

Status of the FAIR Project

Rudolf Maier

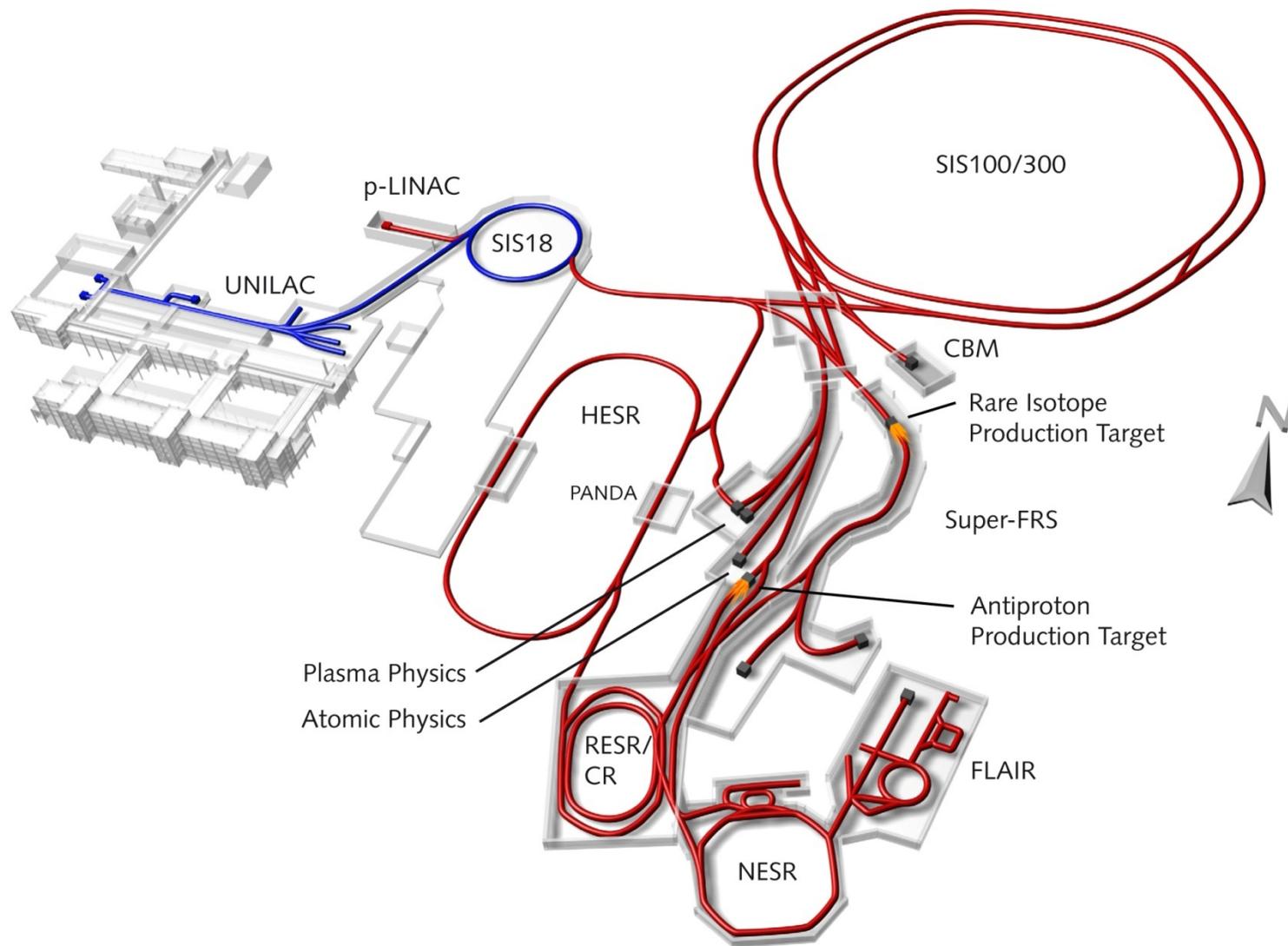
Boris Sharkov (FAIR Director) talk
@ 28 HESR CM 08.12.2009



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



FAIR facility BTR 2005



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	Phase B SIS300 8 MV EC EIA

Modularized Start Version

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



Presse- mitteilung

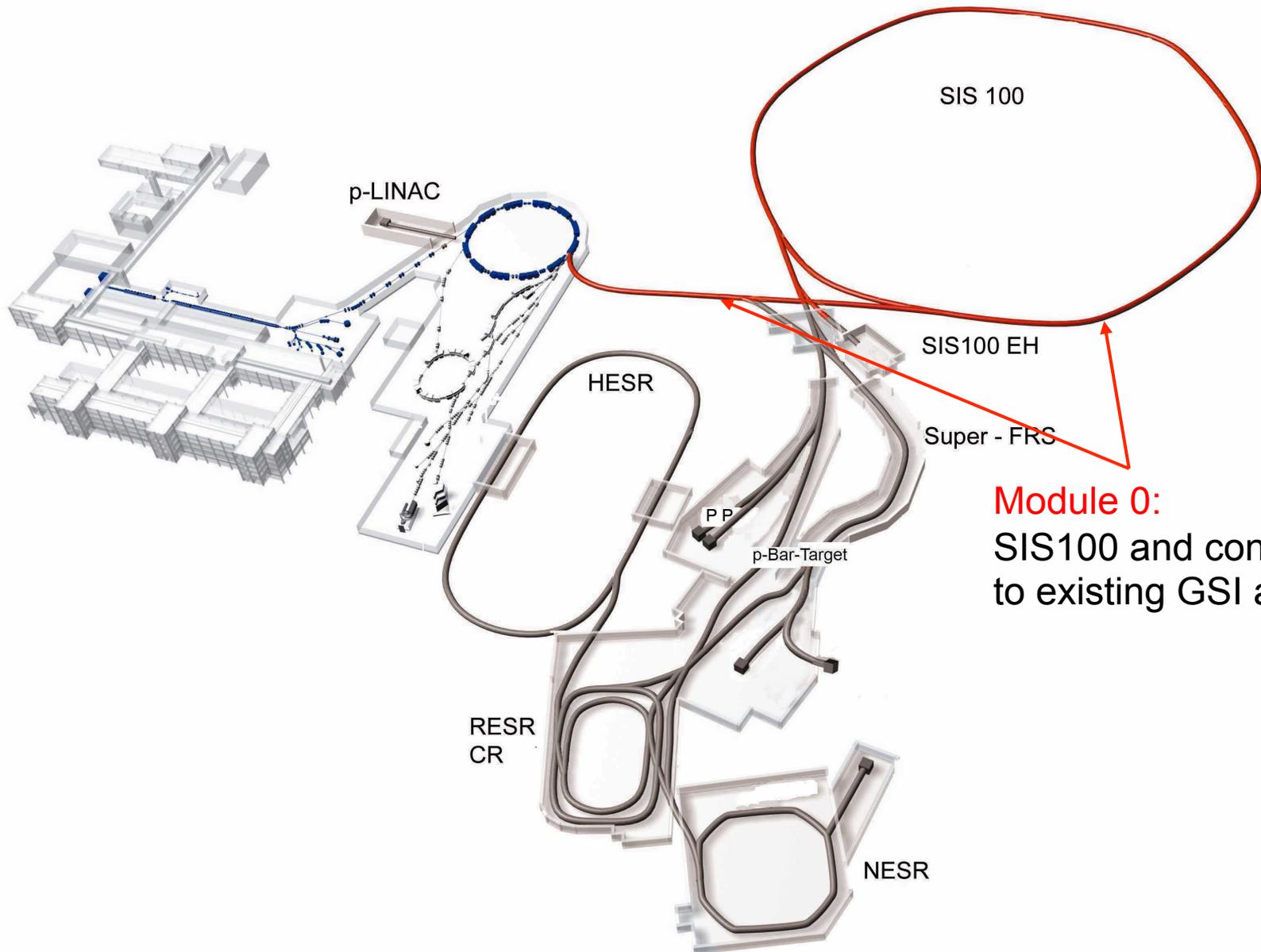
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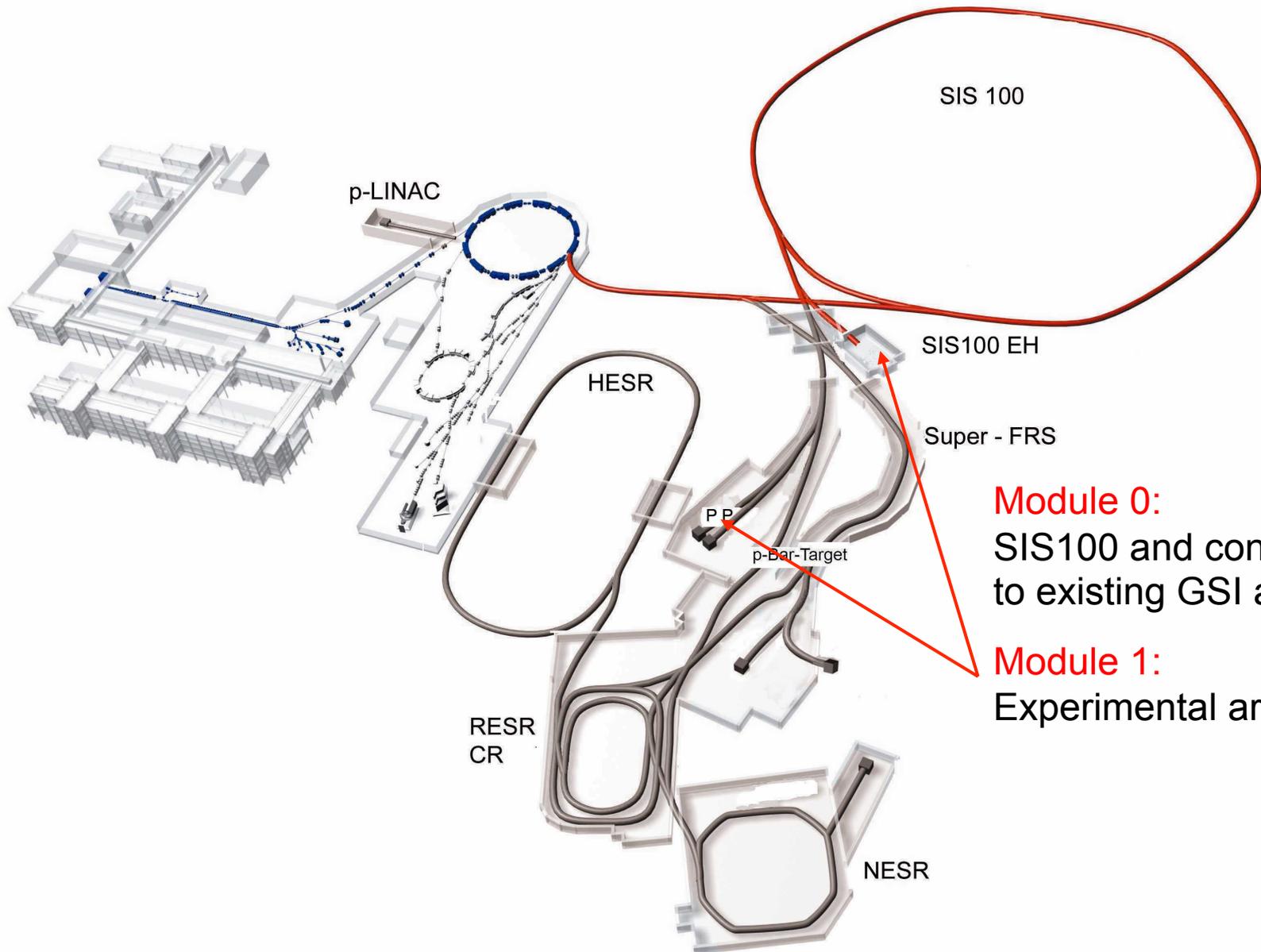
03. September 2009
216/2009

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

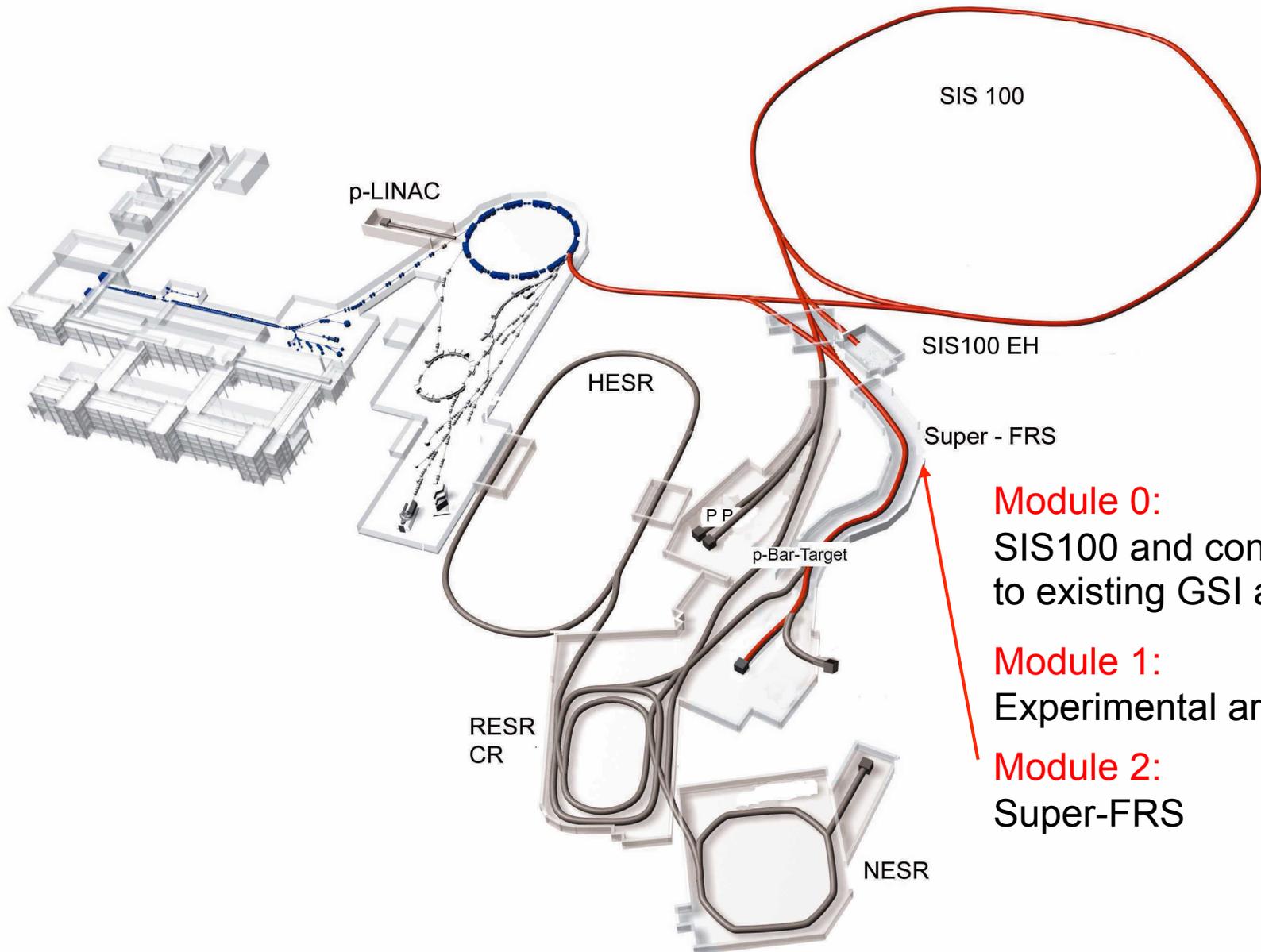


Module 0:
 SIS100 and connection
 to existing GSI accel.

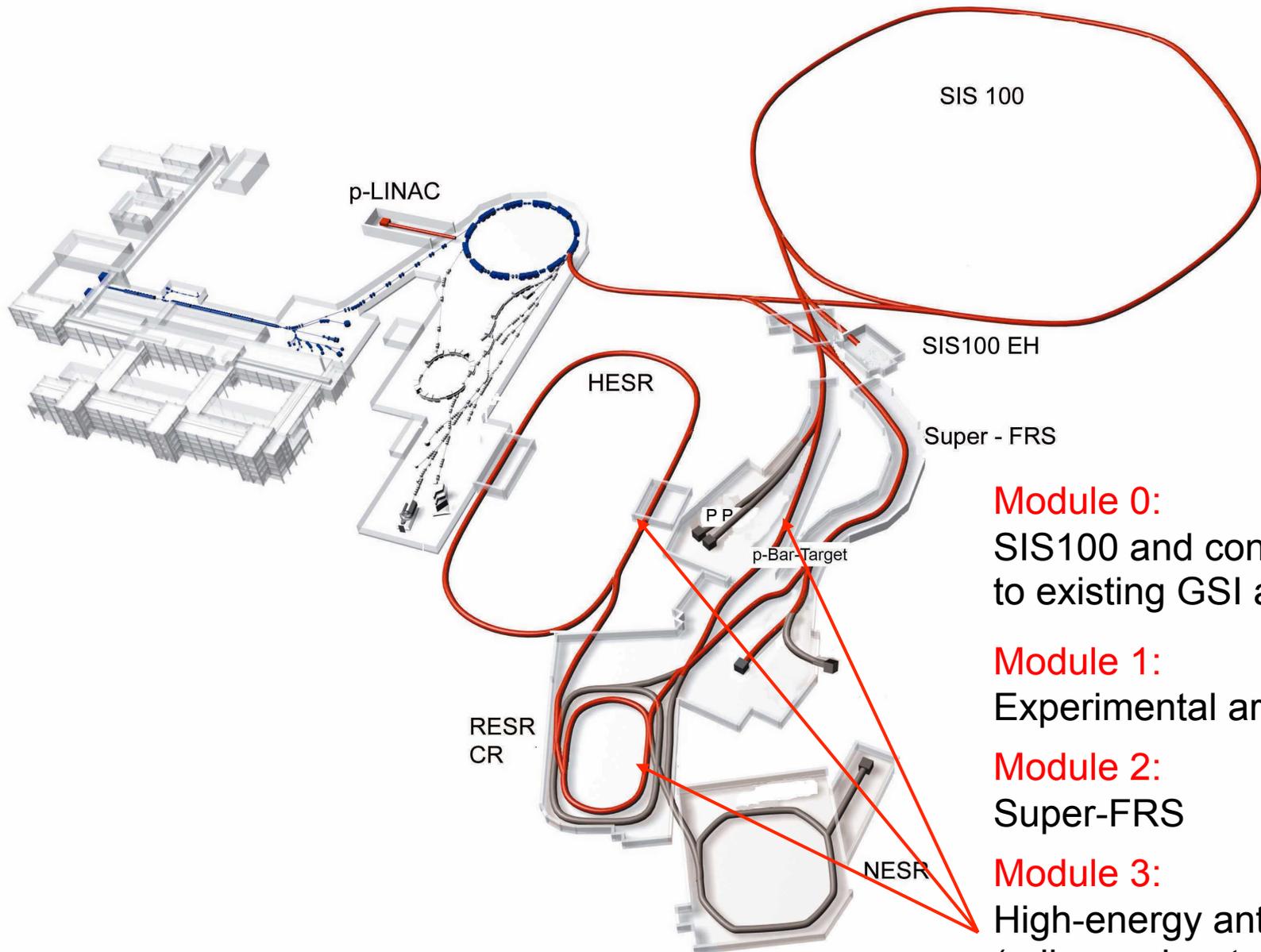


Module 0:
SIS100 and connection
to existing GSI accel.

Module 1:
Experimental areas



- Module 0:** SIS100 and connection to existing GSI accel.
- Module 1:** Experimental areas
- Module 2:** Super-FRS

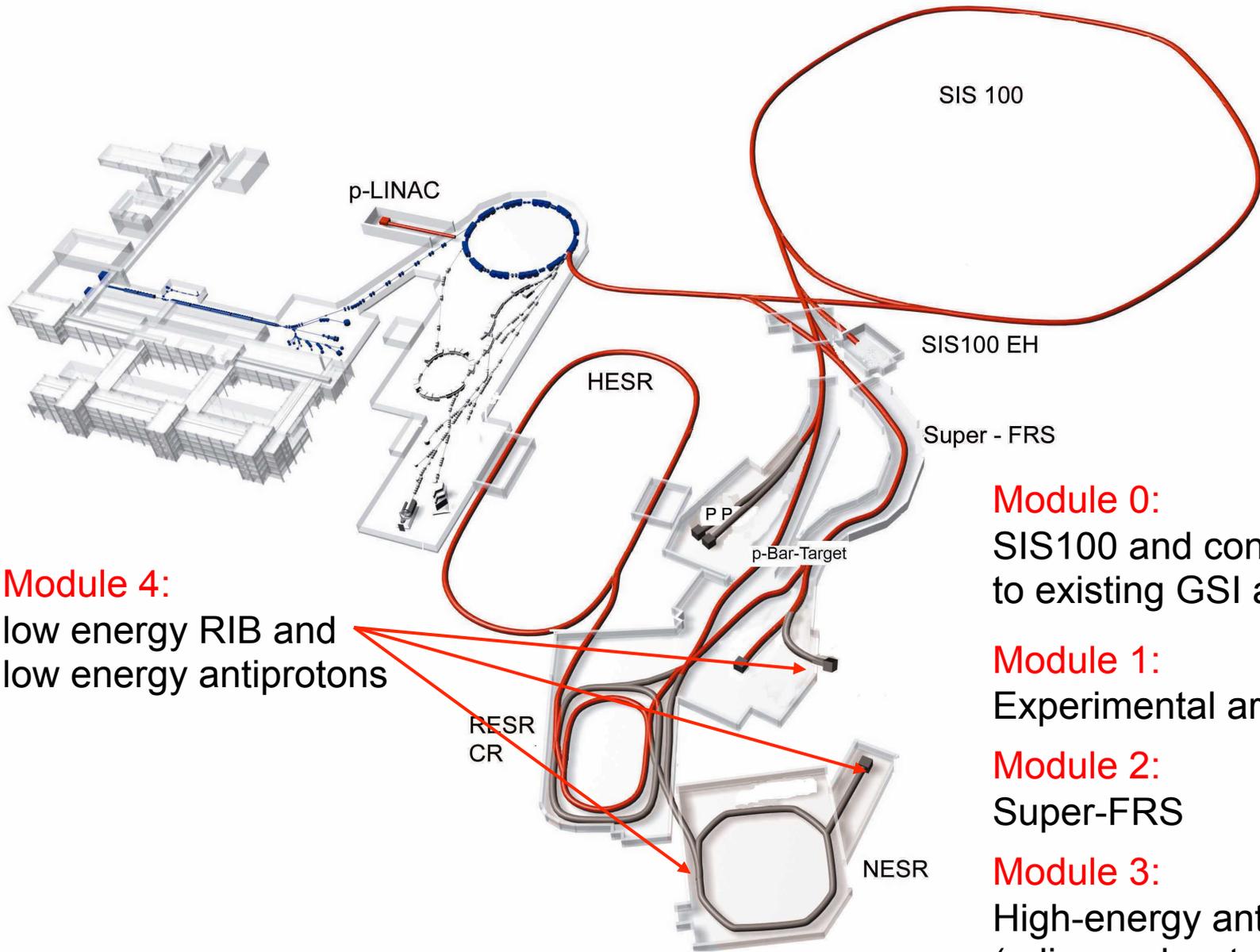


Module 0:
SIS100 and connection
to existing GSI accel.

Module 1:
Experimental areas

Module 2:
Super-FRS

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



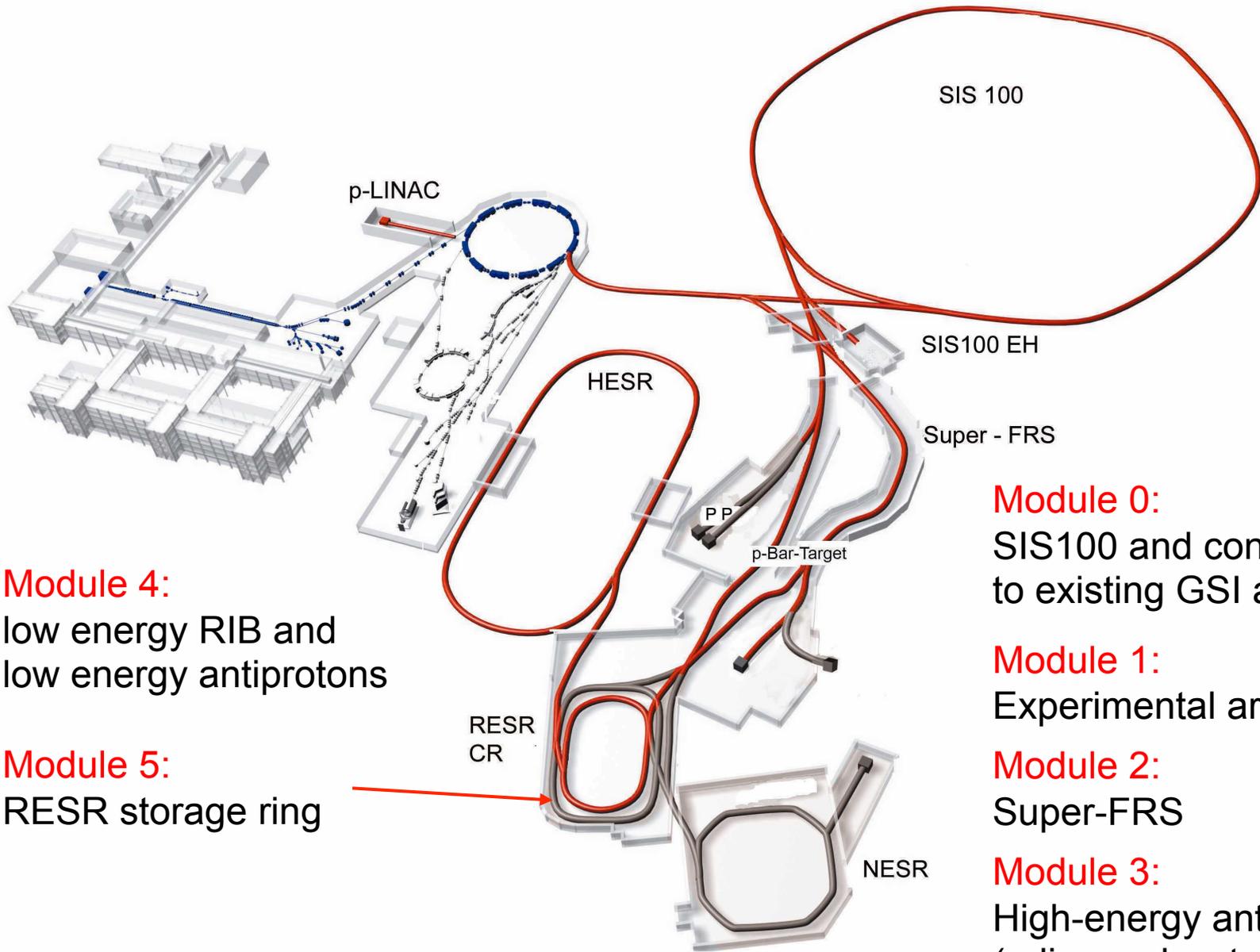
Module 4:
low energy RIB and
low energy antiprotons

Module 0:
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Module 1:
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Module 4:
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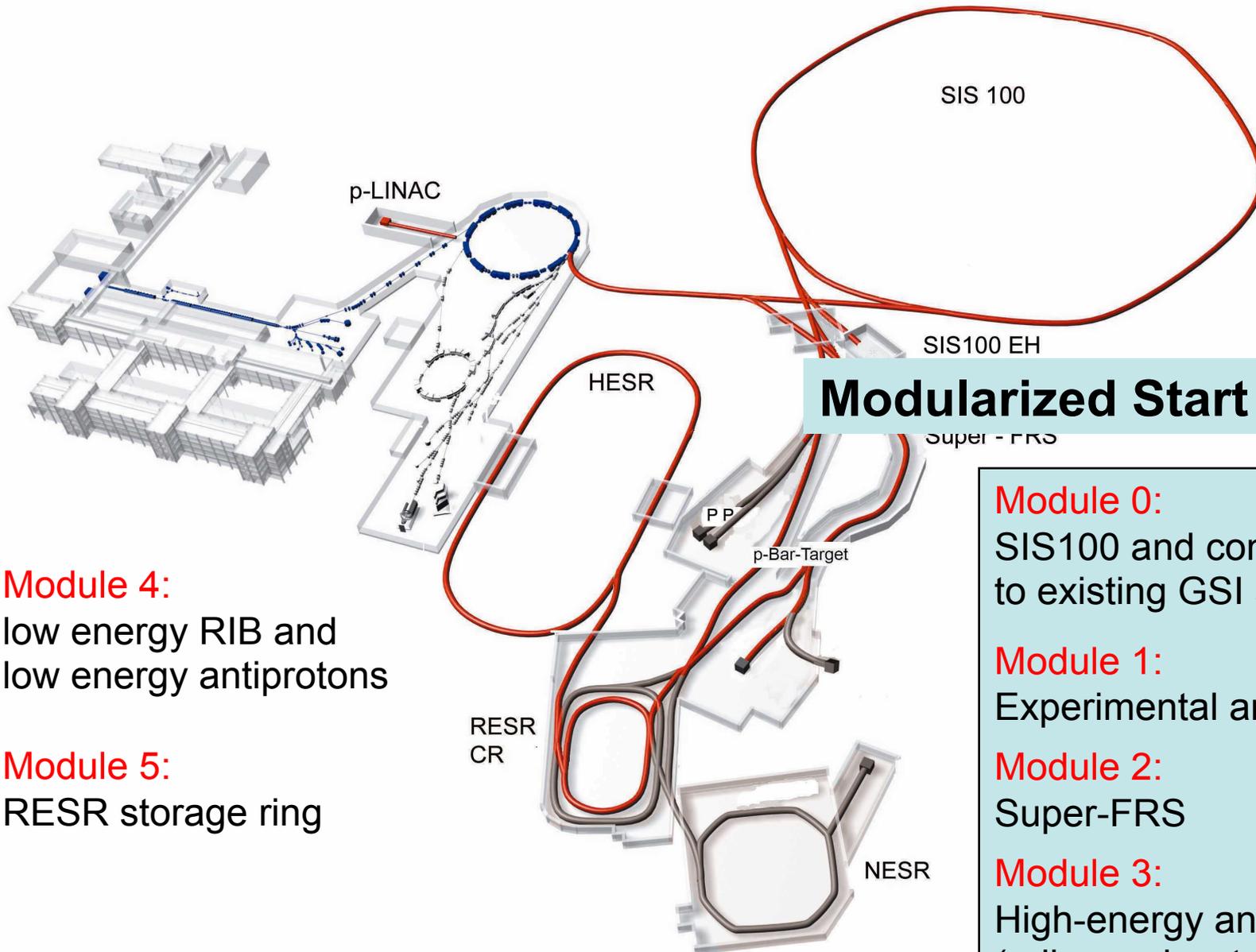
Module 5:
RESR storage ring

Module 0:
SIS100 and connection
to existing GSI accel.

Module 1:
Experimental areas

Module 2:
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Module 3:
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Modularized Start Version

Super-FRS

Module 4:
low energy RIB and
low energy antiprotons

Module 5:
RESR storage ring

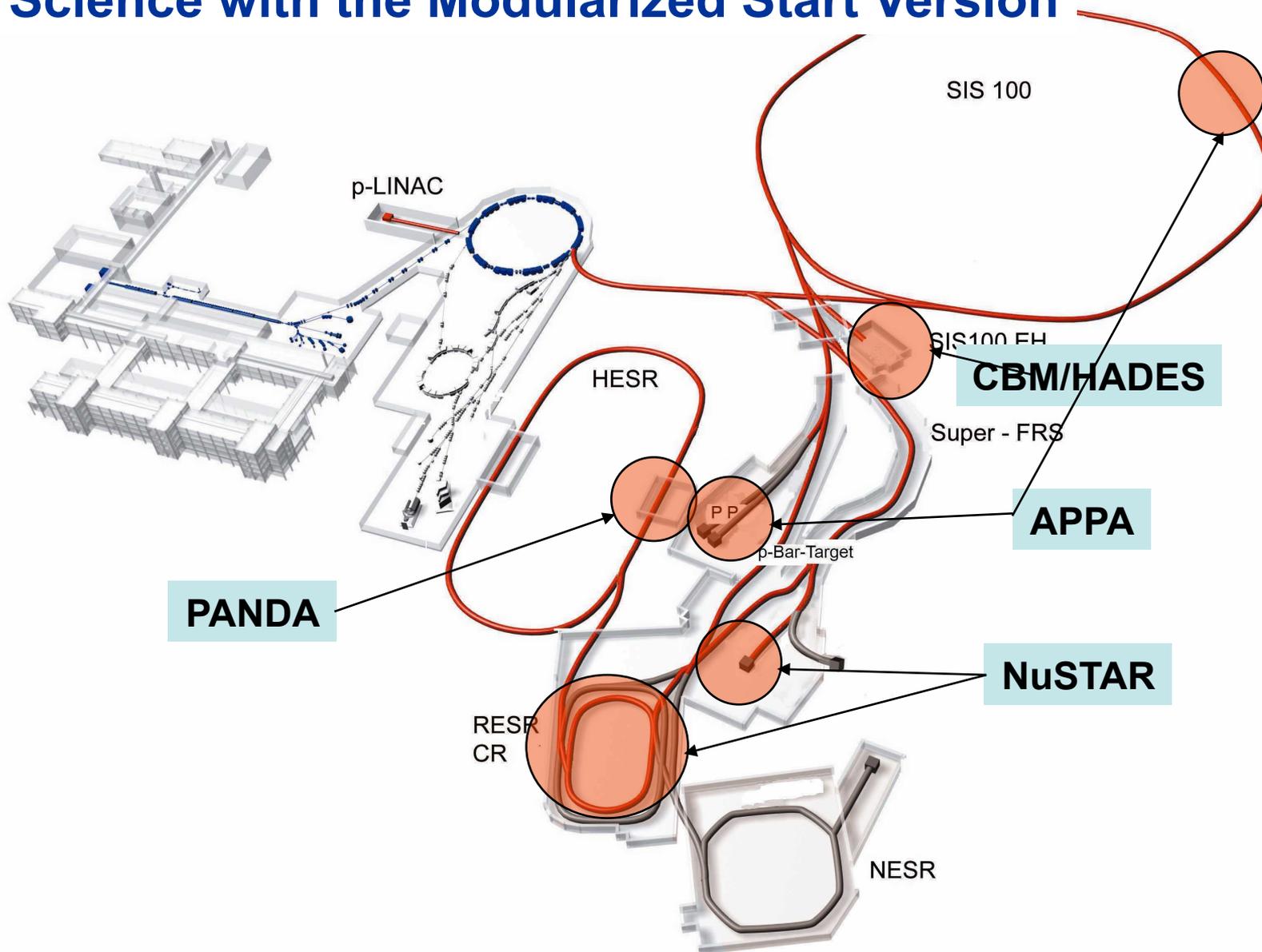
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Science with the Modularized Start Version





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

Summary: APPA Collaborations

Module 1: Unique research opportunities for atomic-, bio-, and plasma-physics as well as applied sciences (BIOMAT, HEDgeHOB, SPARC)

Highest Charge States

Extreme static fields

Relativistic Energies

Extreme dynamical fields and ultrashort pulses

Highest Intensities

Very high energy densities and pressures

Modules 4 and 5: Additional Research Opportunities

SPARC *Precision studies using cooled, stored and trapped ions*

FLAIR *Most intense source of low-energy antiprotons will be accessible*

HEDgeHOB/WDM *Diagnostic tools of high power laser and of proton radiography are optional*

The CBM Collaboration: 55 institutions, 450 members

Croatia:

RBI, Zagreb
Split Univ.

China:

CCNU Wuhan
Tsinghua Univ.
USTC Hefei

Czech Republic:

CAS, Rez
Techn. Univ. Prague

France:

IPHC Strasbourg

Hungaria:

KFKI Budapest
Budapest Univ.

Norway:

Univ. Bergen

India:

Aligarh Muslim Univ.
Panjab Univ.
Rajasthan Univ.
Univ. of Jammu
Univ. of Kashmir
Univ. of Calcutta
B.H. Univ. Varanasi
VECC Kolkata
SAHA Kolkata
IOP Bhubaneswar
IIT Kharagpur
Gauhati Univ.

Korea:

Korea Univ. Seoul
Pusan Nat. Univ.

Germany:

Univ. Heidelberg, P.I.
Univ. Heidelberg, KIP
Univ. Heidelberg, ZITI
Univ. Frankfurt IKF
Univ. Frankfurt, FIAS
Univ. Münster
FZ Dresden
GSI Darmstadt
Univ. Wuppertal

Poland:

Jag. Univ. Krakow
Warsaw Univ.
Silesia Univ. Katowice
AGH Krakow

Portugal:

LIP Coimbra

Romania:

NIPNE Bucharest
Univ. Bucharest

Russia:

IHEP Protvino
INR Troitzk
ITEP Moscow
KRI, St. Petersburg
Kurchatov Inst., Moscow
LHEP, JINR Dubna
LIT, JINR Dubna
MEPHI Moscow
Obninsk State Univ.
PNPI Gatchina
SINP MSU, Moscow
St. Petersburg P. Univ.

Ukraine:

T. Shevchenko Univ. Kiev
Kiev Inst. Nucl. Research



14th CBM Collaboration meeting
5-9 Oct. 2009, Split, Croatia

Summary: CBM/HADES at FAIR

Physics program with large discovery potential at Module 0,1:

- Exploring the equation-of-state of nuclear matter at neutron star densities with multistrange hyperons.
- First measurements of lepton pairs at SIS100 energies to study the modification of hadron properties in dense nuclear matter, and the electromagnetic structure of dense nuclear matter.
- Searching for strange matter.
- First measurement of charm production and propagation at threshold energies.

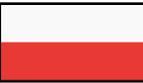
Full version of FAIR:

Mapping the QCD phase diagram, and searching for

- the deconfinement and chiral phase transitions,
- the QCD critical endpoint,
- new states of matter at the highest baryon densities.

Nuclear Structure, Astrophysics and Reactions

> 800 members from 37 countries and 146 institutions



Summary: NuSTAR Collaboration

Module 0-3: Unique research opportunities to study Nuclear Structure and Dynamics and Nuclear Astrophysics

R3B	full program, reactions at relativistic energies, complete kinematics
ILIMA	unique measurements of masses and half-lives in the CR
HISPEC, DESPEC	in-beam (50-100 AMeV) & decay spectroscopy
MATS, LASPEC	precision ground state properties

Modules 4 and 5: Additional Research Opportunities

ILIMA	cooled beams, unique decay modes, isomeric beams in NESR
EXL	elastic and inelastic scattering on internal H, He target in NESR
HISPEC	energy buncher: access to heavier nuclei, low-energy beams
MATS, LASPEC	energy buncher: faster extraction, cleaner beams

At present 410 physicists from 53 institutions in 16 countries



Basel, Beijing, Bochum, IIT Bombay, Bonn, Brescia, IFIN Bucharest, Catania, IIT Chicago, Cracow, IFJ PAN Cracow, Cracow UT, Edinburgh, Erlangen, Ferrara, Frankfurt, Genova, Giessen, Glasgow, GSI, FZ Jülich, JINR Dubna, Katowice, KVI Groningen, Lanzhou, LNF, Lund, Mainz, Minsk, ITEP Moscow, MPEI Moscow, TU München, Münster, Northwestern, BINP Novosibirsk, IPN Orsay, Pavia, IHEP Protvino, PNPI St.Petersburg, KTH Stockholm, Stockholm, Dep. A. Avogadro Torino, Dep. Fis. Sperimentale Torino, Torino Politecnico, Trieste, TSL Uppsala, Tübingen, Uppsala, Valencia, SINS Warsaw, TU Warsaw, AAS Wien

Summary: PANDA Collaboration

Module 0-3: \bar{p} -induced reactions studied with FAIR have an enormous impact in particle physics

All $\bar{q}q$ states can be formed directly (not only 1^{--})

$\bar{p}p$ cross section is high

High probability for production of exotic states

Low final state multiplicities

Nucleon structure can be studied

- discovery potential
- precision studies 1st time
- 2 states 1^{-+} are predicted
- allows complete PWA
- via electromagnetic processes

Module 5: Additional Research Opportunities

Higher luminosity

Maximizes the yield, and then rare phenomena can be studied

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

Cost Estimate Modules 0-3 (Price Basis 2005)

Total accelerator and personnel Modules 0 - 3	502
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Total civil construction Modules 0 - 3	400
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Experiment funding	78
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FAIR GmbH personnel and running costs	47
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Grand Total Modules 0 - 3	1027
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all values in M€

Firm Commitments

FAIR Countries	Total declared Contribution (k€)
Austria	5.000
China	12.000
Finland	5.000
France	27.000
Germany	705.000
Great Britain	8.000
Greece	4.000
India	36.000
Italy	42.000
Poland	23.740
Romania	11.870
Russia	178.050
Slovenia	12.000
Slovakia	6.000
Spain	19.000
Sweden	10.000
Total	1.104.660
Firm Commitments	1.038.660

not firm for the first batch

Kingdom of Saudi-Arabia signed the Declaration to contribute at least 1 %

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

- Driven by civil construction
- Aim for earliest commissioning of accelerators and respective experiments
- Start of construction 2010/11

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

Optimization Progress

Sub-committee of the Machine Advisory Committee

- evaluate radioprotection and safety concept
 - evaluation of parameters entering the radiation calculations
 - access strategies to accelerators and experiments
- optimize cost/value ratio for civil construction

Membership: experts from other centers as well as some MAC members

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
- Setup of the international FAIR company proceeds in parallel

FAIR will open a new era in hadronic, nuclear and atomic research as well as in applied science.

The White Paper outlines **the path to achieve this goal.**

The Modularized Start Version provides an outstanding and world-leading research program for all scientific

FAIR communities.

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!