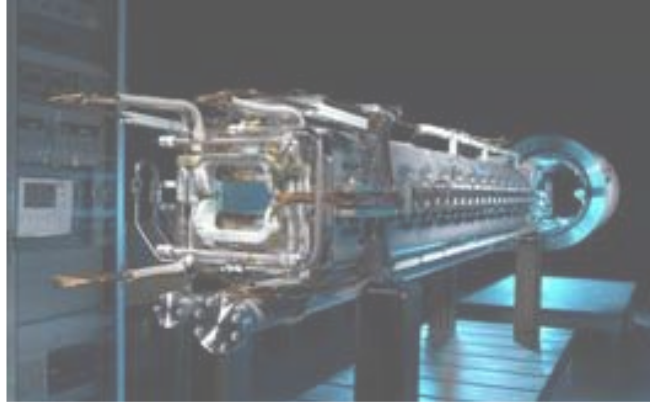




FAIR for Plasma Physics

Boris Sharkov

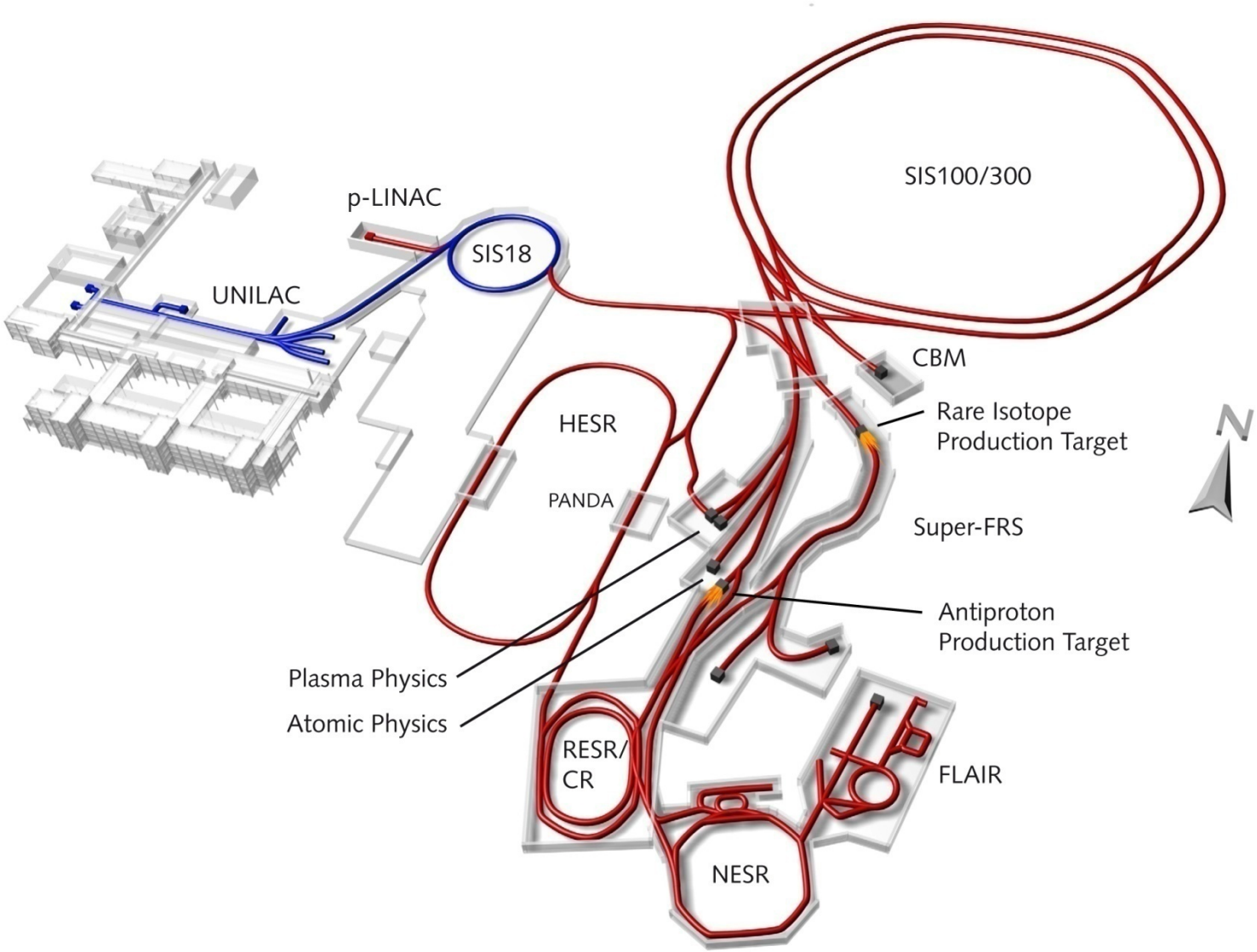
FAIR Scientific Director (des.)

@ Hirschegg 01.02.2010

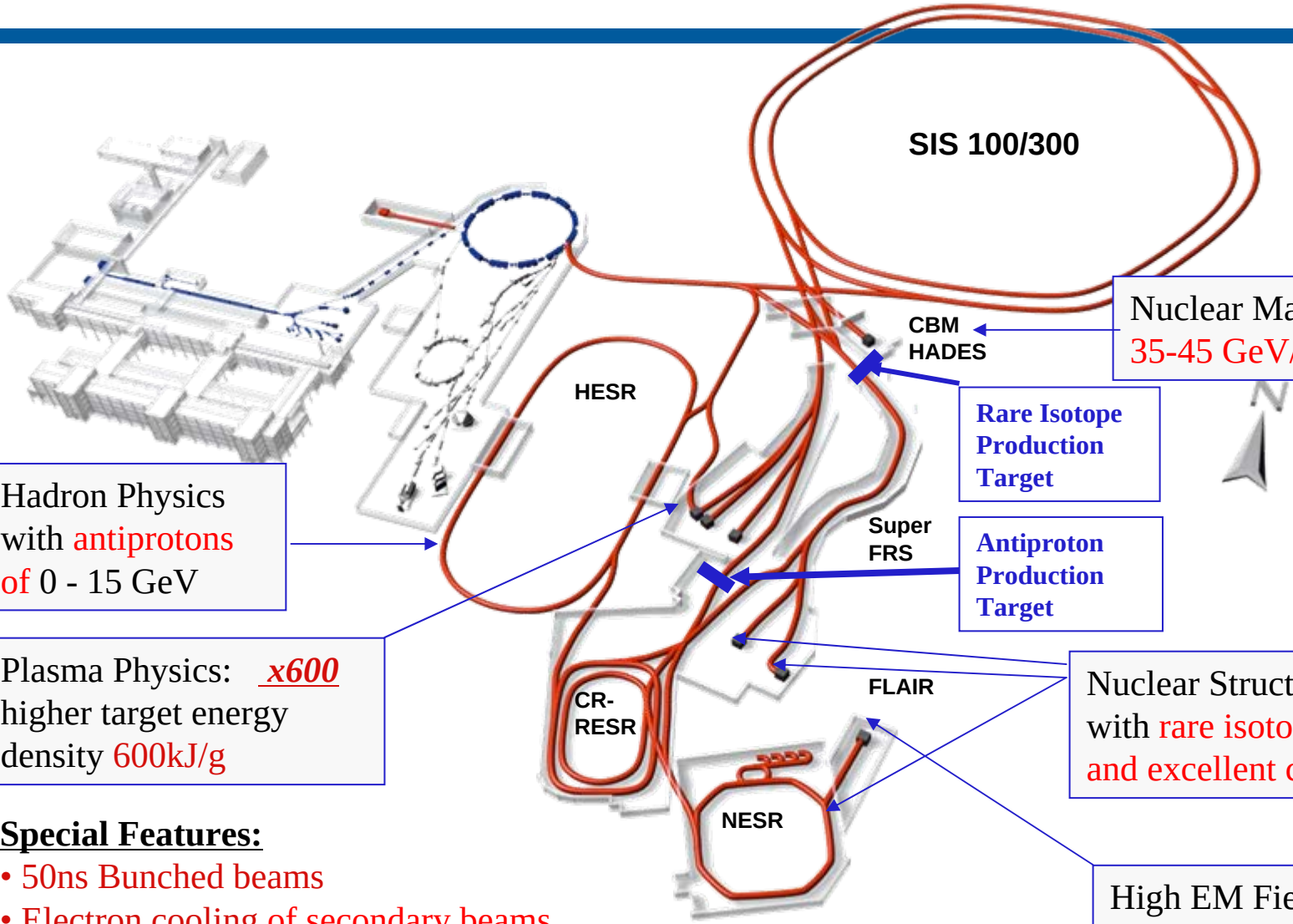
Austria China Finland France Germany Greece India Italy Poland Romania Russia Slovakia Slovenia Spain Sweden U K Saudi Arabia

FAIR

FAIR facility BTR 2005



Research Communities at FAIR



Nuclear Matter Physics with 35-45 GeV/u HI beams, ***x1000***

Rare Isotope Production Target

Antiproton Production Target

Hadron Physics with antiprotons of 0 - 15 GeV

Plasma Physics: ***x600*** higher target energy density 600kJ/g

Nuclear Structure & Astrophysics with rare isotope beams, ***x10 000*** and excellent cooling

Special Features:

- 50ns Bunched beams
- Electron cooling of secondary beams
- SC magnets fast ramping
- Parallel operation

High EM Field (HI)
Fundamental Studies (HI & p)
Applications (HI)

Rationale for new Modularized Start Version (WP) in 2009

- a detailed cost estimate for **CC** presented by architects
- a new cost estimate in 2009 for the **accelerator** complex
- Detailed list of site related construction costs was worked out
- firm commitments of FAIR Member
- States
- Germany and State of Hesse announced to cover "site-dependent" construction costs outside FAIR project budget + 110 M€ !

Bundesministerium für Bildung und Forschung

HESSEN Hessisches Ministerium für Wissenschaft und Kunst

Freiheit Einheit Demokratie

HAUSANSCHRIFT Hannoversche Straße 28-30, 10115 Berlin
POSTANSCHRIFT 11055 Berlin

TEL 030 / 18 57-50 50
FAX 030 / 18 57-55 51
E-MAIL presse@bmbf.bund.de
HOMEPAGE www.bmbf.de

Presse-mitteilung

03. September 2009
216/2009

Konjunkturpaket II unterstützt Spitzenforschung in Darmstadt

Staatssekretär Storm und hessische Ministerin Kühne-Hörmann feiern Richtfest für Testinghalle für das internationale Zukunftsprojekt FAIR

Das GSI Helmholtzzentrum ist gut gerüstet für das internationale Zukunftsprojekt FAIR

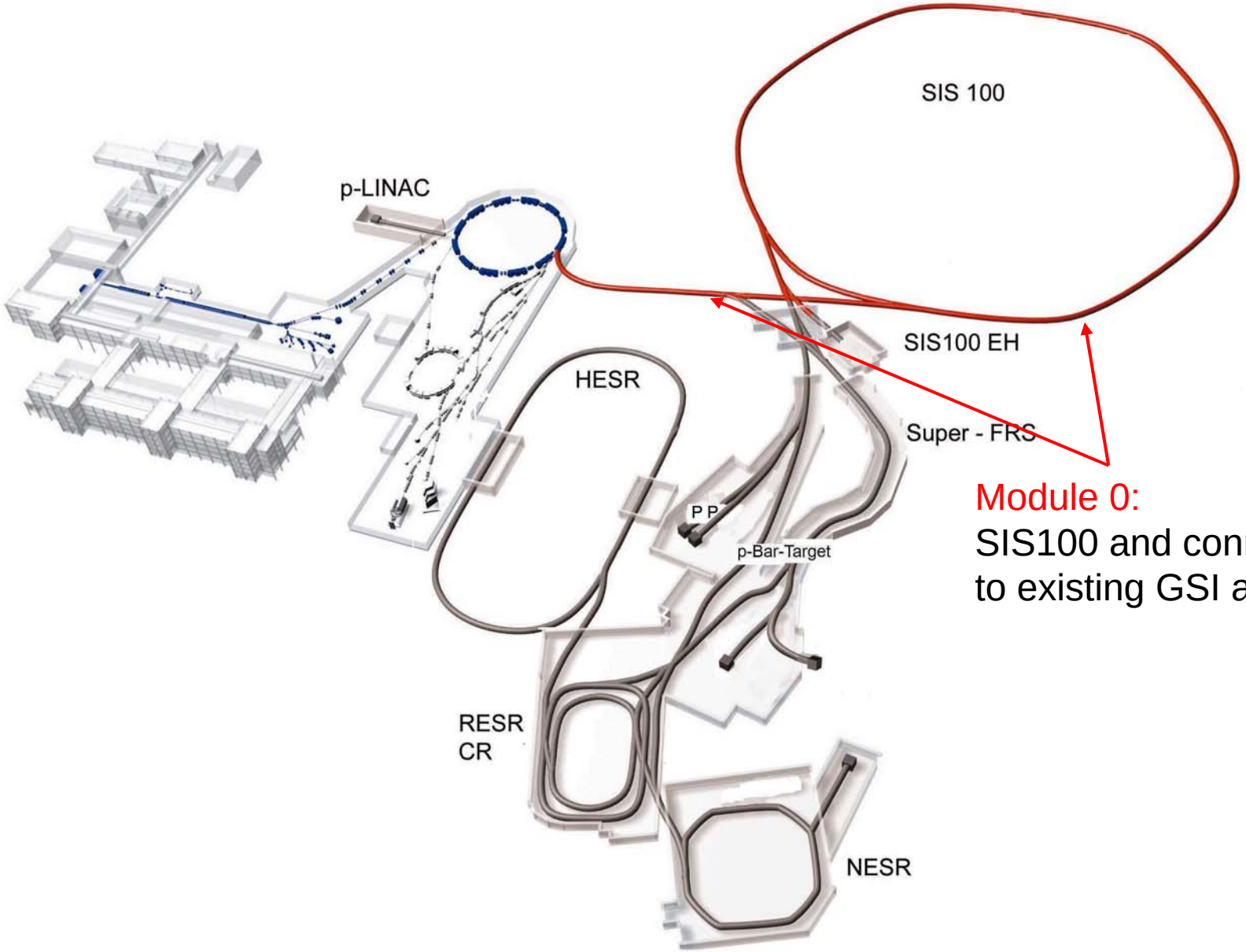
Development of Project Staging

2003	**Recommendation by WissenschaftsRat – FAIR Realisation in three stages**						
2005	**Entire Facility** **Baseline Technical Report**						
2007	**Phase A**						**Phase B** SIS300
2009	**Module 0** SIS100	**Module 1** expt areas CBM/HADES and APPA	**Module 2** Super-FRS fixed target area NuSTAR	**Module 3** pbar facility, incl. CR for PANDA, options for NuSTAR	**Module 4** LEB for NuSTAR, NESR for NuSTAR and APPA, FLAIR for APPA	**Module 5** RESR nominal intensity for PANDA & parallel operation with NuSTAR and APPA	**Module 6** SIS300

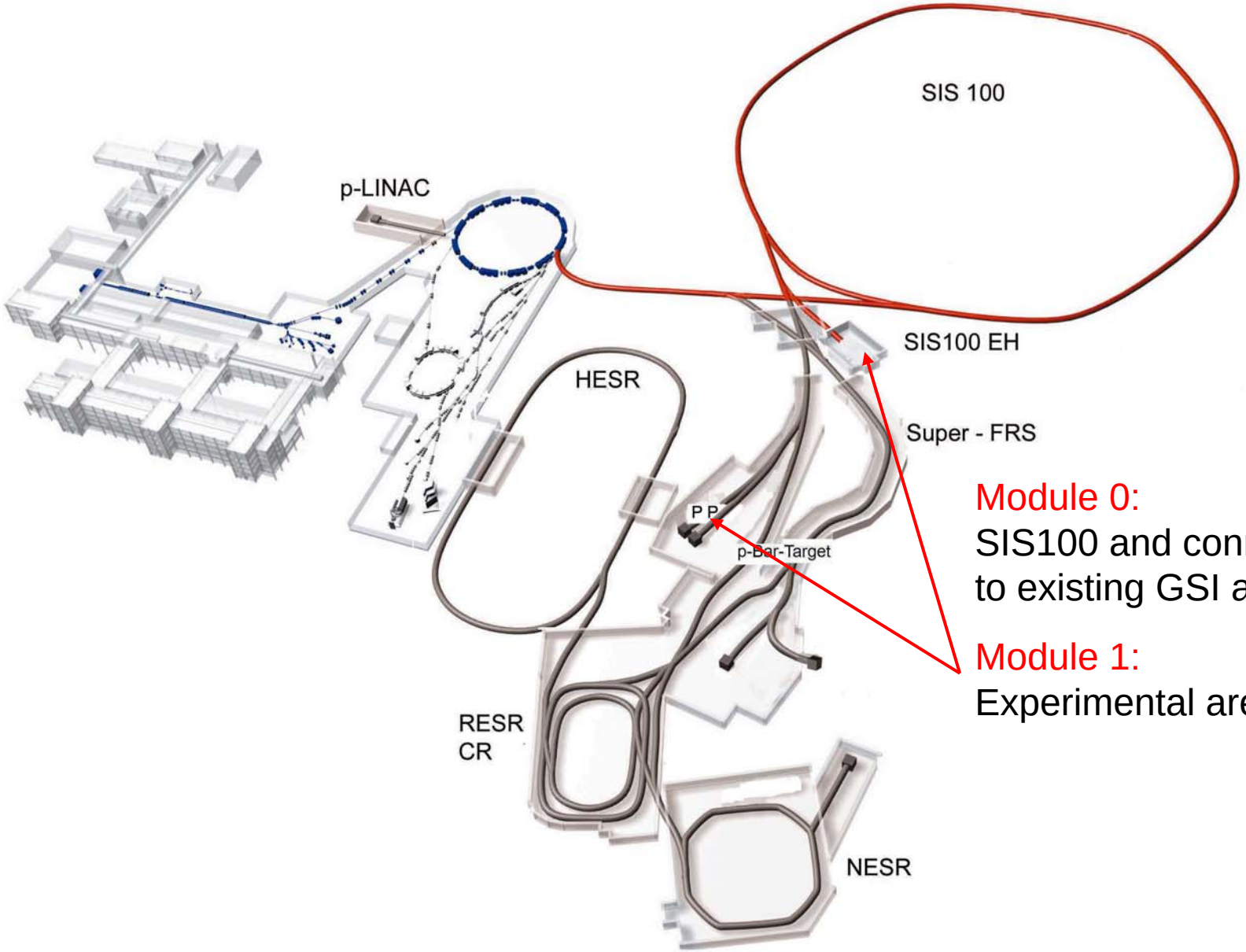
Modularized Start Version

Basic Criteria :

Outstanding research opportunities should be offered to *all four* scientific pillars of FAIR by the Modularized Start Version



Module 0:
SIS100 and connection to existing GSI accel.



Module 0:
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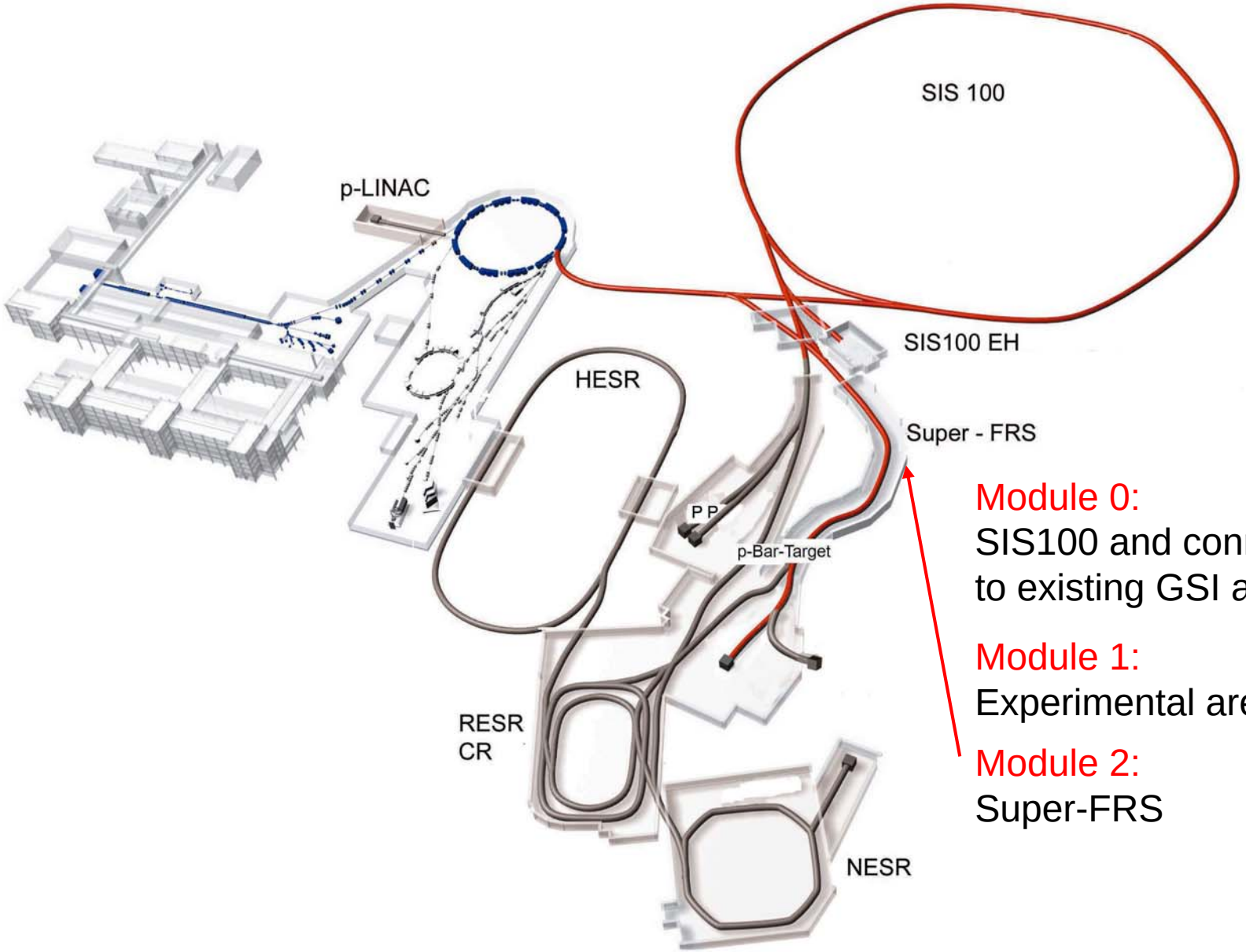
Module 1:
Experimental areas



Module 0:
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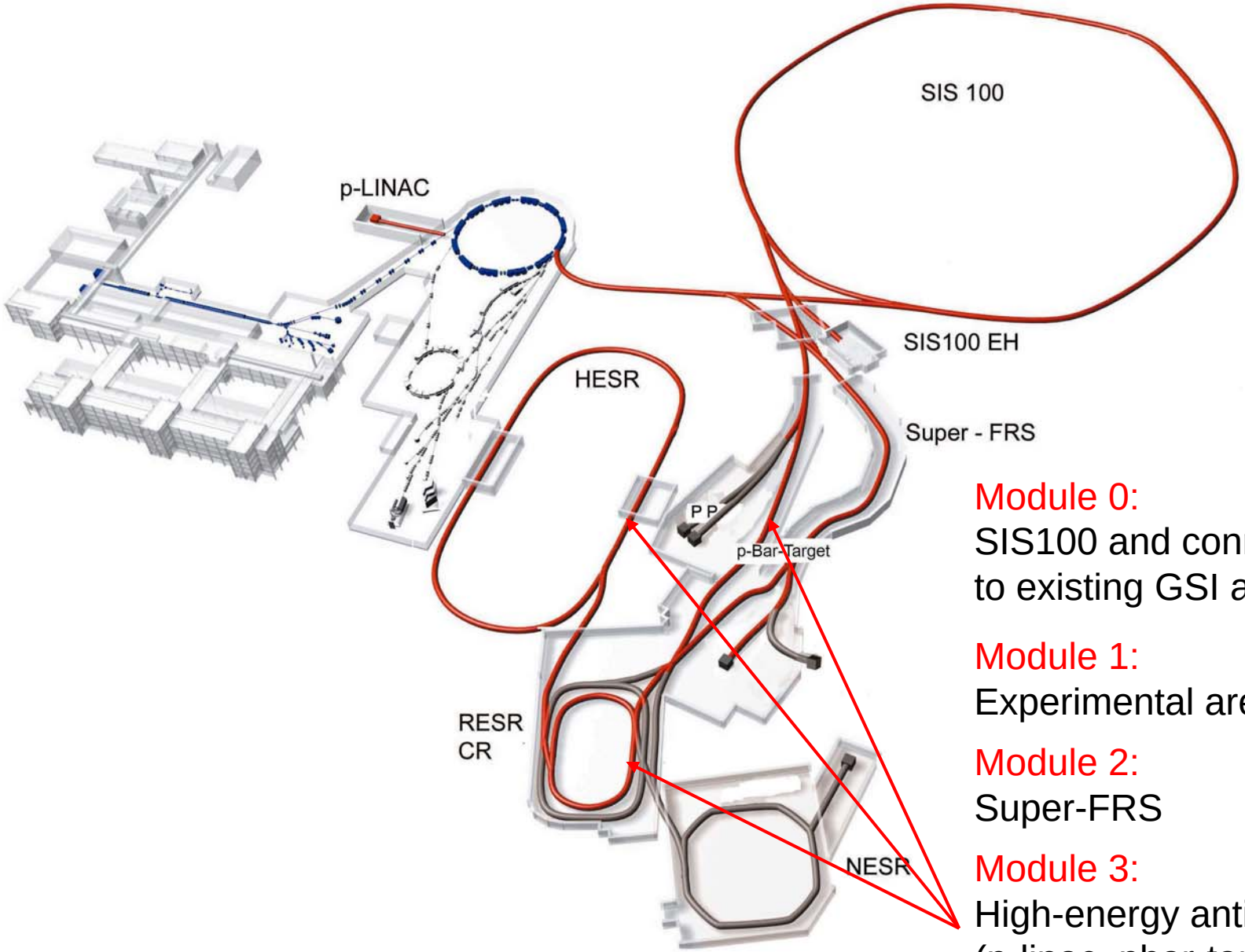
Module 2:
Super-FRS



Module 0:
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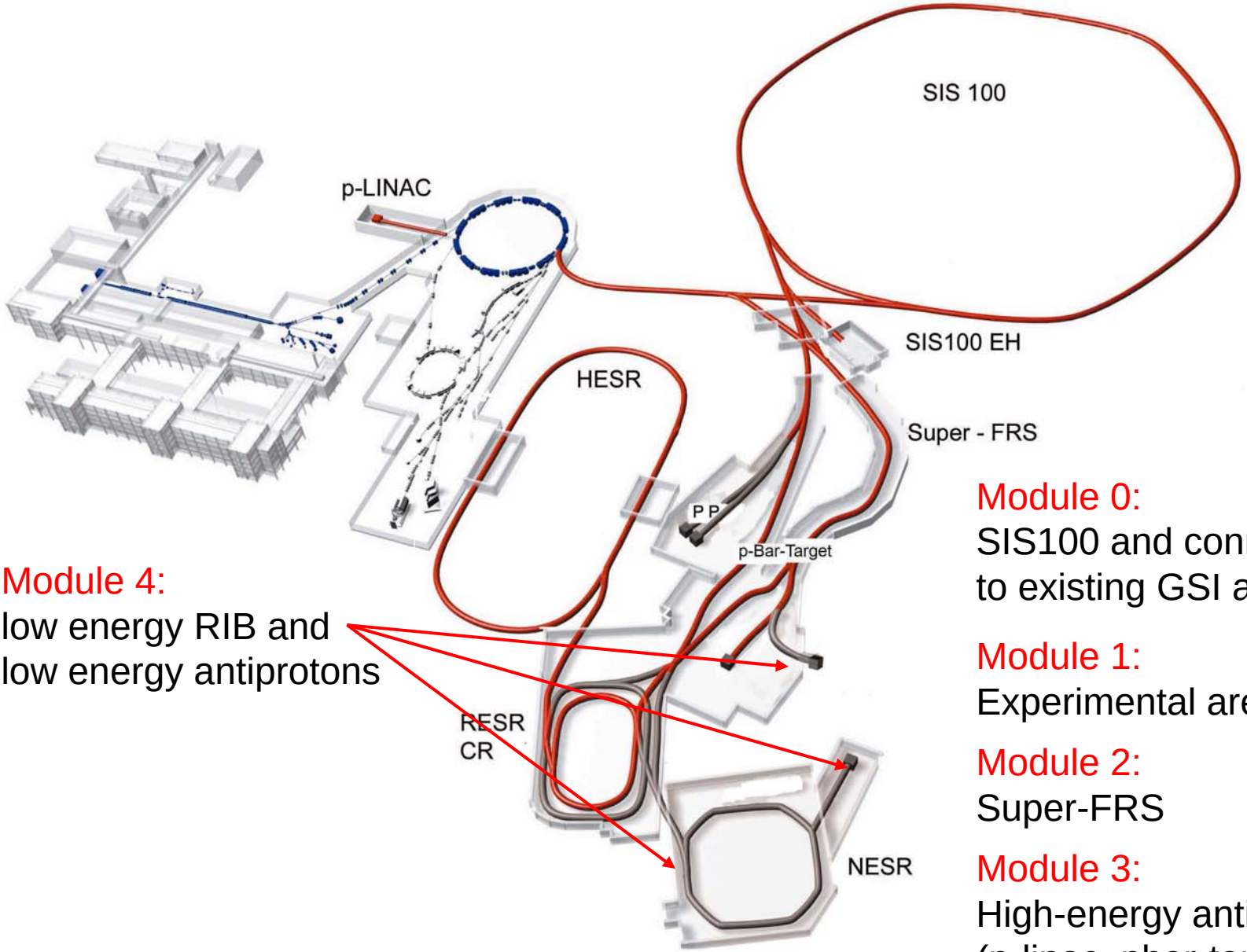
Super-FRS

Module 3:
High-energy antiprotons (p-linac, pbar-target, CR, HESR)



Module 4:
low energy RIB and
low energy antiprotons

Module 0:
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Module 1:
Experimental areas

Module 2:
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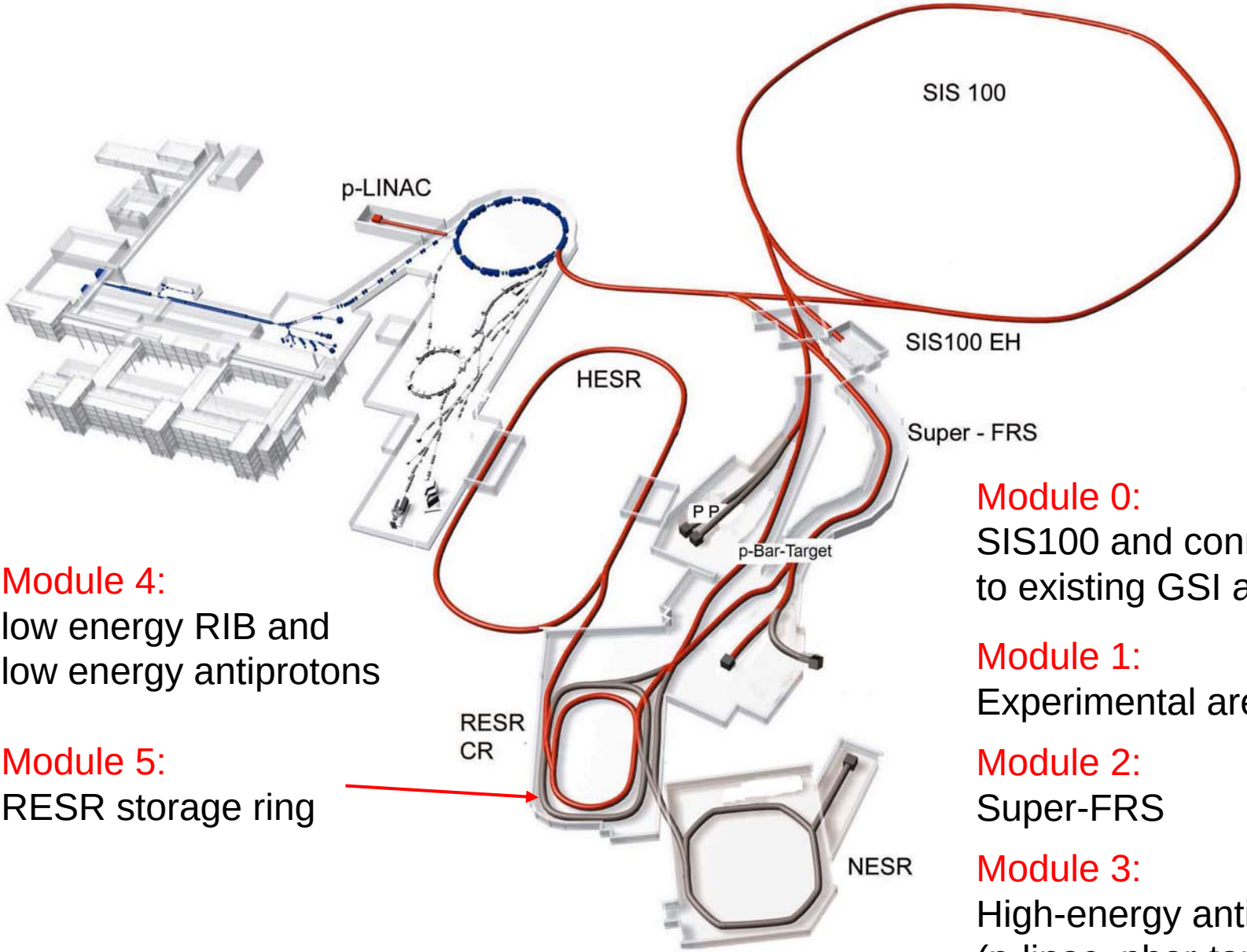
Module 3:
High-energy antiprotons (p-linac, pbar-target, CR, HESR)



Module 4:
low energy RIB and
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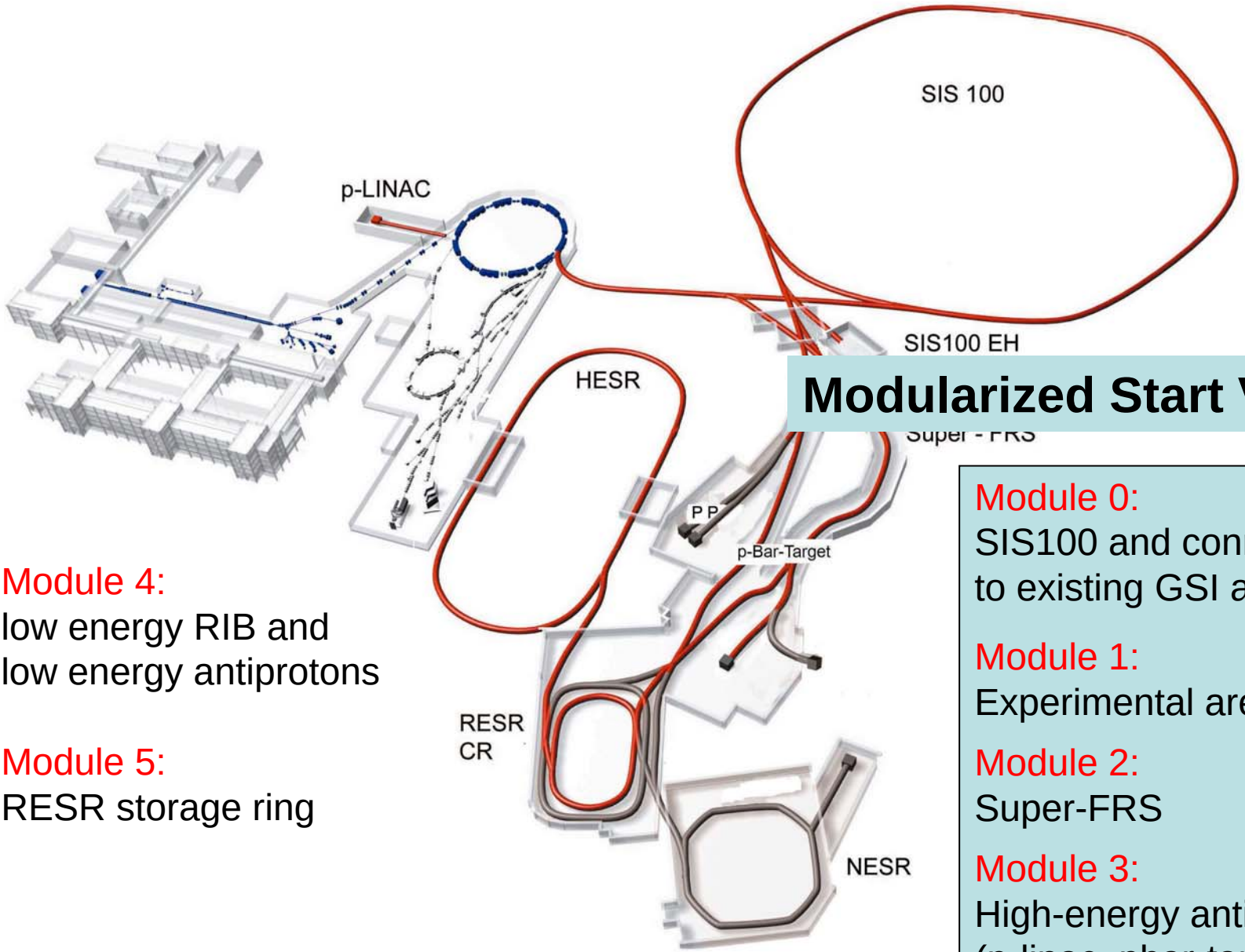
Module 5:
RESR storage ring

Module 0:
SIS100 and connection to existing GSI accel.

Module 1:
Experimental areas

Module 2:
Super-FRS

Module 3:
High-energy antiprotons (p-linac, pbar-target, CR, HESR)



Modularized Start Version

Module 4:
low energy RIB and
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Module 5:
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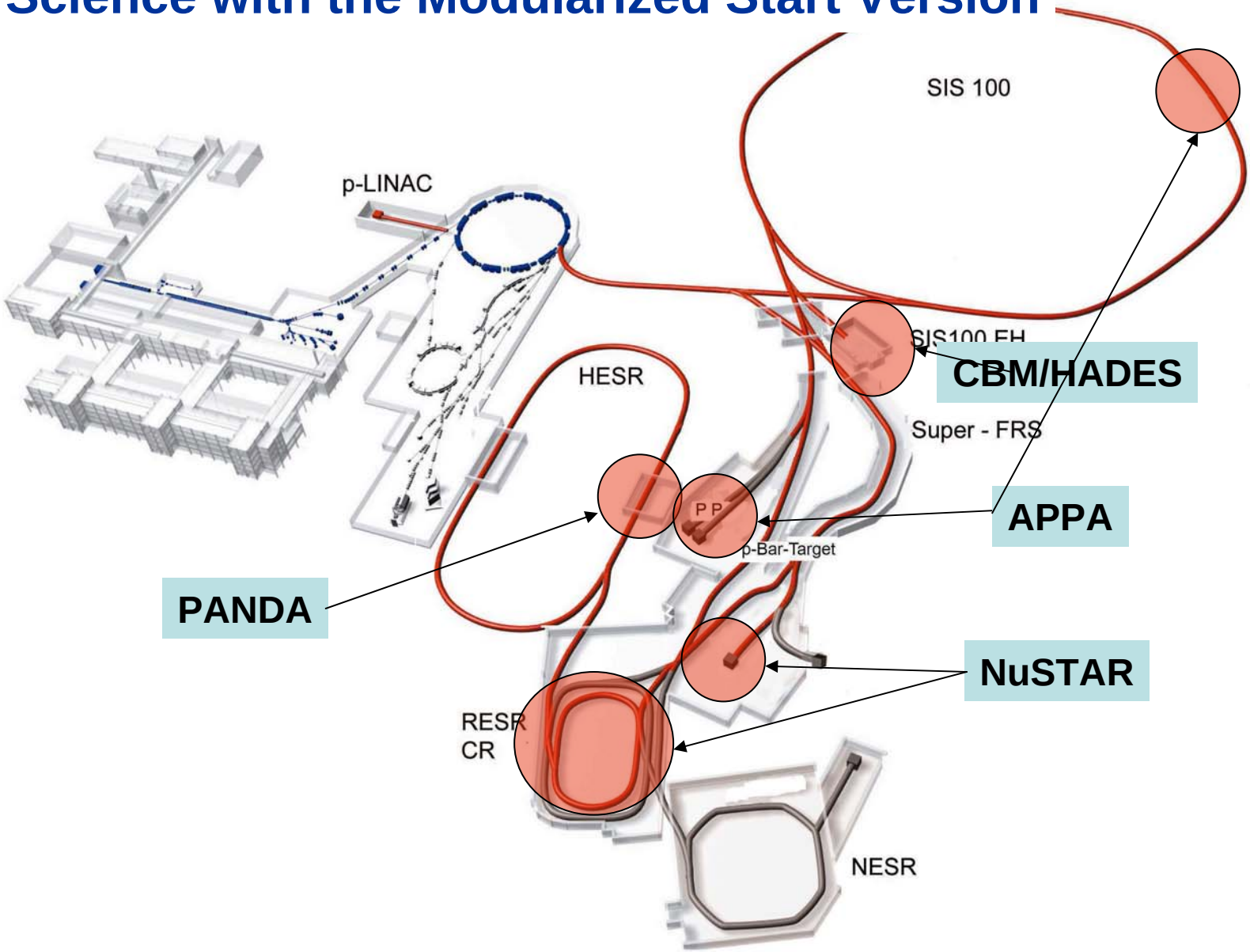
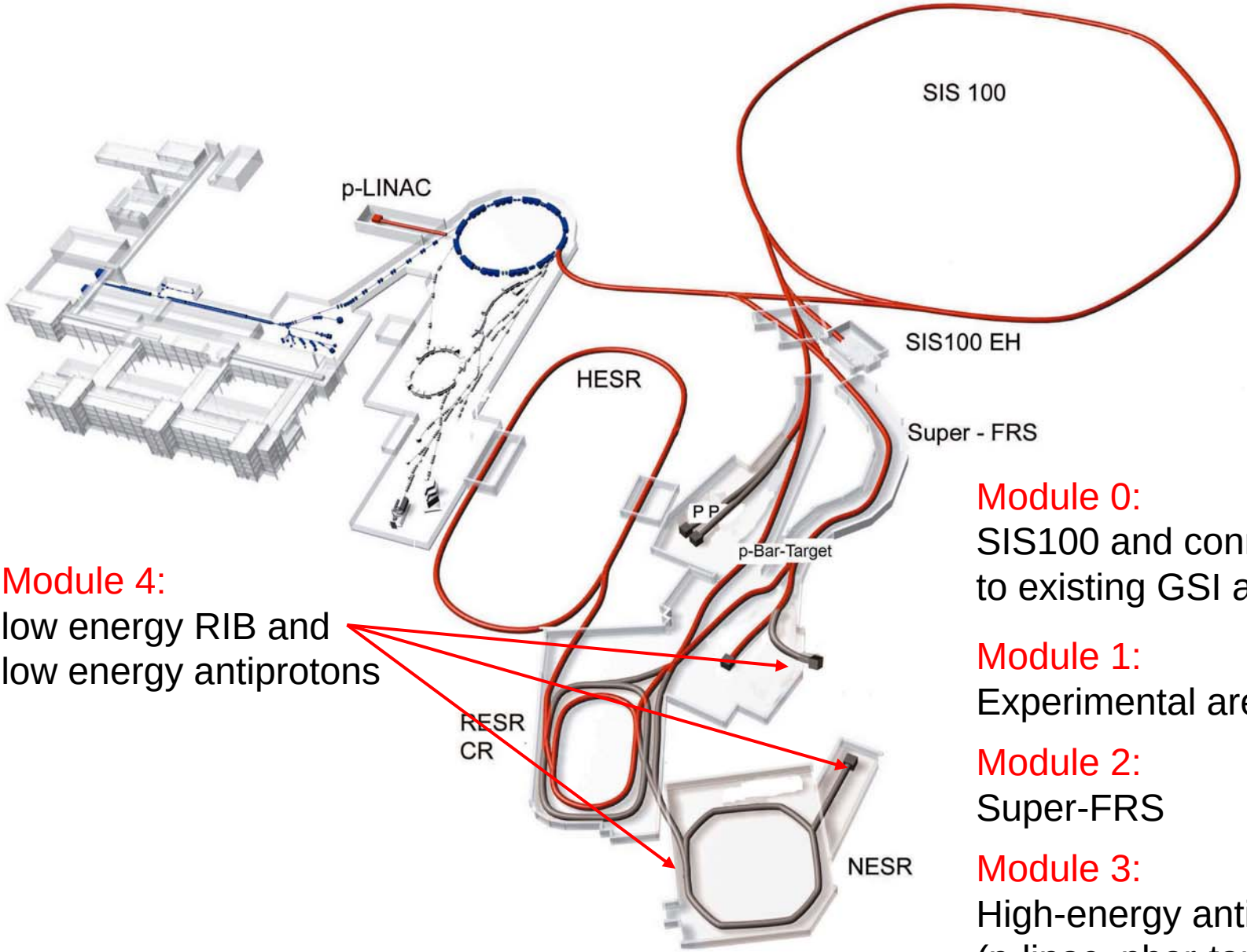
Science with the Modularized Start Version





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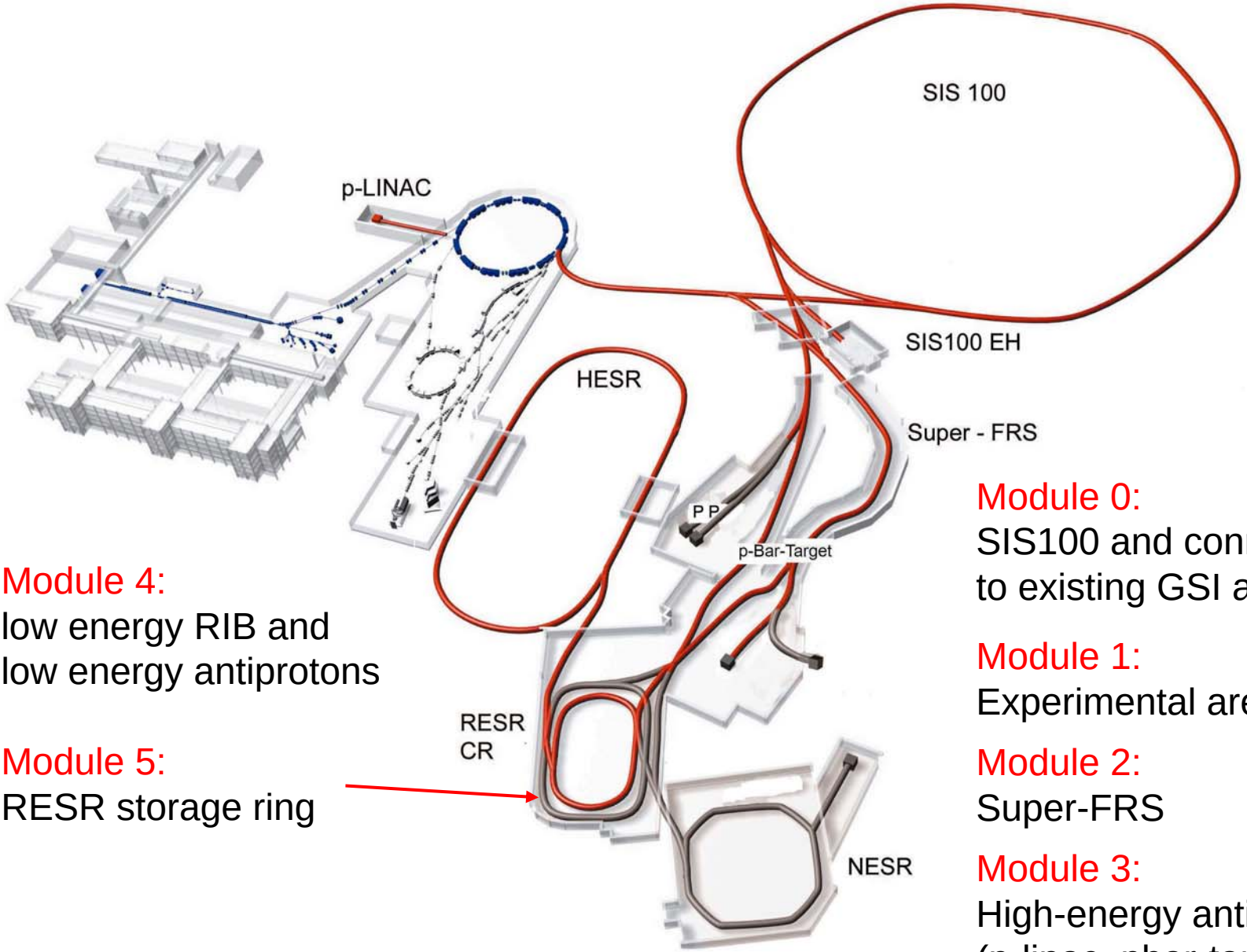

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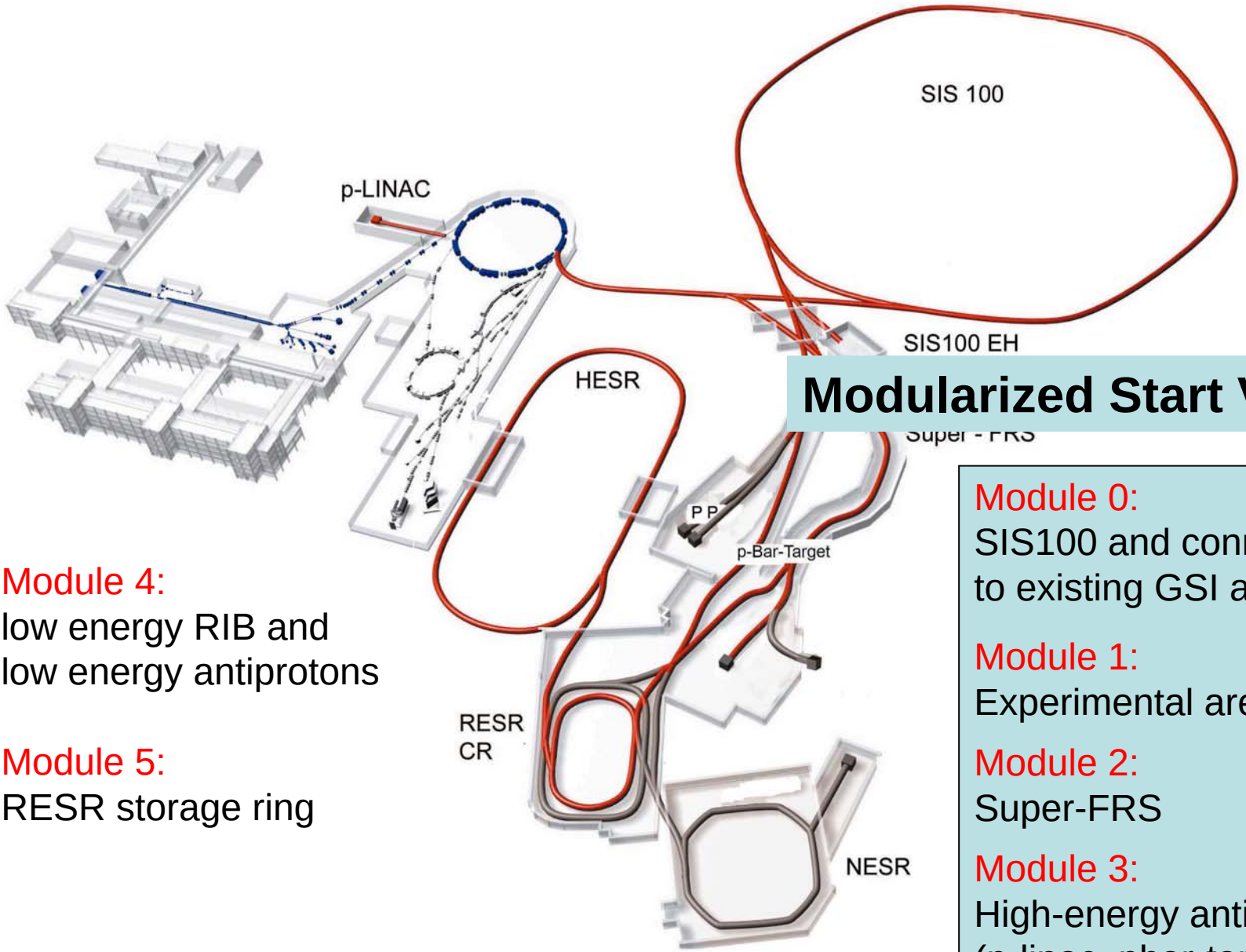

Modularized Start Version

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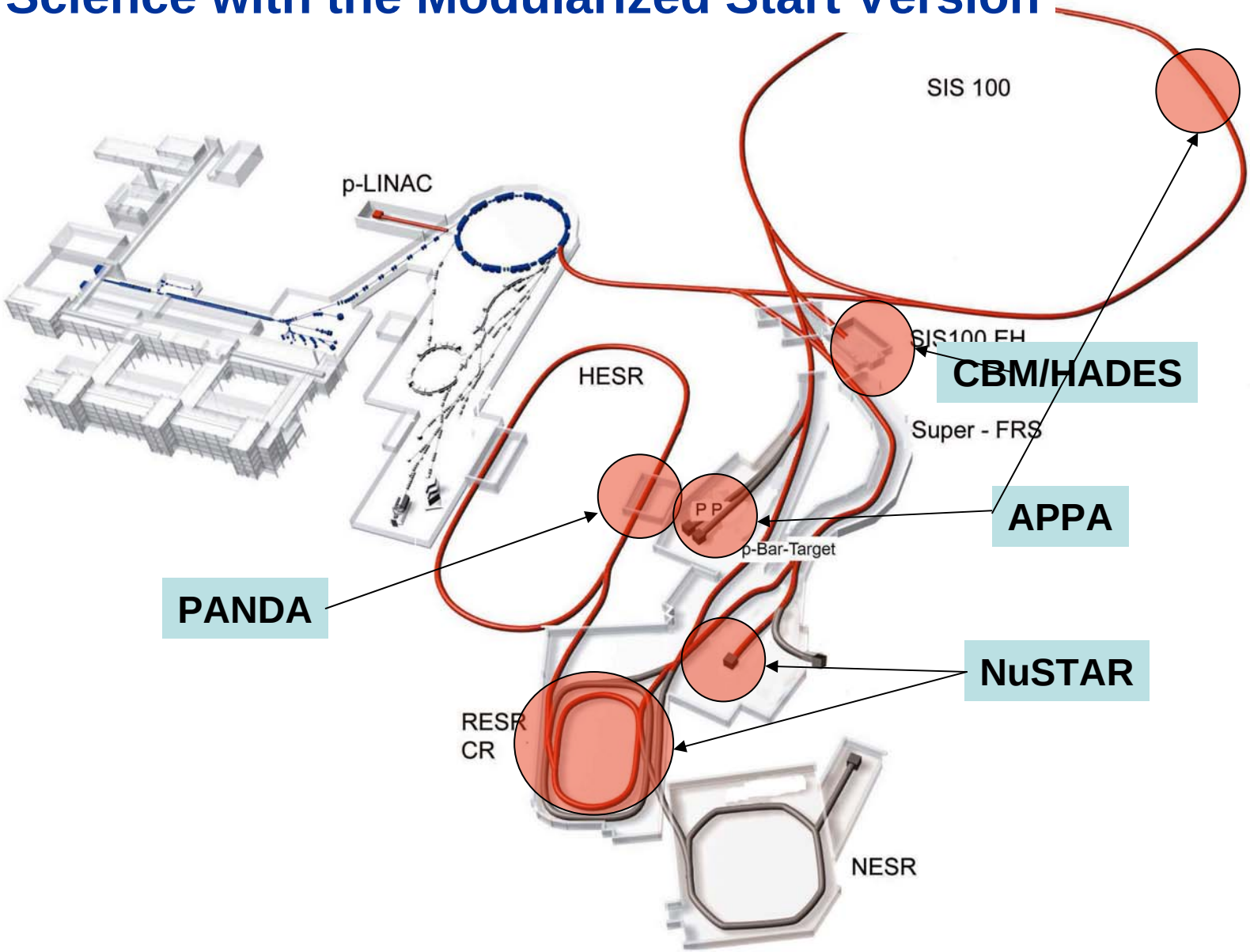
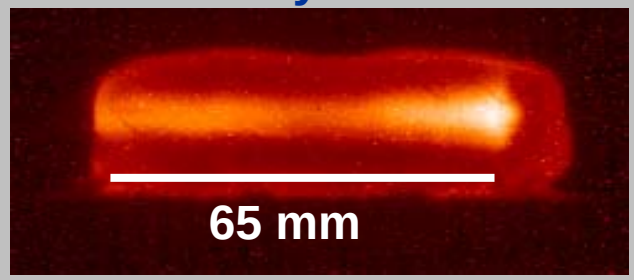
Science with the Modularized Start Version



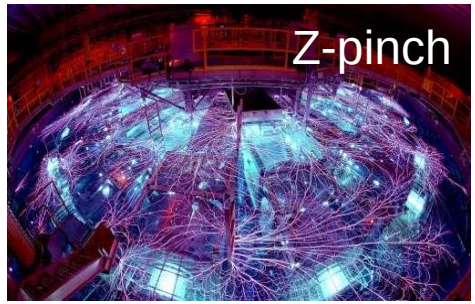
The uniqueness of heavy ion beams compared to other techniques (Laser, Z-pinch)

intense, energetic beams of heavy ions



Ne^{10+} 300 MeV/u; Kr crystal

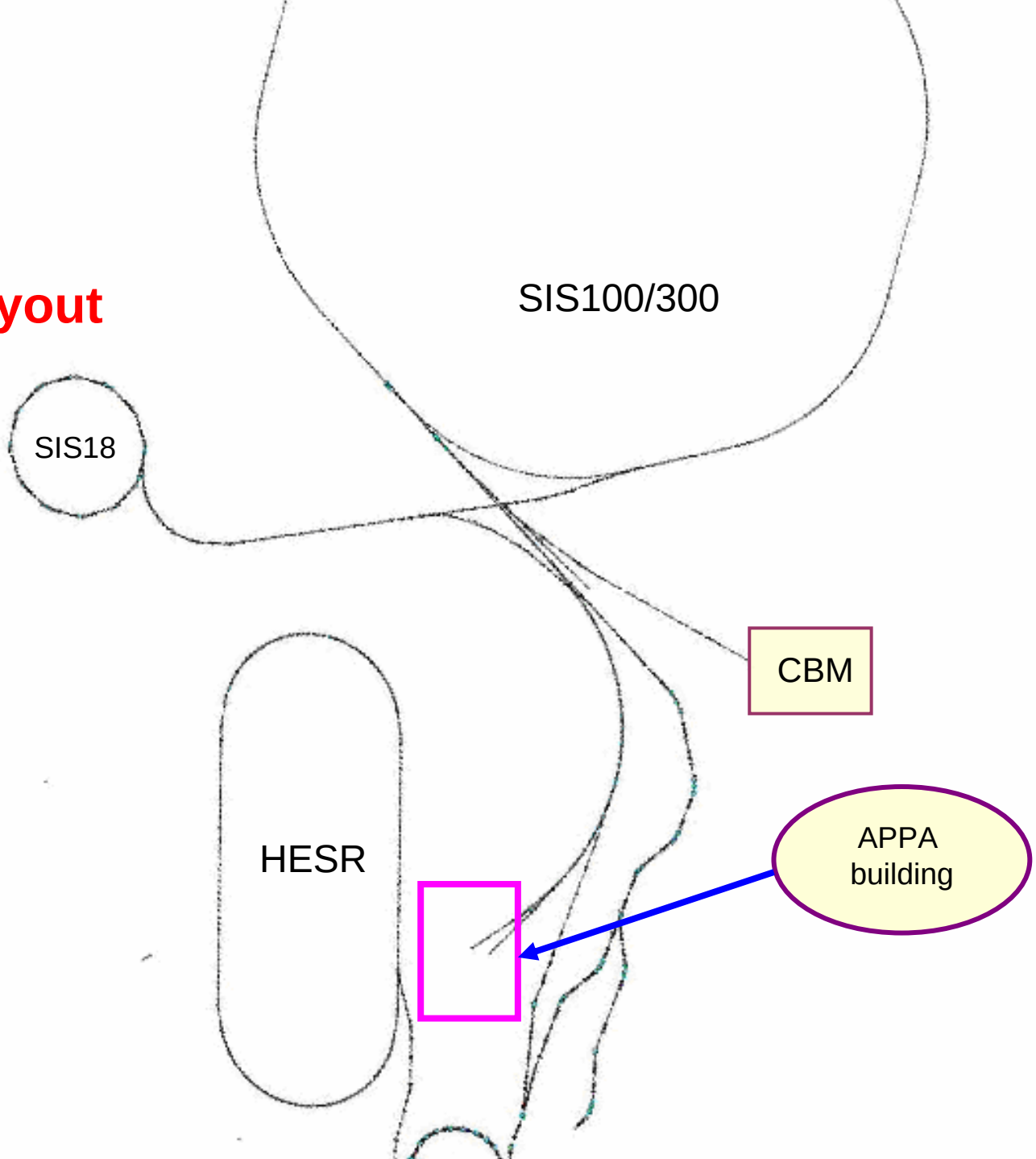
- large volume of sample (mm^3)
- fairly uniform physical conditions
- thermodynamic equilibrium
- any material



Already within module 1: Compared to GSI, FAIR will provide an ***intensity and energy density increase by a factor of 100.***

WDM-parameters: **T:** up to 10 eV **ρ:** ~ solid **P:** up **to 1** Mbar

MSV Layout



APPA Hall

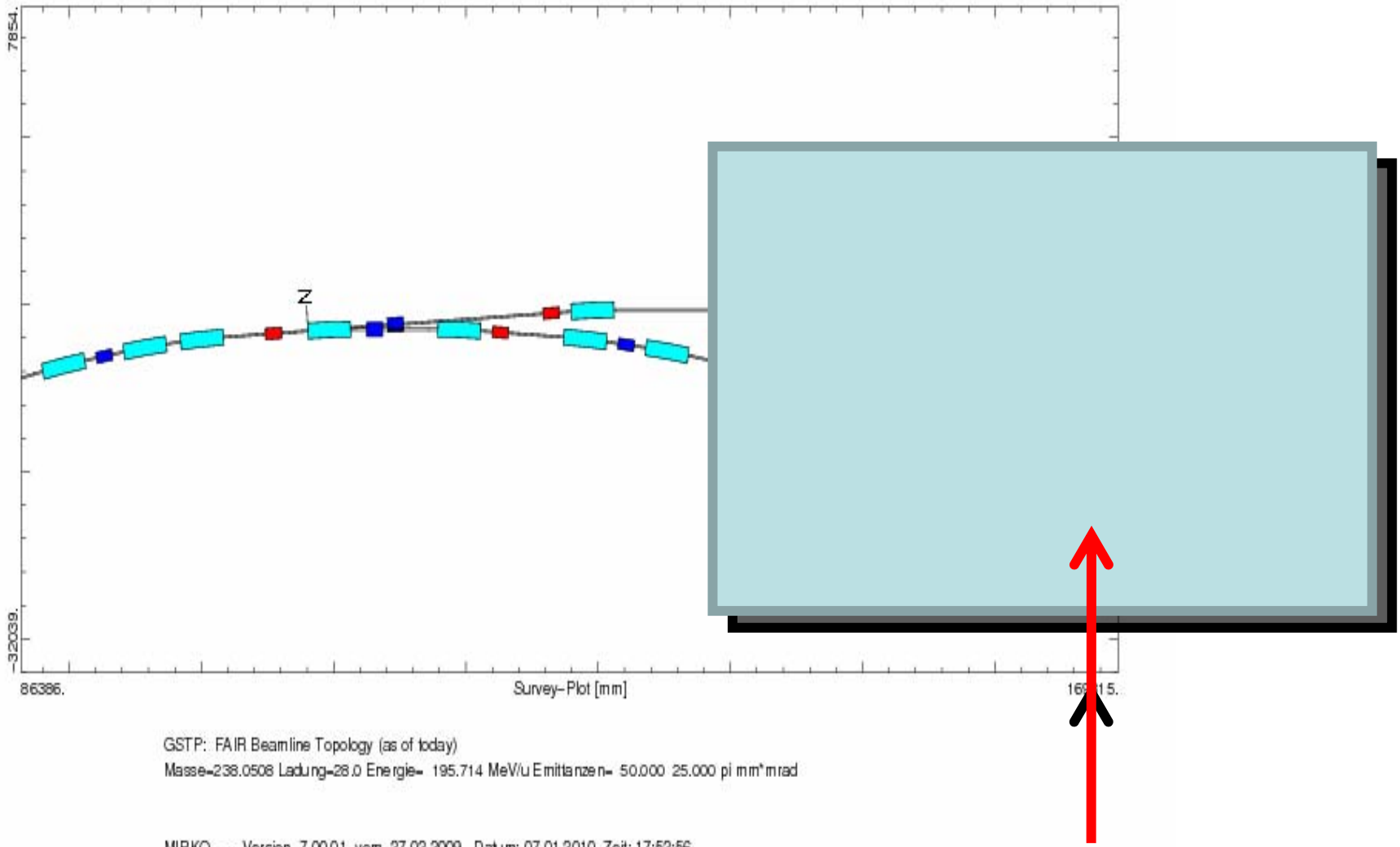
- Between HESR and Antiproton target
- Geologically not optimal, but only place where proton beamline can be added
- Financing through cost savings in SIS construction, CBM cave and antiproton target

Next steps:

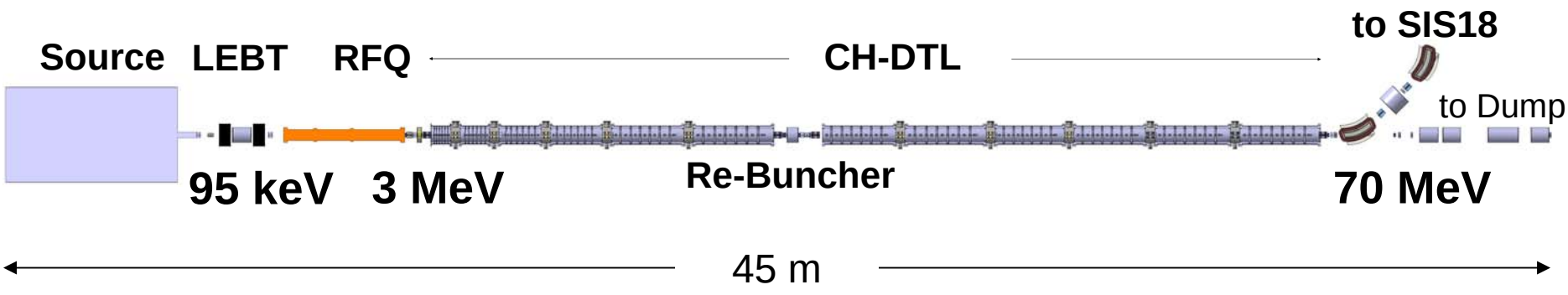
- new realistic space requirements needed for approval by BMBF (expt. areas and other needed space) (to be finished in February)
- then detailed planning will start (later to be checked by HBM) (to be finished in summer)

currently limiting factor for the entire construction approval procedure !

Beamline to the APPA hall



Proton Linac Overview



Beam energy	70 MeV
Beam current (op.)	35 mA
Beam current (des.)	*70 mA*
Beam pulse length	36 µs
Repetition rate	4 Hz
Rf-frequency	325.224 MHz
Tot. hor emit (norm.)	2.1 / *4.2* µm
Tot. mom. spread	≤ ± 10^{-3}
Linac length	≈ 35 m

French Participation Total Invest : 1.7 M€

Perspectives of HED-experiments at FAIR

Up to **200 times** the beam power and **100 times** higher energy density in the target will be available at FAIR

Ion beam U $^{28+}$	SIS-18	SIS-100	
Energy/ion	400MeV/u	0.4-27 GeV/u	
Number of ions	4.10^{9} ions	5.10^{11} ions	X100
Full energy	0.06 kJ	6 kJ	
Beam duration	130 ns	50 ns	
Beam power	0.5 GW	0.1TW	X200
	Lead Target		
Specific energy	1 kJ/g	100 kJ/g	X100
Specific power	5 GW/g	1 TW/g	X200
WDM temperature	~ 1 eV	10-20 eV	

only available at FAIR

Atomic, Plasmaphysics and Applied Physics (APPA)

Plasma-physics

- 246 scientists
- 55 institutions
- 16 countries

BIOMAT

- 110 scientists
- 28 institutions
- 12 countries

SPARC

- 284 scientists
- 83 institutions
- 26 countries

FLAIR

- 144 scientists
- 49 institutions
- 15 countries

Cost Estimate Modules 0-3 (Price Basis 2005)

Total accelerator and personnel Modules 0 - 3	**502**
Total civil construction Modules 0 - 3	**400**
Experiment funding	**78**
FAIR GmbH personnel and running costs	**47**
Grand Total Modules 0 - 3	**1027**

all values in M€

Finance Summary

Cost of Modularized Start Version = 1027 M€

Firm funding commitments of FAIR Partners = 1039 M€

Modularized Start Version secures a swift start within the current funding commitments

Roadmap

- Start of construction 2010/11
- Aim for earliest commissioning of accelerators and respective experiments
- Schadule is driven by **civil construction**

Module	Construction time (months)	Operational
0	72	2015 / 16
1	28	2015 / 16
2	60	2016
3	60	2016

Evaluation Board 16 October 2009

1. The Modularized Start Version **is the right way to proceed**.
2. The project is more focussed and is in even better shape.
3. We should now start as soon as possible!

Preparatory Phase R&D by GSI & Partner Institutes

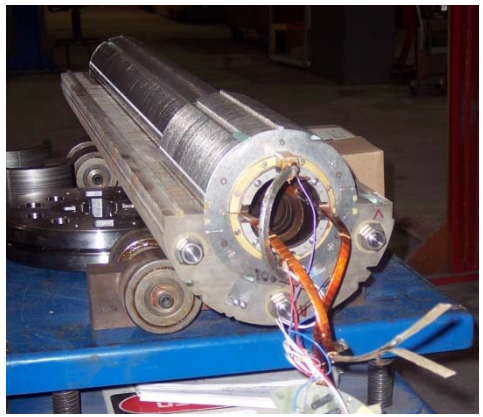
INFN Istituto Nazionale di Fisica Nucleare

BROOKHAVEN NATIONAL LABORATORY

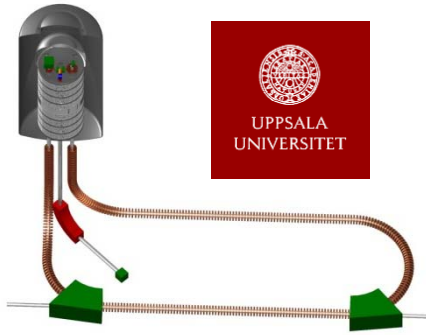
IHEP ИФВЭ

IHEP Protvino

SIS300 magnets



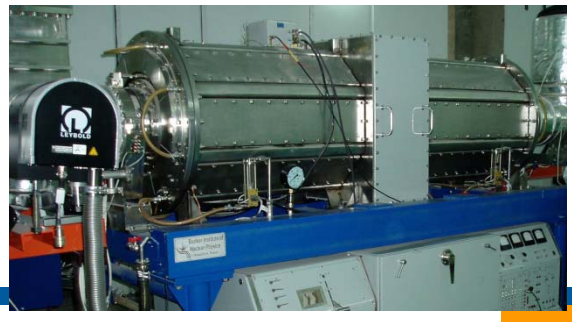
NESR Electron Cooling



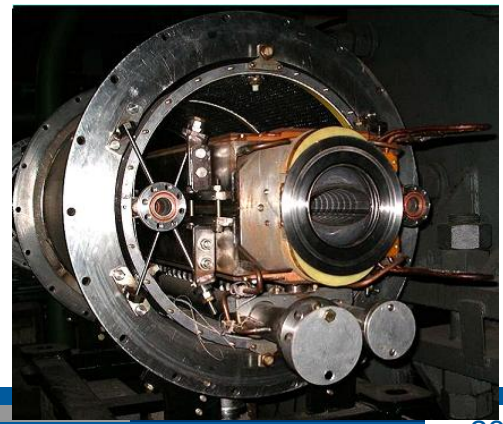
Forschungszentrum Jülich
in der Helmholtz-Gemeinschaft

CEA / CNRS

Variable Frequency Cavities

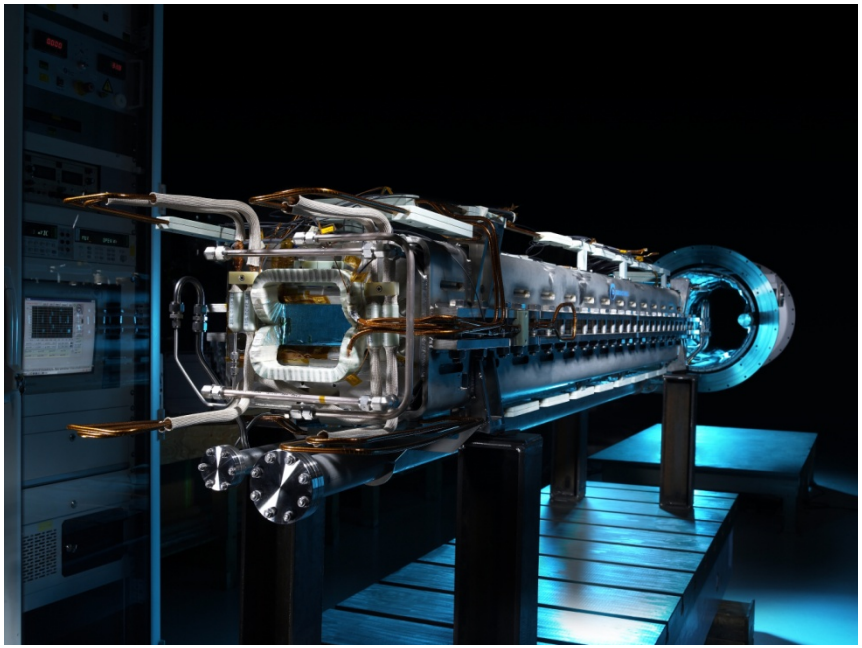


SIS100 rapidly cycling sc magnets



BINP Novosibirsk

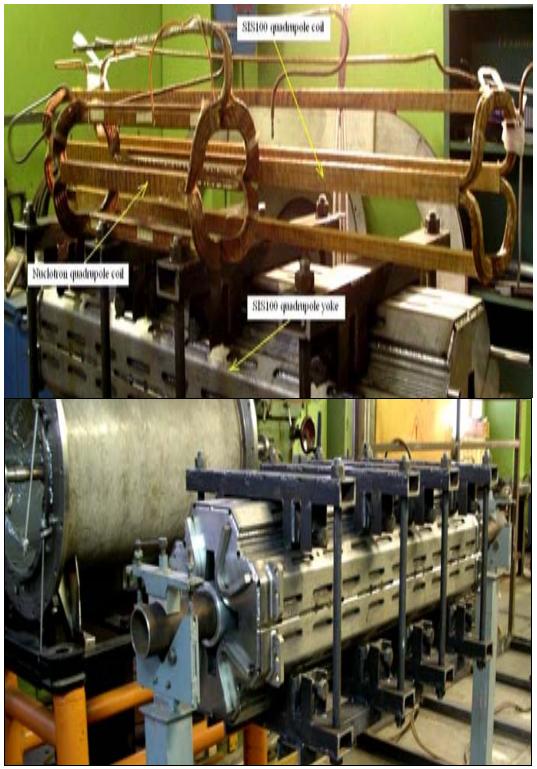
Prototyping examples

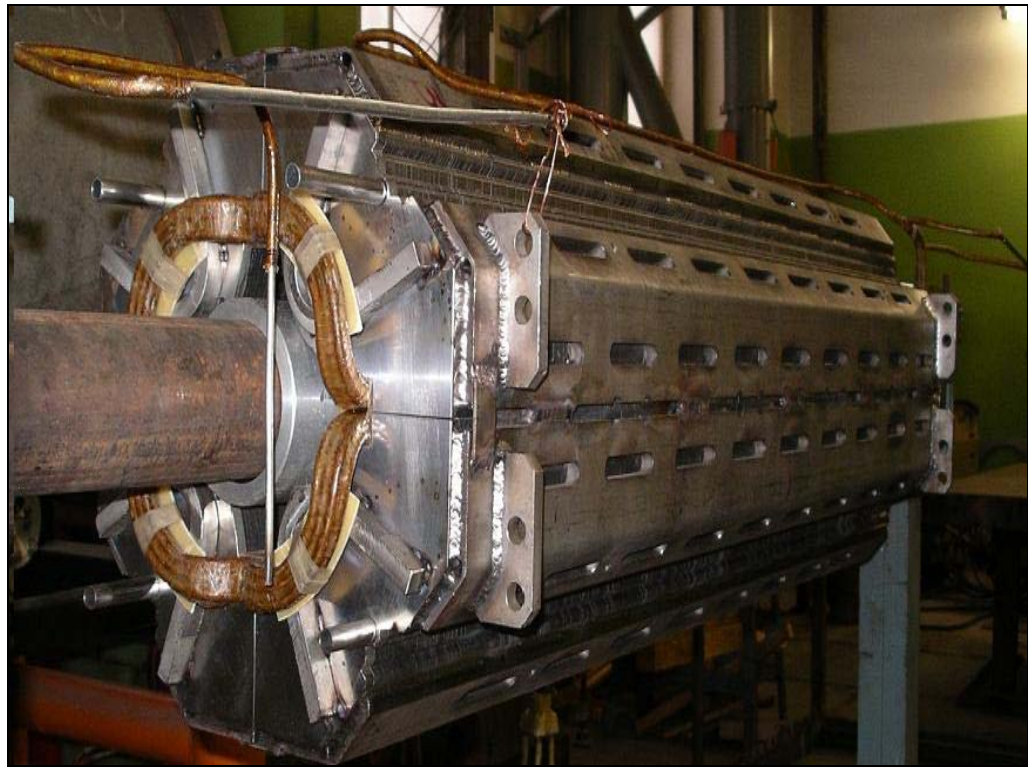


Full size SIS100 dipole (Germany)

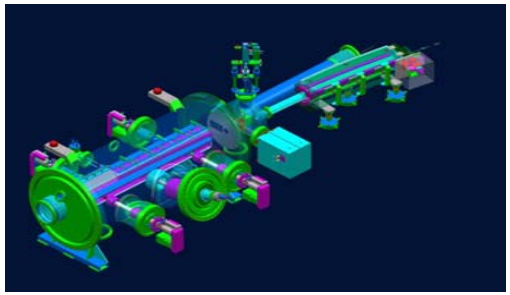
Prototyping examples

First SIS100 Full size quadrupole (Russia)

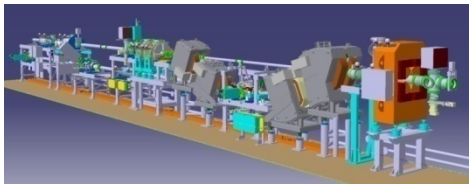




SIS18upgrade Program

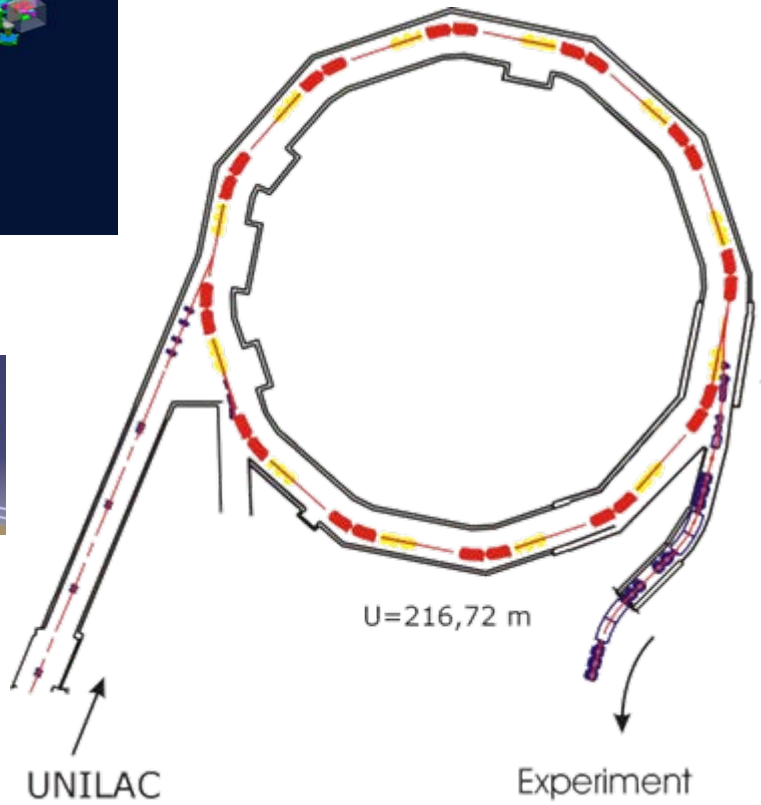


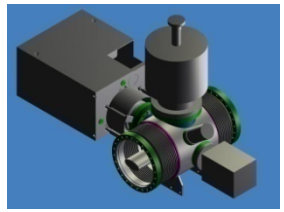
Injection system for low charged state heavy ions



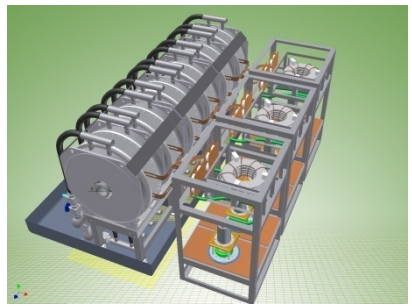
Charge separator for higher intensity and high quality beams

Power grid connection





Scrapers and NEG coating for pressure stabilization



h=2 acceleration cavity for faster ramping

The SIS18upgrade program: Booster operation with low charge state heavy ions

Conclusions

- Based on recent cost estimates and firm commitments of FAIR Member States the Modularized Start Version is elaborated
- Modules 0-3 ensure a physics programme that is unique, competitive with great discovery potential
- All FAIR science communities can perform excellent physics from early on
- The facility can be smoothly upgraded towards the full version of FAIR (modules 4,5,6)
- Setup of the international FAIR company proceeds in parallel

29 April 2010 - Dr. P.Shchedrovizky at GSI / FAIR