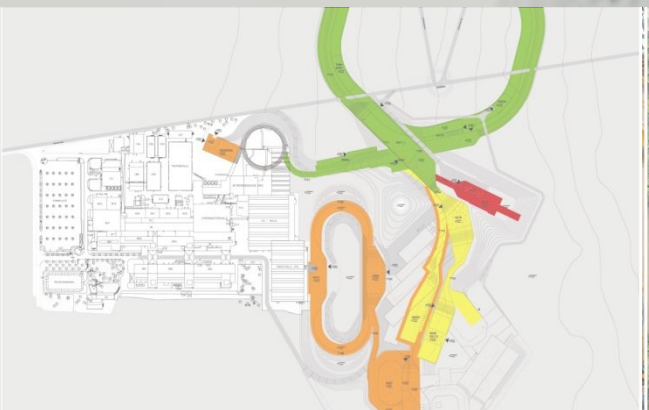
News from FAIR

Georg Schepers
FAIR
PANDA Collaborations Meeting, Goa/India,
13 March 2013



The FAIR Facility

Experiments

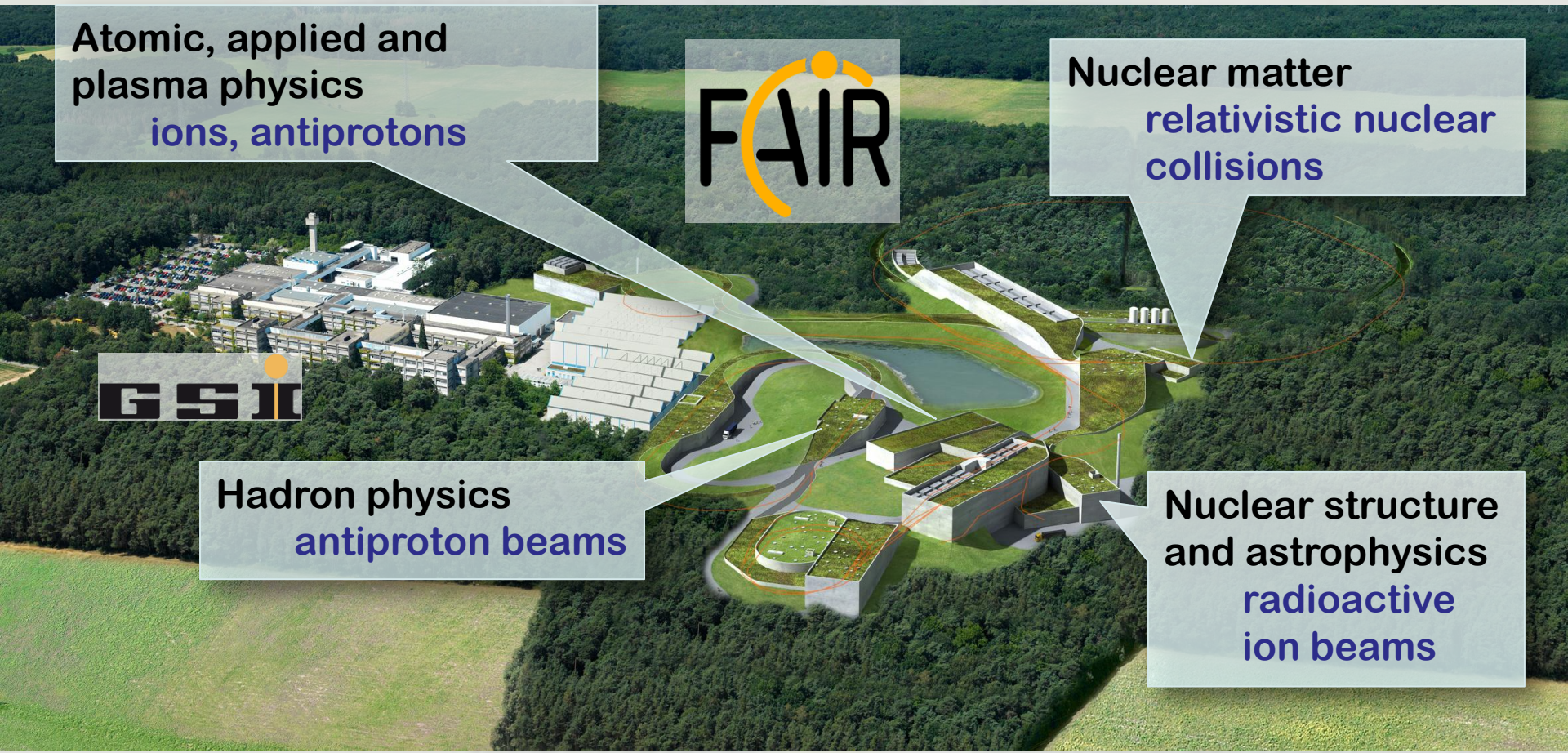
Accelerators

Construction

Project Organization and International Partners

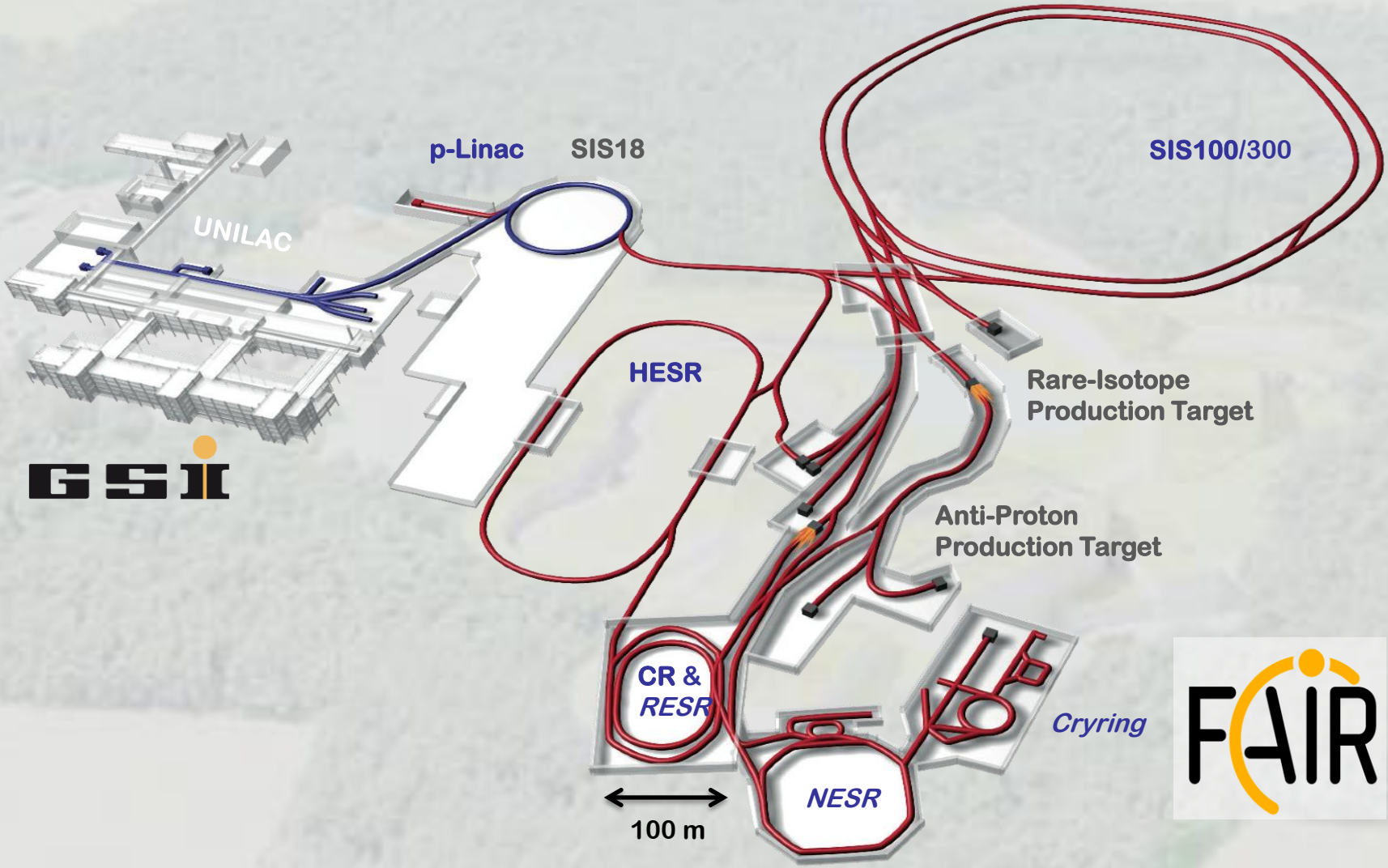
Facility for Antiproton and Ion Research

Facility for Antiproton and Ion Research



Facility for Antiproton and Ion Research

Facility for Antiproton and Ion Research



Facility for Antiproton and Ion Research

Primary Beams

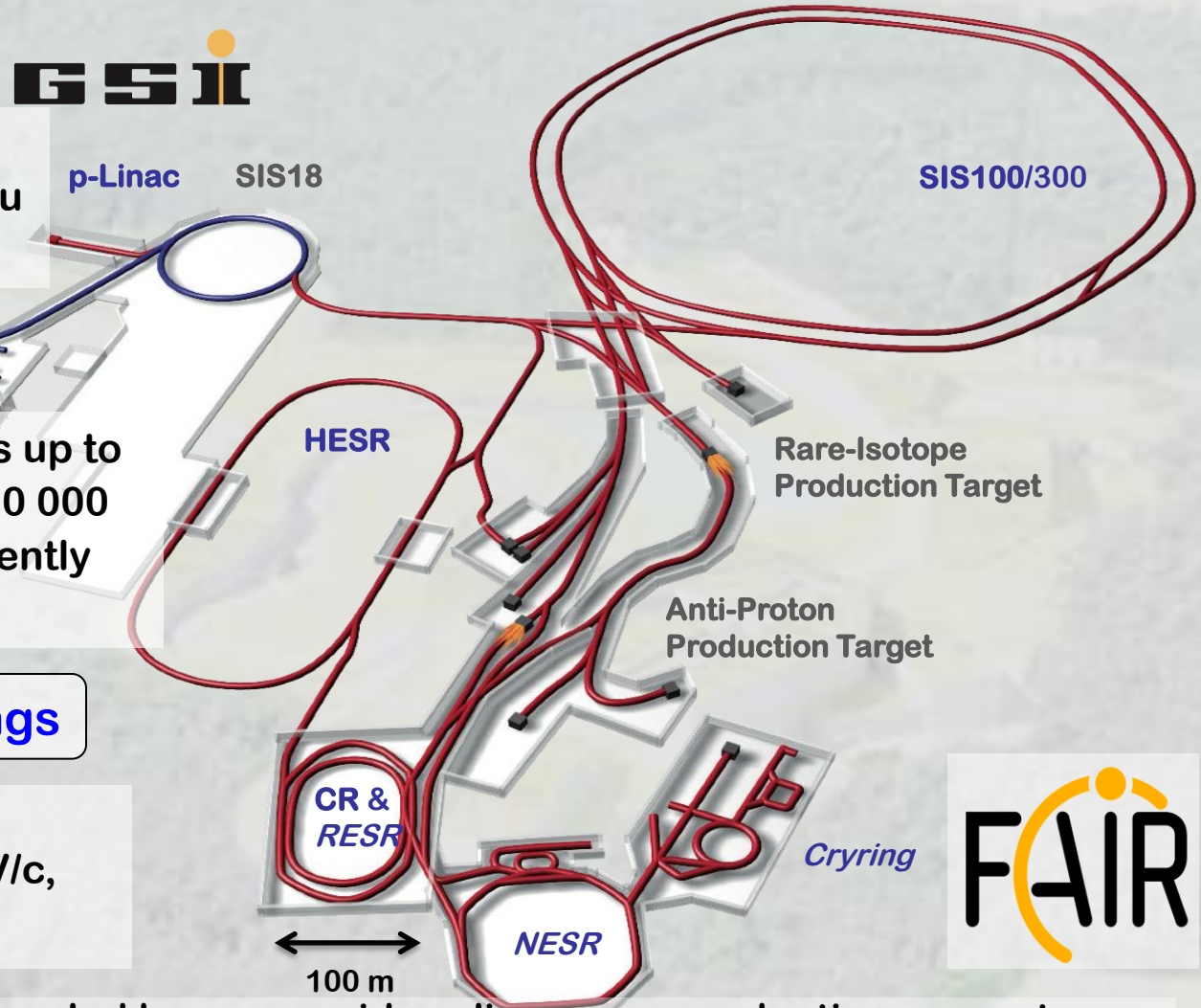
- 10^{12}/s; 1.5 GeV/u; $^{238}U^{28+}$
- 10^{10}/s $^{238}U^{73+}$ up to 35 GeV/u
- 3x10^{13}/s 30 GeV protons

Secondary Beams

- range of radioactive beams up to 1.5 - 2 GeV/u; up to factor 10 000 higher in intensity than presently
- antiprotons 3 - 30 GeV

Storage and Cooler Rings

- radioactive beams
- 10^{11} antiprotons 1 - 15 GeV/c, stored and cooled



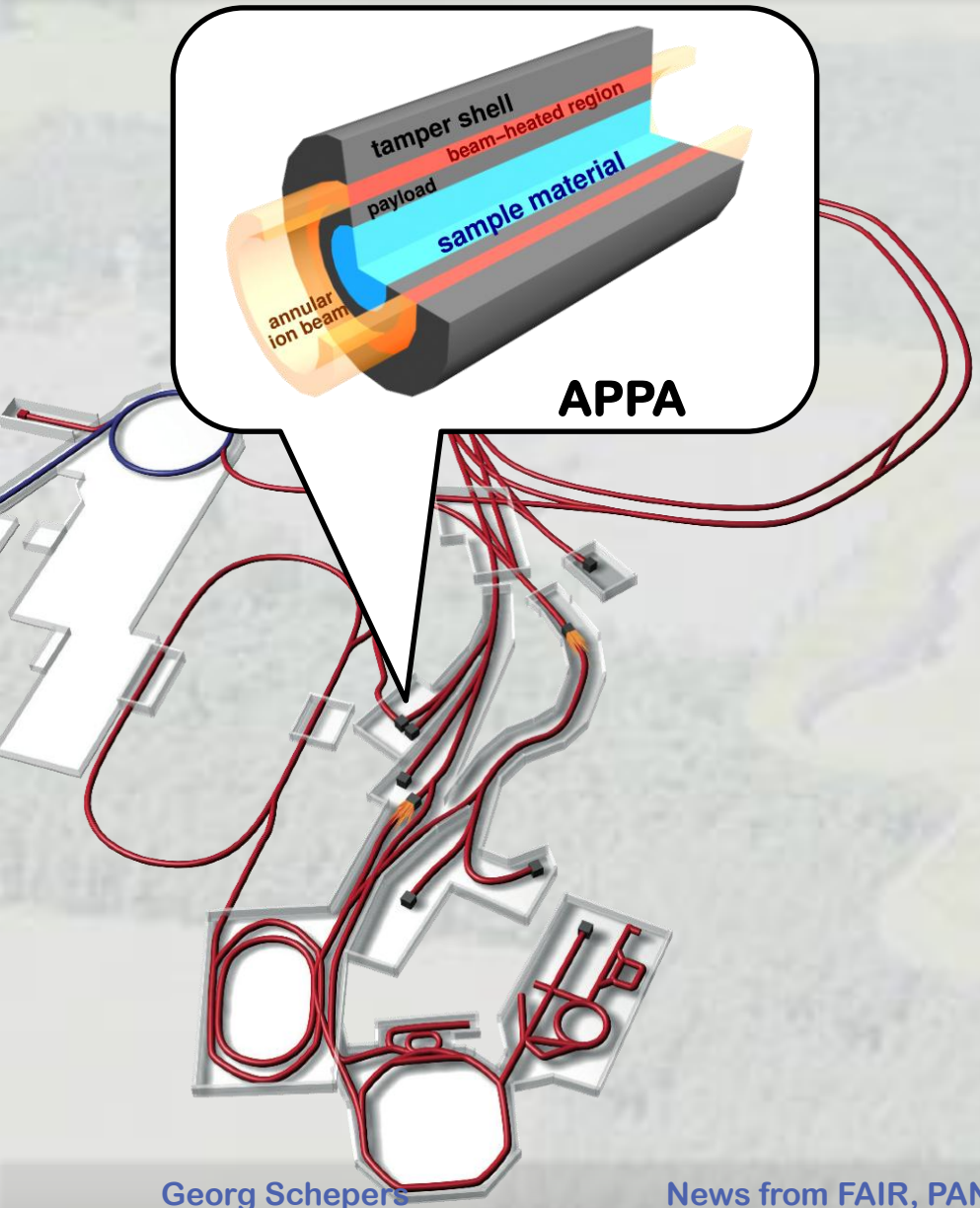
Technical Challenges

- cooled beams, rapid cycling superconducting magnets

Facility for Antiproton and Ion Research

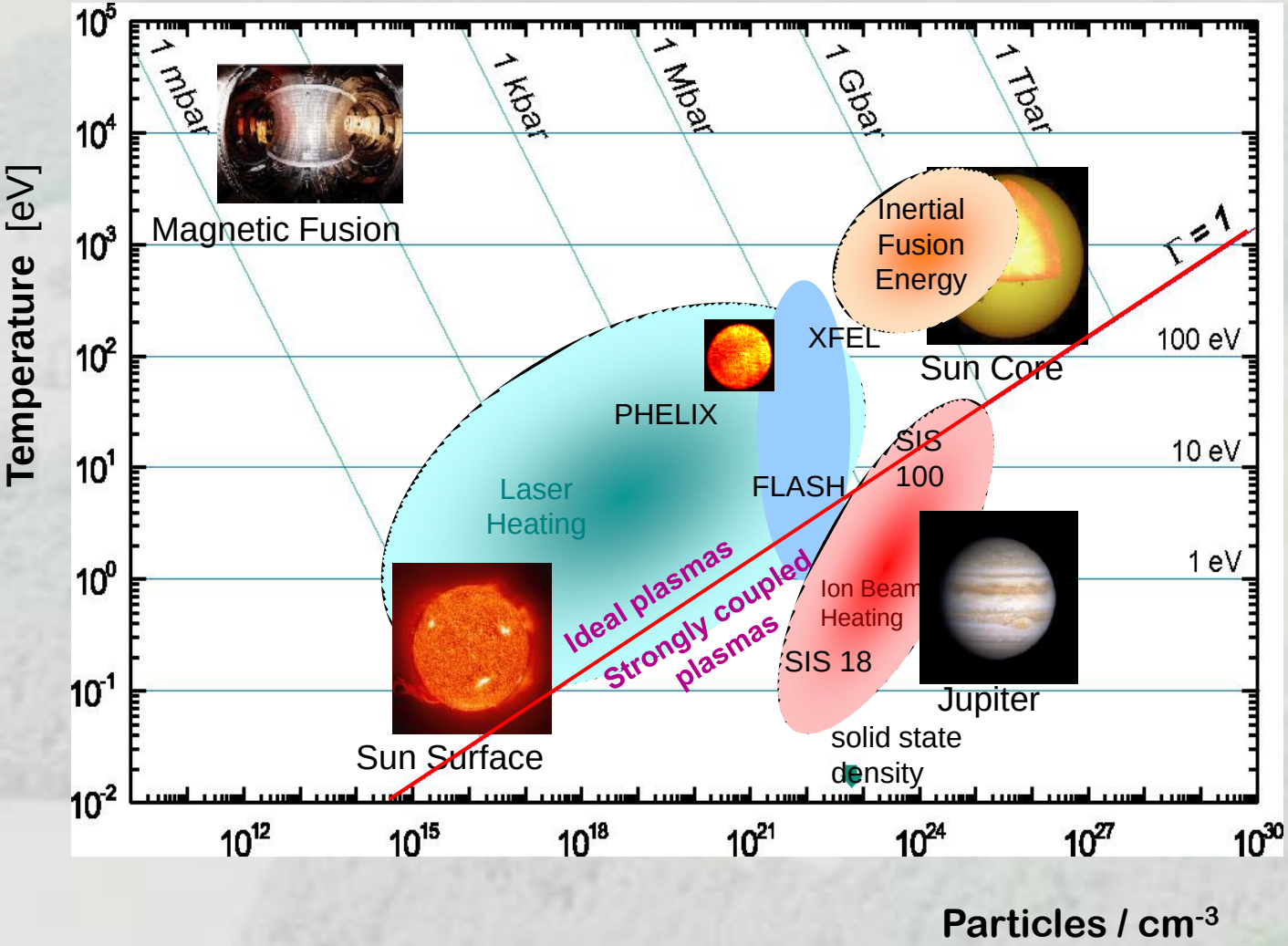
The 4 Scientific Pillars of FAIR

Atomic, Plasma Physics and Applications - APPA



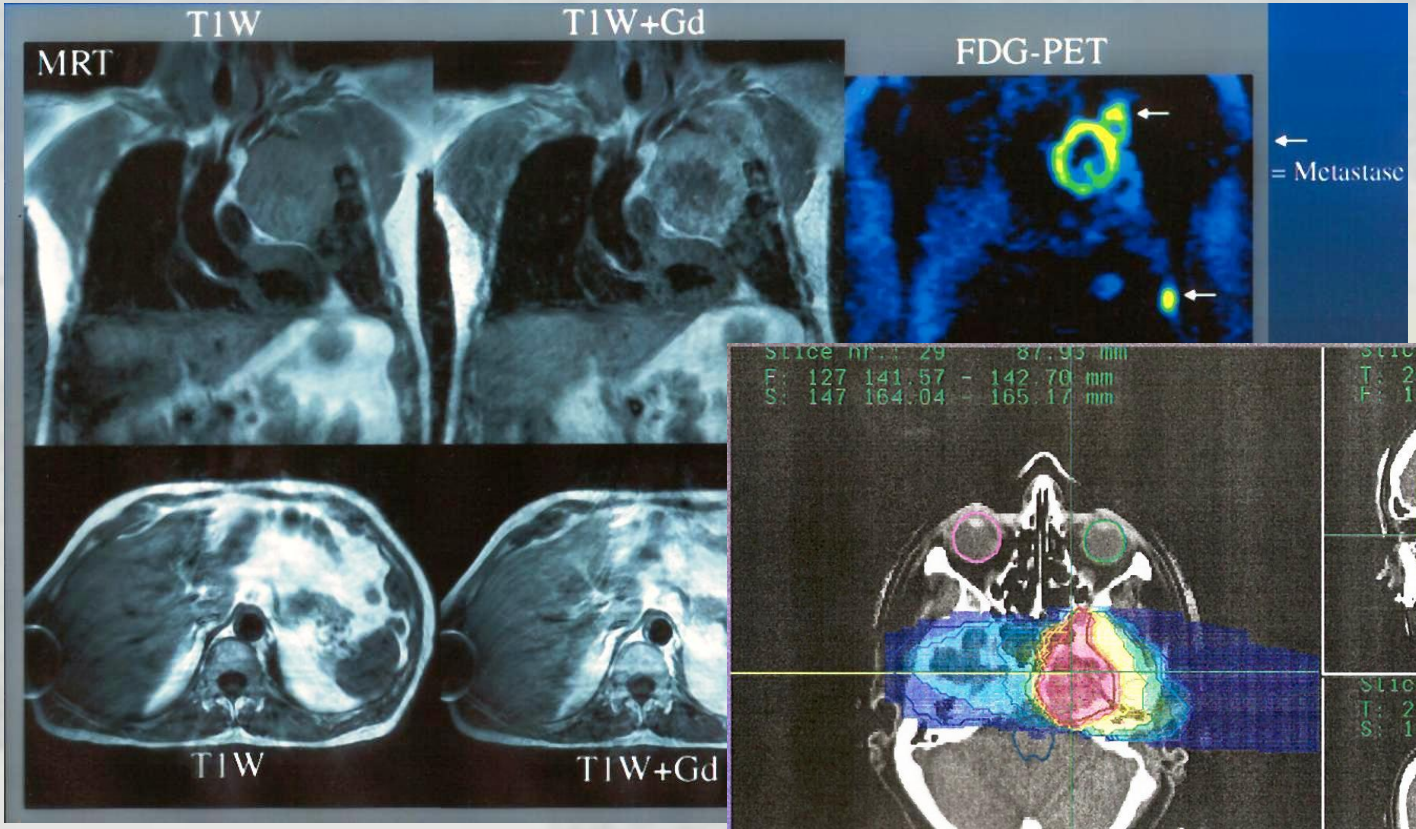
- Collaboration
  - About 500 members (with PhD)
  - Board of APPA Collaborations established
- Options explored for experiments at
  - HESR
  - Cryring at ESR
- Preparation of TDRs

APPA: Plasma Physics Reach

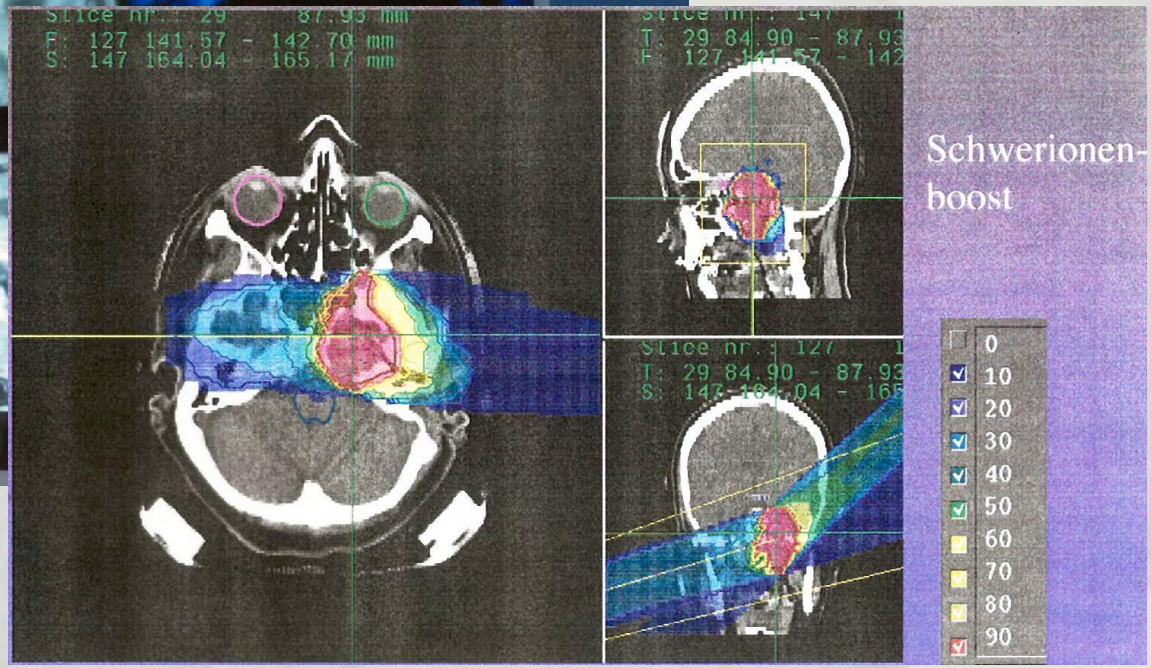


APPA: Nuclear Medicine

Small cell lung carcinoma



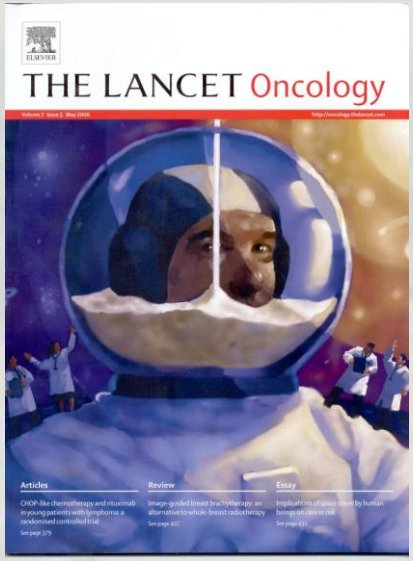
^{12}C Therapy @ GSI

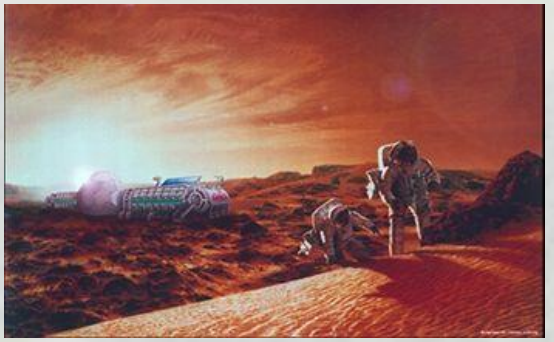


Adenoid cystic ca.

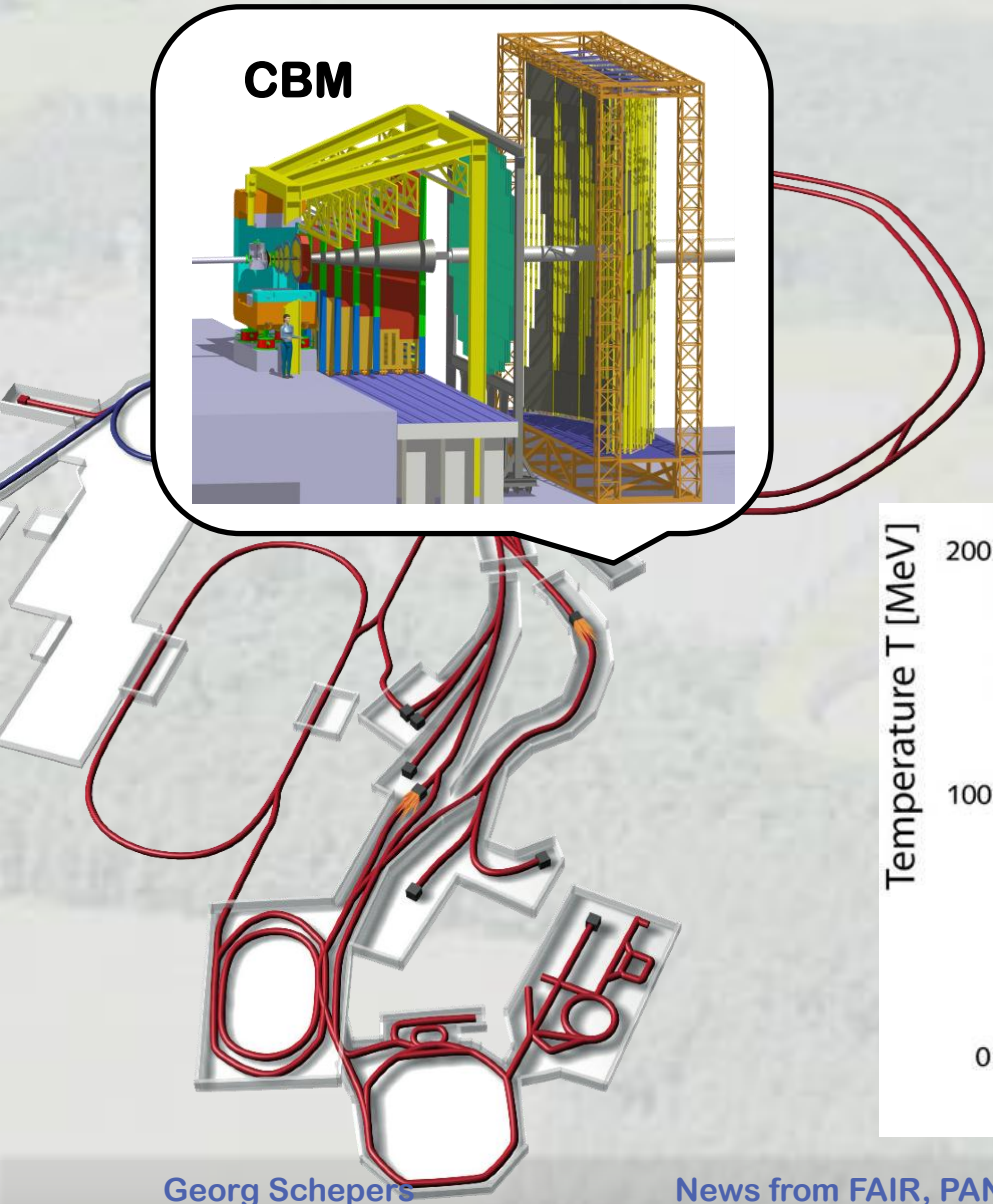
APPA: Biophysics

- **Cosmic radiation**: main hindrance toward manned space exploration: moon (2015), Mars (2030), and beyond
- High uncertainty on **biological effects of heavy ions**
- No effective countermeasures
- NASA started a large experimental campaign in **space radiation biophysics** exploiting NSRL at BNL
- ESA approved in 2008 a similar programme (IBER) in the framework of Aurora, based at GSI/FAIR

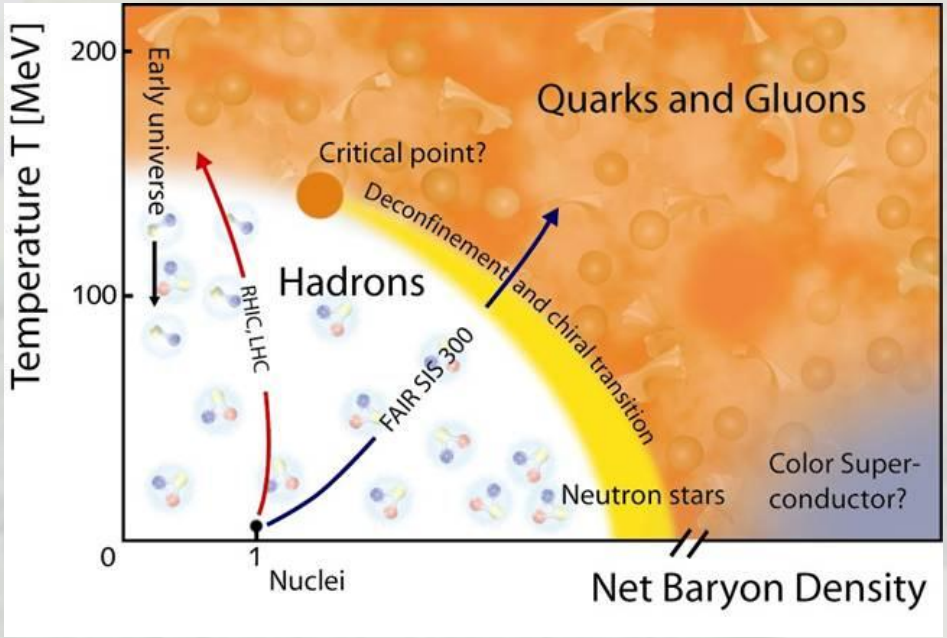




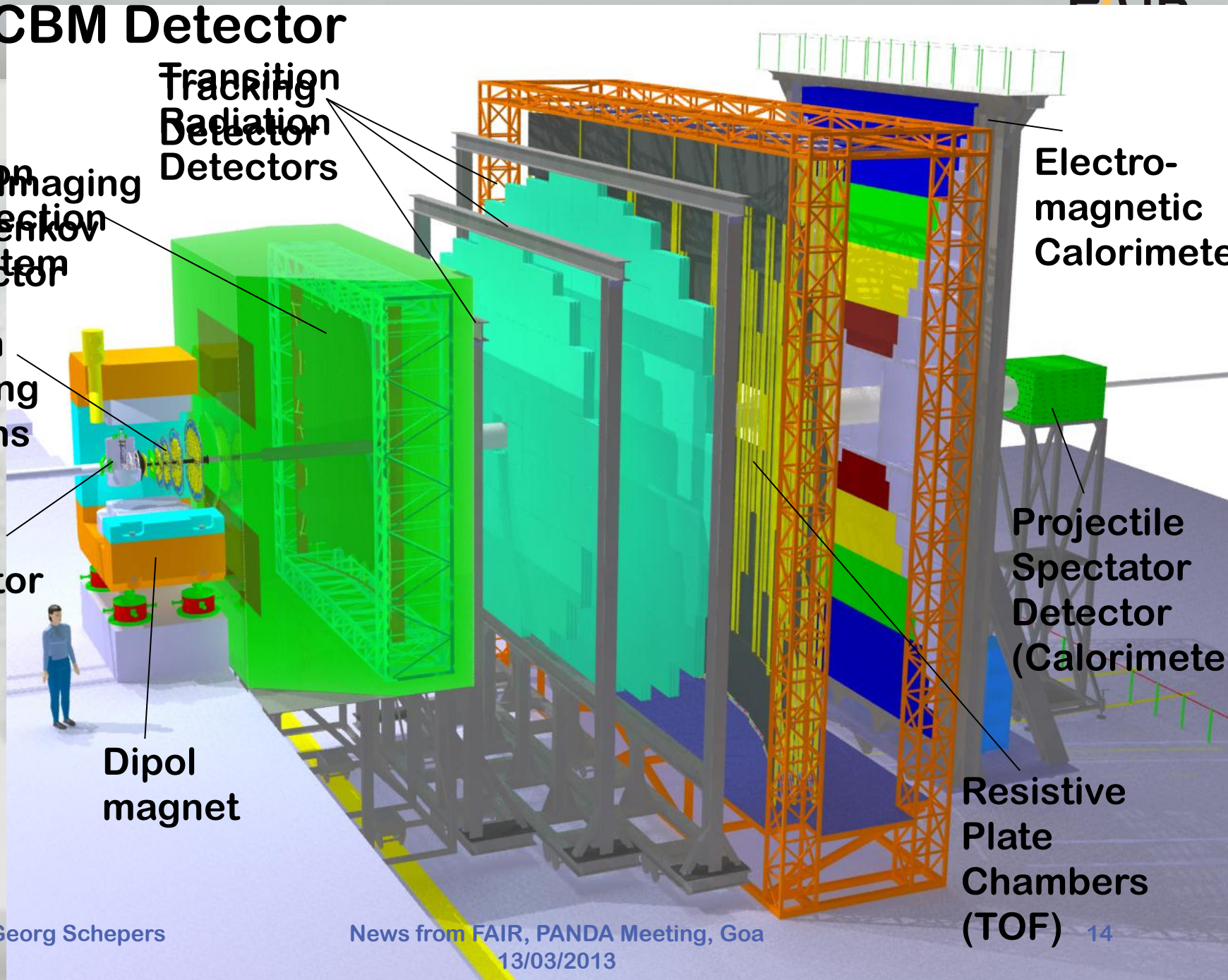
Compressed Baryonic Matter - CBM



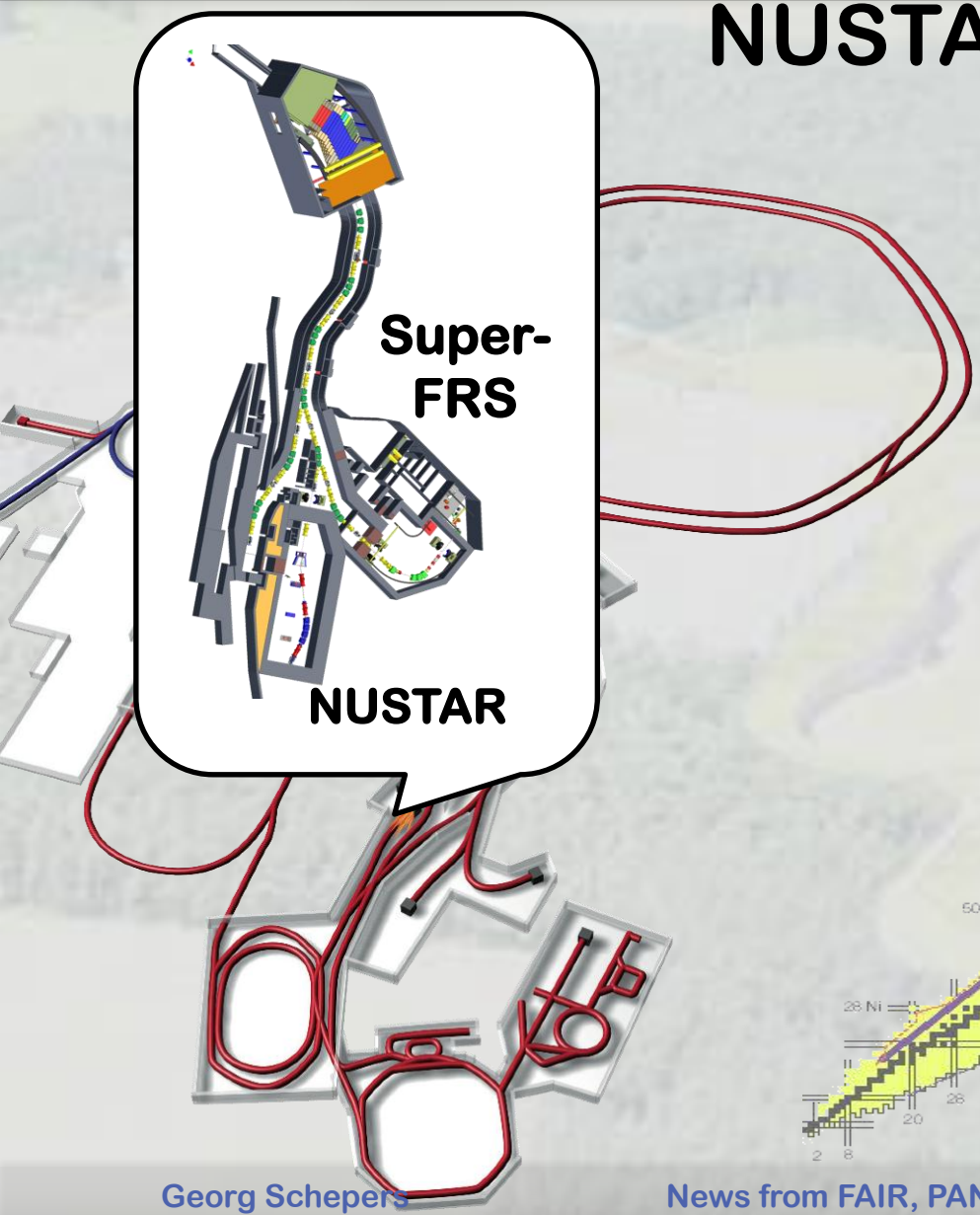
- Collaboration
  - More than 250 members (with PhD)
- Preparation of TDRs
  - 2 submitted
  - More to come



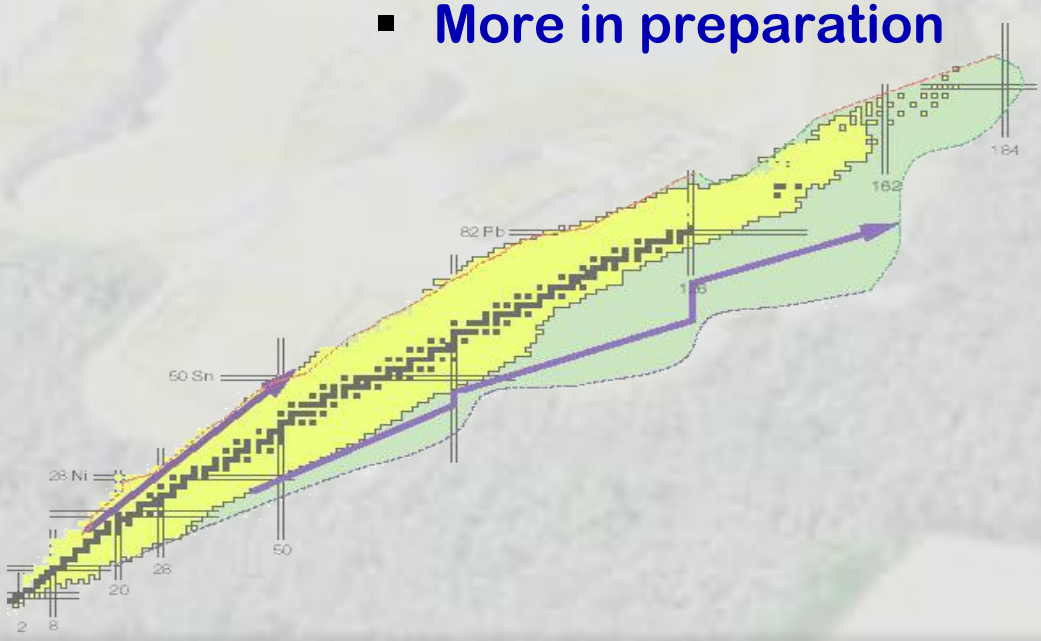
CBM Detector



NUSTAR



- Collaboration
  - About 600 members (with PhD)
- TDRs
  - 6 approved
  - More in preparation

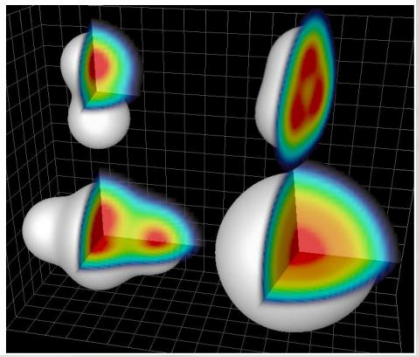


NUSTAR – Physics Case

Nuclear structure

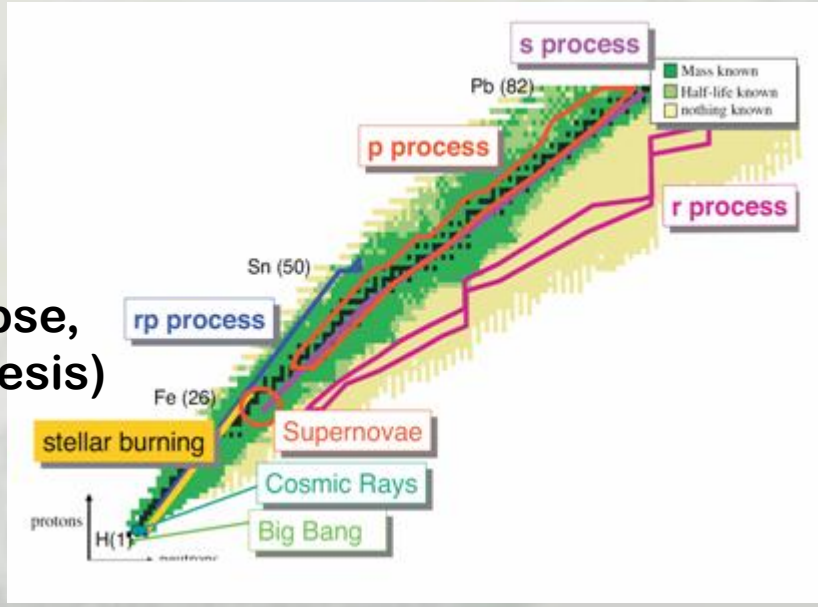
- Underlying QCD structure → complex nucleon-nucleon force
- Study of exotic short lived nuclei far off stability (proton/ neutron skins or halos, new magic numbers…)

  → Pave way for theoretical framework with predictive power for nuclei beyond experimental reach

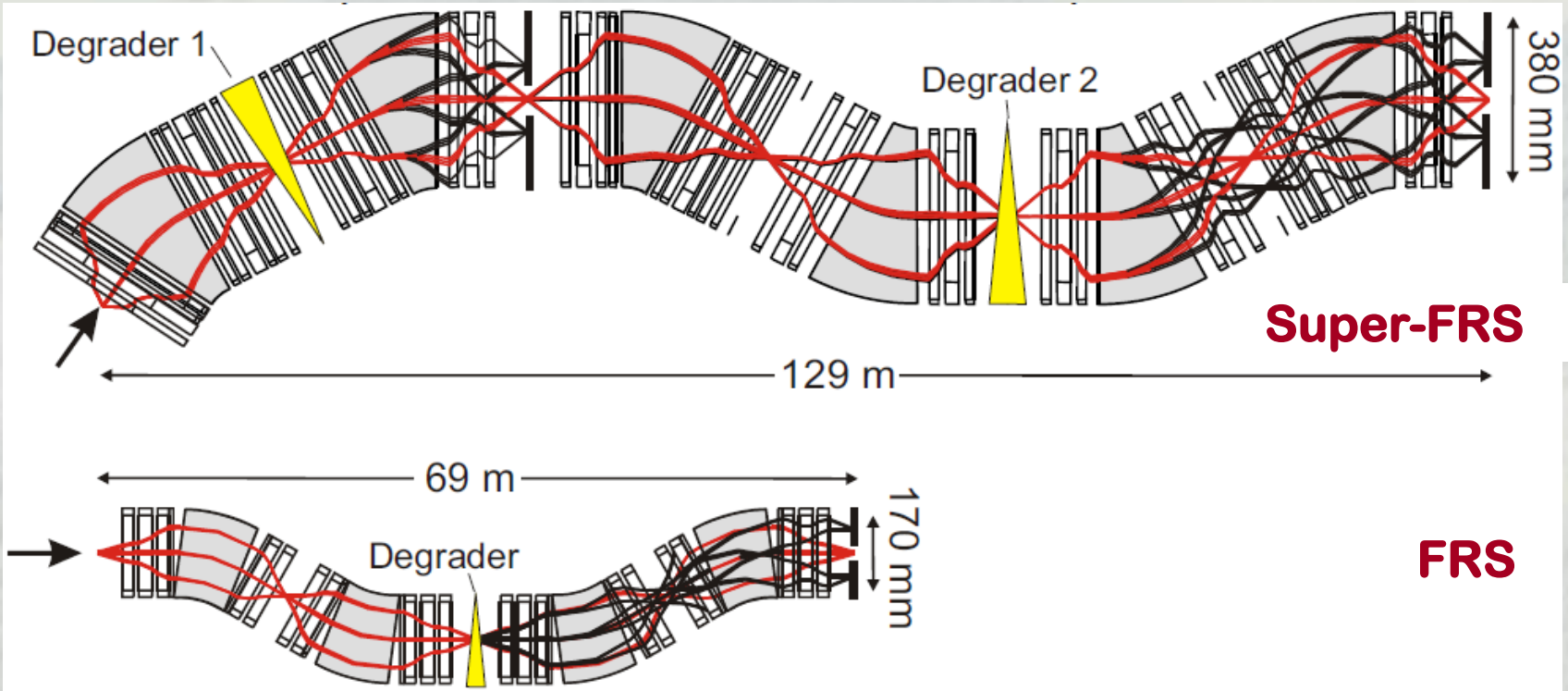


Astrophysics

- Origin of the heavy elements?
- Physics of stellar explosions (core-collapse, thermonuclear supernovae, nucleosynthesis)
- Compact objects and the explosions on their surfaces (x-ray bursts)



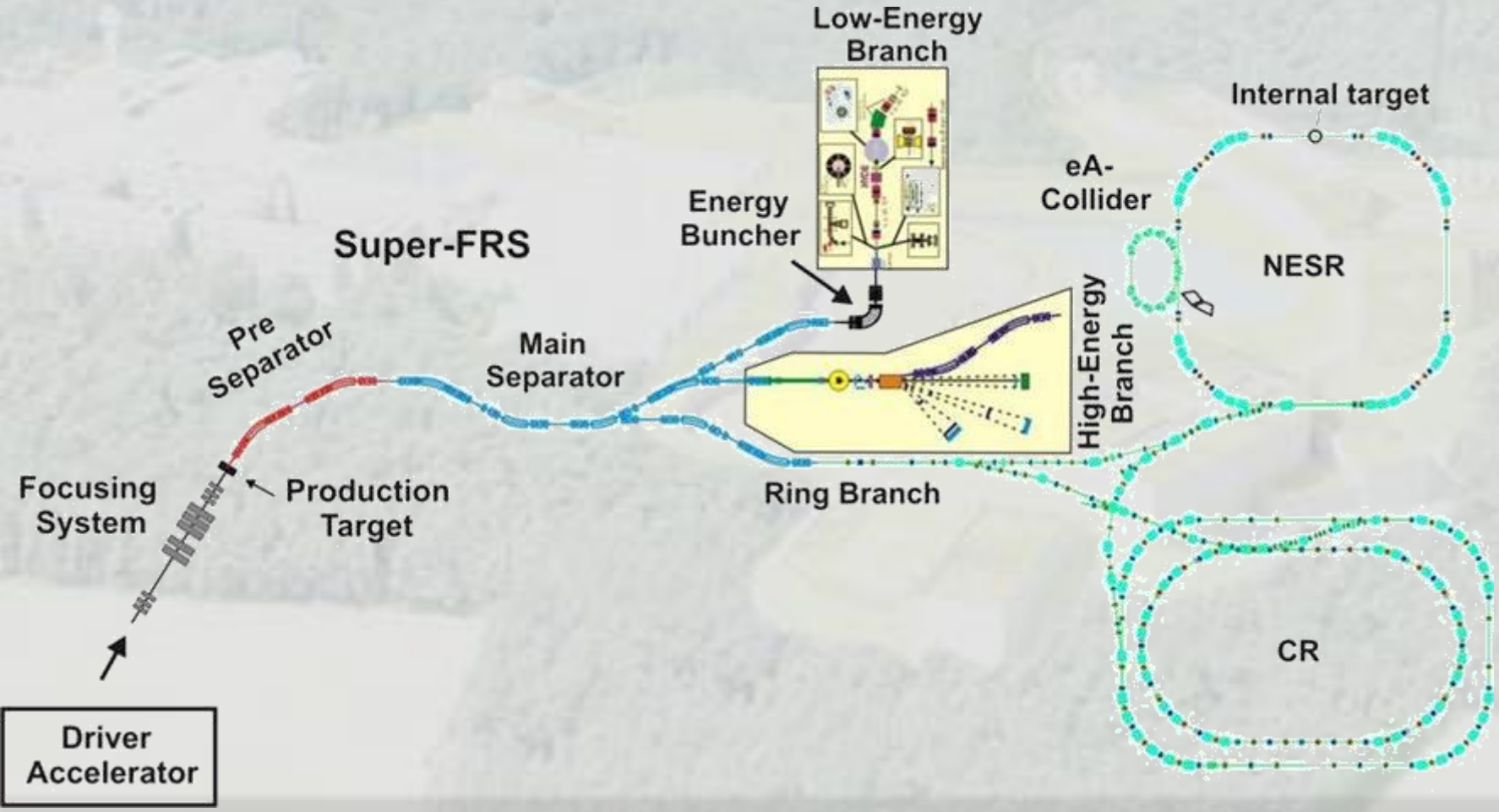
GSI FRS → FAIR Super-FRS



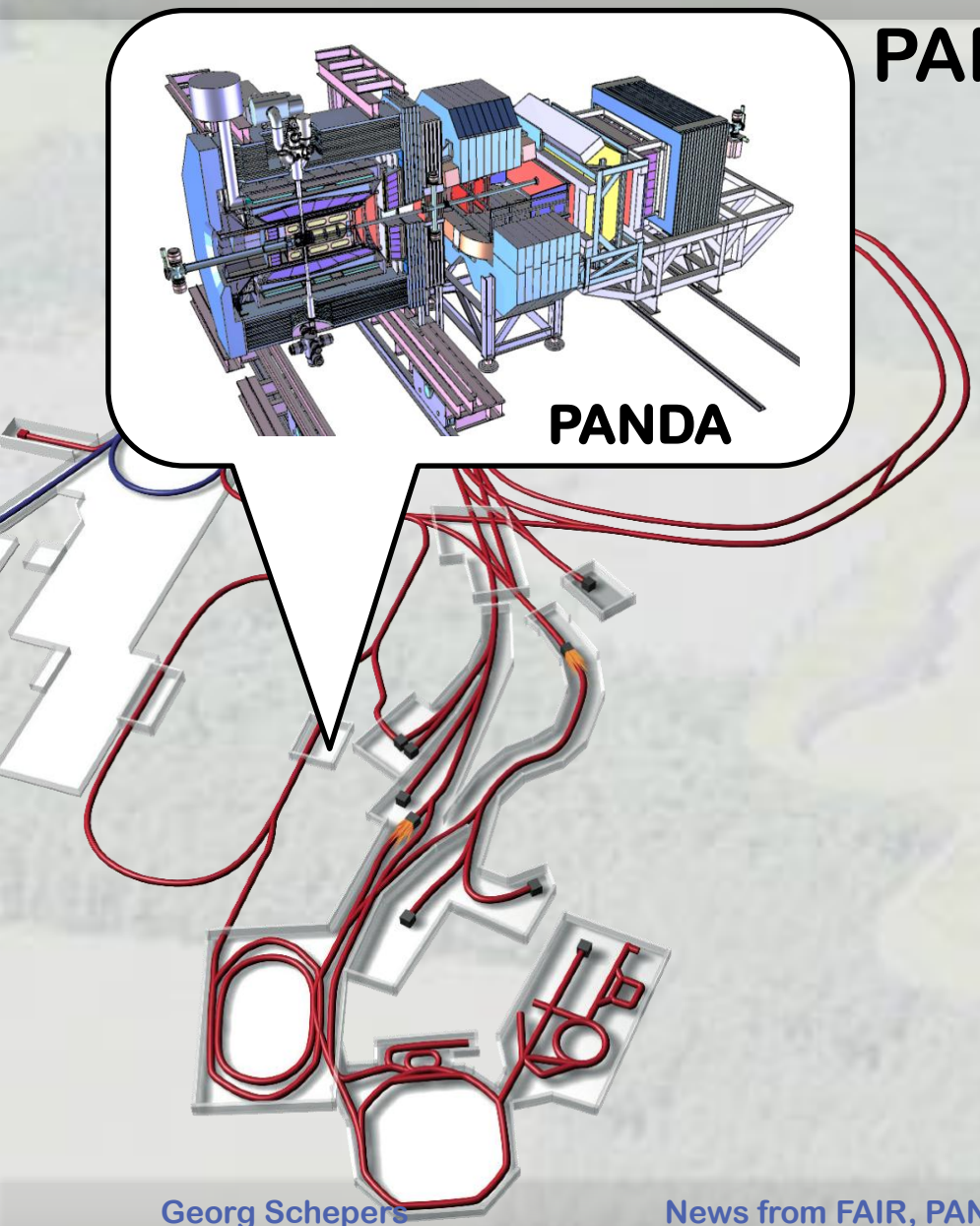
	$B\rho_{max}$	$\Delta p/p$	$\Delta\Phi_x$, $\Delta\Phi_y$	resolving power	gain factor ^{19}C	gain factor ^{132}Sn
FRS	18 Tm	1.0 %	±13, ±13 mrad	1500	1	1
Super-FRS	**20 Tm**	**2.5 %**	**±40, ±20 mrad**	**1500**	5	10
				including primary rate	**1000**	**7500**

NUSTAR

- Production of intensive rare isotope beams by in-flight projectile fragmentation/fission (access to short-lived isotopes)
- Detailed investigations, large variety of experimental techniques

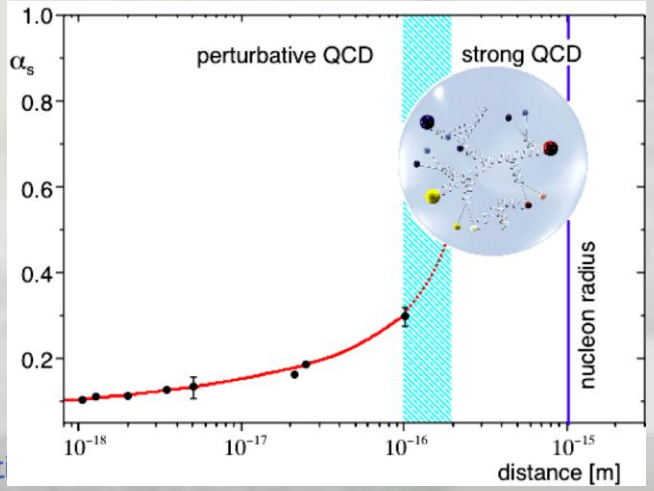


Antiproton Anihilations at Darmstadt



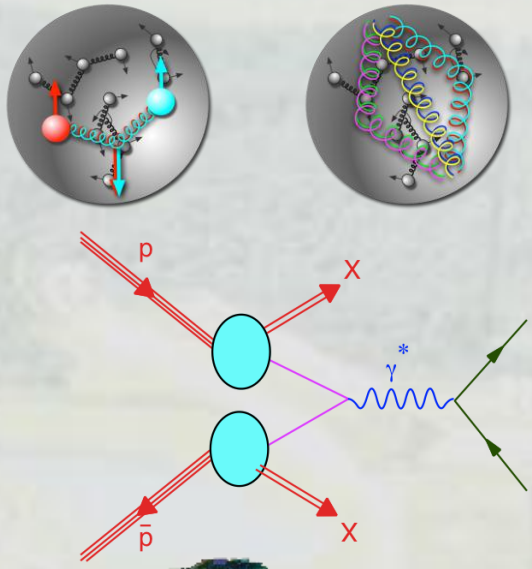
PANDA

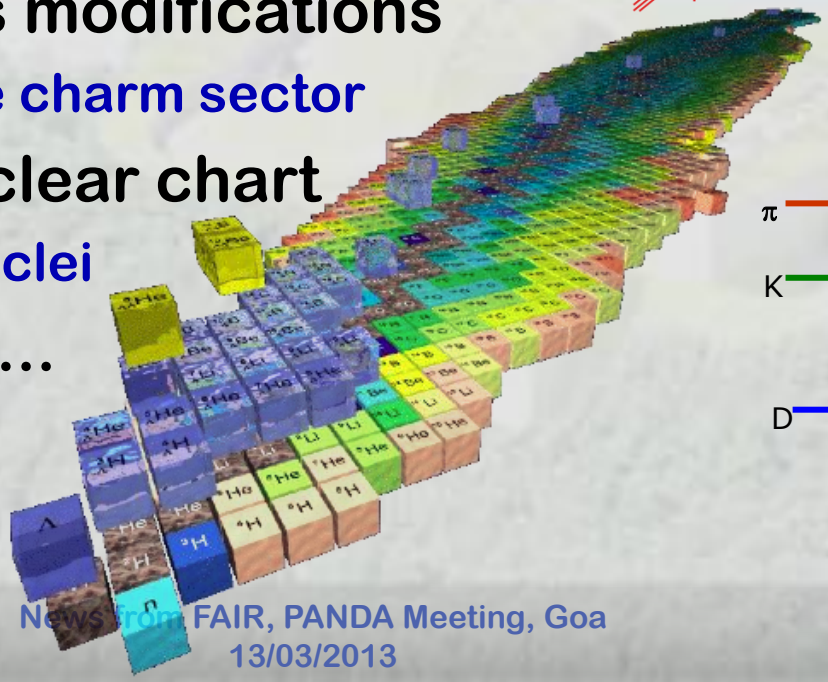
- Collaboration
  - About 340 members (with PhD)
  - Premounting at FZJ being prepared
- TDRs
  - 4 approved
  - 2 under review
  - More in preparation

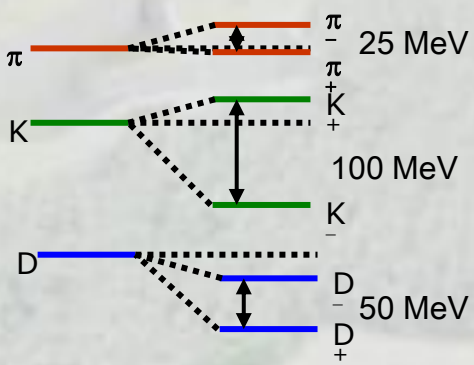


PANDA Physics Case

- Gluonic excitations
  - Hybrids, glueballs
- Charmonium states
  - Precision spectroscopy
- Time-like
  - Form factors, nucleon structure
- In medium mass modifications
  - Extension to the charm sector
- Extension of nuclear chart
  - Double hypernuclei
- And much more…

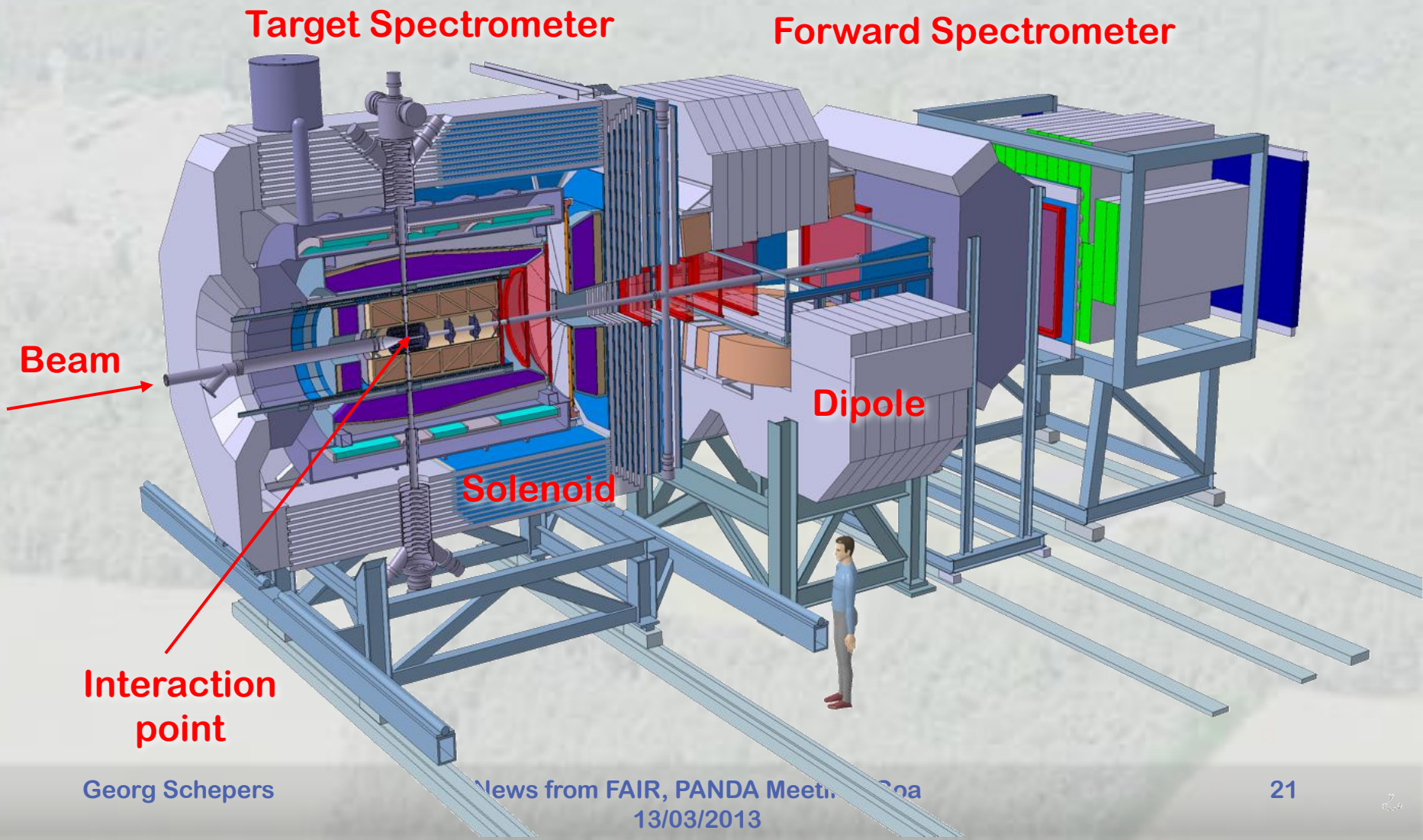






PANDA Experimental Set-Up

- Fixed target magnetic spectrometer experiment



Current Status

History: FAIR Convention End of 2010

Signing of the FAIR Convention by representatives of the founding countries Finland, France, Germany, India, Poland, Romania, Russia, Slovenia and Sweden in Wiesbaden on **4/10/2010**

Funding Modules 0-3

Contracting Party	Contribution (in 2005 M€)
Finland	5.00
France	27.00
Germany	705.00
India	36.00
Poland	23.74
Romania	11.87
Russia	178.05
Slovenia	12.00
Sweden	10.00
Total	**1.008,66**

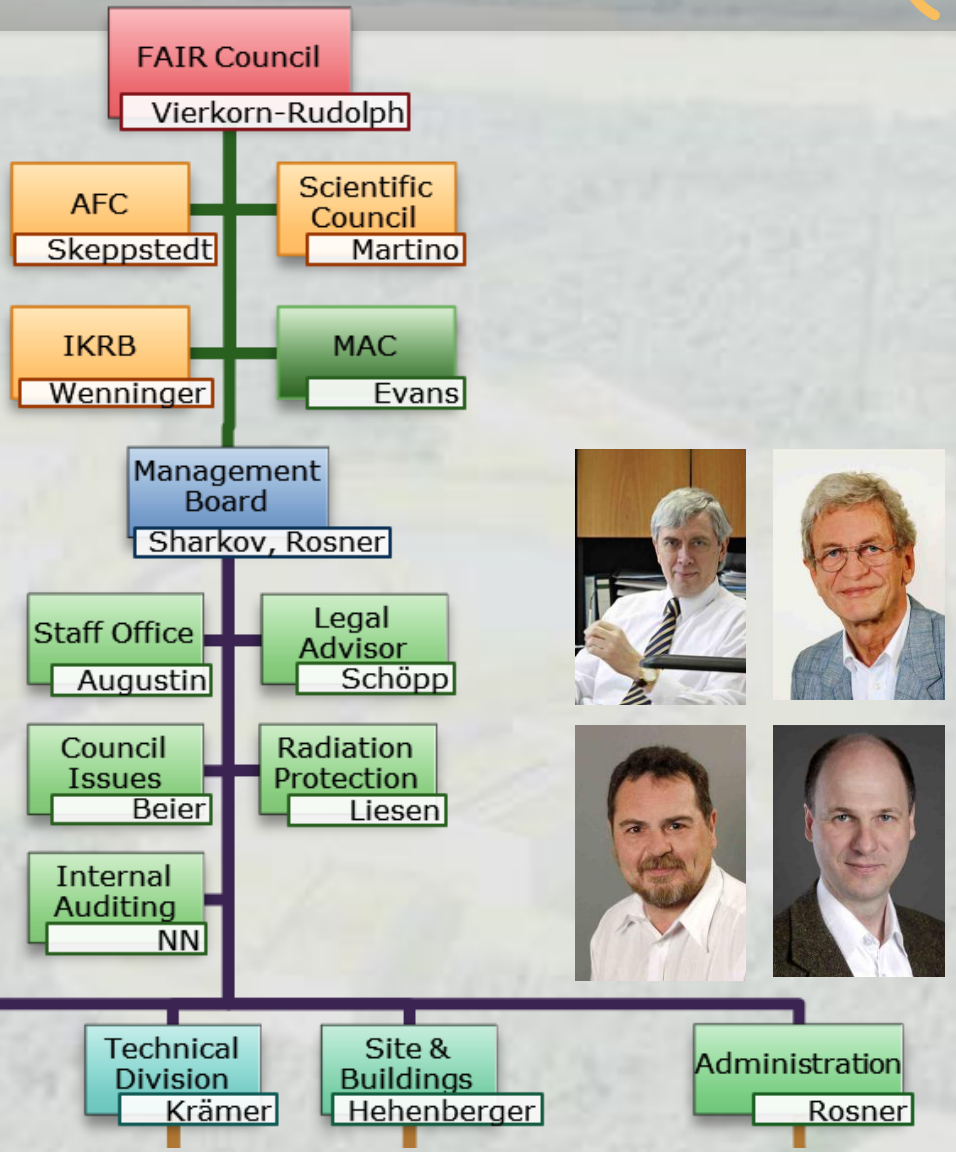
- **All numbers in 2005 €** (escalation until 2018 ca. +50%)
- Spain expected to join soon (with 11.87 M€)
- China and the UK are potential Associate FAIR Members and will contribute to the experiments (6.6 M€)

Project Organisation

- 2 companies
  - Helmholtz Centre GSI
  - FAIR Europe GmbH
- Collaboration for common project

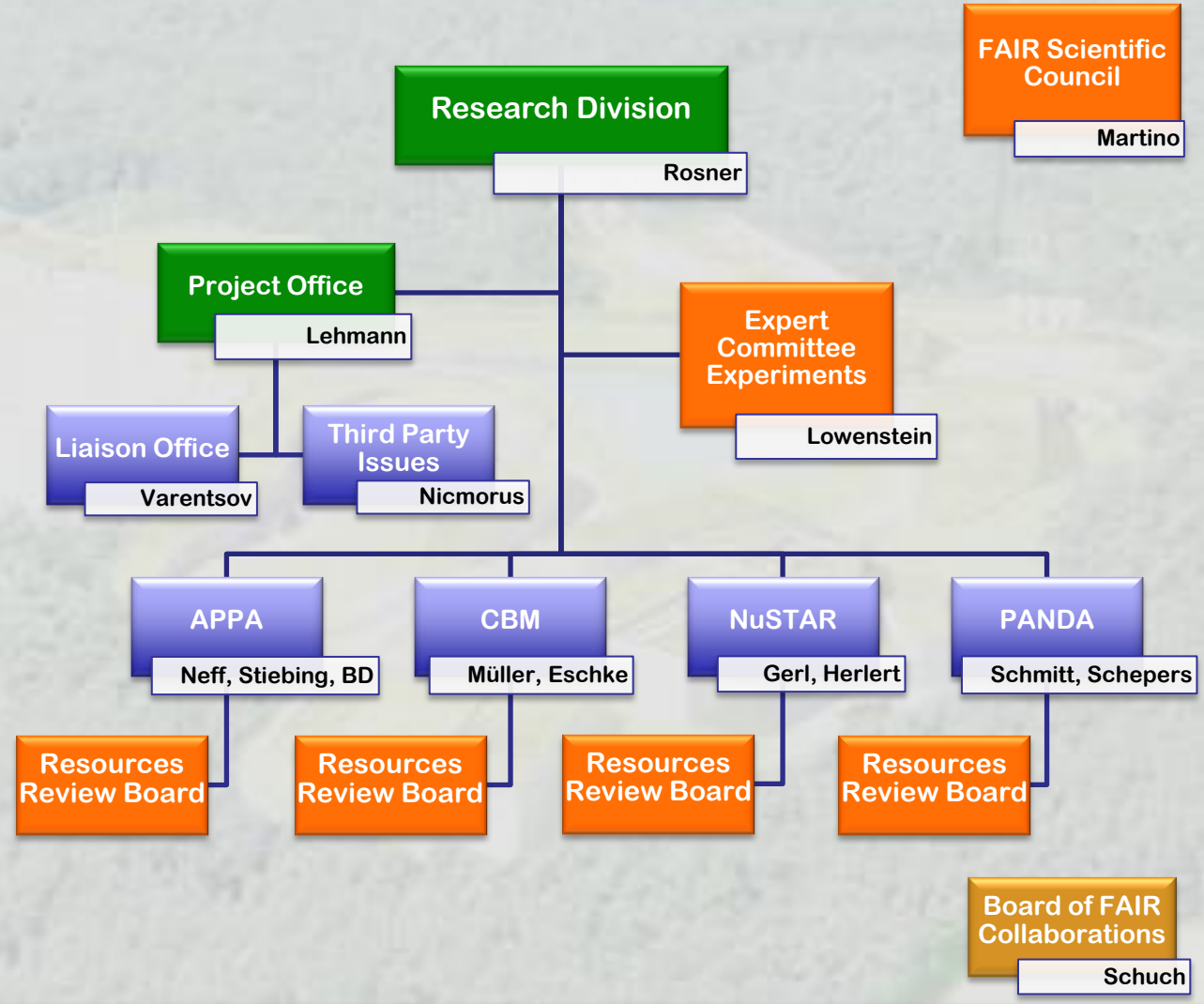
FAIR GmbH

- Governed by Council
  - 9 shareholders
    - India 3.5%: 36 M€
  - Chaired by
    - Beatrix Vierkorn-Rudolph
    - Sibaji Raha (vice)
- Working solely for FAIR Project



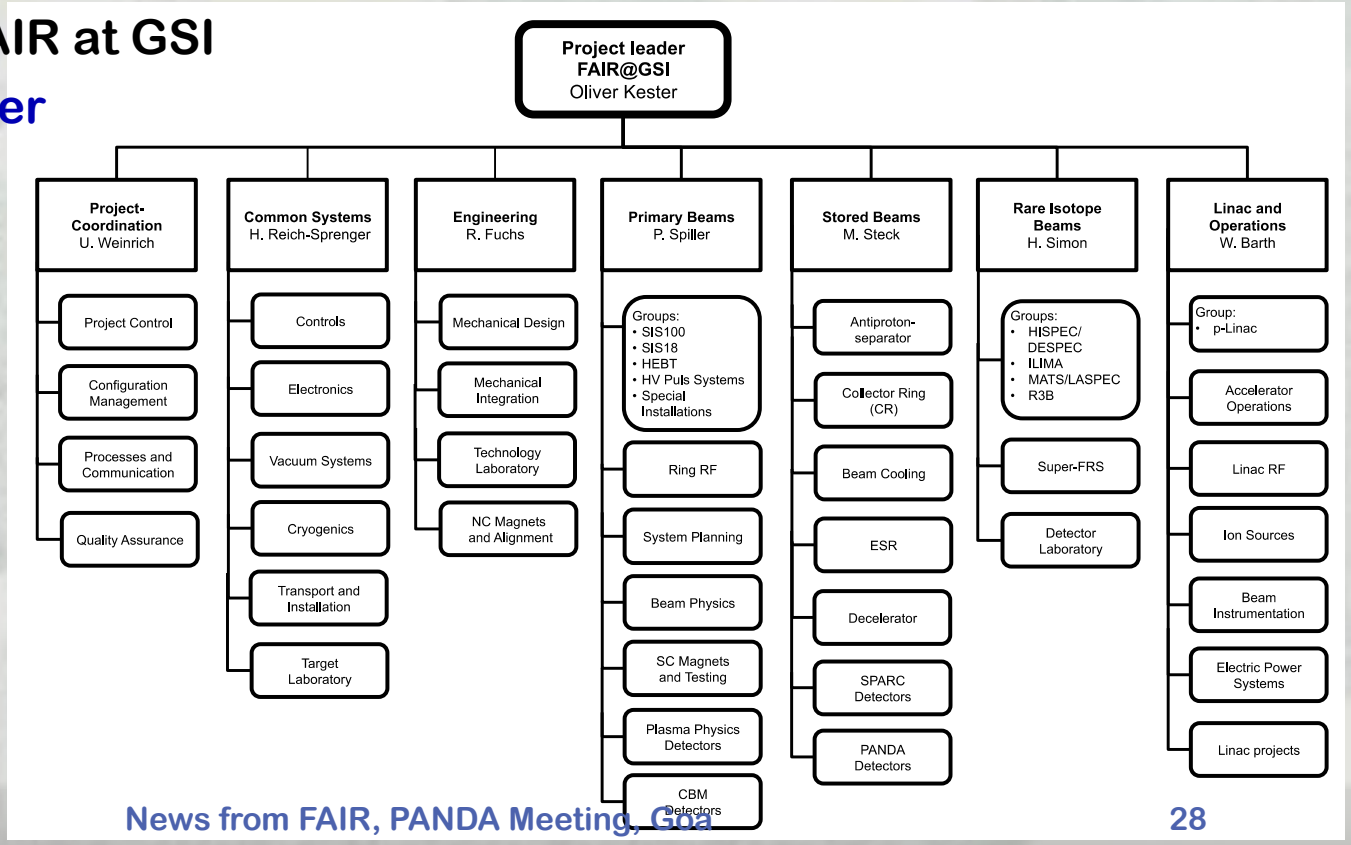
FAIR Research Division

- Experiment Coordinators
  - in place
- Expert Committee Experiments
  - 1st meeting 19 Nov. 2012
  - 5 TDRs approved
- Scientific Council
  - 2nd meeting 28 Nov. 2012
- Resources Review Boards
  - first meetings Spring 2013



Helmholtz Centre GSI

- GSI currently being restructured
  - Main focus FAIR Project
  - Head of GSI Council:
    - Beatrix Vierkorn-Rudolph
  - GSI managing directors: Horst Stöcker, Peter Hassenbach
- Project lead FAIR at GSI
  - Oliver Kester



FAIR Construction Site Jan 2013

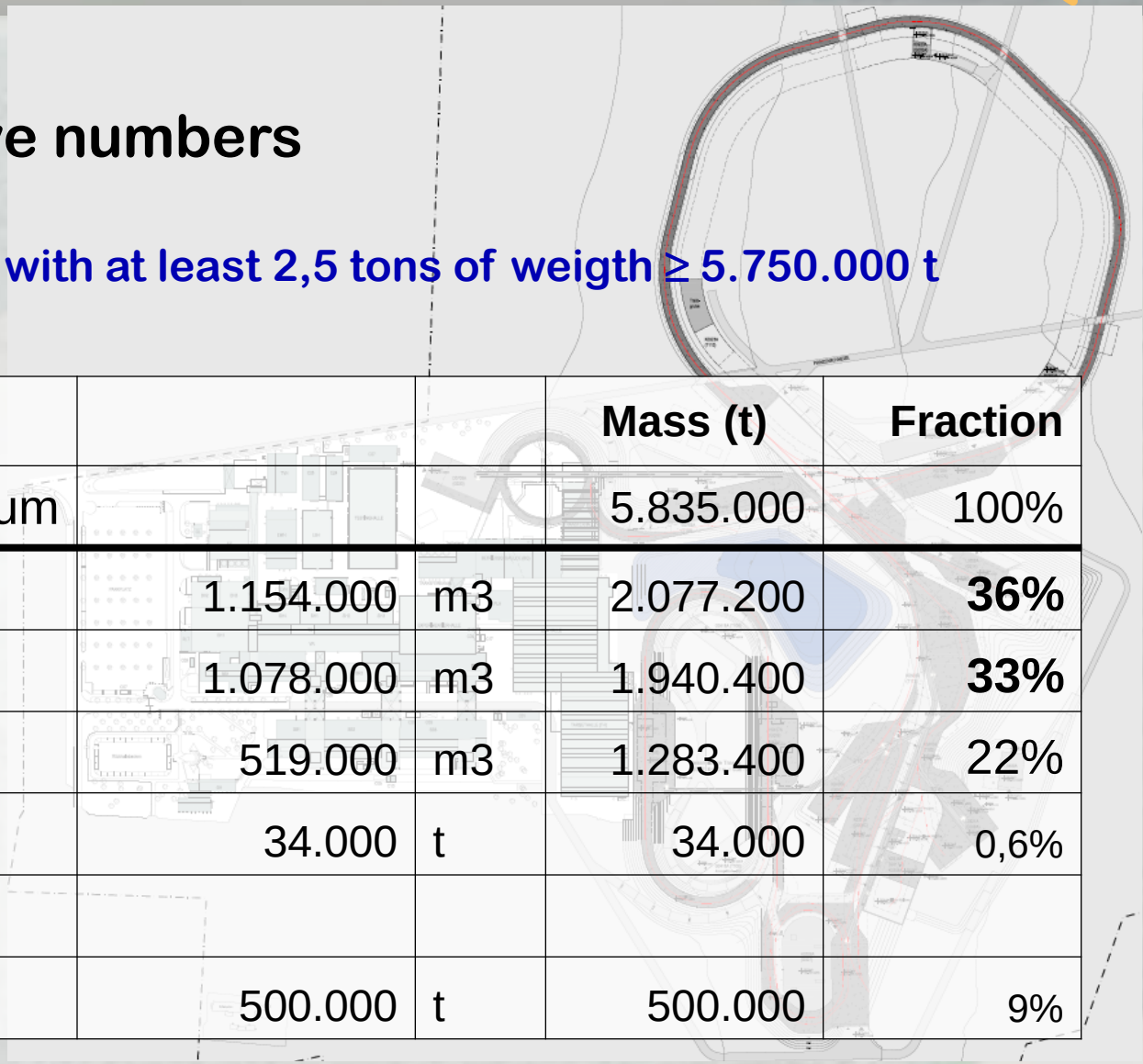
webcam monitoring the construction site
http://fair-center.eu/

First Post Drilling 31/8/2011

Civil Construction

Some illustrative numbers

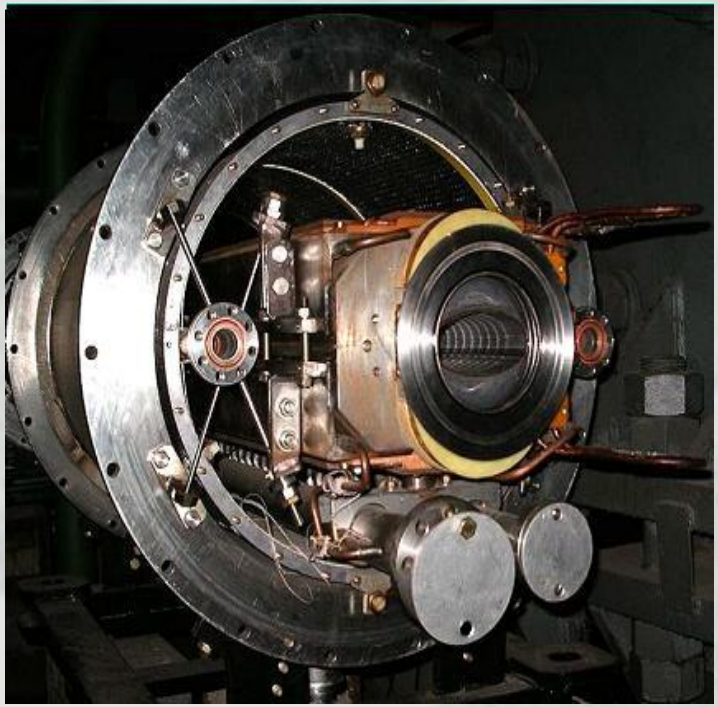
Cheops Pyramid:
2,3 Millionen Stones with at least 2,5 tons of weigth ≥ 5.750.000 t



Type			Mass (t)	Fraction
Sum			5.835.000	100%
Soil out	1.154.000	m3	2.077.200	**36%**
Soil in	1.078.000	m3	1.940.400	**33%**
Concrete	519.000	m3	1.283.400	22%
Steel for concrete	34.000	t	34.000	0,6%
Other	500.000	t	500.000	9%

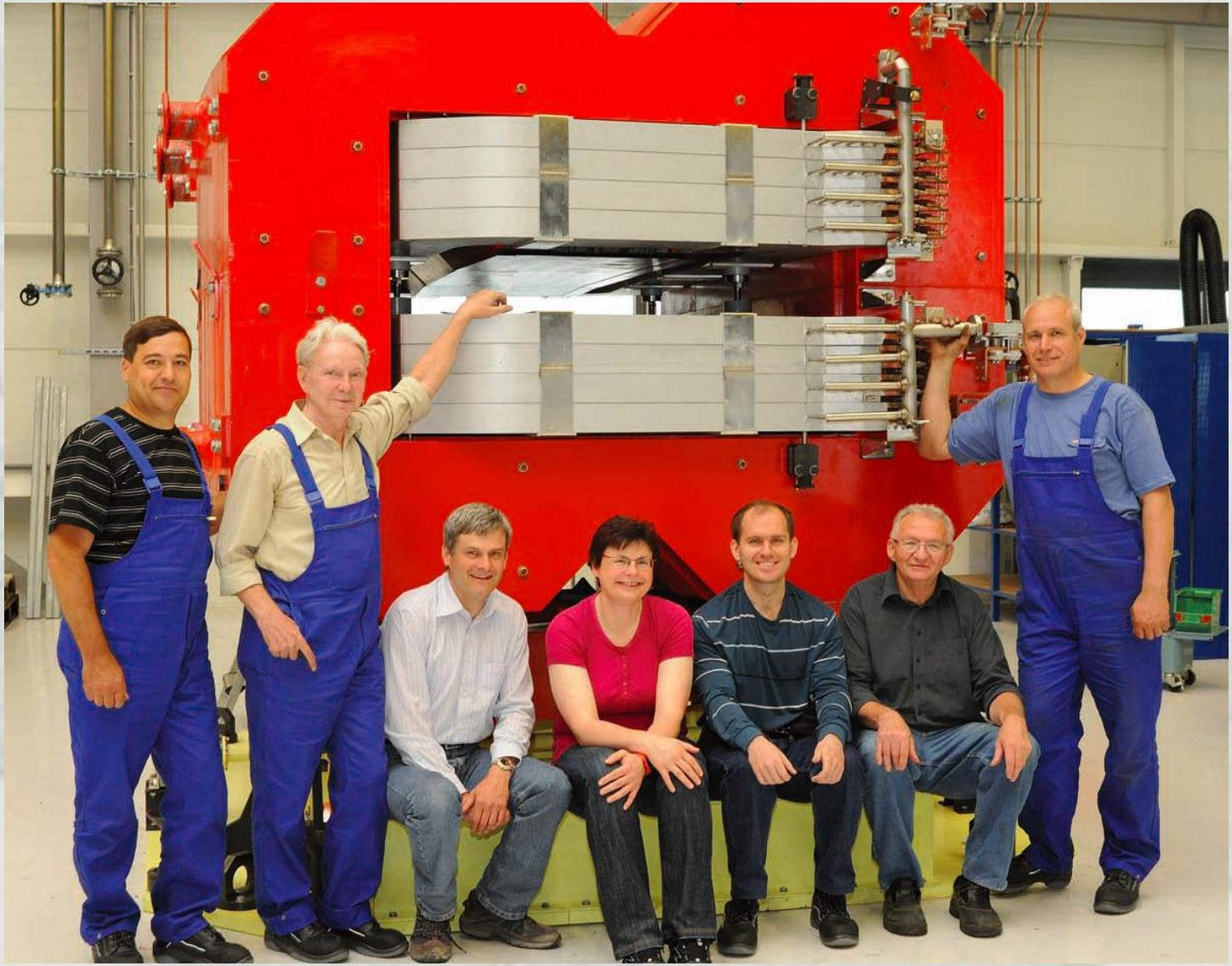
Accelerators

Compact & cost effective
Fast cycling superconducting magnets
dB/dt ~ 4T/s



- **Ordered for SIS100 from Babcock Noell in Jan. 2012 (German in-kind contribution, BMBF grant to GSI)**
- **Many other parts of SIS100 and CR in preparation (in-kind or tender)**
- **HESR ready to go out for tender (BMBF grant through FAIR)**

First SuperFRS Magnet



Funding Early 2012

- Cheques
  - 50 M€
  - +Verbundforschung
  - 64+ M€

Funding July 2012

- 526 M€ for construction
  - largest BMBF grant ever

Licensing Applications / Permits

- General construction permit for all buildings by city of Darmstadt: Oct 2012
- 4 of 13 radioprotection licenses received;

Timelines

6 Submission building permits

7 Site preparation

8 Civil construction contracts

9 Building of accelerator & detector components

10 Completion of civil construction work

11 Installation & commissioning of accelerators and detectors

12 Data taking

The 4 Scientific Pillars of FAIR

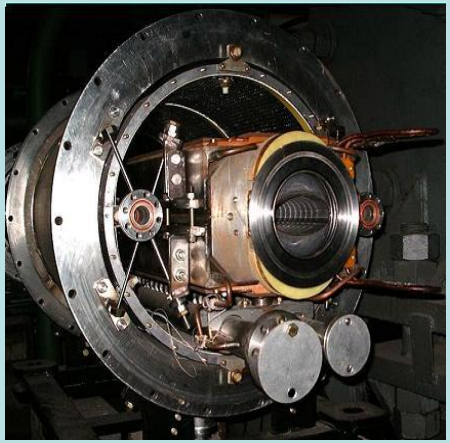
Construction

FAIR Experiment Collaborations

- APPA
- CBM
- NUSTAR
- PANDA

all extremely well evaluated by the Scientific Council

Accelerators



Strong International Partners

FAIR Council

Resources Review Board

Thank you