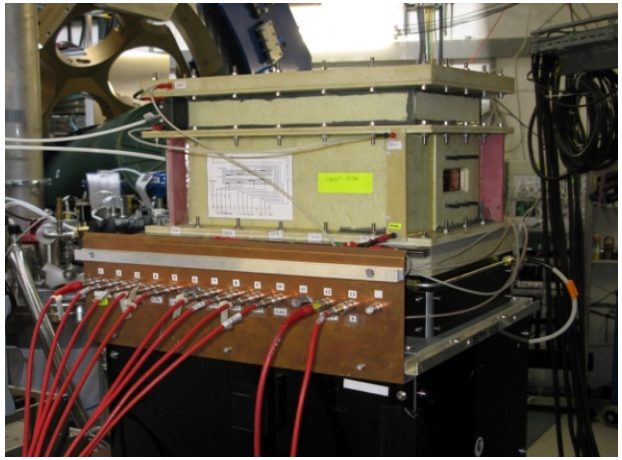
X-ray optics, channel-cut crystals



Laser systems

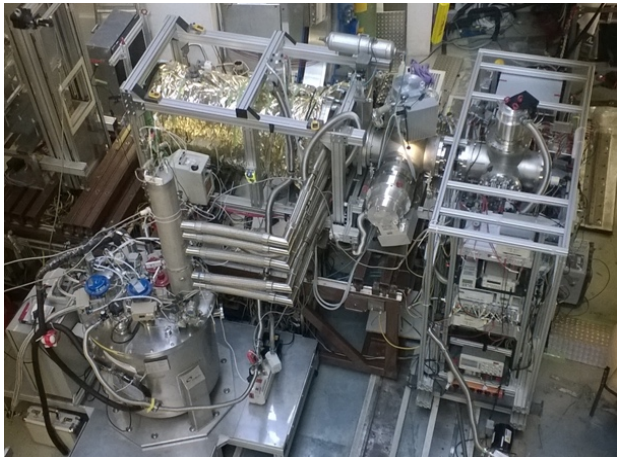
NUSTAR – Detector Development

O-TPC

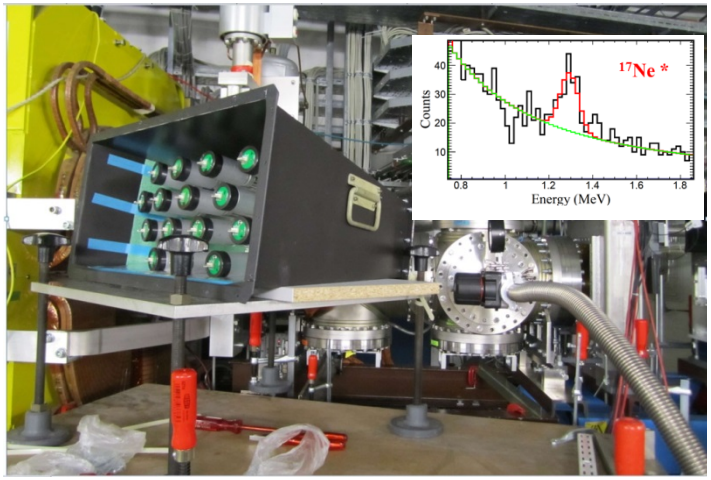


Backward-angle neutron detector

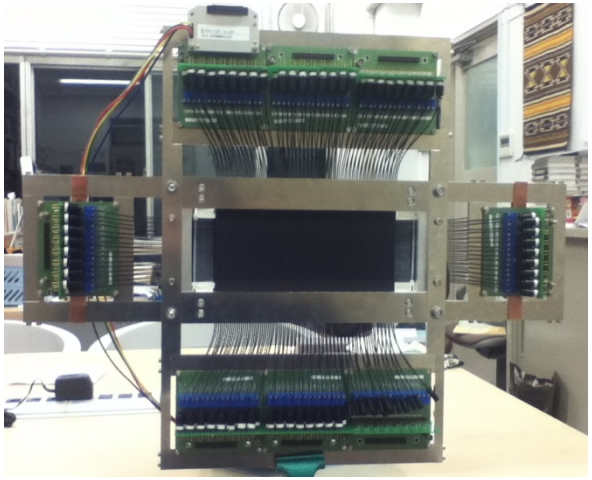
Ion Catcher → LEB-MATS/LASPEC



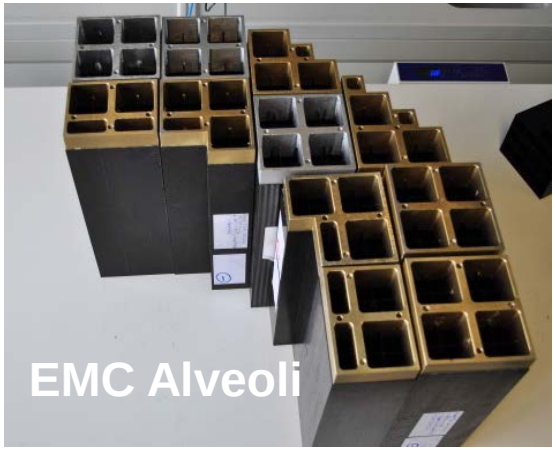
GADAST prototype measurements at S2

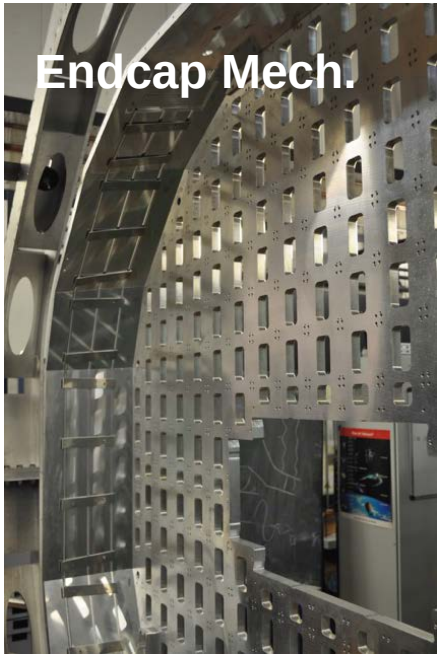


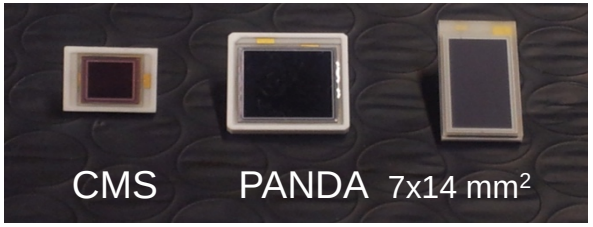
Full integrated S2 fiber tracker

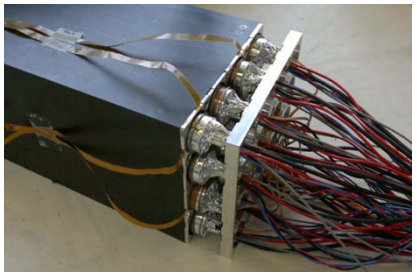


PANDA – Detector Development

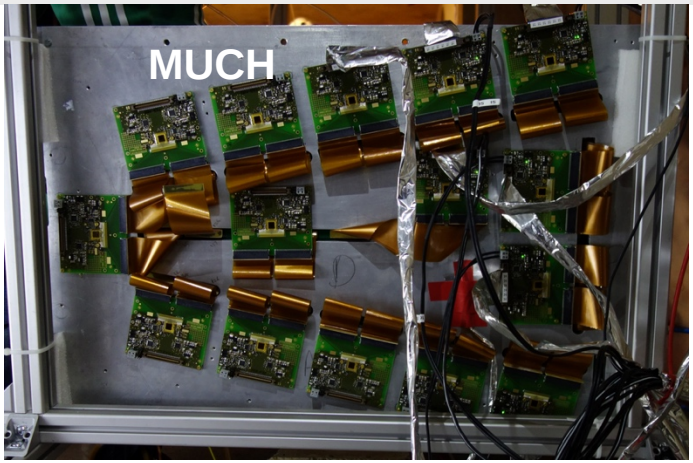


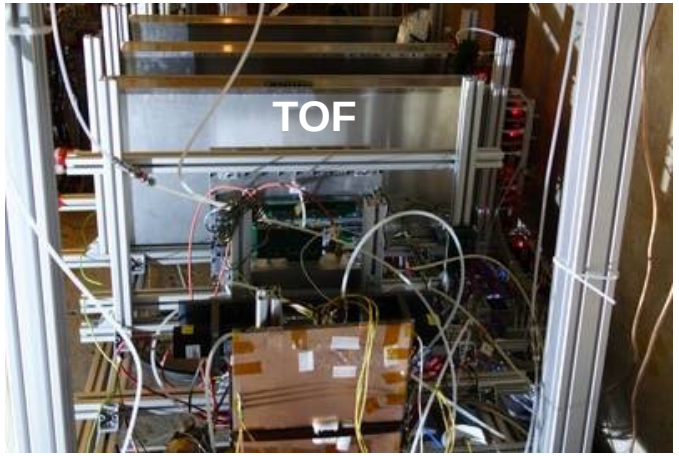


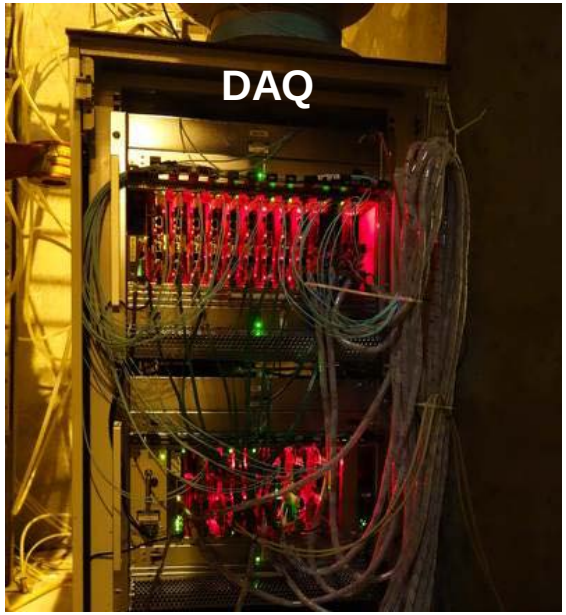


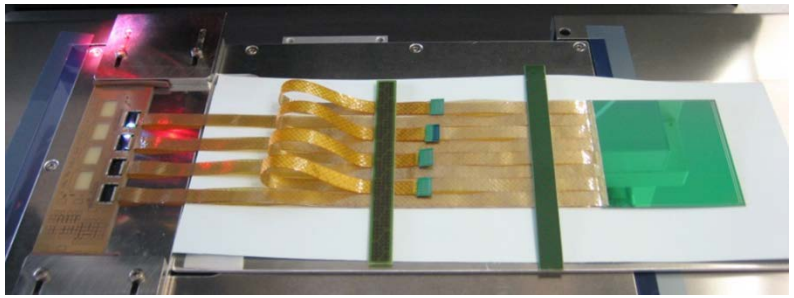


CBM – Detector Development

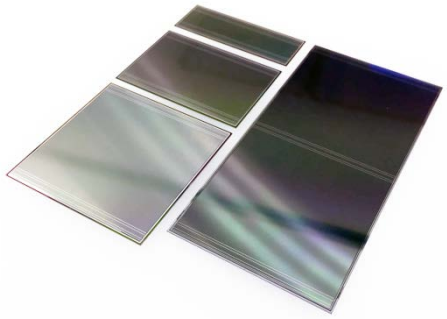


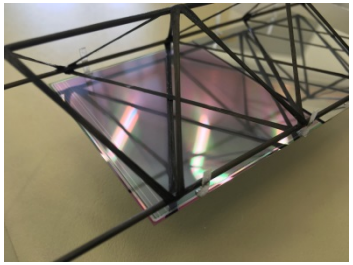






Silicon tracker

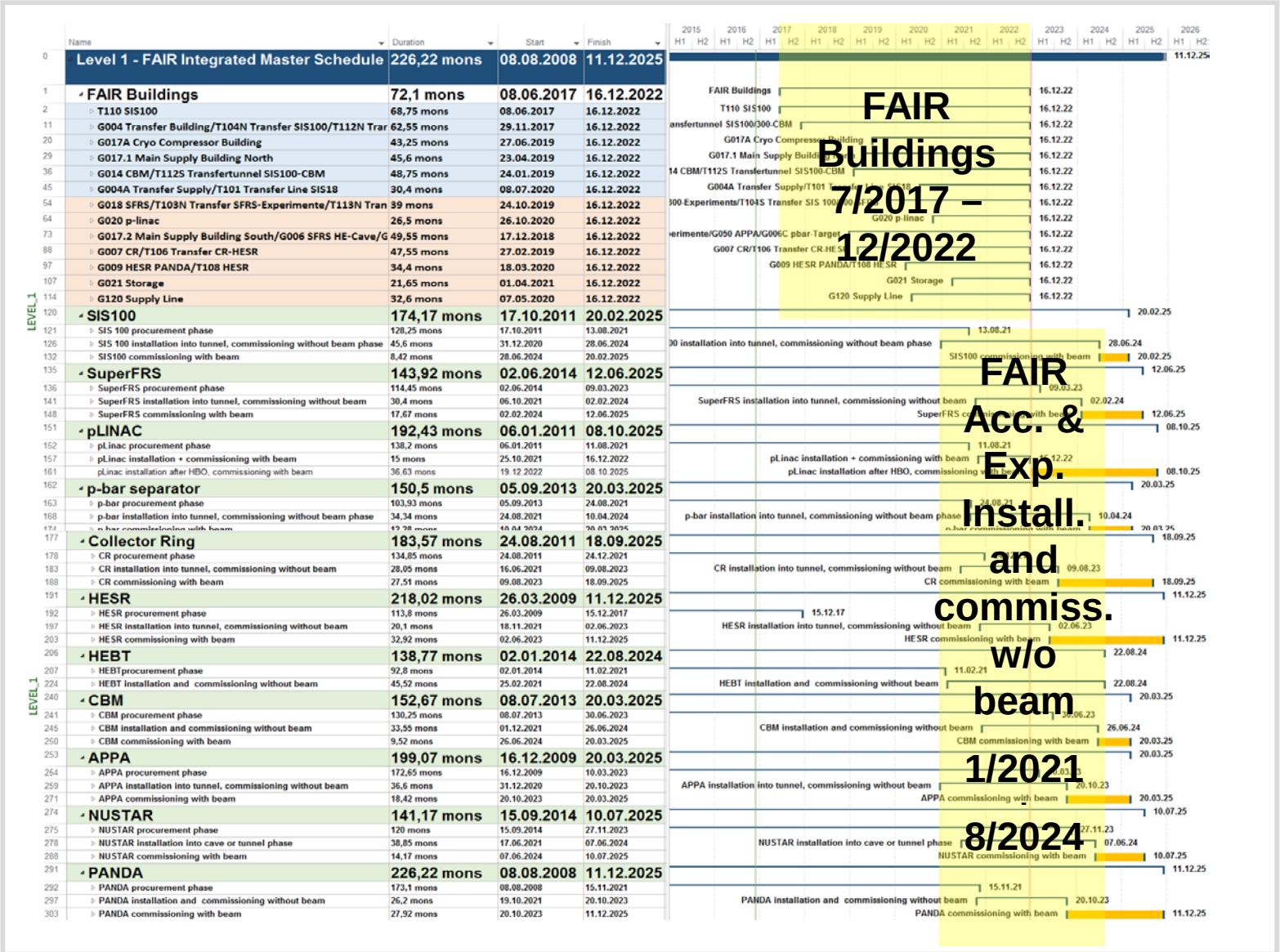




Preparatory Work for FAIR

- SIS18 upgrade
  - Machine upgrade
  - Shielding re-enforcement
- Campus development
  - New canteen
  - More office space
  - Green IT-Cube

Integrated Project Time Schedule – Level 1: FAIR Buildings, Accelerators & Experiments



	Name	Duration	Start	Finish
0	Level 1 - FAIR Integrated Master Schedule	226,22 mons	08.08.2008	11.12.2025
1	FAIR Buildings	72,1 mons	08.06.2017	16.12.2022
2	T110 SIS100	68,75 mons	08.06.2017	16.12.2022
11	G004 Transfer Building/T104N Transfer SIS100/T112N Tran	62,55 mons	29.11.2017	16.12.2022
20	G017A Cryo Compressor Building	43,25 mons	27.06.2019	16.12.2022
29	G017.1 Main Supply Building North	45,6 mons	23.04.2019	16.12.2022
36	G014 CBM/T112S Transfertunnel SIS100-CBM	48,75 mons	24.01.2019	16.12.2022
45	G004A Transfer Supply/T101 Transfer Line SIS18	30,4 mons	08.07.2020	16.12.2022
54	G018 SFRS/T103N Transfer SFRS-Experimente/T113N Tran	39 mons	24.10.2019	16.12.2022
64	G020 p-linac	26,5 mons	26.10.2020	16.12.2022
73	G017.2 Main Supply Building South/G006 SFRS HE-Cave/G	49,55 mons	17.12.2018	16.12.2022
88	G007 CR/T106 Transfer CR-HESR	47,55 mons	27.02.2019	16.12.2022
97	G009 HESR PANDA/T108 HESR	34,4 mons	18.03.2020	16.12.2022
107	G021 Storage	21,65 mons	01.04.2021	16.12.2022
114	G120 Supply Line	32,6 mons	07.05.2020	16.12.2022
120	SIS100	174,17 mons	17.10.2011	20.02.2025
121	SIS 100 procurement phase	128,25 mons	17.10.2011	13.08.2021
126	SIS 100 installation into tunnel, commissioning without beam phase	45,6 mons	31.12.2020	28.06.2024
132	SIS100 commissioning with beam	8,42 mons	28.06.2024	20.02.2025
135	SuperFRS	143,92 mons	02.06.2014	12.06.2025
136	SuperFRS procurement phase	114,45 mons	02.06.2014	09.03.2023
141	SuperFRS installation into tunnel, commissioning without beam	30,4 mons	06.10.2021	02.02.2024
148	SuperFRS commissioning with beam	17,67 mons	02.02.2024	12.06.2025
151	pLINAC	192,43 mons	06.01.2011	08.10.2025
152	pLinac procurement phase	138,2 mons	06.01.2011	11.08.2021
157	pLinac installation + commissioning with beam	15 mons	25.10.2021	16.12.2022
161	pLinac installation after HBO, commissioning with beam	36,63 mons	19.12.2022	08.10.2025
162	p-bar separator	150,5 mons	05.09.2013	20.03.2025
163	p-bar procurement phase	103,93 mons	05.09.2013	24.08.2021
168	p-bar installation into tunnel, commissioning without beam phase	34,34 mons	24.08.2021	10.04.2024
174	p-bar commissioning with beam	42,28 mons	10.04.2024	20.03.2025
177	Collector Ring	183,57 mons	24.08.2011	18.09.2025
178	CR procurement phase	134,85 mons	24.08.2011	24.12.2021
183	CR installation into tunnel, commissioning without beam	28,05 mons	16.06.2021	09.08.2023
188	CR commissioning with beam	27,51 mons	09.08.2023	18.09.2025
191	HESR	218,02 mons	26.03.2009	11.12.2025
192	HESR procurement phase	113,8 mons	26.03.2009	15.12.2017
197	HESR installation into tunnel, commissioning without beam	20,1 mons	18.11.2021	02.06.2023
203	HESR commissioning with beam	32,92 mons	02.06.2023	11.12.2025
206	HEBT	138,77 mons	02.01.2014	22.08.2024
207	HEBTprocurement phase	92,8 mons	02.01.2014	11.02.2021
224	HEBT installation and commissioning without beam	45,52 mons	25.02.2021	22.08.2024
240	CBM	152,67 mons	08.07.2013	20.03.2025
241	CBM procurement phase	130,25 mons	08.07.2013	30.06.2023
245	CBM installation and commissioning without beam	33,55 mons	01.12.2021	26.06.2024
250	CBM commissioning with beam	9,52 mons	26.06.2024	20.03.2025
253	APPA	199,07 mons	16.12.2009	20.03.2025
254	APPA procurement phase	172,65 mons	16.12.2009	10.03.2023
259	APPA installation into tunnel, commissioning without beam	36,6 mons	31.12.2020	20.10.2023
271	APPA commissioning with beam	18,42 mons	20.10.2023	20.03.2025
274	NUSTAR	141,17 mons	15.09.2014	10.07.2025
275	NUSTAR procurement phase	120 mons	15.09.2014	27.11.2023
278	NUSTAR installation into cave or tunnel phase	38,85 mons	17.06.2021	07.06.2024
288	NUSTAR commissioning with beam	14,17 mons	07.06.2024	10.07.2025
291	PANDA	226,22 mons	08.08.2008	11.12.2025
292	PANDA procurement phase	173,1 mons	08.08.2008	15.11.2021
297	PANDA installation and commissioning without beam	26,2 mons	19.10.2021	20.10.2023
303	PANDA commissioning with beam	27,92 mons	20.10.2023	11.12.2025