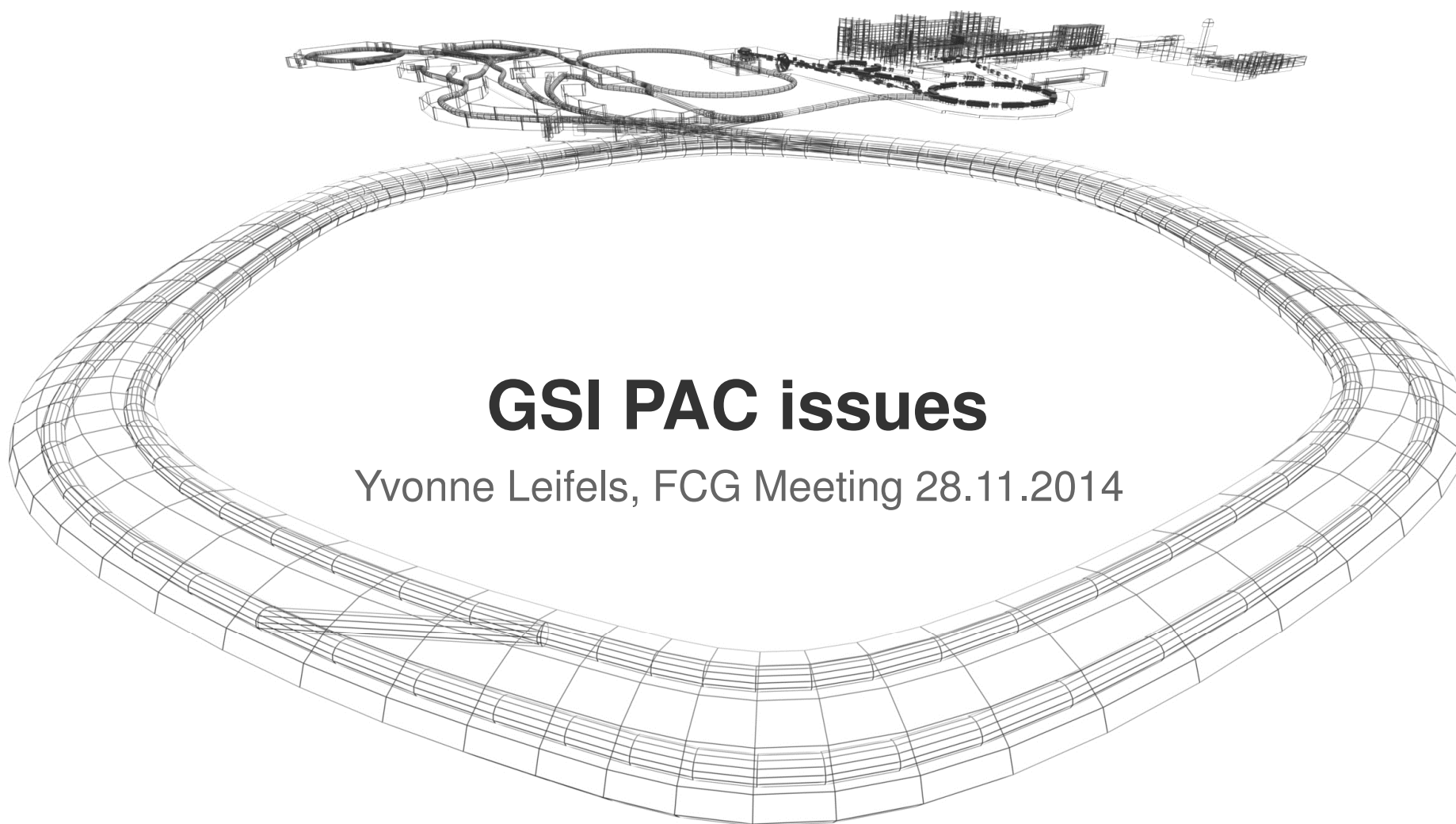


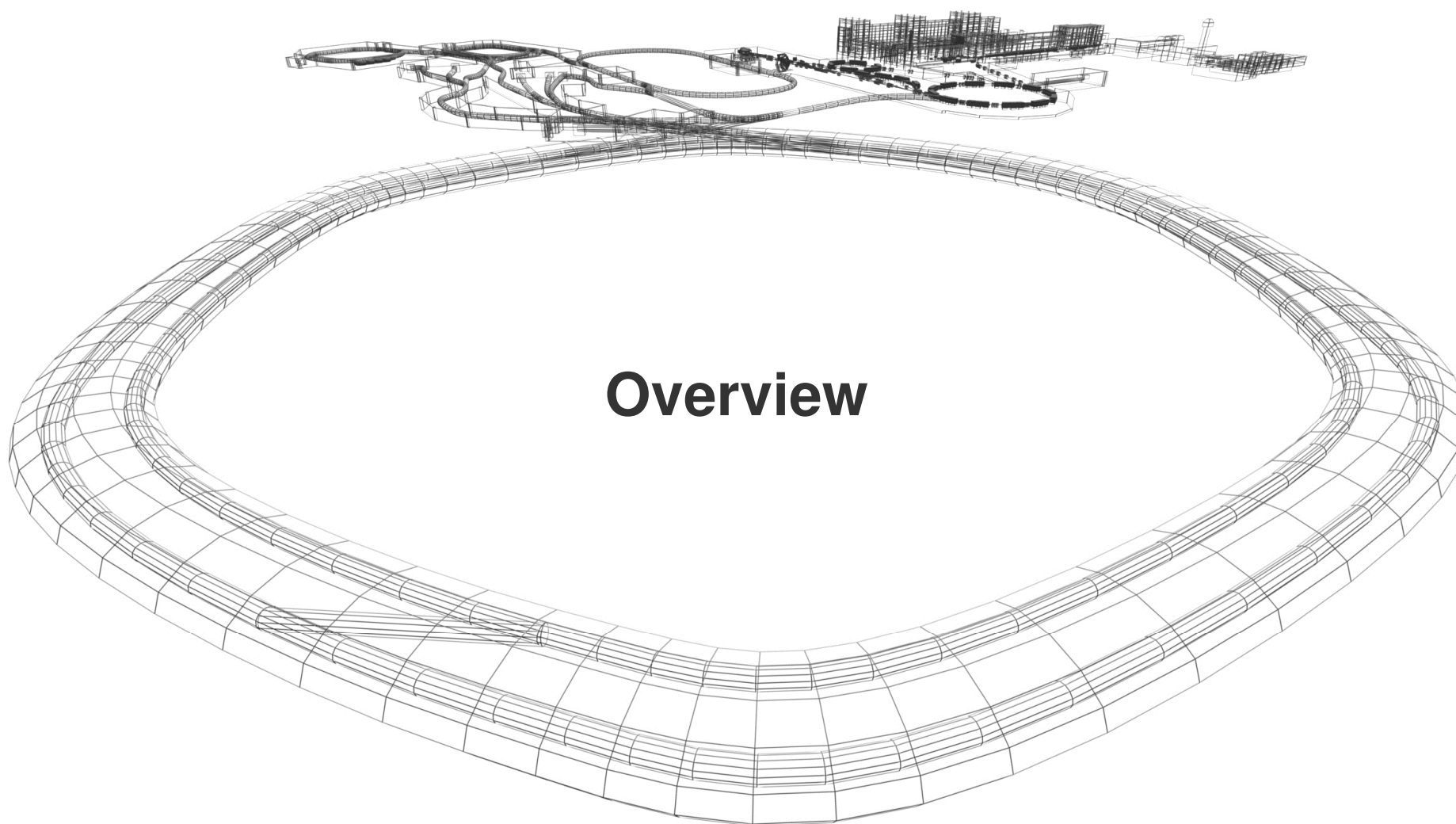


GSI PAC issues

Yvonne Leifels, FCG Meeting 28.11.2014

Outline

- Overview
- Summary of ENSAR activities
- Outlook
 - Research in the times of FAIR construction



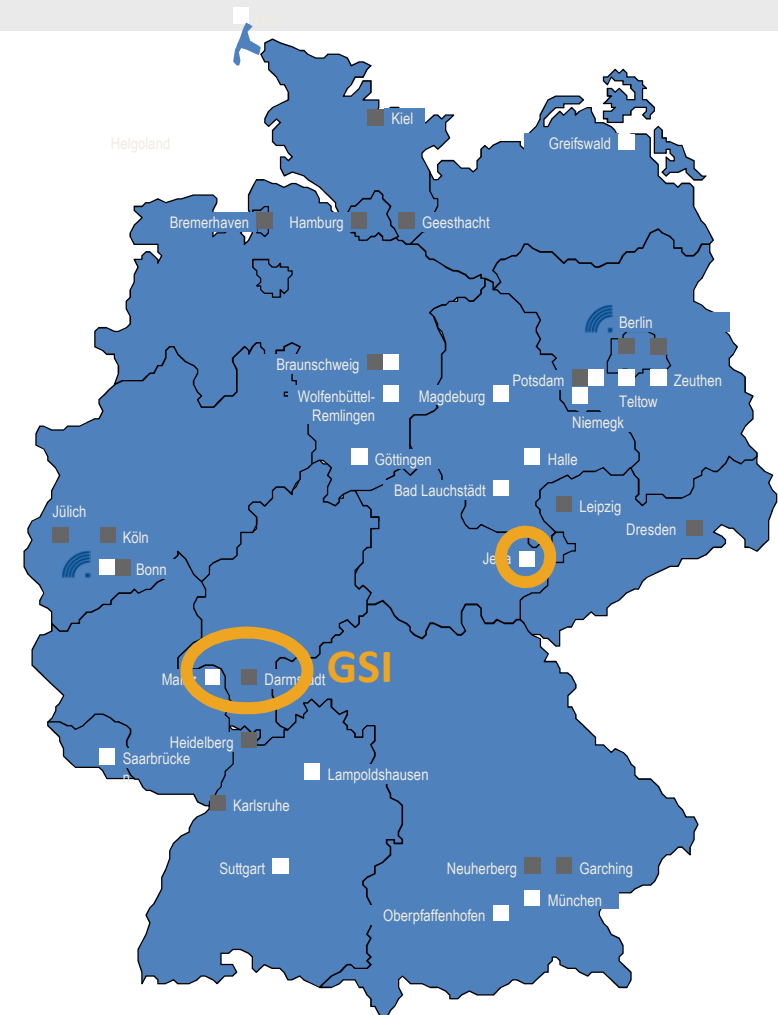
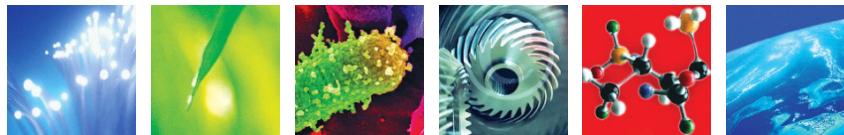
Overview

GSI – member of the Helmholtz association

- Helmholtz: Facts and Figures

- 18 Research Centres
- 37.000 Employees
- 15.000 Scientists & Engineers
- 7.000 Doctoral Students
- Budget ca. 3.9 Billion Euro
(including Third Party Funding)

Largest Research Organization in Germany



Stammsitz



HELMHOLTZ
| GEMEINSCHAFT

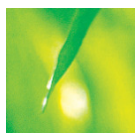
Helmholtz

GSI – Member of the Helmholtz association

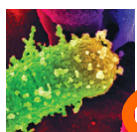
HGF research areas



Energy



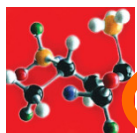
Earth and Environment



Health



Key Technologies



Matter



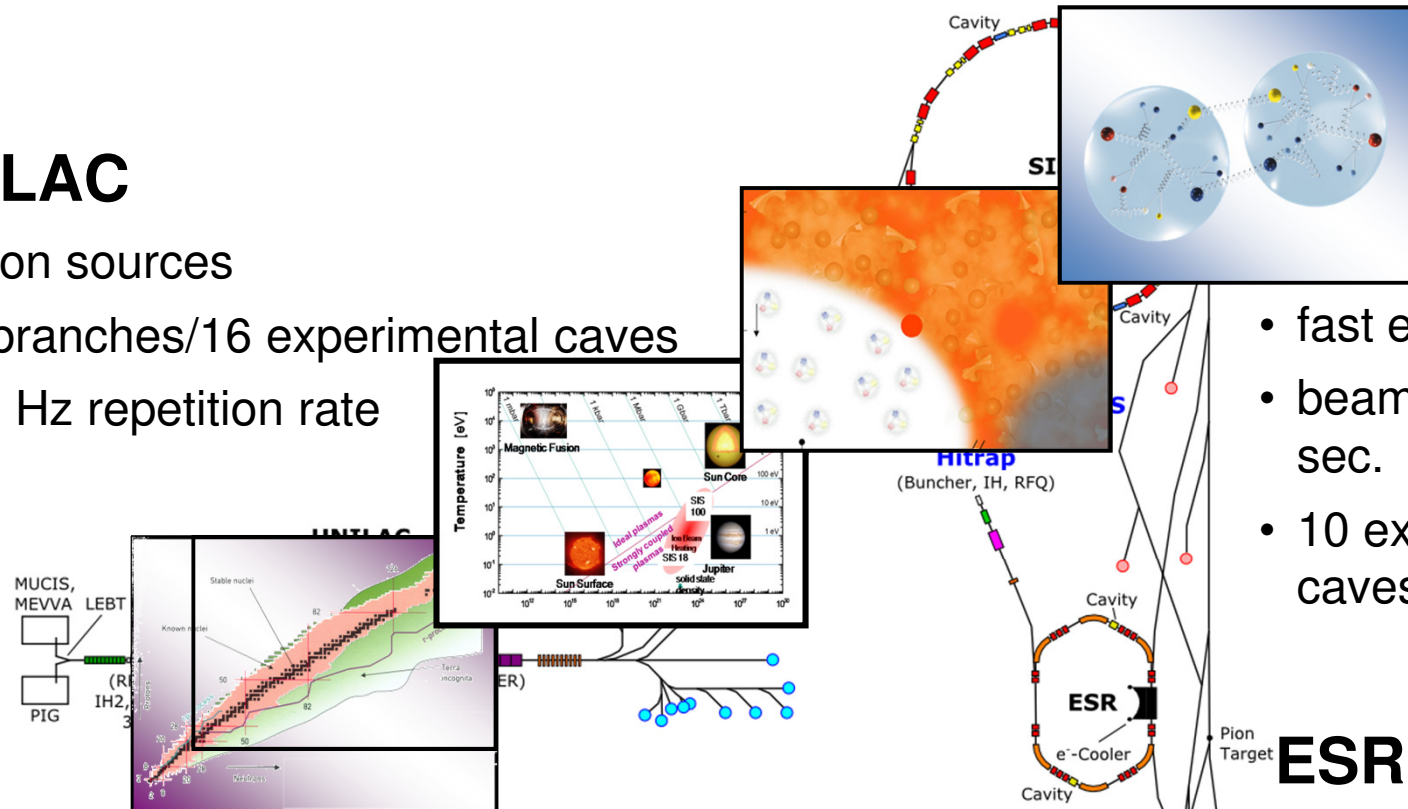
Transport and Space



GSI research infrastructures

UNILAC

- 3 ion sources
- 4 branches/16 experimental caves
- 50 Hz repetition rate



Research Topics

- nuclear structure, nuclear astrophysics
- atomic physics, plasma physics, biophysics, materials research and applications
- nuclear and quark matter
- hadron physics

0 25 m
A. Bloch-Späh, 2011

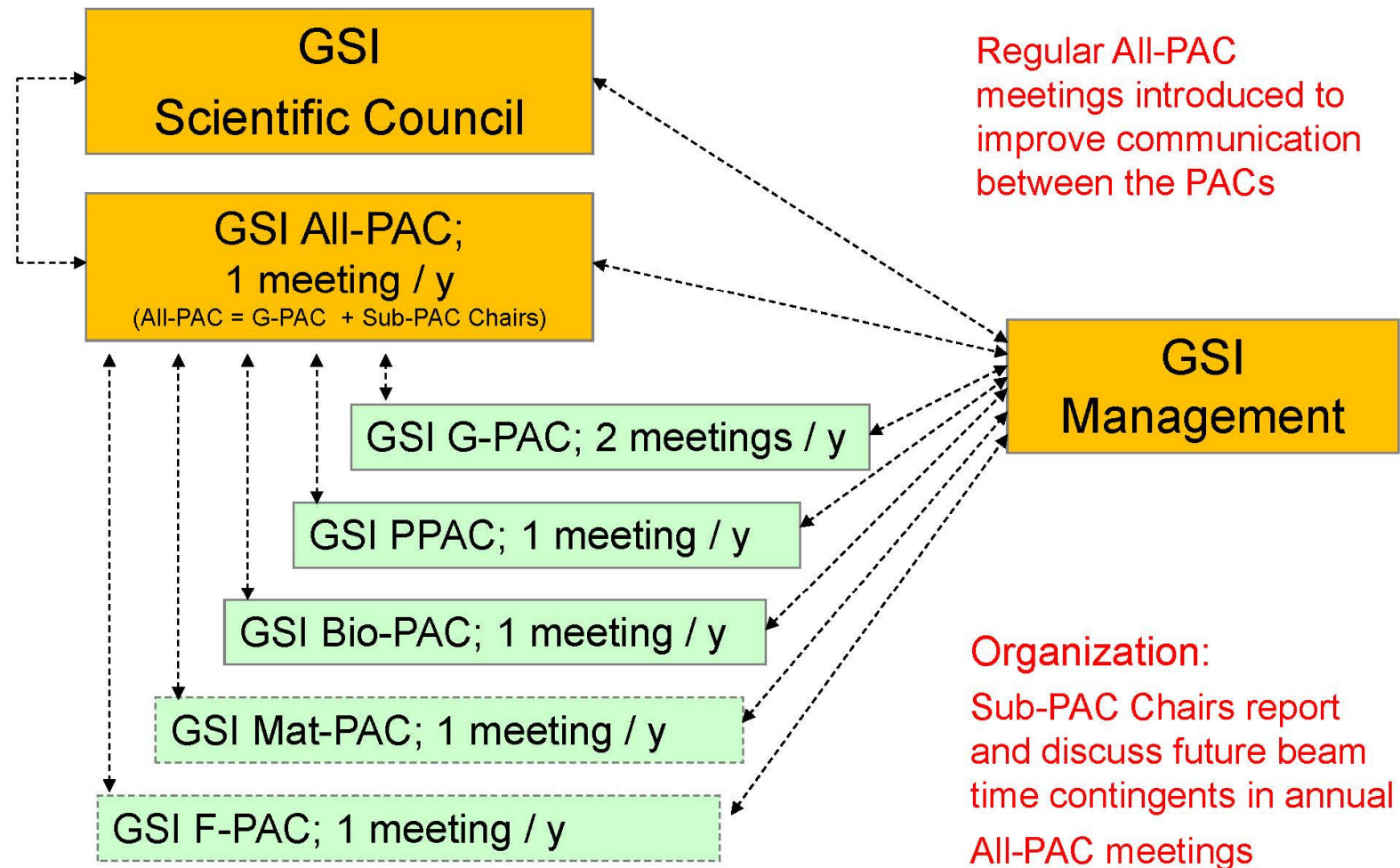
rigidity 18Tm
extraction

- fast extraction
- beam pulse 1 μ s-10 sec.
- 10 experimental caves

ESR

- beam pulse from a few seconds up to 30 minutes

PAC structure and organization



General – PAC

Topics:

- Hadron and Nuclear Physics
- Atomic Physics
- Detector Tests (incl. tests for FAIR collaborations)

Members:

Bertram Blank	CEN Bordeaux, France
Yorik Blumenfeld	CERN-ISOLDE, Switzerland
Wilton Catford	Univ. Surrey, UK
Paolo Giubellino (Chair)	IFNF Turin, Italy
Ronnie Hoekstra	KVI Groningen; Netherlands
Stefan Leupold	Uppsala Univ., Sweden
Norbert Pietralla	TUD, Germany
Hendrik Schatz	MSU, USA
Reinhold Schuch	Stockholm Univ., Sweden
Andreas Türler	PSI, Switzerland
Michiharu Wada	RIKEN, Japan
Matthias Weidemüller	Univ. Heidelberg, Germany

Biophysics and Radio-Biology PAC

Topics:

- Biological radiation damage
- Therapy related research (clinical radiobiology, moving targets)
- Space-related research (biological effects)
- Modeling (physics and biology)
- Imaging and Dosimetry

Members:

Francis Cucinotta
Dudley Goodhead

NASA Johnson Space Center, Houston, USA
em. Director Med. Res. Council Rad. and Genome
Stability Unit, Oxford, UK

Thomas Haberer
Amy Kronenberg
Günther Reitz (Chair)
Laure Sabatier

Heidelberg Ion-Beam Therapy Center (HIT), Germany
LBNL, Berkeley, USA
German Aerospace Center (DLR), Germany
CEA, Fontenay-aux-Roses, France

Materials Research PAC

Topics:

- Materials modification by ion beams
- Physics and technology of nanostructures
- Problems of radiation hardness

Members:

Pavel Apel	Flerov Laboratory, Dubna, Russia
Serge Bouffard	University of Caen, France
Klas Hjort	University Uppsala, Sweden
Werner Wesch, Chair	Universität Jena, Germany

Plasmaphysics PAC

Topics:

- High energy density physics
- EOS, phase transitions and transport properties
- Heavy ion interactions with plasmas
- Proton acceleration (imaging, injection in an accelerator)
- High field physics

Members:

Prof. Dr. Vladimir Fortov (Chair)	Russian Academy of Sciences, Moscow, Russia
Dr. Dirk Gericke	Univ. Warwick, Coventry, United Kingdom
Dr. Alexander Golubev	ITEP, Moscow, Russia
Dr. Dieter H.G. Schneider	LLNL-PAT/NIF, Livermore, USA
Dr. Vladimir Tikhonchuk	Univ. Bordeaux, Talence, France
Dr. Oswald Willi	Heinrich Heine Univ., Düsseldorf, Germany

Classification of proposals

Classification of Proposals in Categories

- A: 'must' be done;
- C: deferred;
- D: rejected

B-ranking (can be done if beamtime available) was abandoned in All-PAC01 since B-proposals will not be scheduled due to the large backlog of A-rated experiments.

- Experiments which are dormant are re-evaluated after three years
- Experiments which have had significant beamtime are asked for reports on the PAC meetings
- Short annual status reports are requested from all active experiments

GSI Future - FAIR

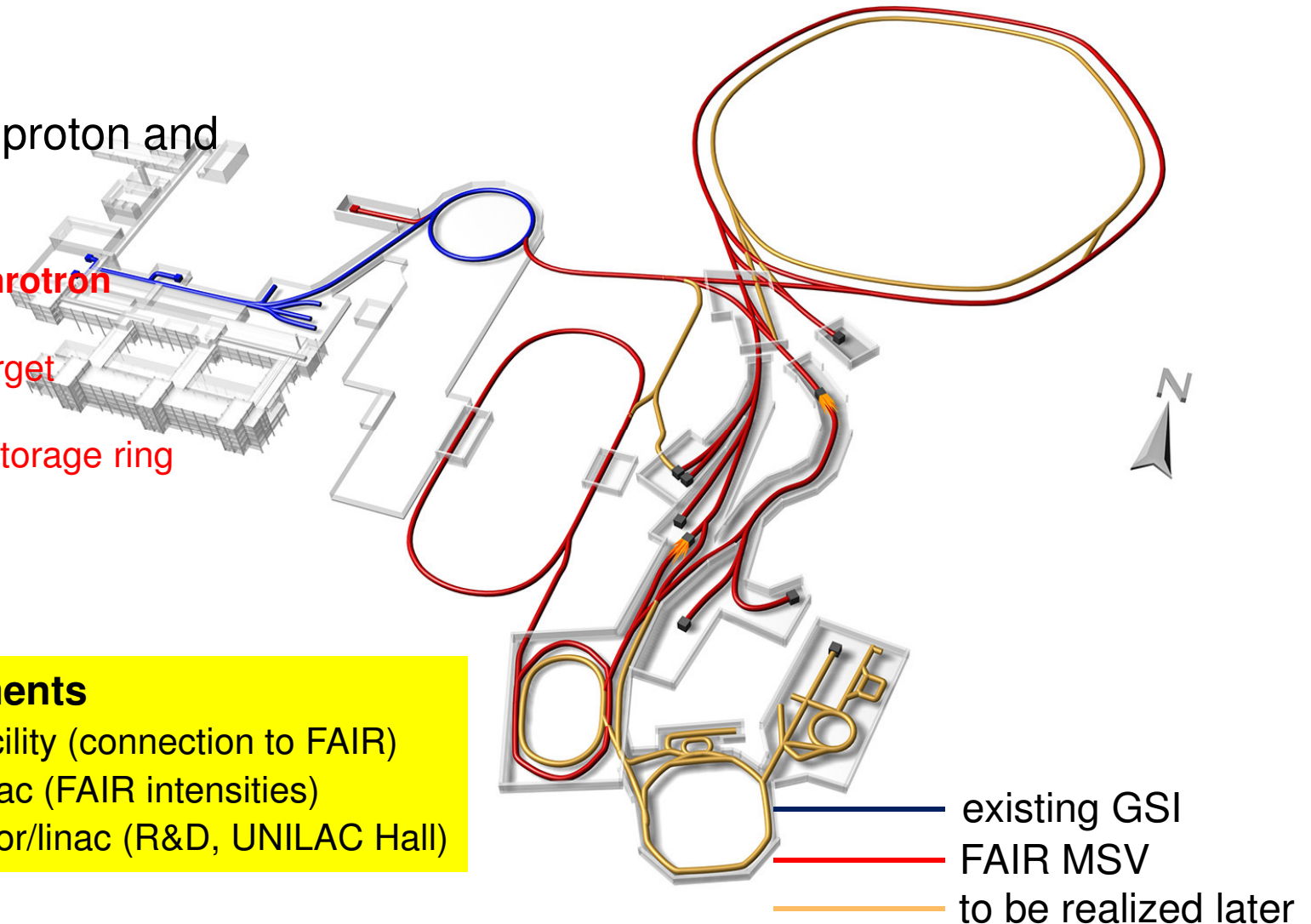
FAIR facility:

center for antiproton and ion research:

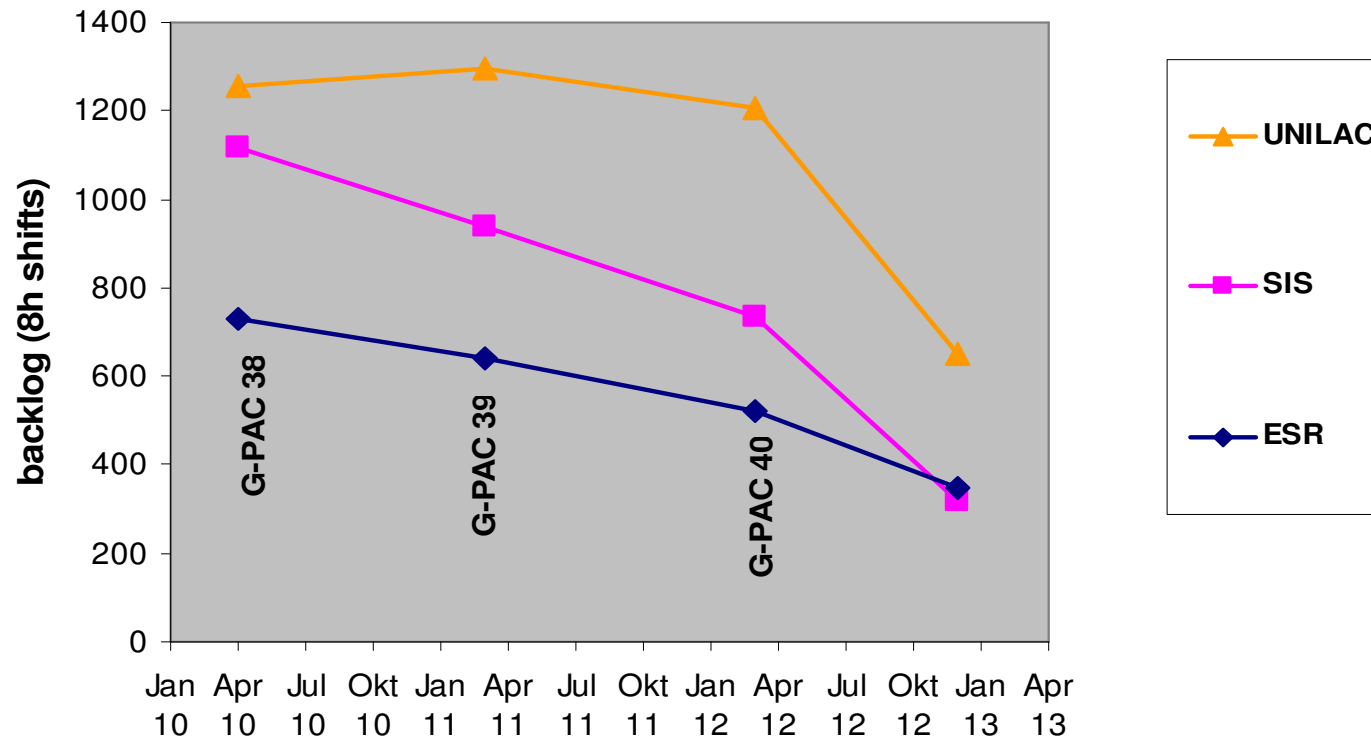
- p-linac
- **100Tm synchrotron**
- **Super FRS**
- Anti proton target
- Collector ring
- High energy storage ring

GSI committments

- link existing facility (connection to FAIR)
- high energy linac (FAIR intensities)
- cw demonstrator/linac (R&D, UNILAC Hall)



Situation in 2013



- substantial backlog
- limited resources
- reduced beam time (no beam time in 2013)
- no further calls for proposals, PACs suspended

Maintaining scientific excellence in 2014

New proposals by external users channeled through the FAIR collaborations, the GSI representatives of the research fields or the FAIR Project leaders

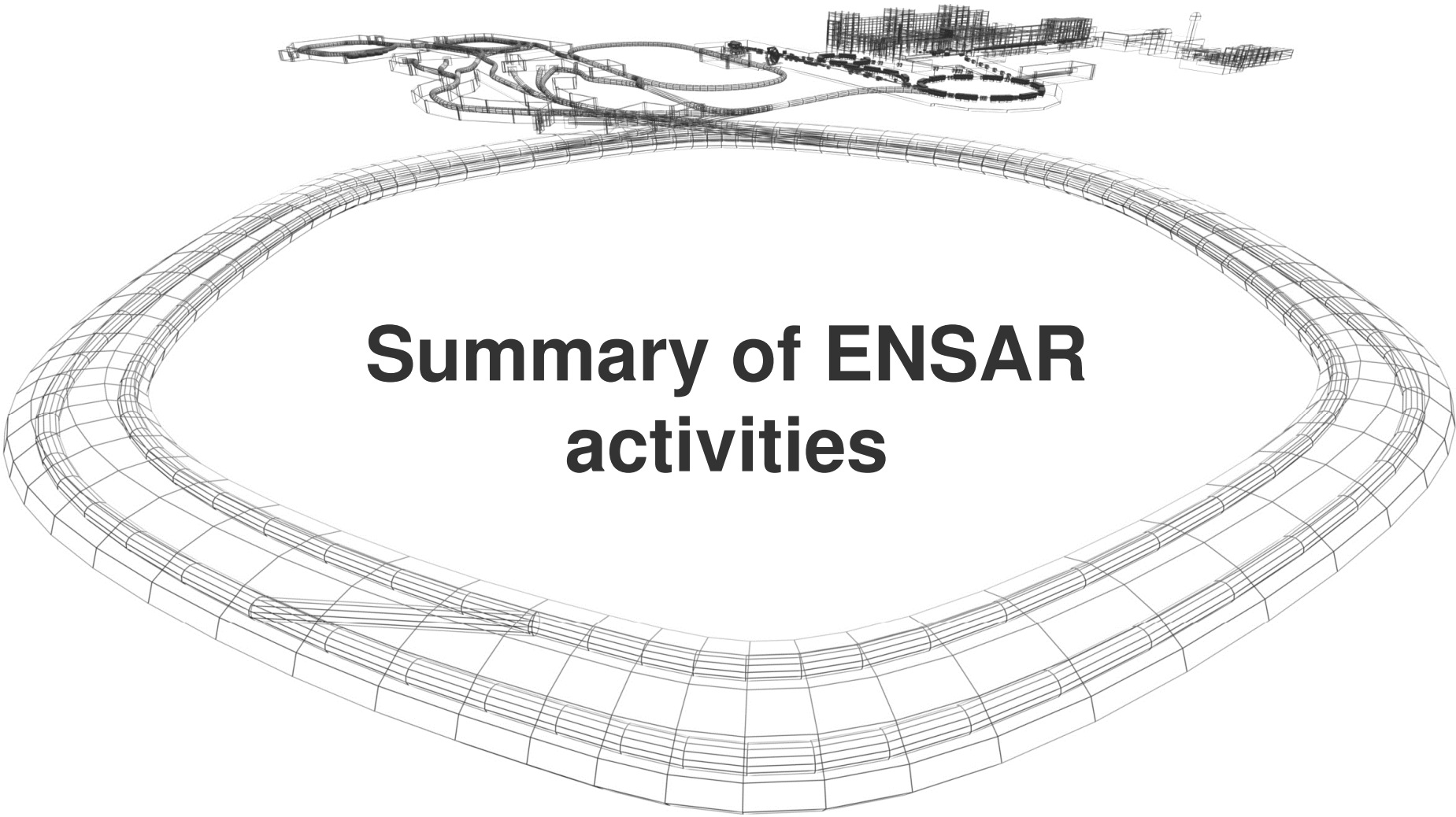
Internal pre-sorting of backlog and new proposals done by GSI representatives of the research fields

Head of the G-PAC, chairs of WBR (Wissenschaftlicher Beirat) of GSI and BFC (Board of FAIR collaborations) and the internal research field representatives made recommendations on beam time distribution

Main Criteria

- scientific impact
- important campaigns
 - AGATA
- FAIR relevance
 - detector tests
 - scientific proof of principle
- technical feasibility
 - strong constraints from accelerator side

→ **FAIR detectors tests combined with forefront research**

A detailed wireframe model of a particle accelerator, likely the FAIR facility. The model shows a large, circular ring structure with a complex internal layout of pipes and components. The text 'Summary of ENSAR activities' is centered within the ring.

Summary of ENSAR activities

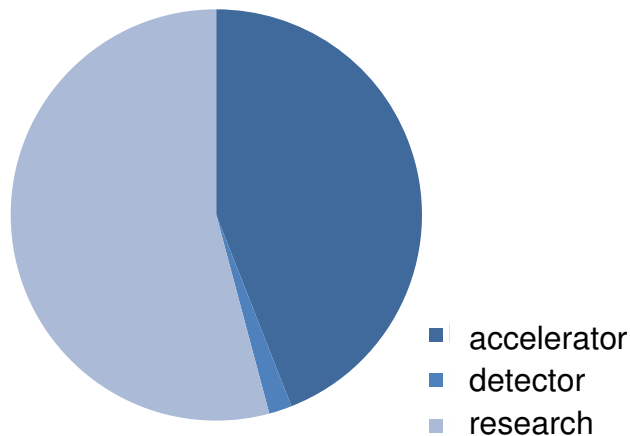
Beam time 2014

Beam time GSI 2014: 8 months

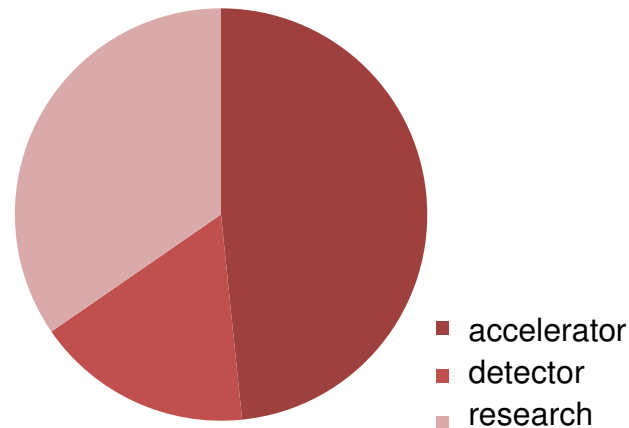
ENSAR relevant experiments: AGATA, R3B, applications (material science), heavy elements (TASCA, SHIP), atomic/nuclear physics in storage rings

and pion and proton induced reactions with HADES and FRS

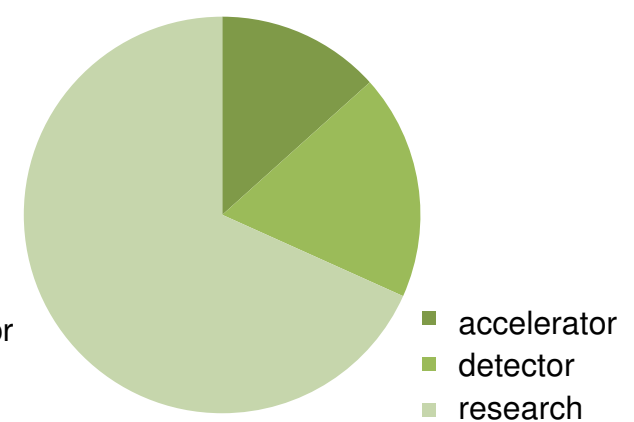
UNILAC 4500 h



SIS 4000 h



ESR 1800 h



Beam time 2014 End of **AGATA** campaign



FRS-detector suite yields
A and Z of incoming beam
and provides x,y tracking
-TU Darmstadt and GSI



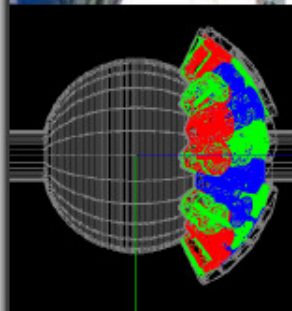
Advanced Gamma-ray
Tracking Array (AGATA)

up to $5 \times 2 + 10 \times 3 = 40$
segmented HP Ge-crystals

$d \sim 20 \text{ cm}$

$\varepsilon_{ph} \approx 17\%$

$\Delta E \approx 0.4\%$



Lund-York-Cologne
CALorimeter (LYCCA)

A and Z particle-ID after
secondary target by means of

- x,y tracking
- ΔE -E (Si-CsI)
- Time-of-flight (plastic)



Experiments (e.g.):

Coulomb excitation around ^{208}Pb

Fine structure in Pygmy resonances

Coulex on isomeric state in ^{52}Fe

Lifetimes in heavy Zr-Mo isotopes...

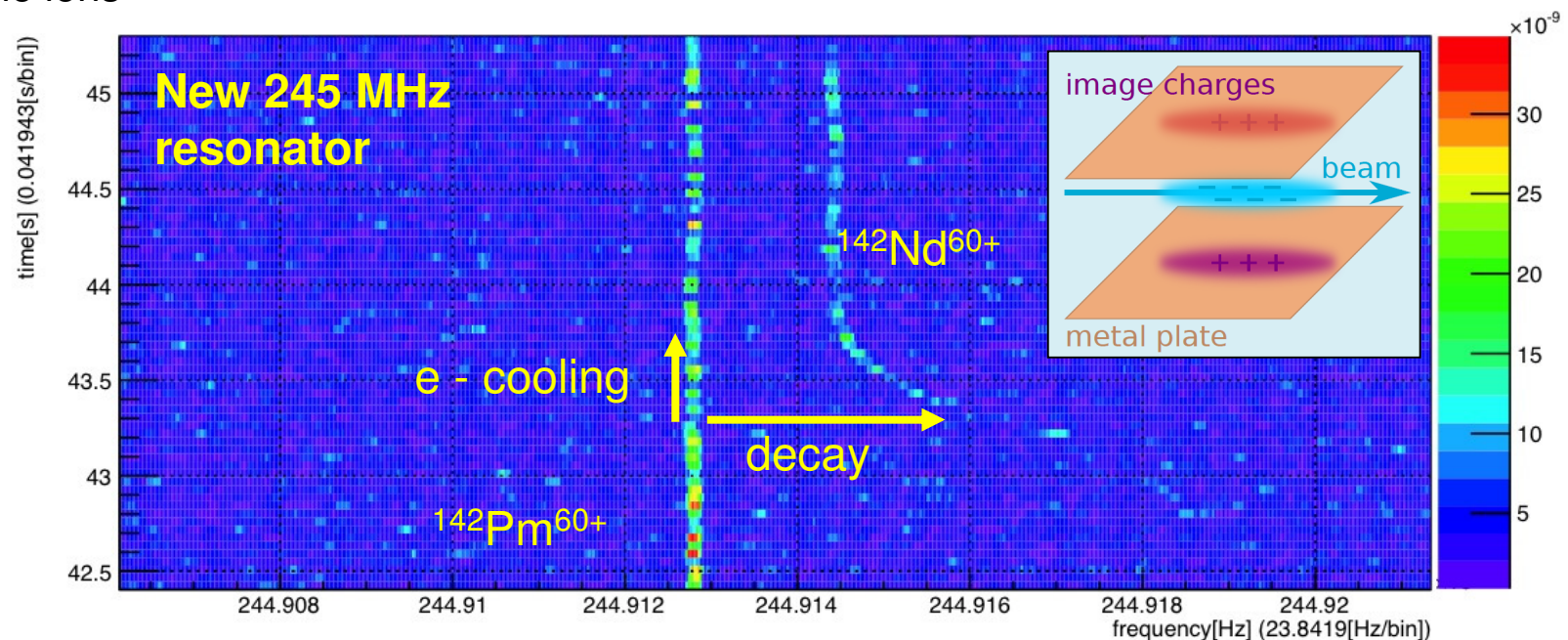
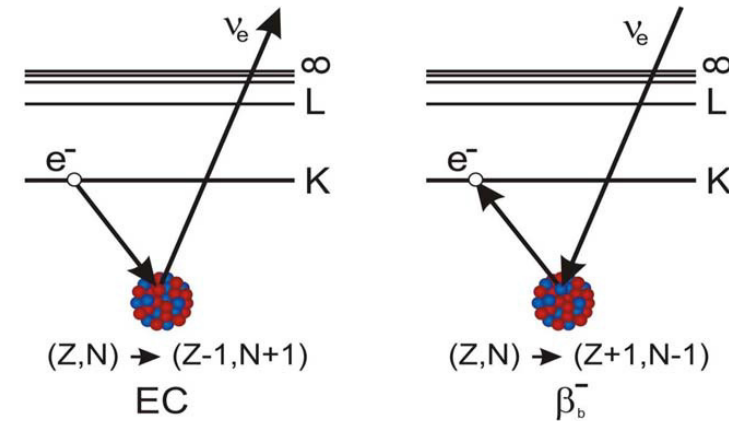
Decay-spectroscopy of single ions

Two body β -decay of highly charged ions

- state similar to the one in nucleosynthesis
- atoms before and after decay in „simple“ quantum states

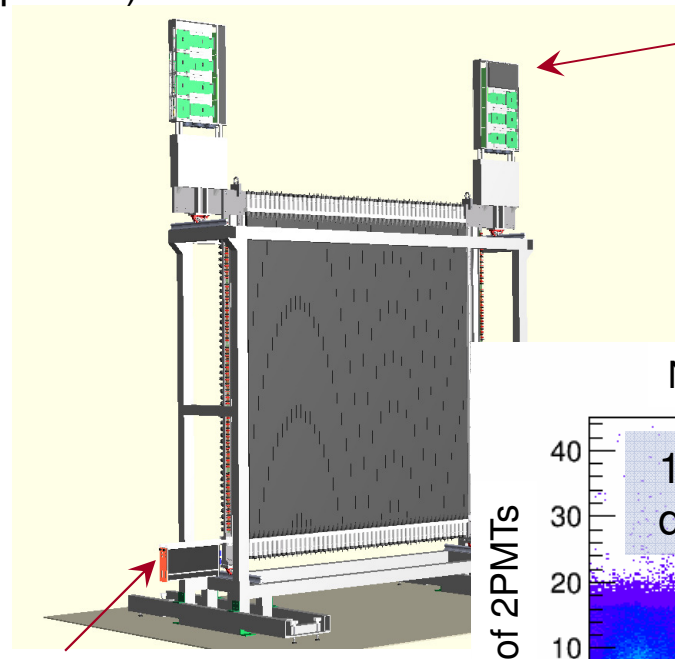
Technic: Schottky measurements

- non-destructive measurement of the beam
- measurement of decay time and kinematic of single ions



Performance tests

6 double planes in test (August and October 2014)
(full detector 30 double planes)



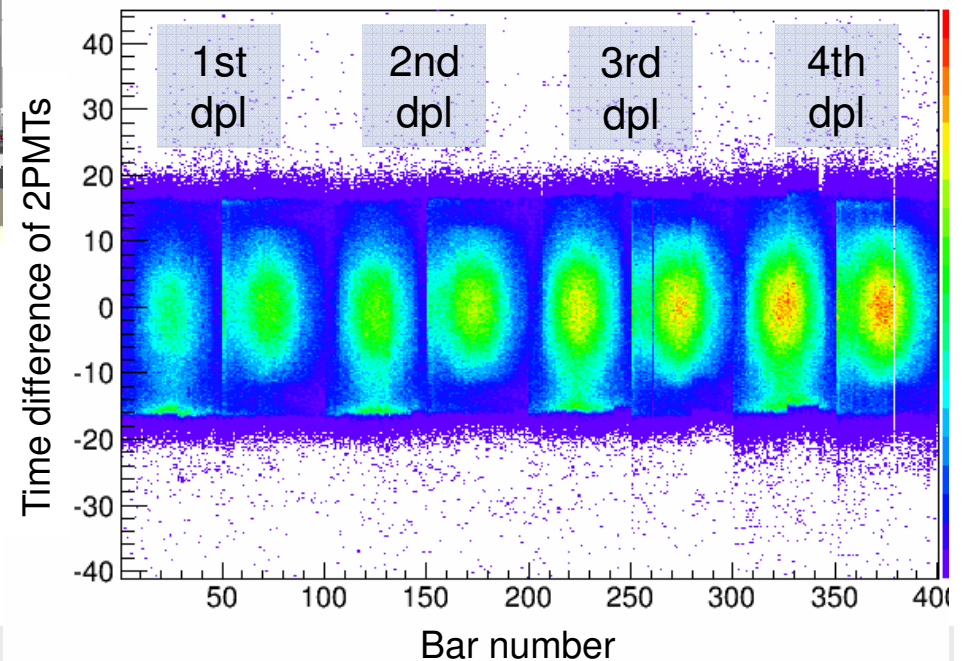
HV system



FPGA TDC
based

Readout
Electronics

Neutron hit patterns in 4 double planes

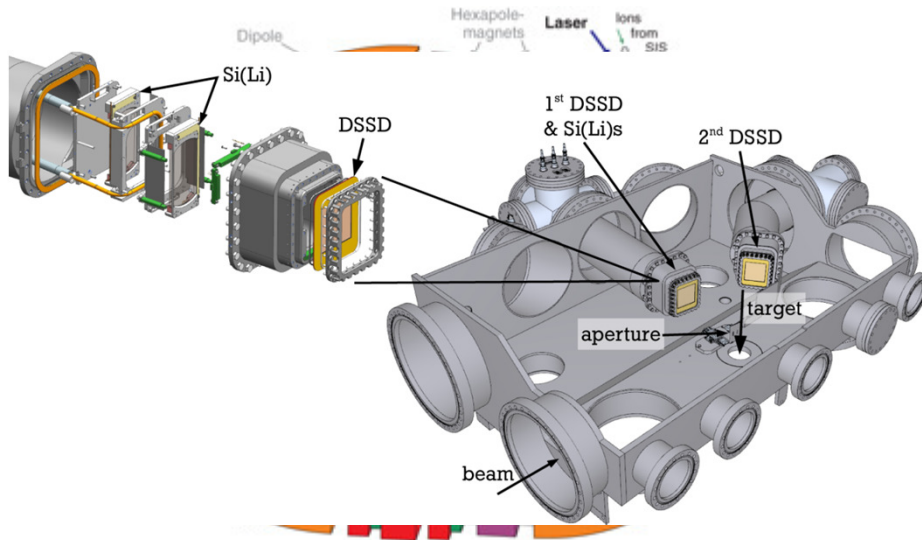


Time resolution : 140 ps (σ)

(Better than design goal: 150ps)

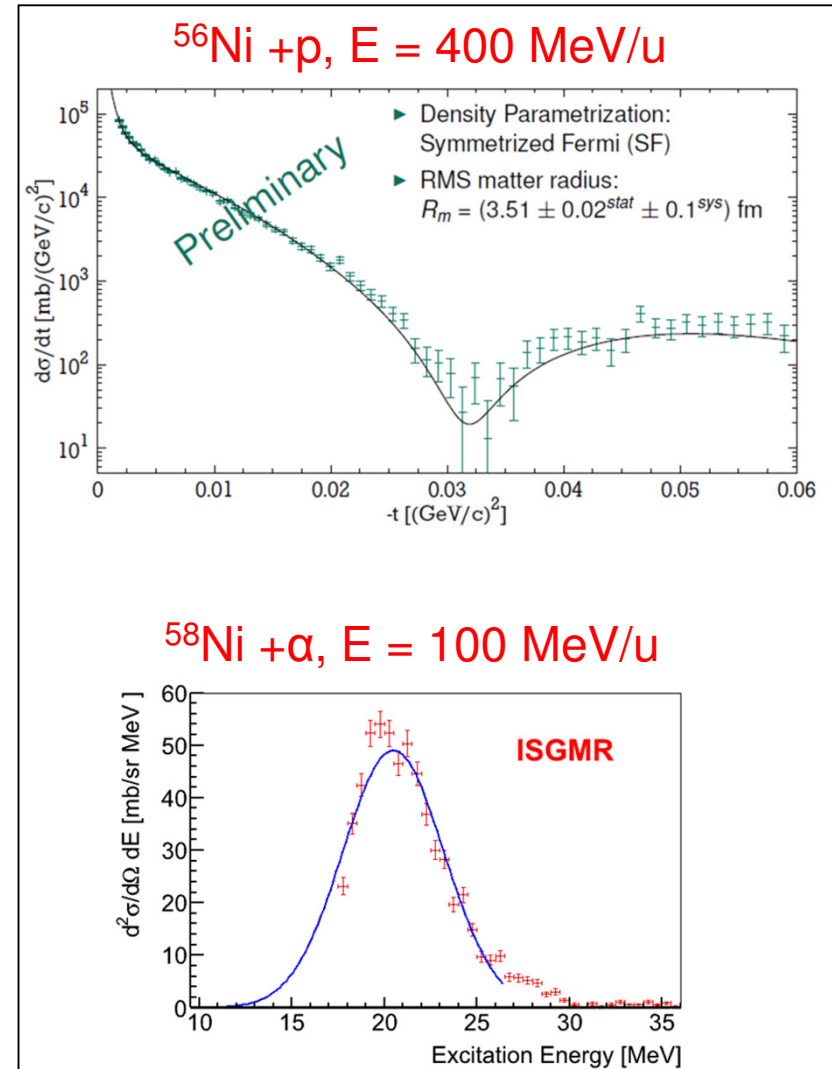
Research highlight

EXL – Nuclear reactions with stored radioactive beams



Preliminary results:

- proof of principles of experimental concept fully successful
- data analysis in progress $\Rightarrow$ determine nuclear matter distribution of ^{56}Ni
- feasibility study for investigation of GMR successful (data down to $\Theta_{\text{cm}} \leq 1^\circ$)



Summary for ENSAR

Beam hours		Users		Number of days		Number of projects		T&S	
Estimate		Estimate		Estimate		Estimate		Contract	
3750	4750	230	207	2250	2765	33	28	264.621	209.500

Recent developments

- financing of GSI secured
 - ✓ preparing midterm strategy for research until FAIR is operational
- merging of GSI with FAIR being prepared
 - ✓ common administration
 - ✓ joined meetings of Scientific Councils
 - ✓ joined meetings of directorates
- integrated construction plan for FAIR presented to Scientific Councils

Mid term research strategy

2015

UNILAC beam time

- ~3.5 months, restricted conditions
- call for proposals being prepared
 - nuclear physics (SHE)
 - plasma physics
 - materials research
 - biophysics
 - atomic physics

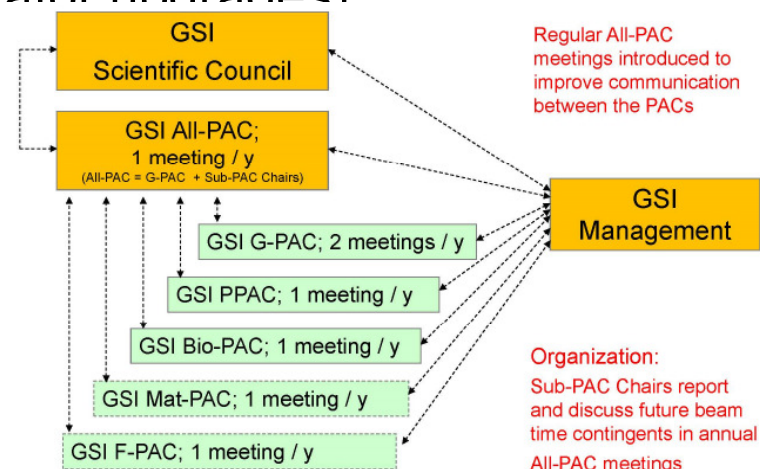
“ALL-PAC”

2016

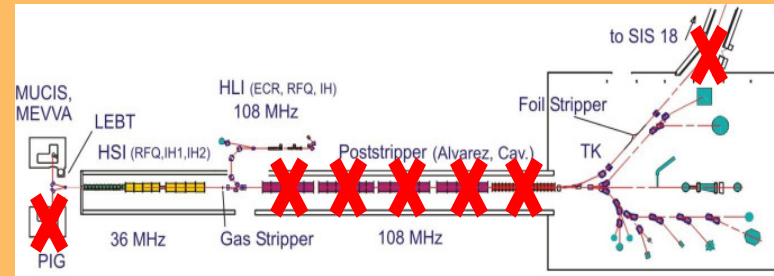
no beam (extended accelerator upgrades)

>2016

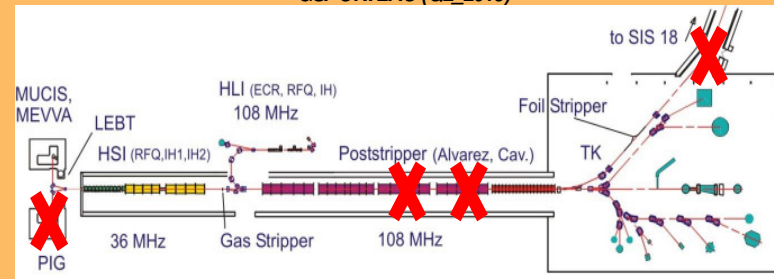
improved GSI accelerator
detectors enable forefront
for the international experiment
until FAIR is operational



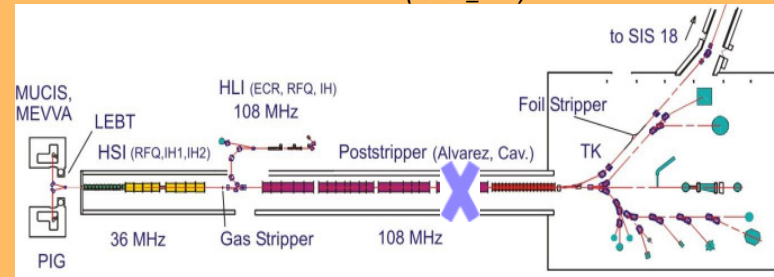
Randbedingungen/Strahlzeit 2015



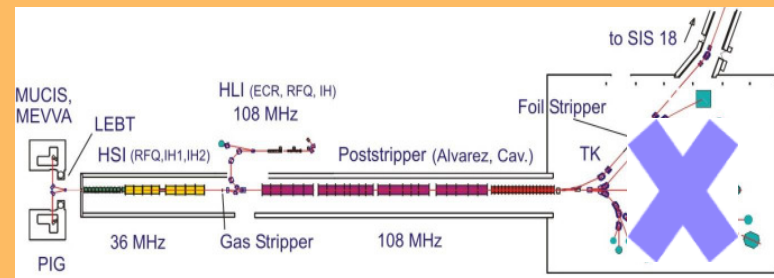
GSI-UNILAC (Q2_2015)



GSI-UNILAC (Q3/Q4_2015)



GSI-UNILAC (2017) (nur Kurzpuls)



GSI-UNILAC (2018) (nur Kurzpuls)

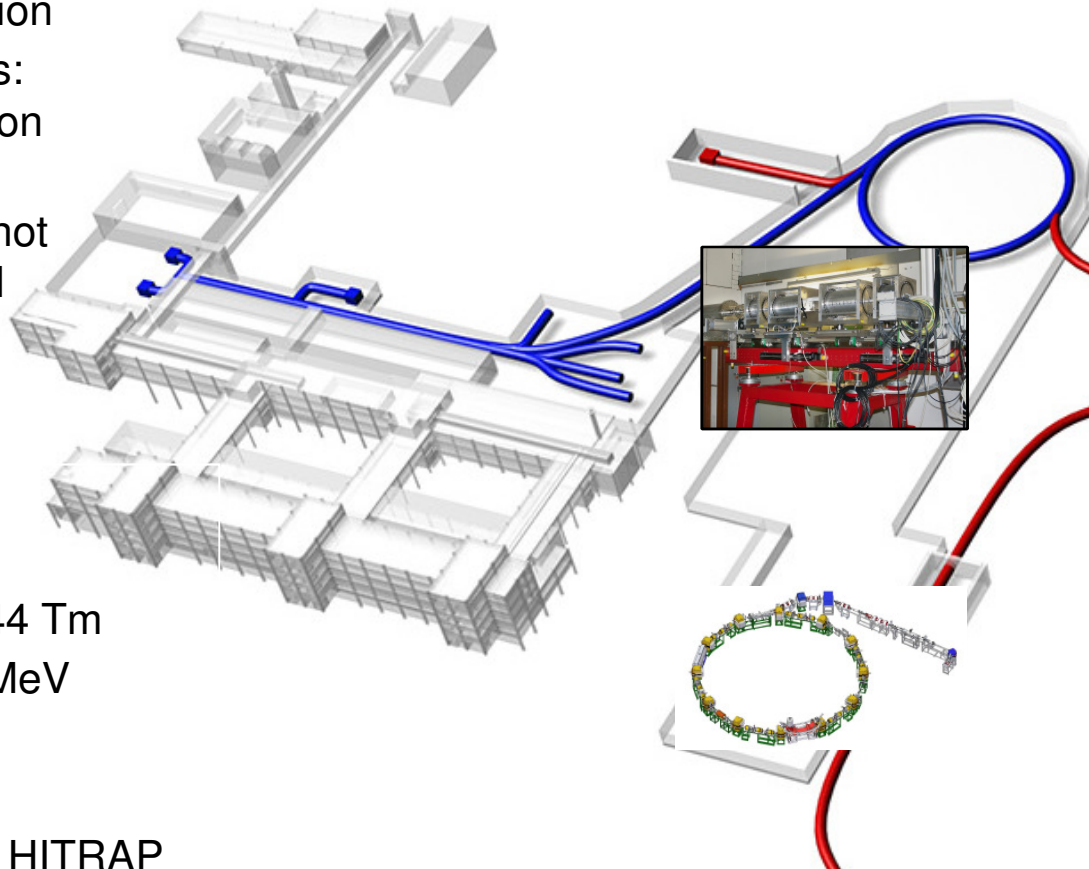
New infrastructures for ENSAR

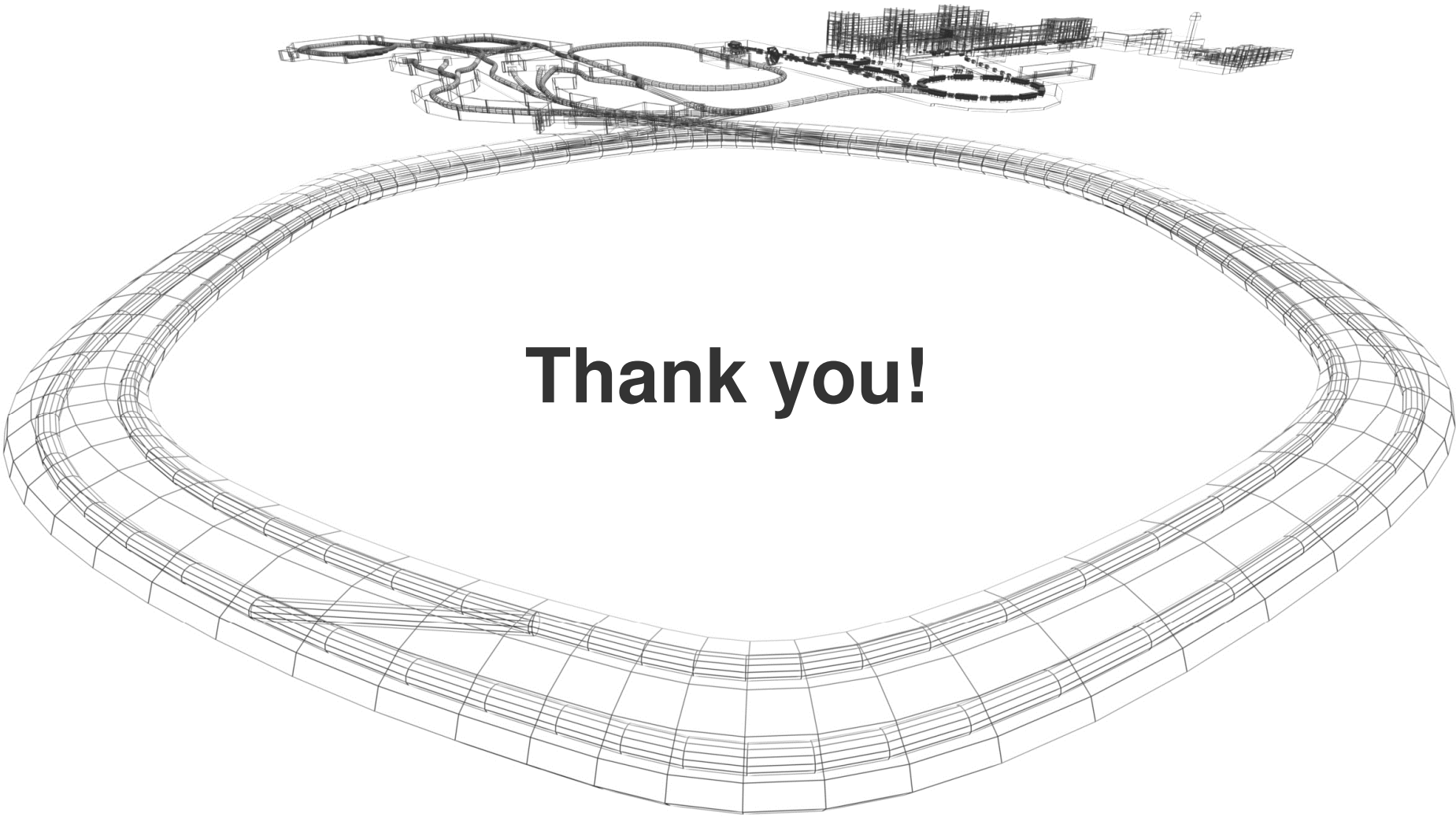
2014 PRIOR proton microscope

- 3.5 – 4.5 GeV protons @ SIS-18
 - 25 – 40 μm position resolution
- static and dynamical experiments: expansion of hot wires $\rightarrow$ EOS von metals
- research areas: new materials, hot plasmas, biophysics and medical applications
- FAIR@10 GeV: resolution $\leq 1\mu\text{m}$

2015 CRYRING

- circumference 51.63 m
- rigidity 0.054-1.44 Tm
- energy for protons 0.14-96 MeV
- electron cooling
- fast and slow extraction
- bridging gap between ESR and HITRAP
- atomic and nuclear physics



A detailed 3D wireframe model of a particle accelerator, likely a synchrotron. The model shows a large, circular ring structure composed of many segments, with a complex network of smaller components and structures at the top. The text 'Thank you!' is centered within the large ring.

Thank you!