The existing GSI acceleration Facility

Contents

- Overview of the GSI and the existing accelerator systems

- general requests for the existing systems to serve as a FAIR injector

- the main definitions and parts of the upgrade program

- cost and schedule aspects of the upgrade program

GSI - Gesellschaft für Schwerionenforschung
Centre for Heavy Ion Research

Budget: 75 Mio. € (90% Bund,10% Hessen)

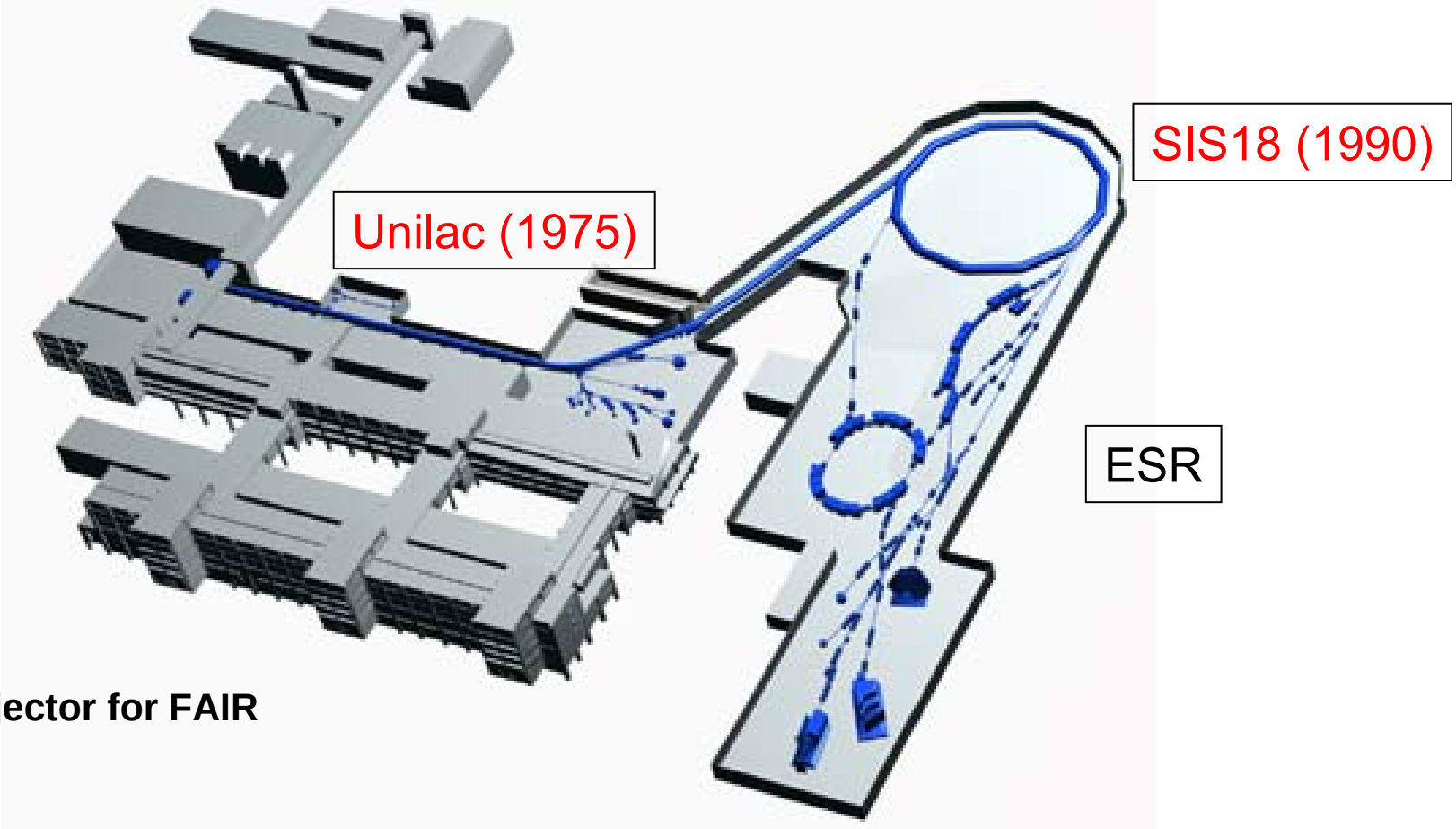
Employees: 1000

External Scientific Users: 1000

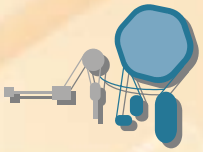
Large Scale Facilities: Accelerators and Experiments

GSI-Accelerator
(present facility)

Facility to accelerate ions from p to U (energies from 1 to 1000 MeV/u)



Red: injector for FAIR



GSI-Accelerator
Overview

Existing accelerator sections

Low-energy branch (1.4 – 12 MeV/u)

2 ionsource terminals

1 High charge injector

UNILAC (with RFQ, IH, Alvarez-, single-gap-resonator-, stripper- sections)

Various beam lines to experiments and SIS

High-energy branch (11-1000 MeV/u)

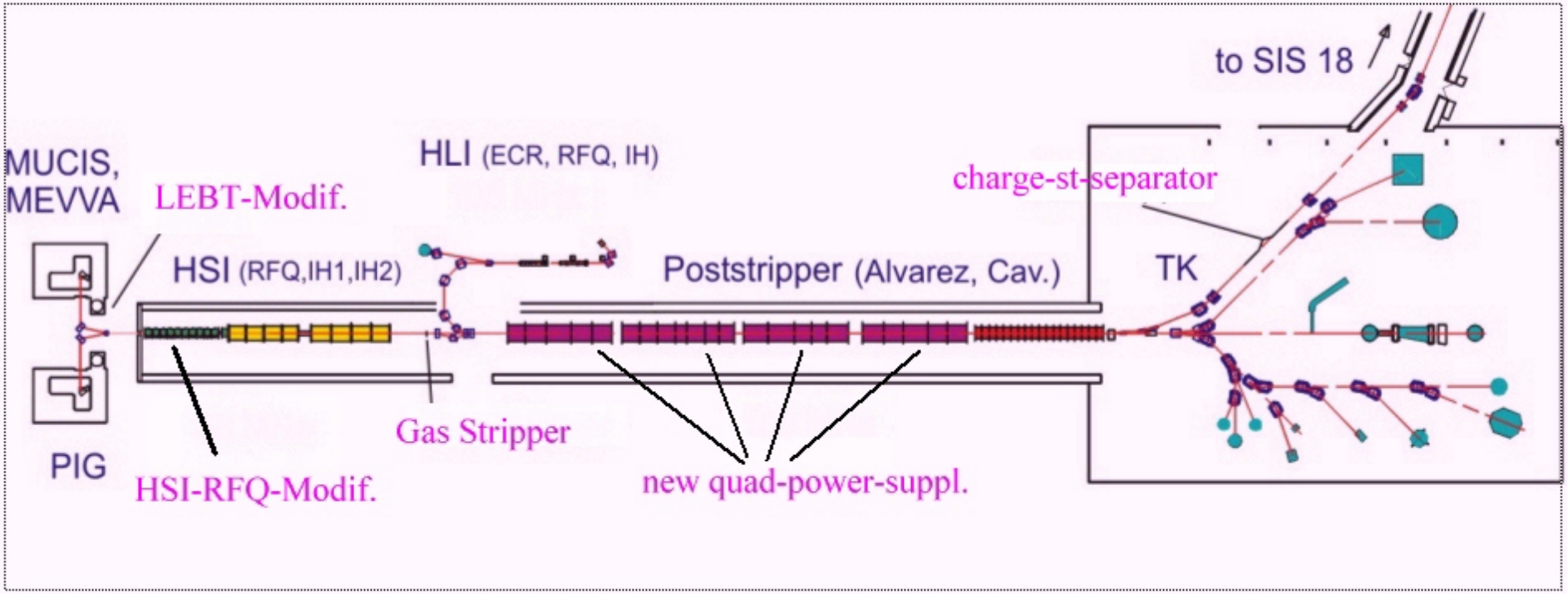
Synchrotron SIS18

‚Experimental storage ring' ESR

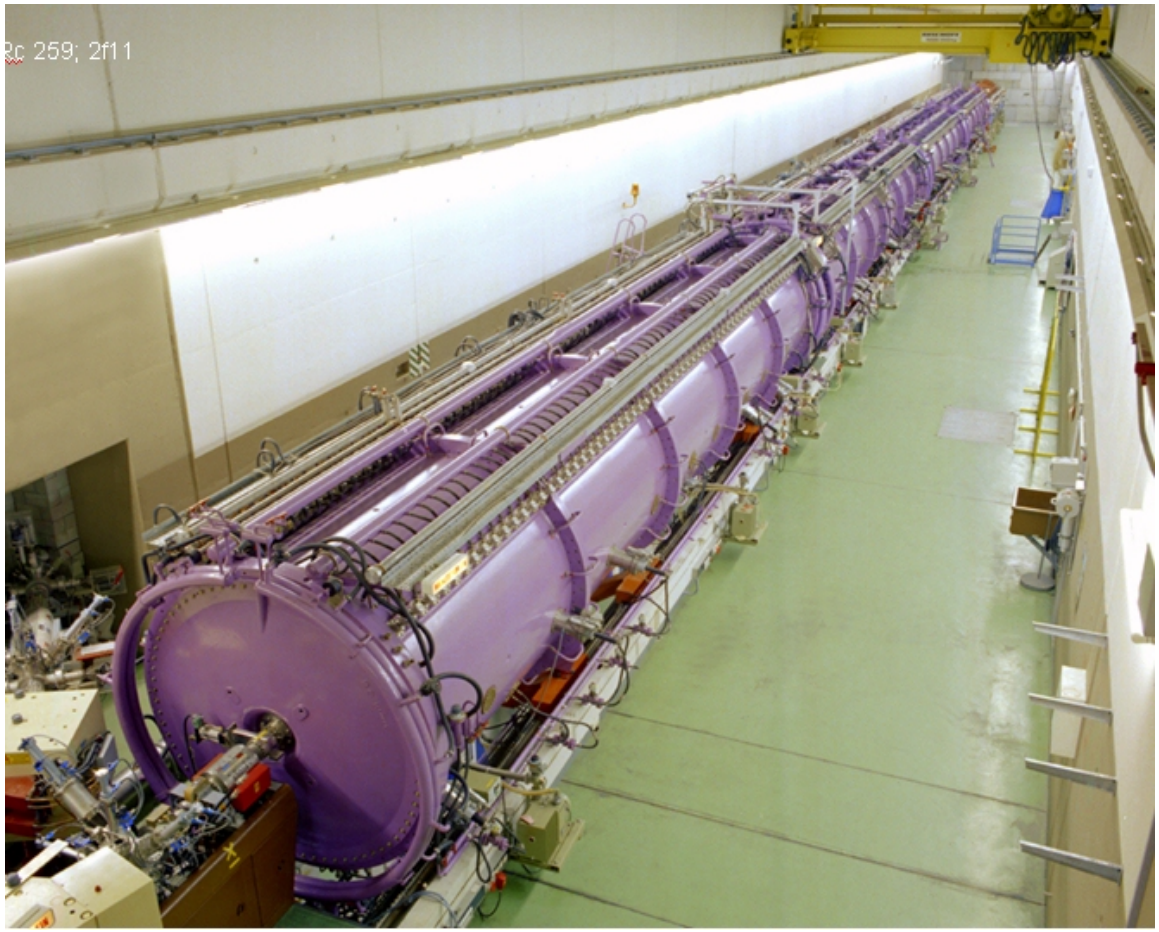
Various beam lines to experiments

Various test- and measurement facilities

GSI-Accelerator
UNILAC

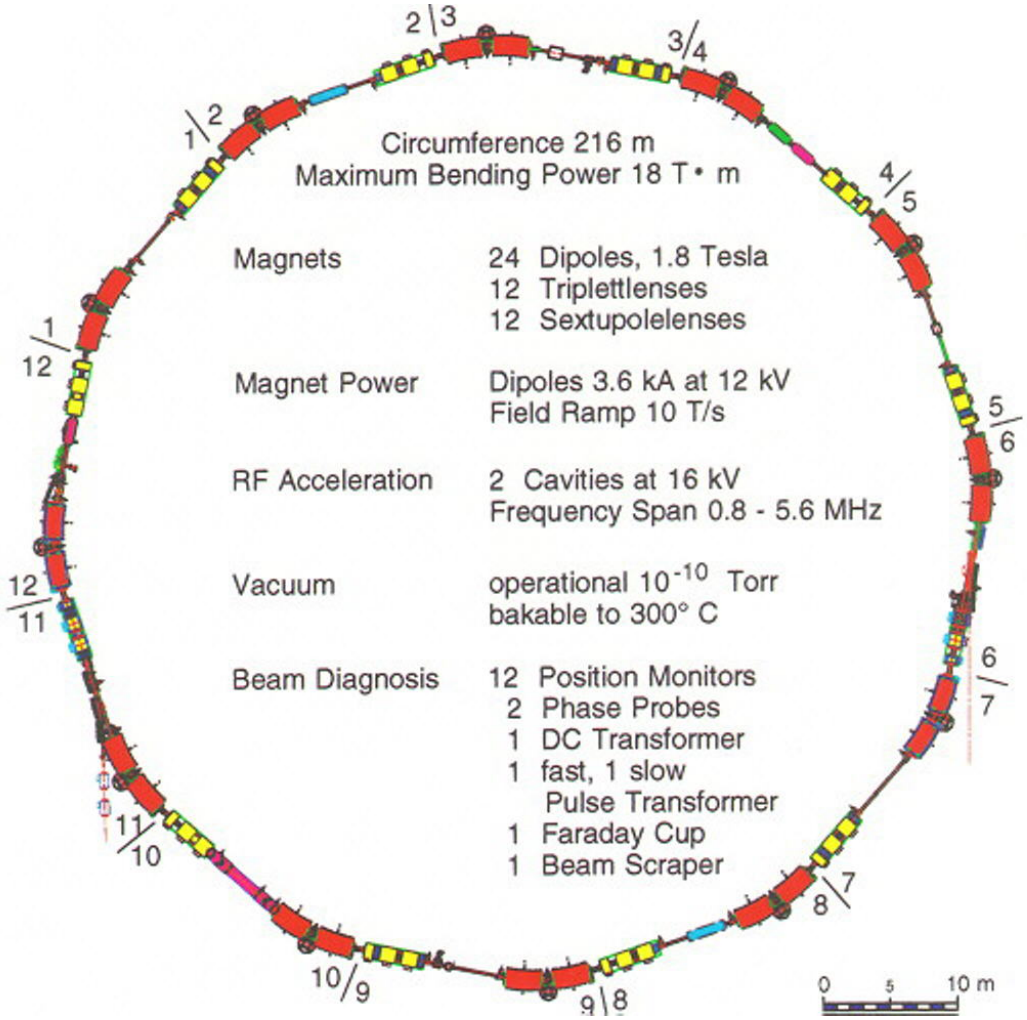


GSI-Accelerator
Overview



Alvarez-section of the UNILAC

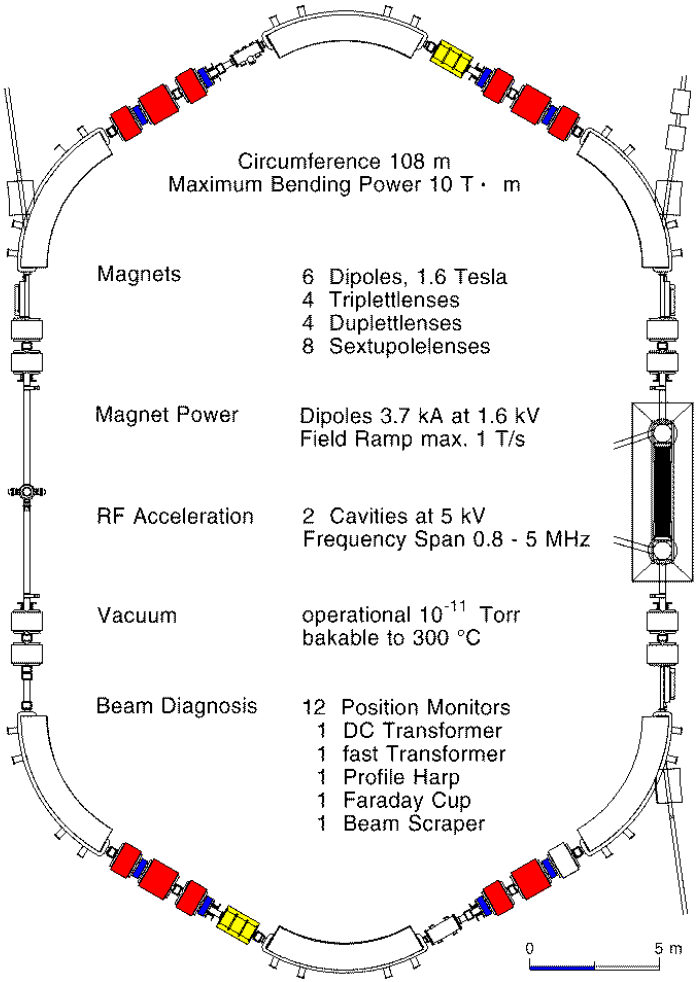
GSI-Accelerator SIS18



GSI-Accelerator
Overview

Section of the synchrotron SIS18

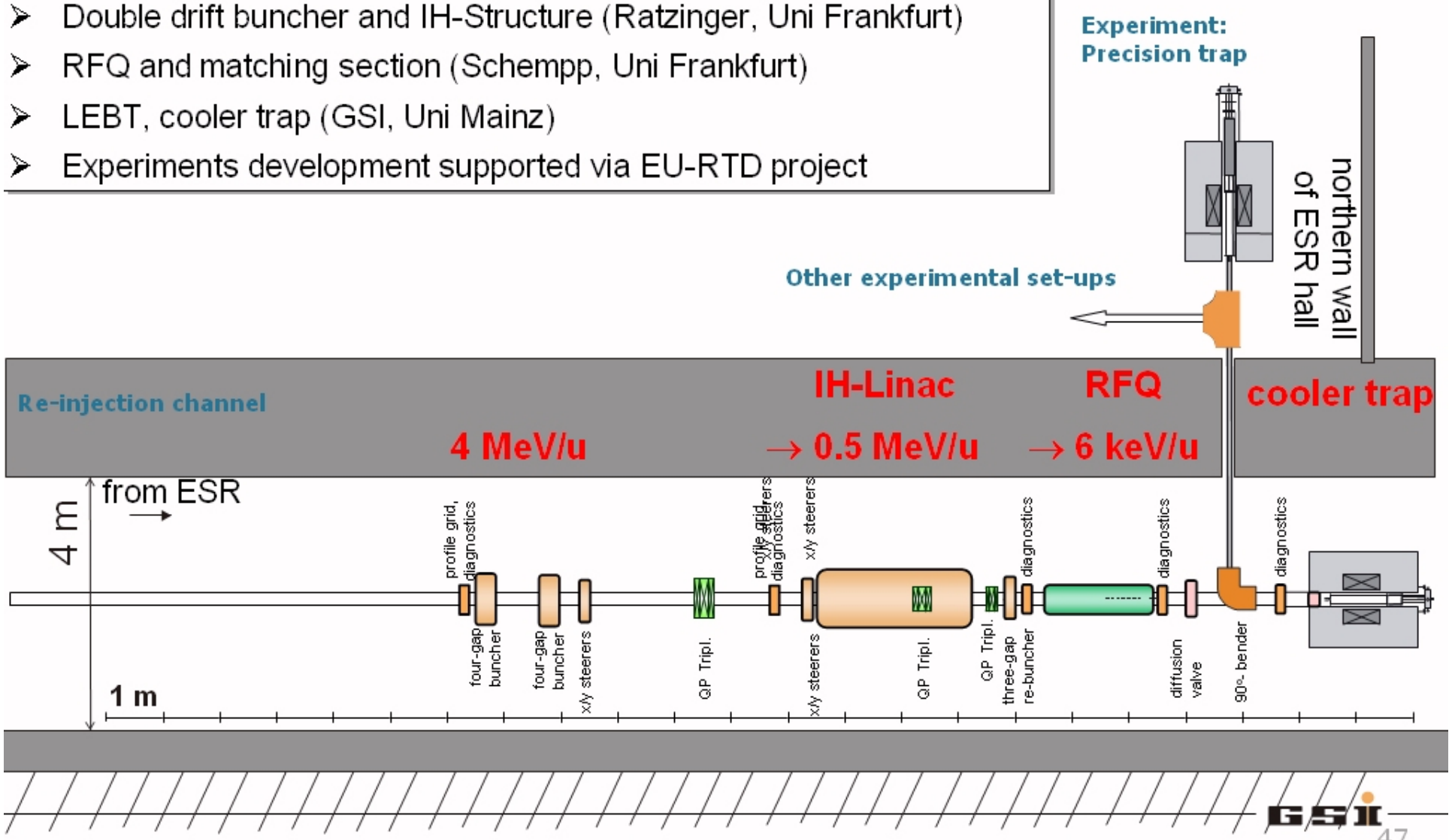
GSI-Accelerator
ESR

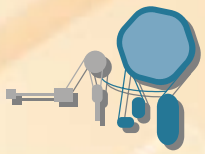


HITRAP

collaboration:

- Double drift buncher and IH-Structure (Ratzinger, Uni Frankfurt)
- RFQ and matching section (Schempp, Uni Frankfurt)
- LEBT, cooler trap (GSI, Uni Mainz)
- Experiments development supported via EU-RTD project



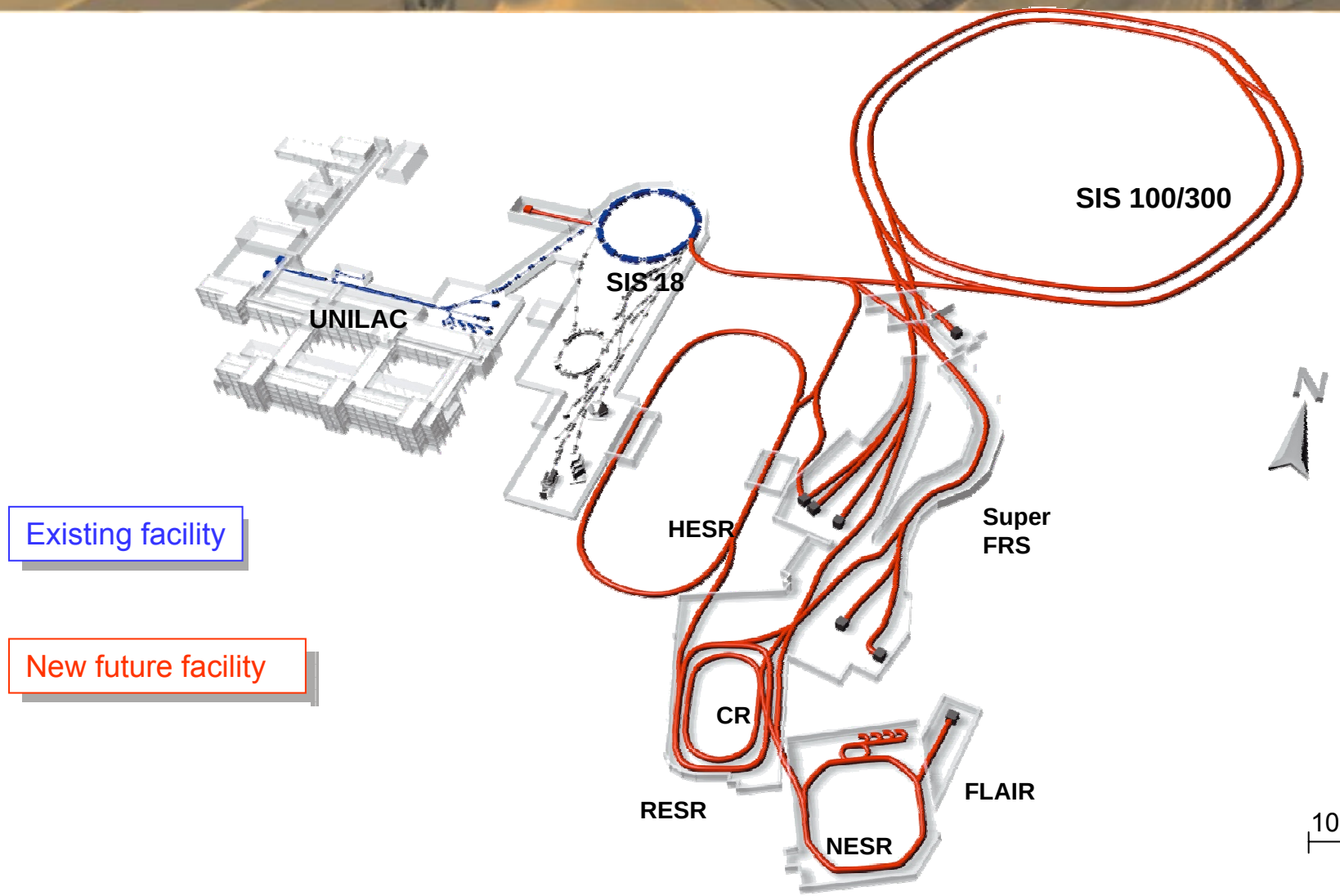


GSI-Accelerator (Projects)

Major Projects

HIT-Projekt (Heidelberg), CNAO/Projekt (external projects)	**(-2008/9)**
• **Know-how-Transfer Siemens (Therapy)**	
• **HITRAP**	**(- 2009)**
• **28 GHz EZR**	**(- 2011)**
• **ISL (material research) (construction)**	**(-2008)**
• **UNILAC upgrade Programm**	**(-2011)**
• **SIS18-upgrade Programm**	**(-2011)**
• **Technical systems for FAIR**	**(-2015)**

Present GSI and FAIR



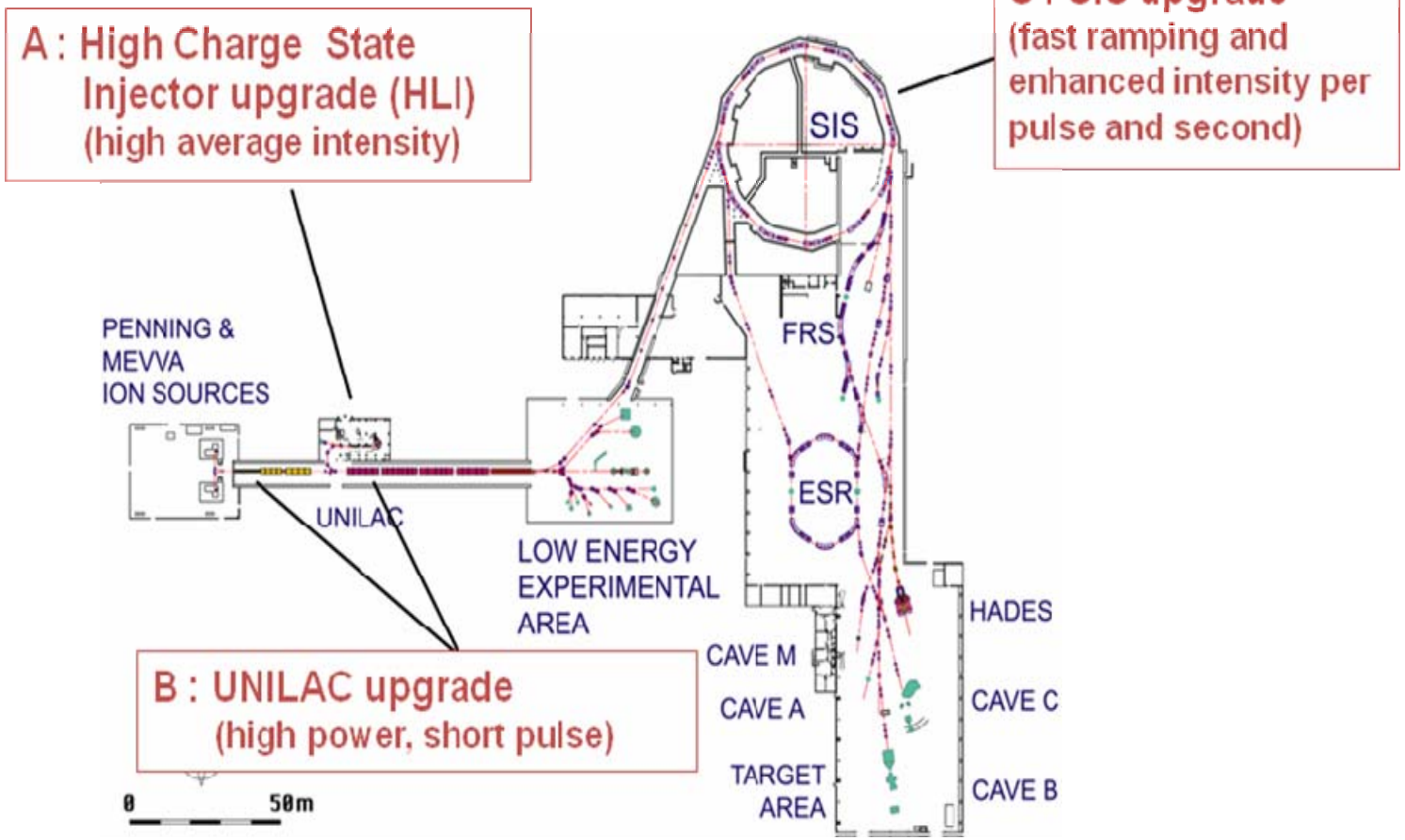
FAIR requirements -> GSI upgrade

- goal :
  - max. intensity/time for UNILAC /SIS18 at intermediate and high charge states for heavy ions to be transferred to SIS100

- SIS:
  - Pulse intensity increase for heavy ions (e. g. U^{28+})
  - Reduction of cycle time (increase of particles/s)

- UNILAC:
  - Pulse intensity increase
  - Optimization of brilliance (for SIS18-injection)

The existing accelerator facility



Overview of the existing facility (UNILAC, SIS18) with the upgrade measures

SIS18 upgrade program (main topics)

luation of high current effects and cures by theoretical
stigations and within machine experiments

injection system,new bunch compressor cavity, and extensions of
er supplies

ns against ‘desorption’ process (reduction of internal losses),

nproved vacuum system (NEG-coated vacuum chambers)

nstallation of ‘ion beam catchers’

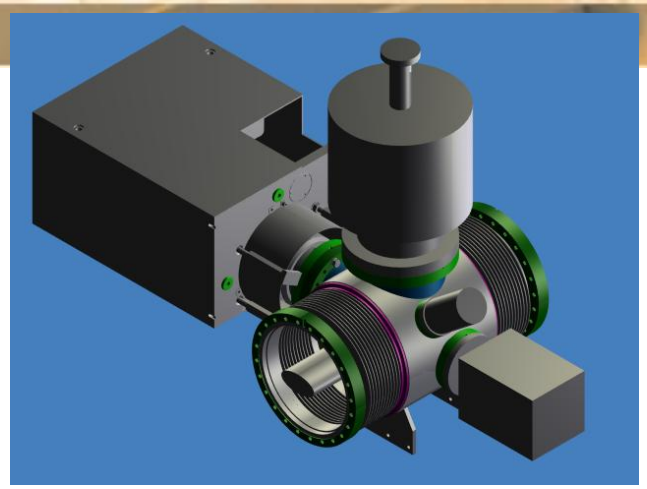
ncrease of injection energy

ns to fight beam losses due to ‘resonances’

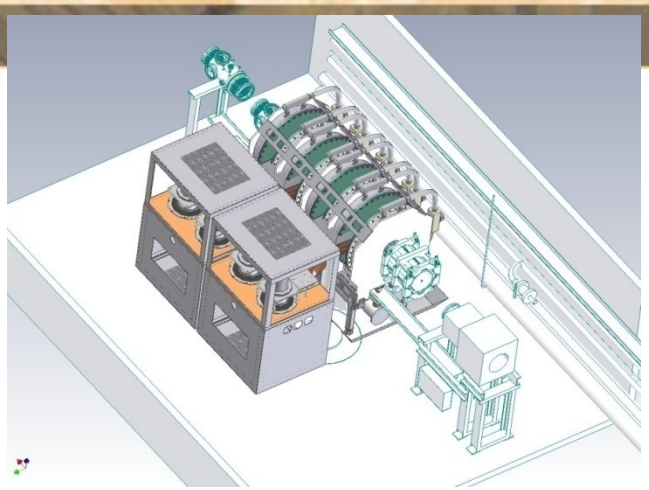
roved beam diagnostics (beam control)

eased pulse power by new pulse power connection, new rf-
em (h=2) (to reduce acceleration ramp, cycle time)

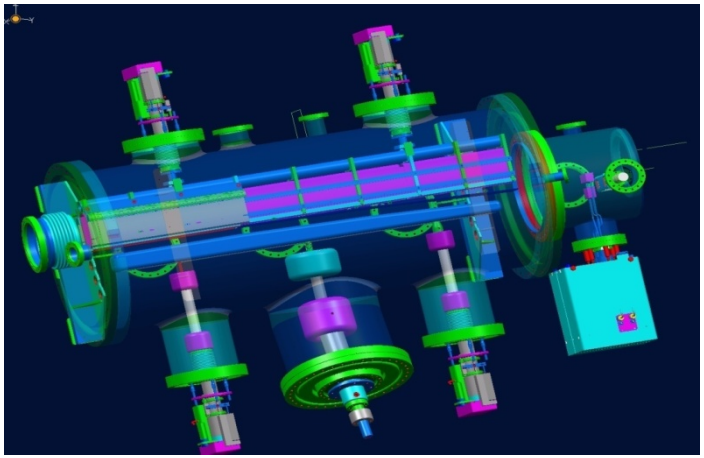
SIS18 upgrade program (examples)



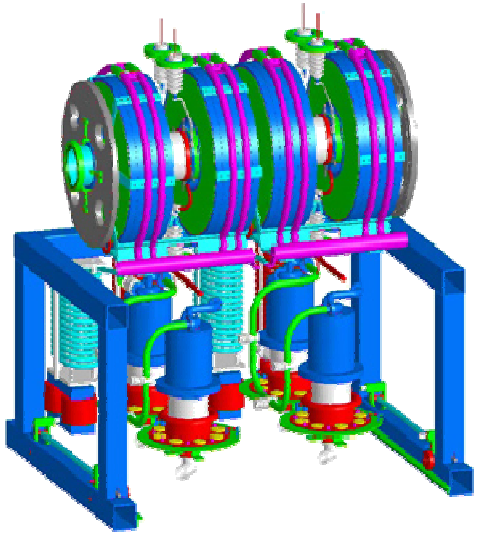
Ion catcher



New RF-accel. system (H=2)

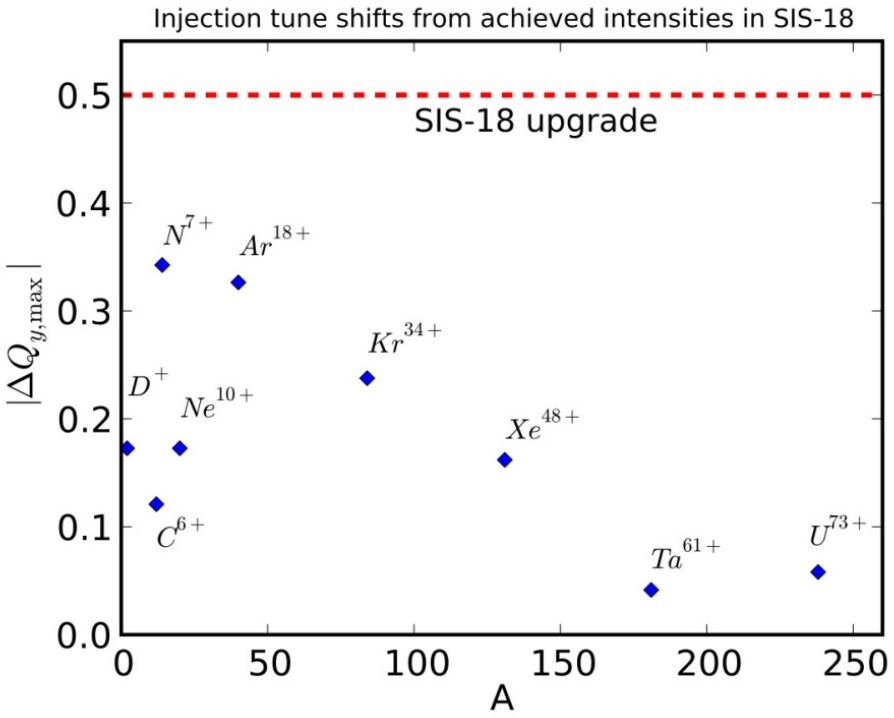


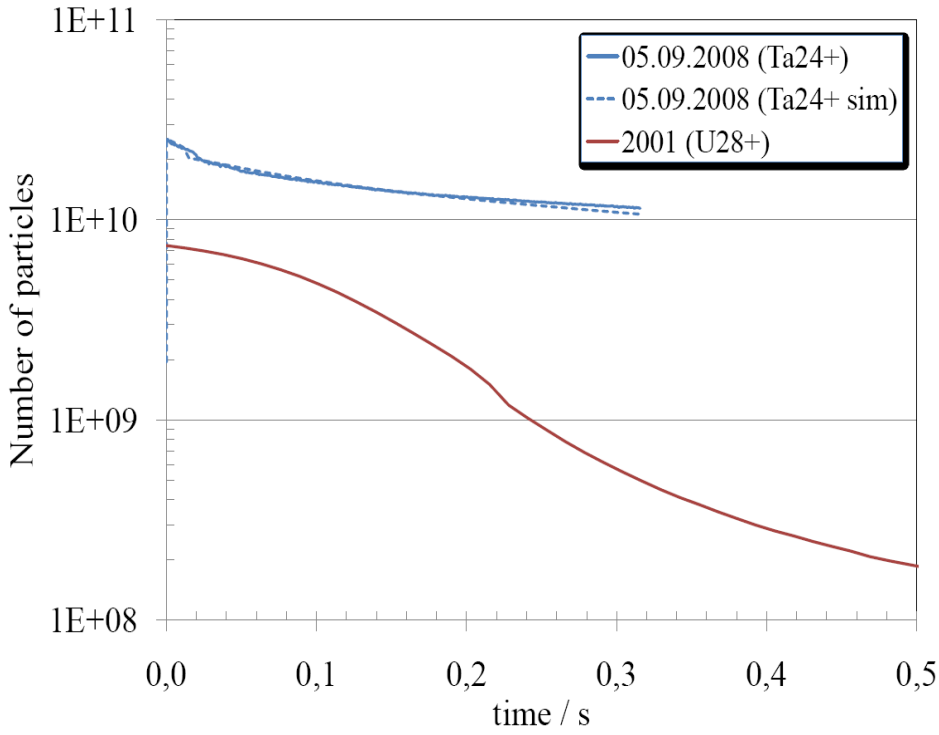
New HV injection septum



Bunch compressor cavity

SIS18 upgrade program (status, improvements)





Achieved pulse intensities (highly charged ions)

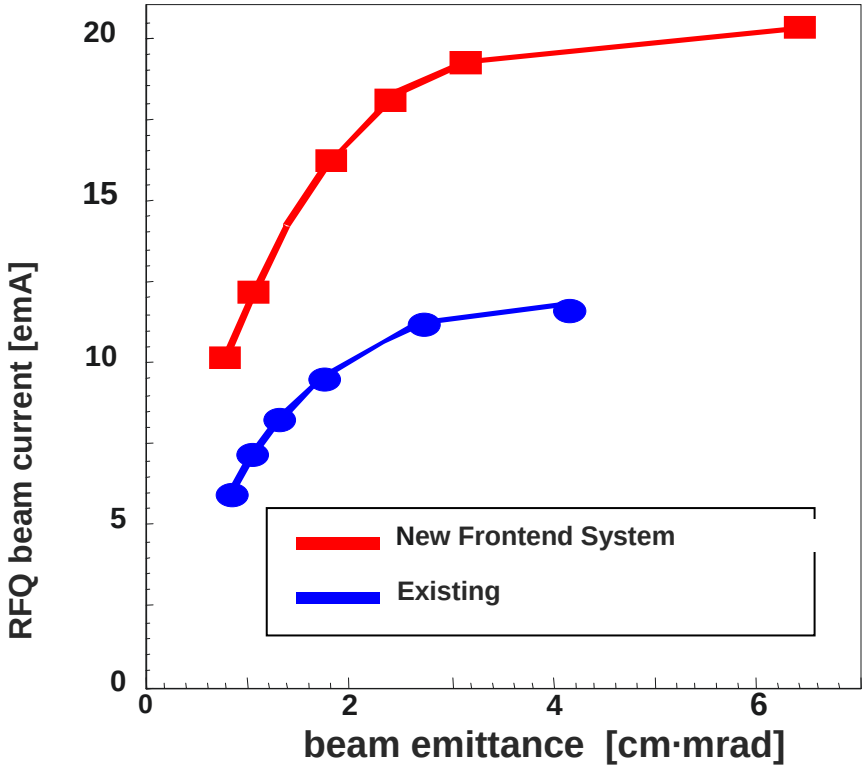
Achieved improvements Heavy ions, intermediate charge states with reduced acc. ramps

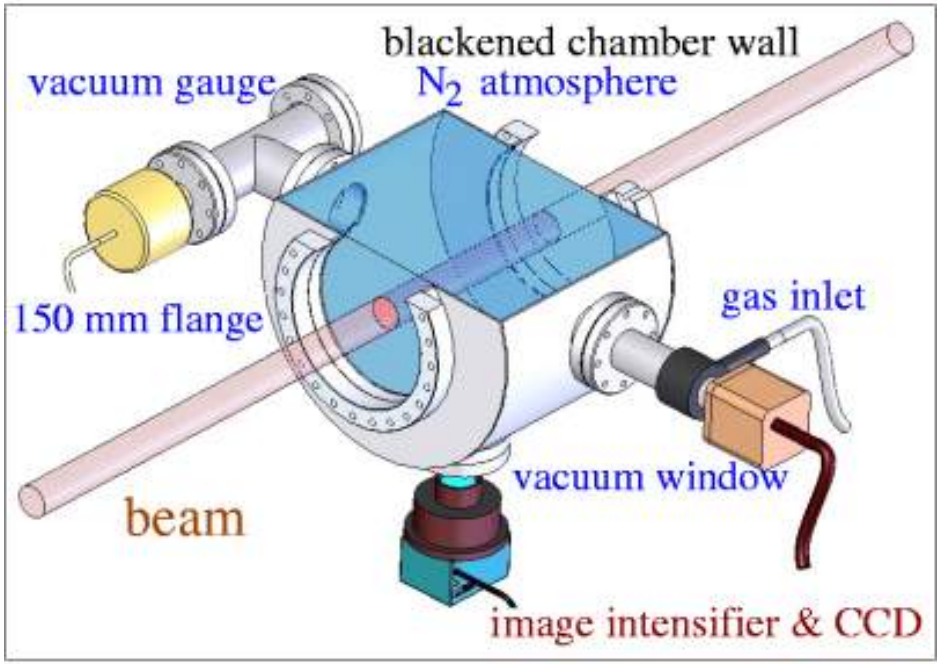
UNILAC upgrade program (main topics)

- Ion source development (high current)
- Minimization of beam losses (increase of acceptance LEBT RFQ, TK)
- Optimized stripping efficiency (modified ‘gas stripper’)
- Improved ‘beam brilliance’ (no. of particle within emittance) (for SIS18 injection)
- Improved beam diagnostics (optimized beam parameters, beam control)
- High current operation (e.g. minimization of beam losses)

- Modification/replacements of subsystems (to keep availability)

UNILAC upgrade program (examples)



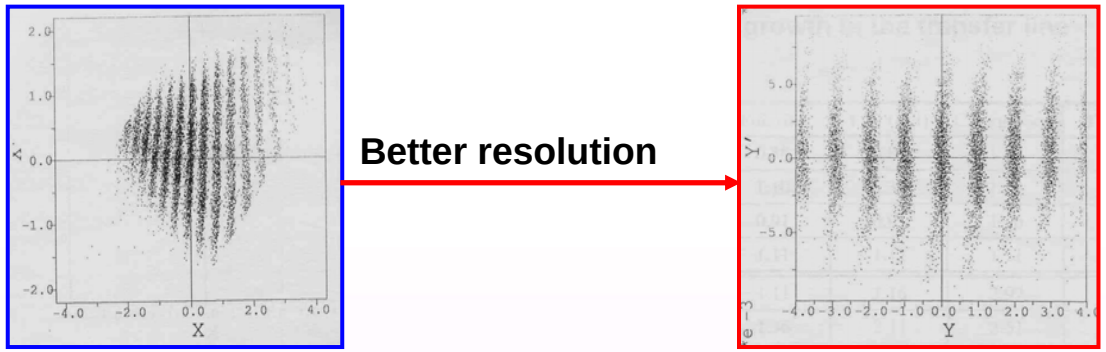


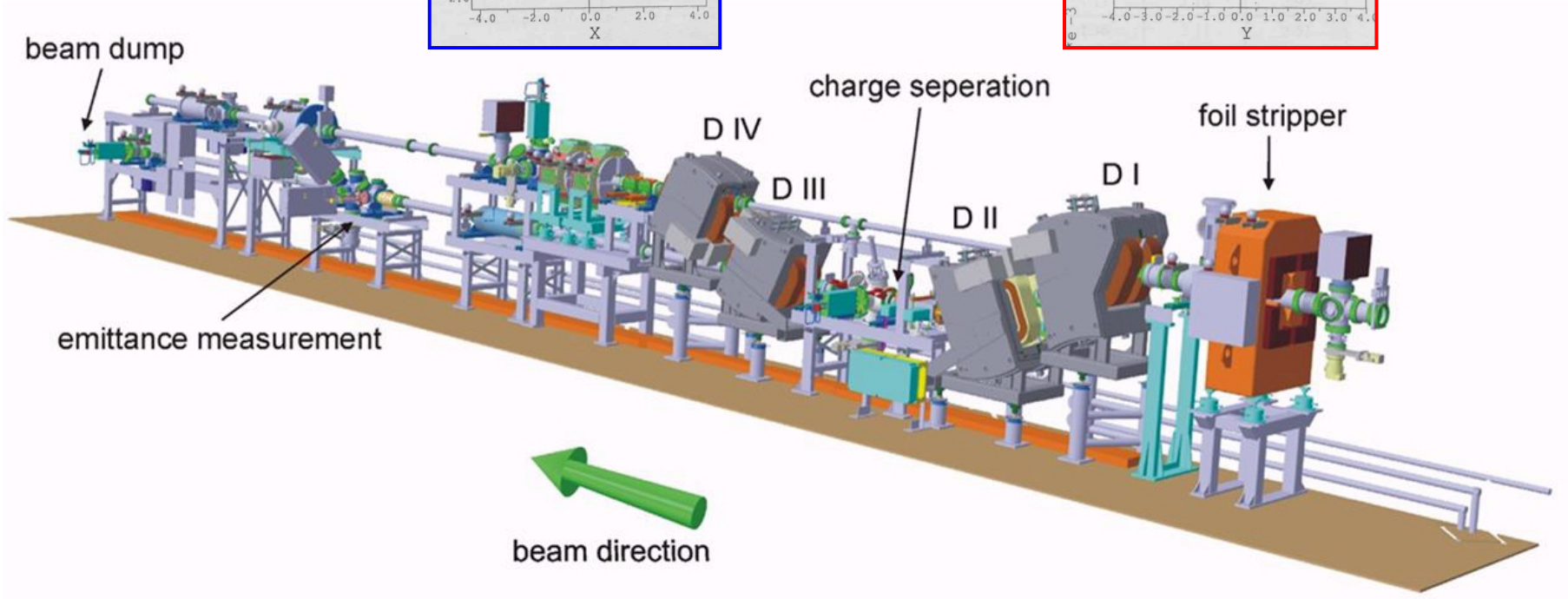
Modified UNILAC Frontend-System (enhanced U^{4+} intensity)

High Current Beam Diagnostics (Beam Induced Fluorescence monitor

UNILAC upgrade program (examples)

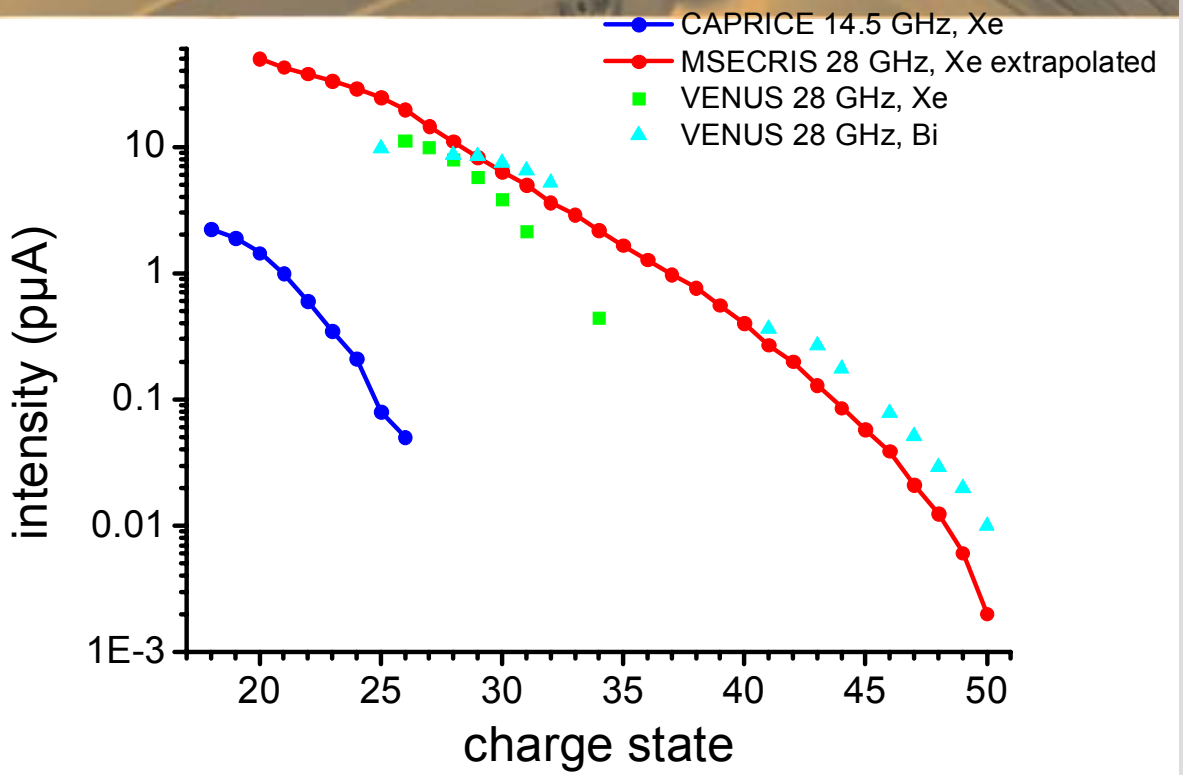
Old system **New system**



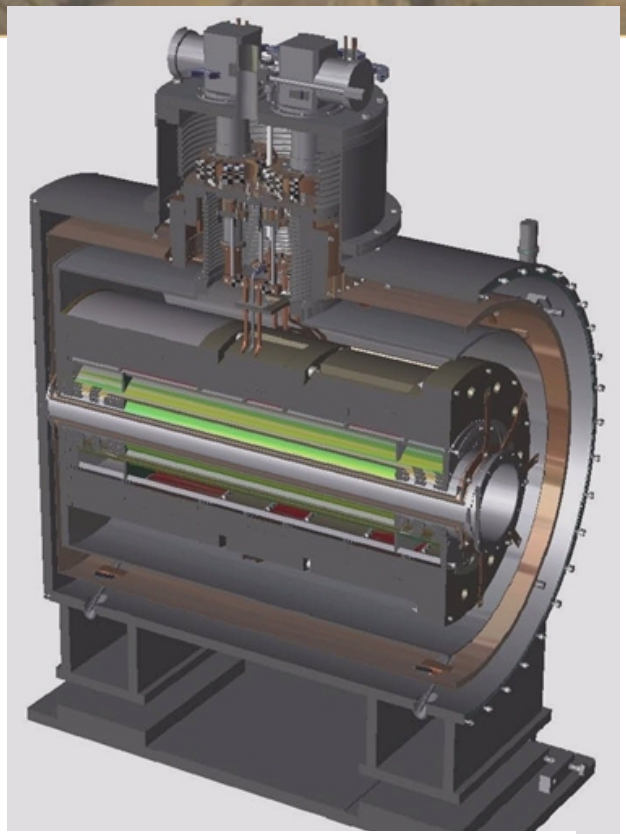


New Compact Charge Separator (improved heavy ion transfer to SIS18

UNILAC upgrade program (examples)



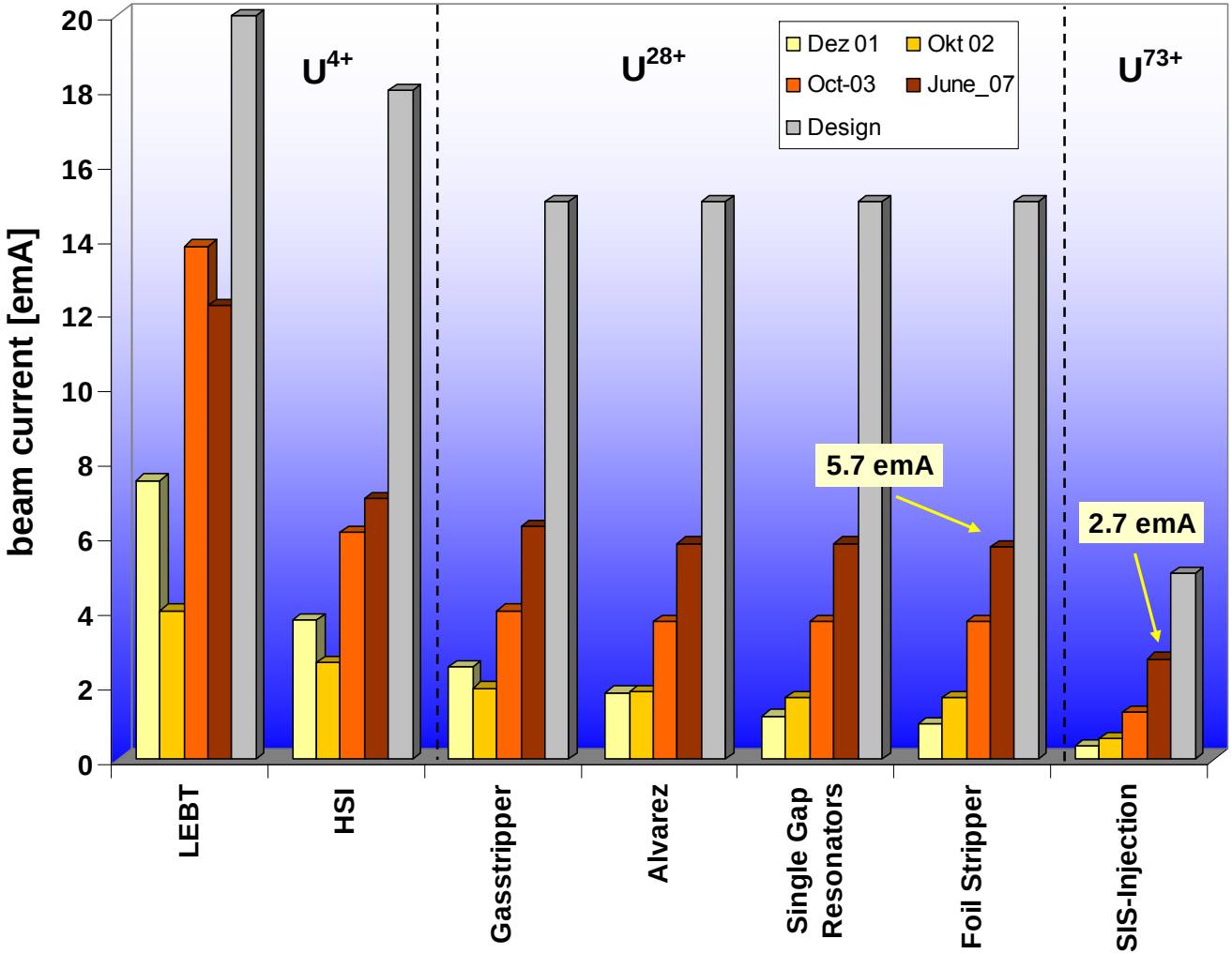
Ion intensities (Present ECR and MSECRIS)



MSECRIS , sc-magnets, 28 GHz

New superconducting ECR ion source for high intensity and high charge states

UNILAC upgrade program (status, improvements)



achieved enhancement of beam-intensities for U-ions

Schedule

Shutdown | Beamtime available

	2009				2010				2011				2012				2013				2014				2015			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Beamtime UNILAC																												
Beamtime SIS																												
Beamtime ESR																												
Shut-Down UNILAC				1		6		7			8									13								
Shut-Down SIS		2		3				14			9			11														
HSI		4						12						12														
HLI				5							10																	
commissioning HEST FAIR																						??		??		??		??

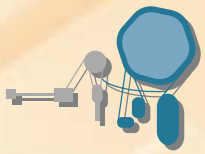
1	"repair" Alvarez 1	6	"repair" Alvarez 2	8	"repair" Alvarez 4	11	link p-linac	13	upgrade control-
2	upgrade vacuum SIS p	7	"repair" Alvarez 3	9	new area for sc mag		link HEBT FAIR	14	SIS alignment
3	upgrade vacuum SIS part 2			10	upgrade LEBT HLI		mod. SIS dipole p		
4	upgrade RFQ HSI					12	upgrade LEBT HS		
5	upgrade RFQ HLI								

Remarks

for the given experiment beam times a reduction of about 15% for maschine experiments/ commissioning has to be considered

it is assumed that no accelerator sections (e.g. ESR) will be dismantled within the given period

Longterm beam-time- /shutdown schedule (planned /estimated)



Thank you for your attention