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Overview HESR

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HIC4FAIR

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HESR consortium members

(i) Forschungszentrum Jülich,

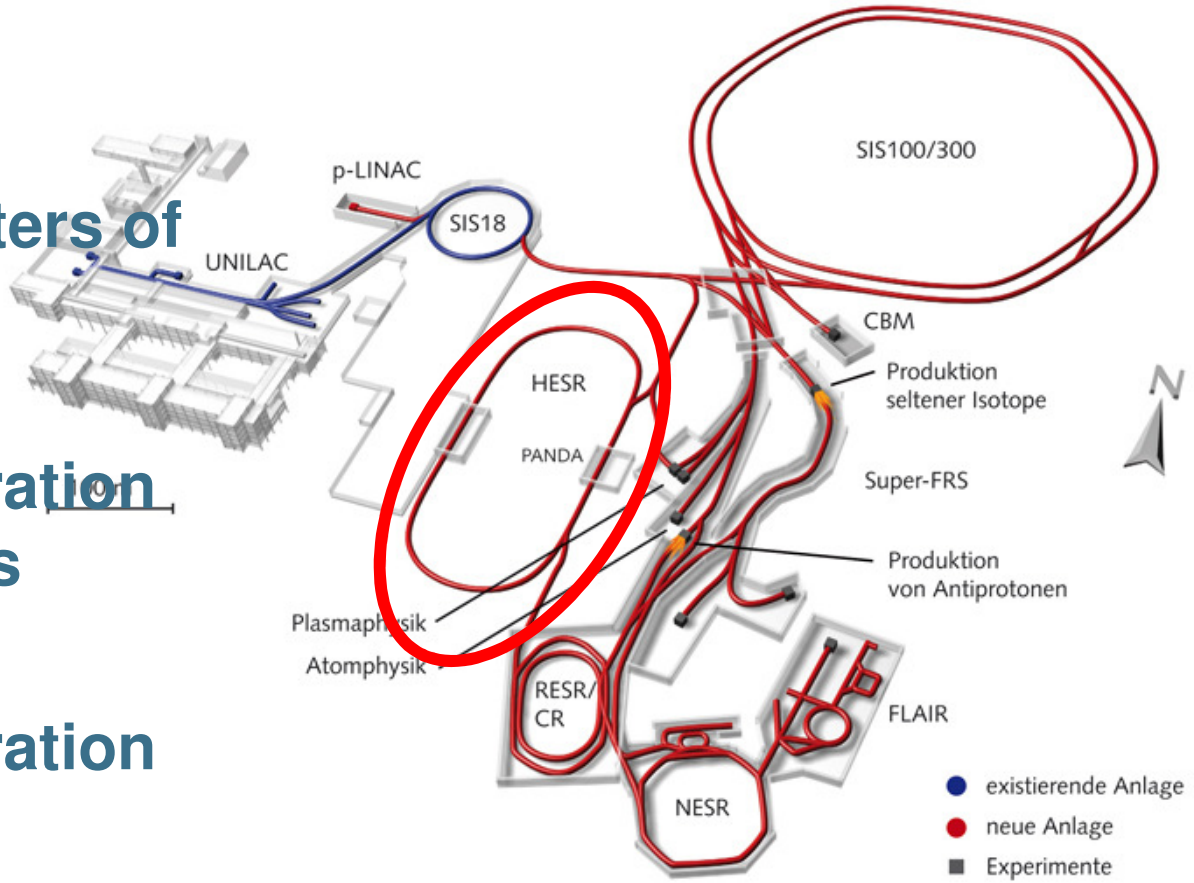
(ii) INCDIE ICPE-CA Bucharest,

(iii) ISYST Slovenia,

(iv) GSI Darmstadt.

Outline

- Basic Parameters of HESR
- Modes of operation for antiprotons
- Modes of operation for ions
- Status of technical components



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Basic parameters of HESR

User collaborations interested in HESR

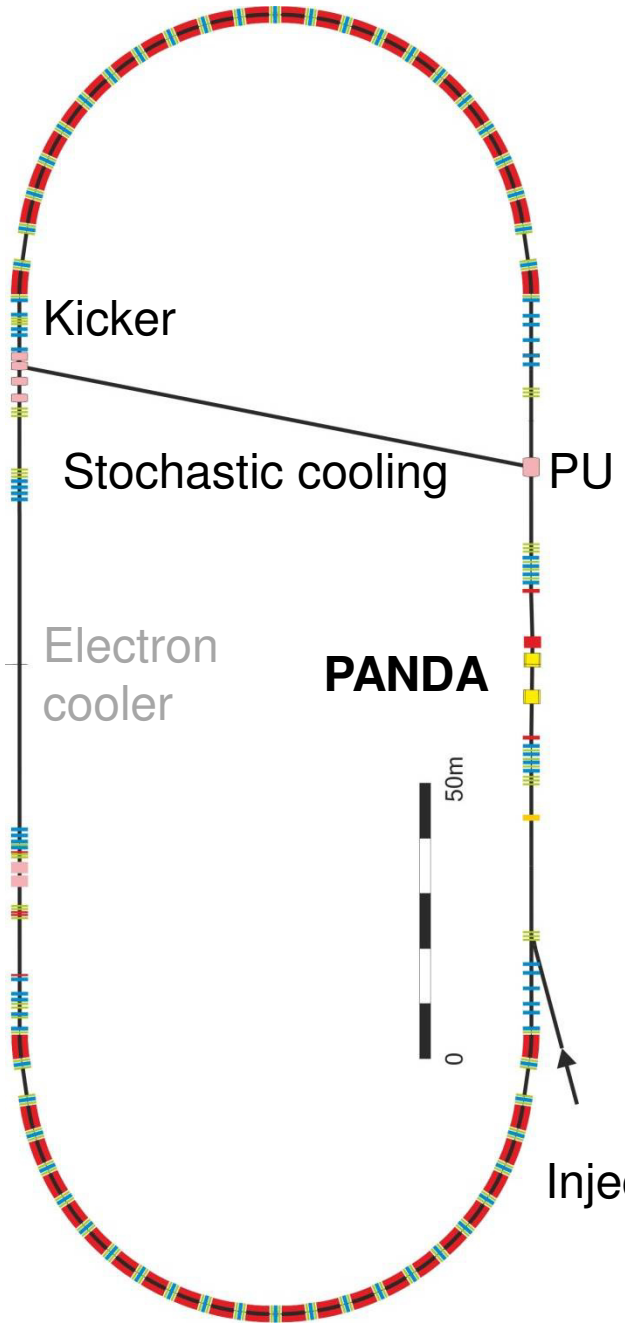
- **PANDA:** Antiproton-proton interaction

- **APPA:** ***S***tored ***P***articles ***A***tomic Physics ***R***esearch ***C***ollaboration

- **NUSTAR:** ***I***someric Beams, ***Li***fetimes and ***Ma***sses

With heavy ion and radioactive beams

Basic Data of HESR



- Circumference 574 m
  - 2 arcs of 155 m
  - 2 straight sections of 132 m
- Magnetic rigidity: 5 – 50 Tm
- Injection from CR at 13 Tm
- Maximum dipole field: 1.7 T
- Dipole field at injection: 0.4 T
- Dipole field ramp: 0.025 T/s

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Modes of operation for antiprotons

Modes of Operation with PANDA

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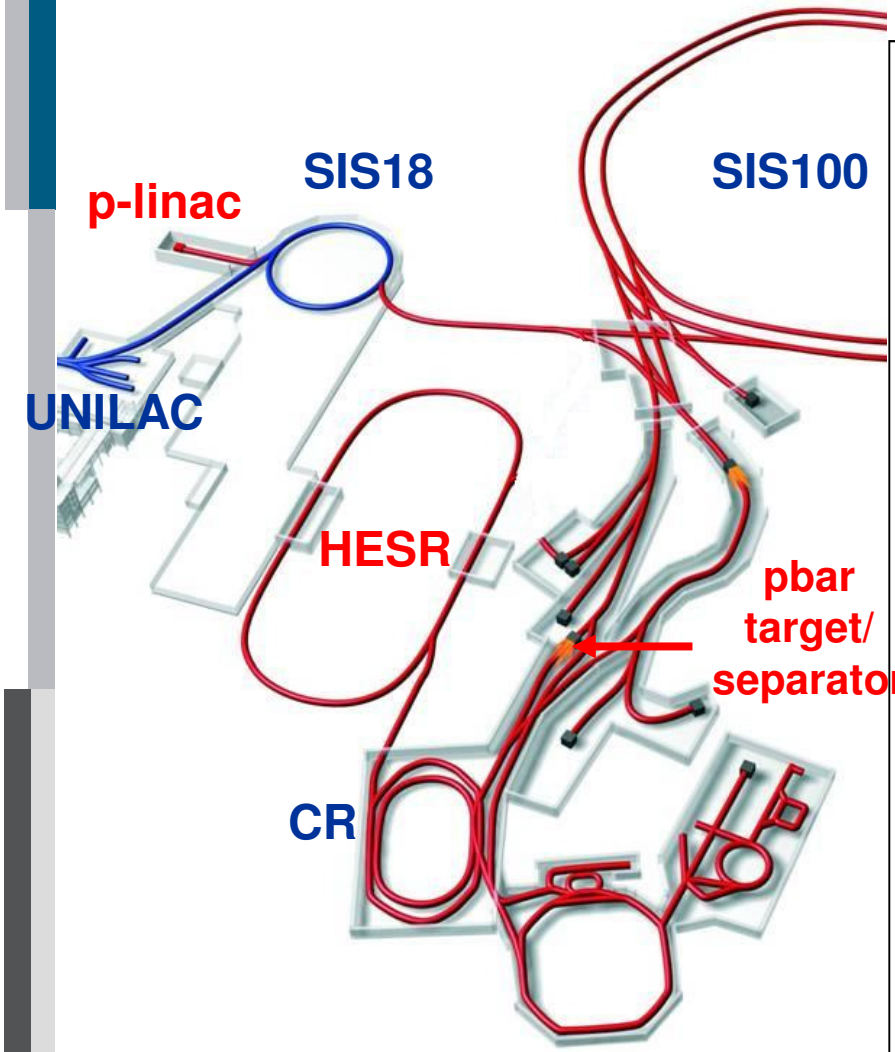
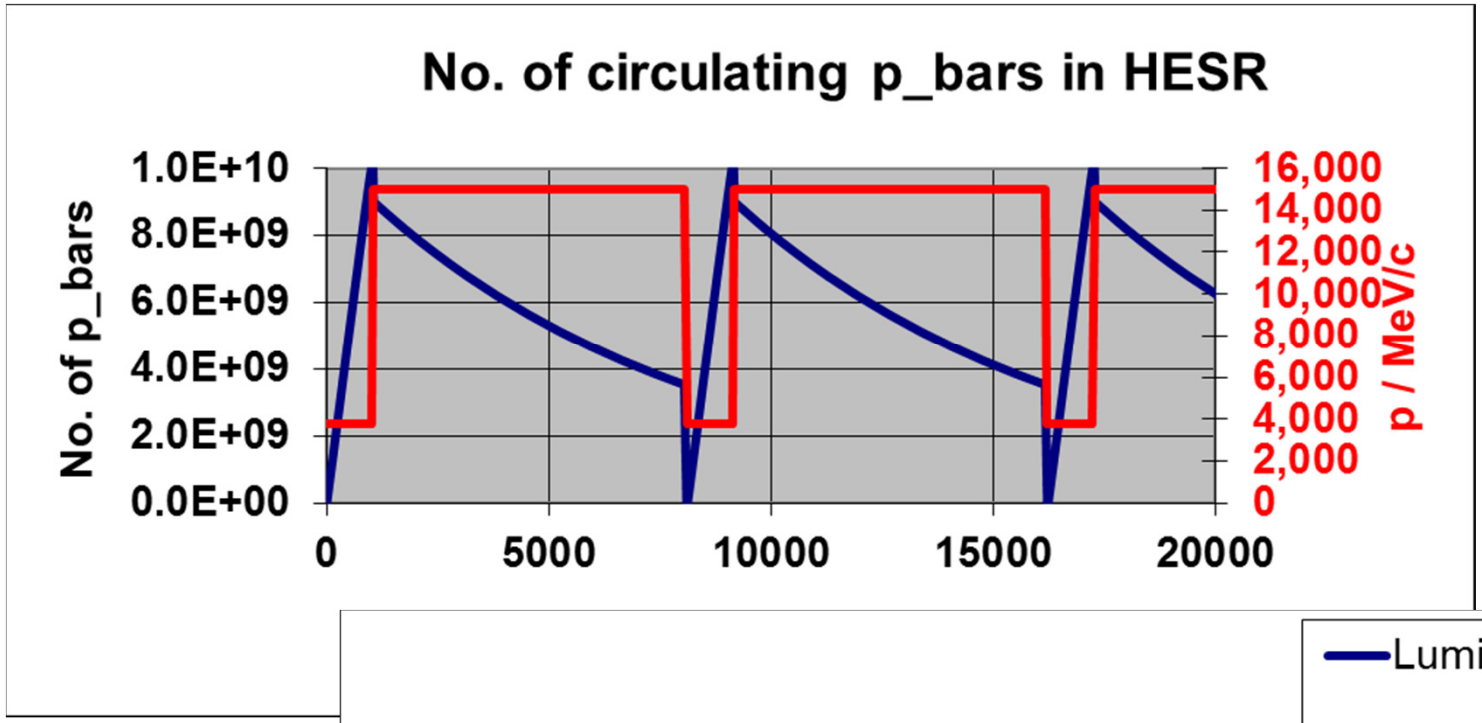
Experiment Mode	High Resolution Mode	High Luminosity Mode
Target	Hydrogen Pellet target with $4*10^{15}$ cm^{-2}	
rms-emittance	1 mm mrad	
Momentum range	1.5 – 8.9 GeV/c	1.5 – 15.0 GeV/c
Intensity	$1*10^{10}$	$1*10^{11}$
Luminosity	$2*10^{31}$ cm^{-2} s^{-1}	$2*10^{32}$ cm^{-2} s^{-1}
rms-momentum resolution	$5*10^{-5}$	$1*10^{-4}$

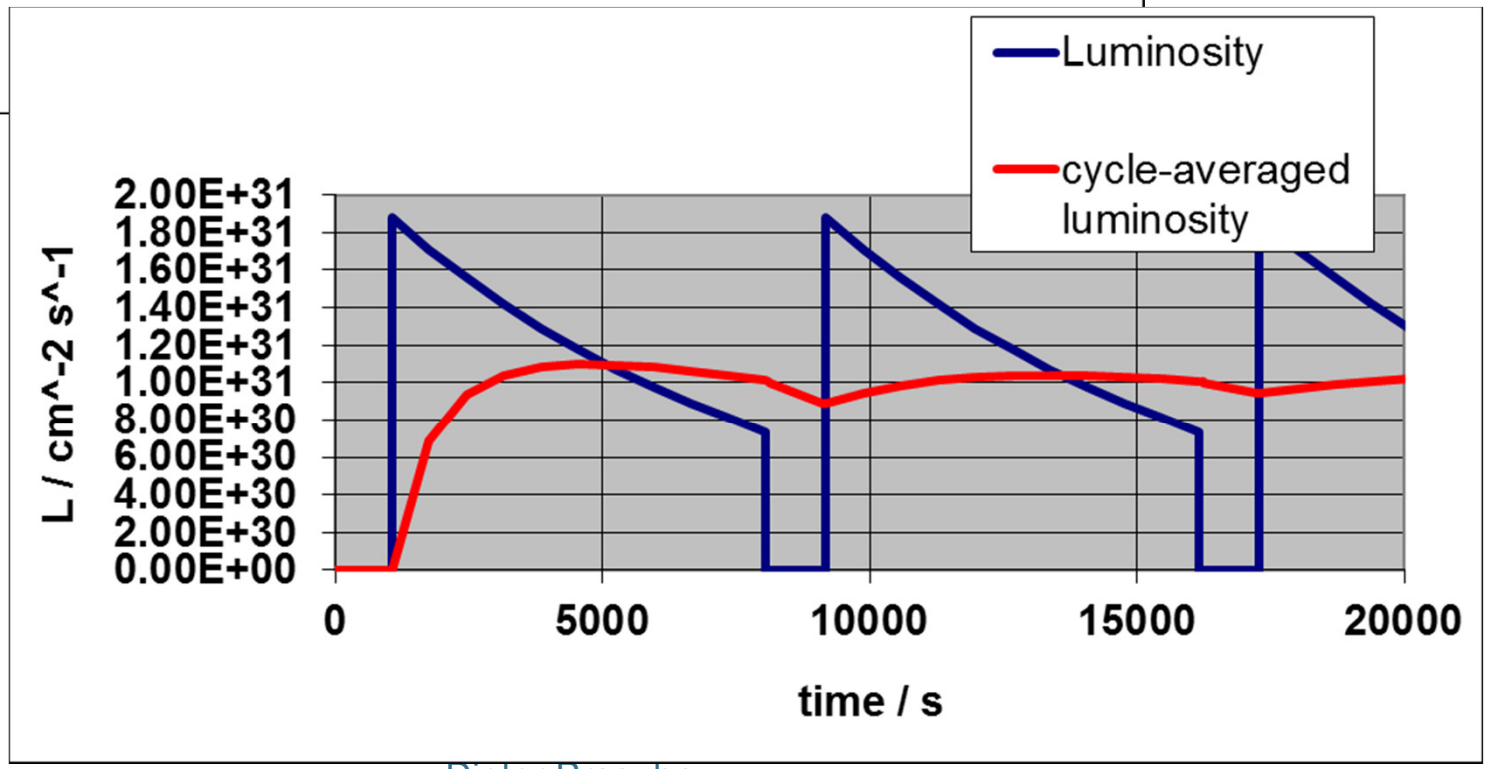
Antiproton Chain (Modularised Start Version)



- acceleration in p-linac to 70 MeV
- multiturn injection into SIS18, acceleration to 4 GeV
- transfer of 4 SIS pulses to SIS100
- acceleration to 29 GeV and extraction of single bunch
- antiproton target and separator for 3 GeV antiprotons
- collection and 10 s pre-cooling of 10^8 p-bars in the Collector Ring CR

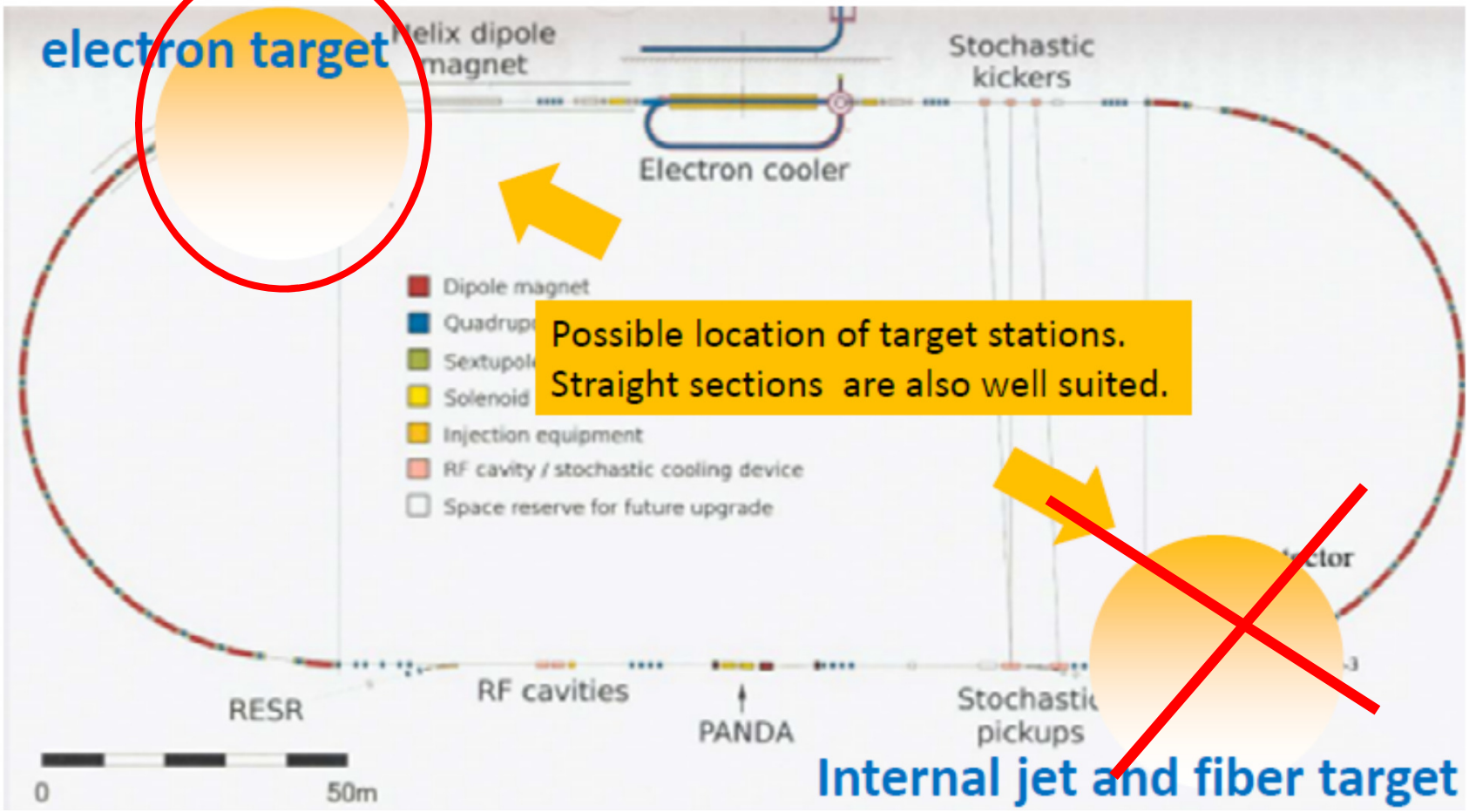
- Every 10 s transfer of 10^8 p-bars at 3 GeV to HESR
- accumulation and storage of antiprotons in the HESR


No. of circulating p_bars in HESR
No. of p_bars
1.0E+10
8.0E+09
6.0E+09
4.0E+09
2.0E+09
0.0E+00
0
5000
10000
15000
20000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
p / MeV/c


Luminosity
cycle-averaged luminosity
L / cm^-2 s^-1
2.00E+31
1.80E+31
1.60E+31
1.40E+31
1.20E+31
1.00E+31
8.00E+30
6.00E+30
4.00E+30
2.00E+30
0.00E+00
0
5000
10000
15000
20000
time / s

Modes of Operation for heavy ions

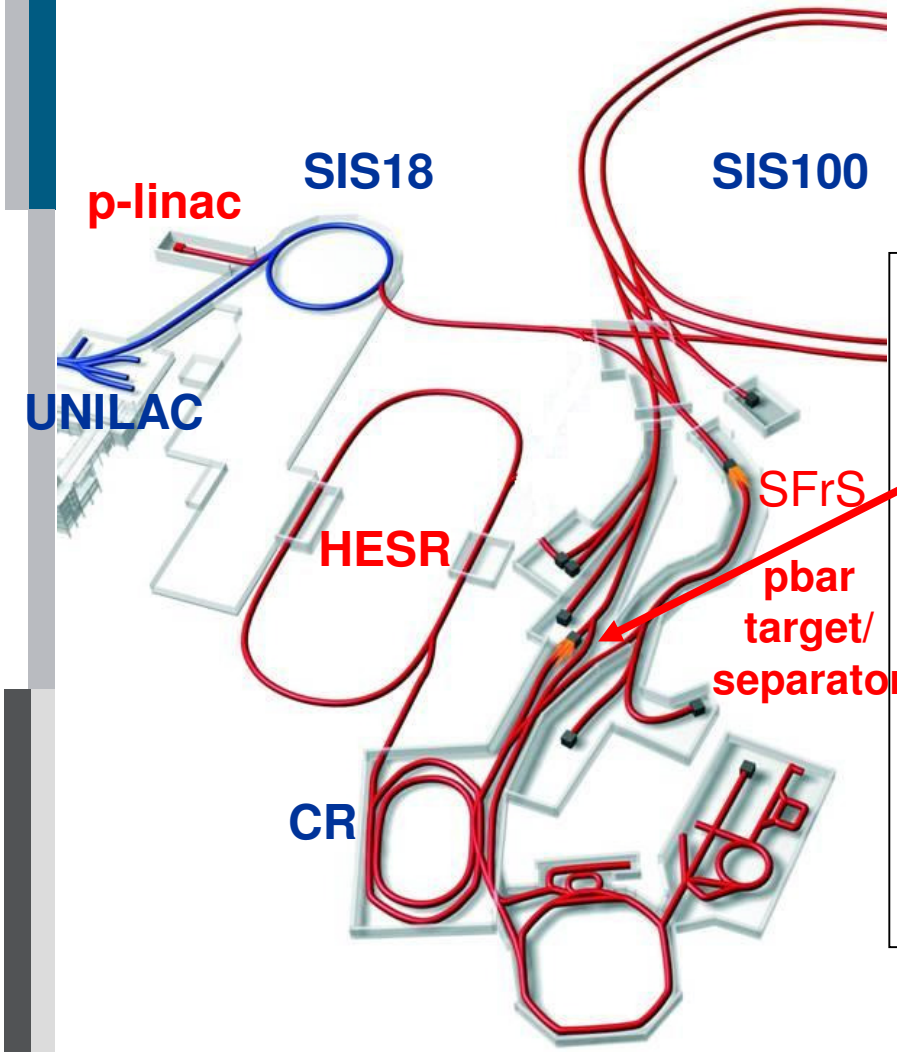
Experimental Conditions at the HESR



Data for Heavy Ions ($^{238}U^{92+}$)

Injection:	$B^*\rho$=12 Tm (740 MeV/u) β = 0.83
Maximum magn. rigidity	$B^*\rho$=50 Tm (5 GeV/u) β =0.98
Minimum magn. Rigidity	$B^*\rho$= 5 Tm (170 MeV/u) β =0.53

Possible ways for ions into the HESR (Modularised Start Version)



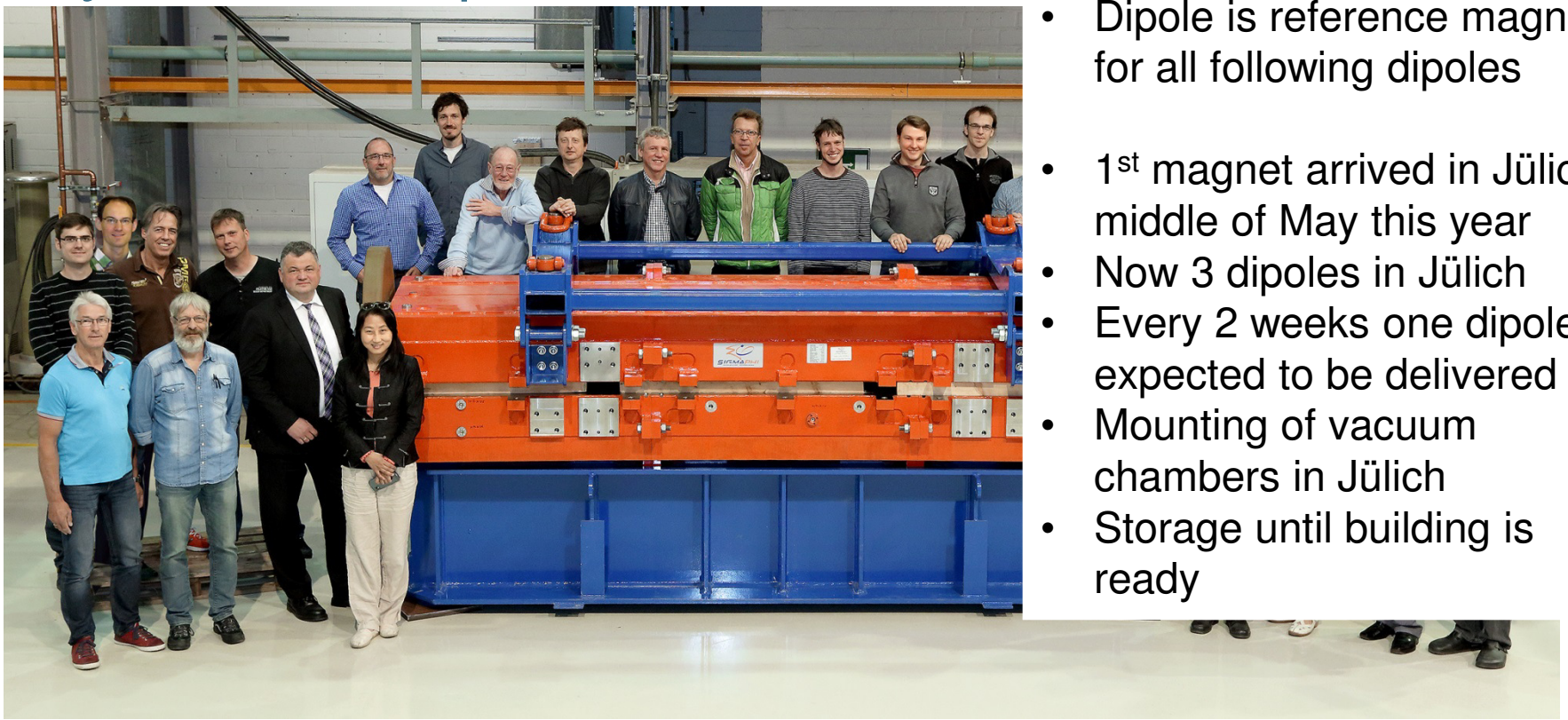
- acceleration in UNILAC and SIS18
- Bypass the antiproton target
- collection and pre-cooling of ions in the Collector Ring CR
- transfer of ions at 12 Tm to HESR
- (accumulation and) storage, acceleration and cooling of ions in the HESR

Status of technical components

Magnets (Tendering by FAIR)

Dipoles:

May 2015: 1st dipole in Jülich



- 1st of its kind ready and measured in January 2015
- Series production released
- Dipole is reference magnet for all following dipoles

- 1st magnet arrived in Jülich middle of May this year
- Now 3 dipoles in Jülich
- Every 2 weeks one dipole is expected to be delivered
- Mounting of vacuum chambers in Jülich
- Storage until building is ready

Delivery of last dipole (46) expected for Q2/2017

Quadrupoles:

- 1st of its kind accepted
- Reference magnet for the next magnets

- 5 quadrupoles expected to arrive in Jülich this week

- In Jülich mounting of the complete units

Sextupole – Quadrupole – Steerer planned

Delivery of last quadrupole (84) expected Q2/2017

Power Converters

Quadrupole power converters:

- 1st of its kind in house and accepted since Q3/2014
- All Quad-PoCo have been delivered to Jülich in the middle of July 2015

Dipole test power converter:

- Is delivered and used by the dipole manufacturer for the measurement of the dipoles

The HESR dipole PoCos:

- are specified, but will be ordered matched to the CC schedule

RF and stochastic cooling

First amplifiers have arrived and been tested in Jülich

Tanks for stochastic cooling are under construction,

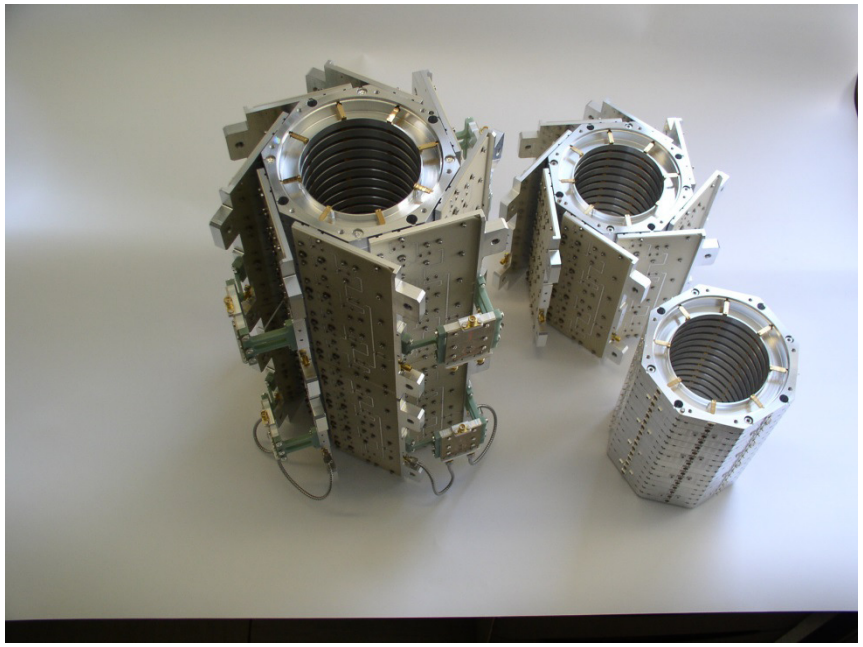
1st Pickup tank is expected to be ready Q3/2015,

1st kicker tank Q4/2015.

They will be installed in COSY for tests

Barrier bucket prototype in use at COSY

First tank arrived in Jülich

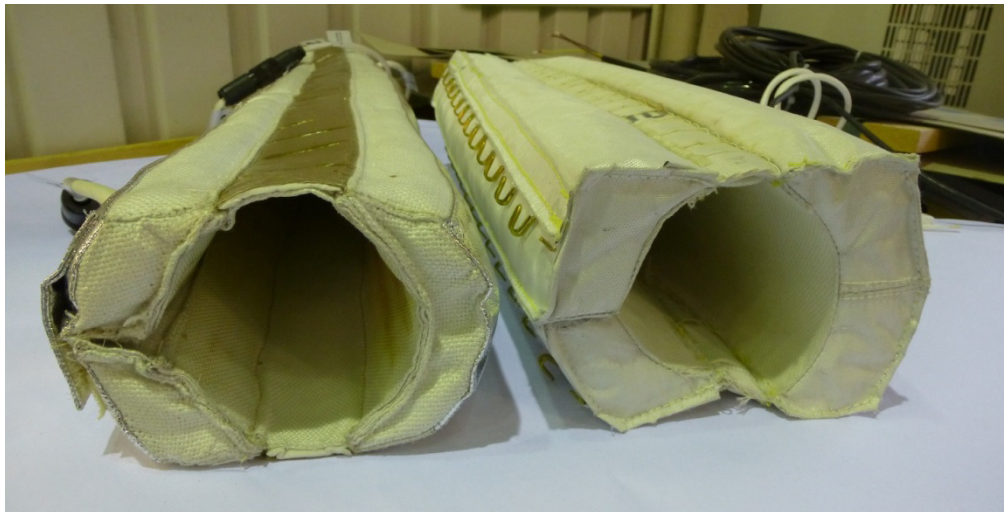


2-4 GHz PU-structures

Vacuum

- Design vacuum for HESR had been 10^{-9} mbar

- According to an early recommendation of MAC the vacuum system was upgraded to a bakeable system
- NEG-coating plus heating jackets are foreseen in the dipole sections from the beginning



Heating jackets for the dipole chambers on the test bench

Status:

Straight vacuum chambers for the whole HESR are in house

- Bent vacuum pipes for the dipoles are ordered
- 1st bent dipole vacuum chamber is NEG-coated by GSI

The detailled Specs for the slow control will be finished autumn 2015.

Injection

Injection kicker and supply:
Design of the manufacturer is accepted,
Kicker tank is under construction

First test expected Q3/2015

Diagnostics

Prototype BPM is under construction and will be tested end of this year.

Then series production will start.

Further In-Kind contributions:

Romania: Sextupoles and steerers:

Prototypes of each kind have arrived in Jülich in Q2/2015, series production has started.

Time schedule for delivery to Jülich is matched to the mounting schedule with quadrupoles

Power Converters:

Prototype is accepted, series production started

Material for the series production is ordered

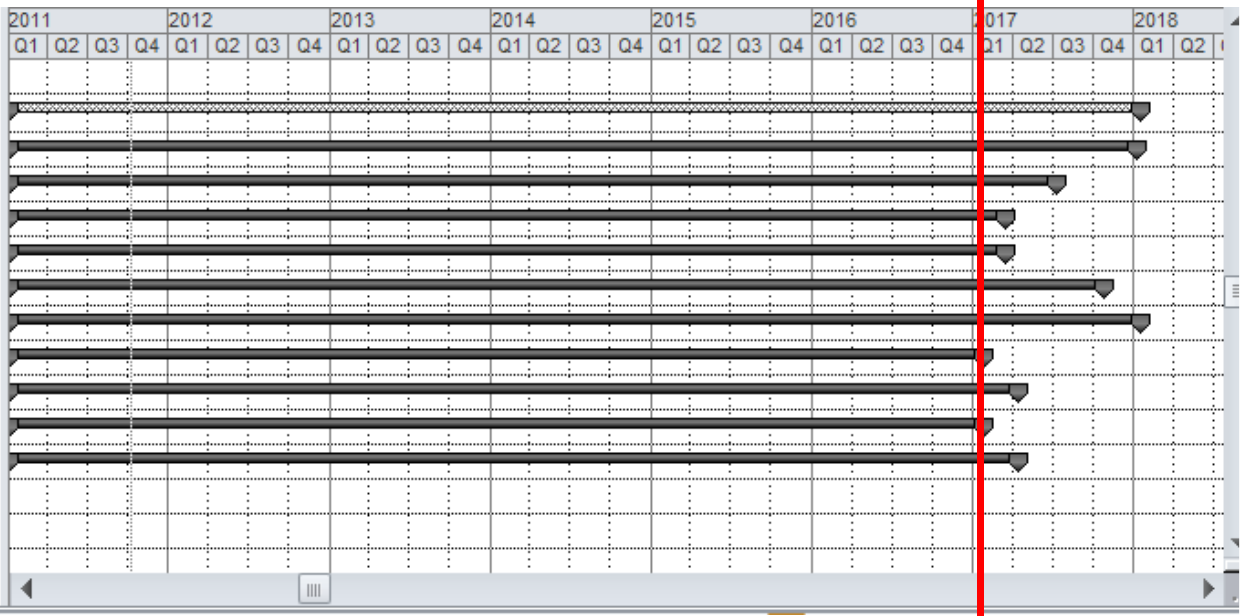
In-Kind contribution from Slovenia

Diagnostics: Specifications are prepared together with GSI

Slow control: Specifications for vacuum control are under discussion together with GSI

HESR overall time schedule

	Vorgangsname	Dauer	Fertig stellen
13			
14	HESR	91.85 M	Di 16/01/18
15	Magnets	91.55 M	Mo 08/01/18
58	Power Converters	85.05 M	Mo 10/07/17
101	RF-Systems	80.85 M	Di 14/03/17
144	Injection/Extraction	80.85 M	Di 14/03/17
187	Beam Diagnostics	89 M	Fr 27/10/17
230	Vacuum	91.85 M	Di 16/01/18
273	Electron Cooling	79.2 M	Do 26/01/17
316	Stochastic Cooling	81.9 M	Mi 12/04/17
359	Experimental Devices	79.2 M	Do 26/01/17
402	PANDA integration	82 M	Fr 14/04/17



All components of HESR are scheduled to be “ready to move into tunnel” 2017

Thank you for your attention