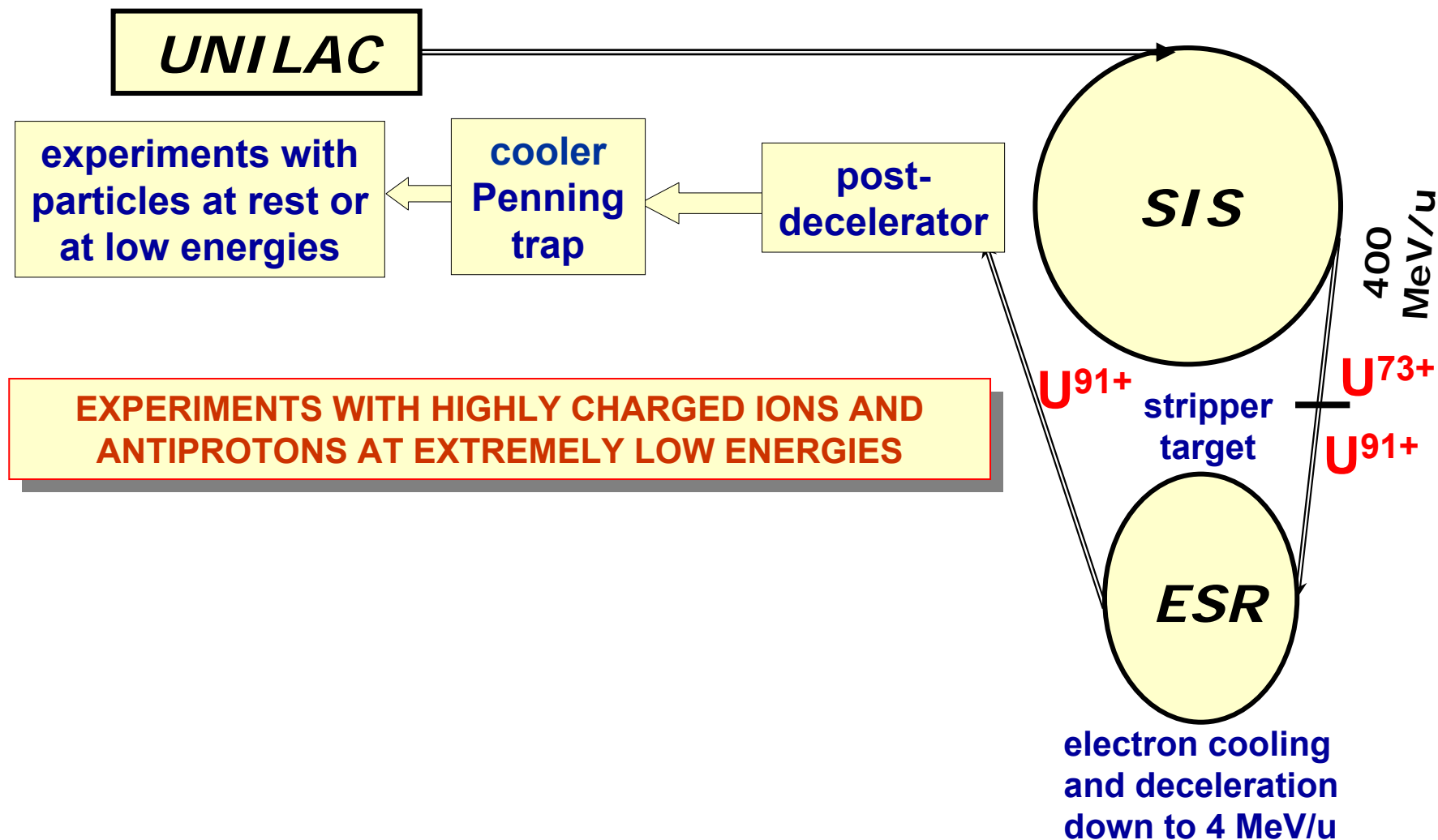


HITRAP at the ESR Storage Ring



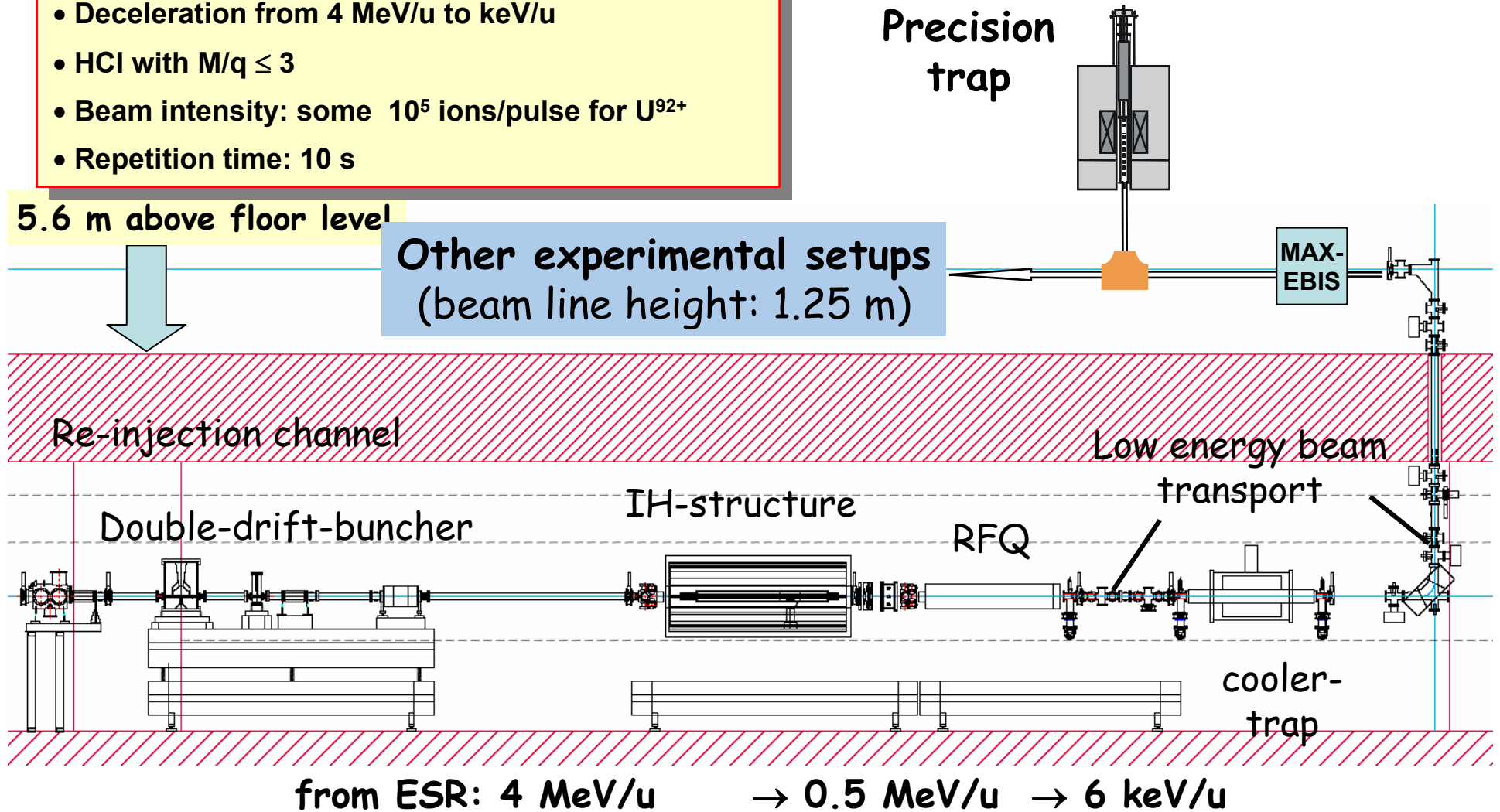
HI TRAP overview in the re-injection channel at ESR

Operational Parameters:

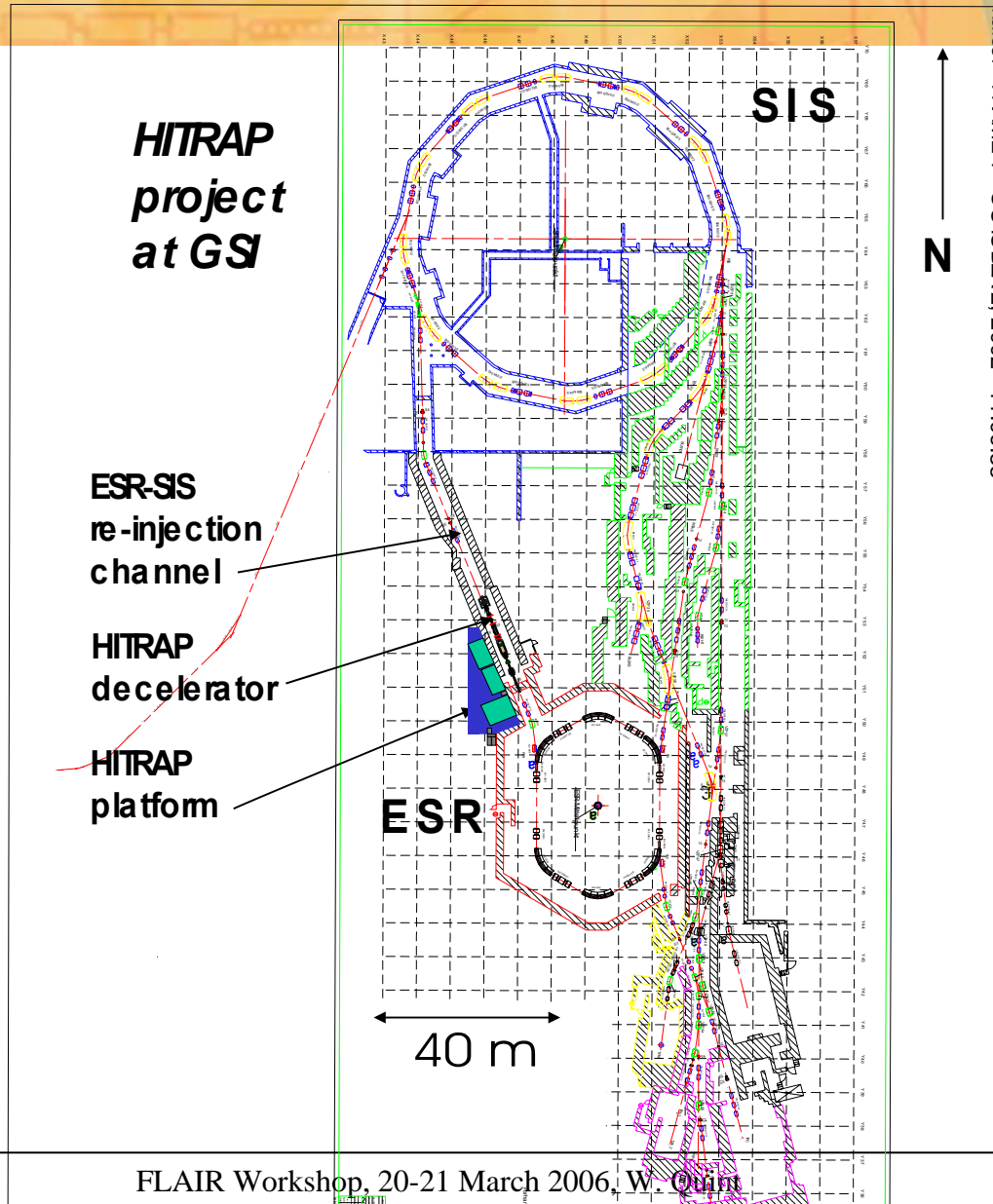
- Deceleration from 4 MeV/u to keV/u
- HCI with $M/q \leq 3$
- Beam intensity: some 10^5 ions/pulse for U^{92+}
- Repetition time: 10 s

5.6 m above floor level

Other experimental setups
(beam line height: 1.25 m)

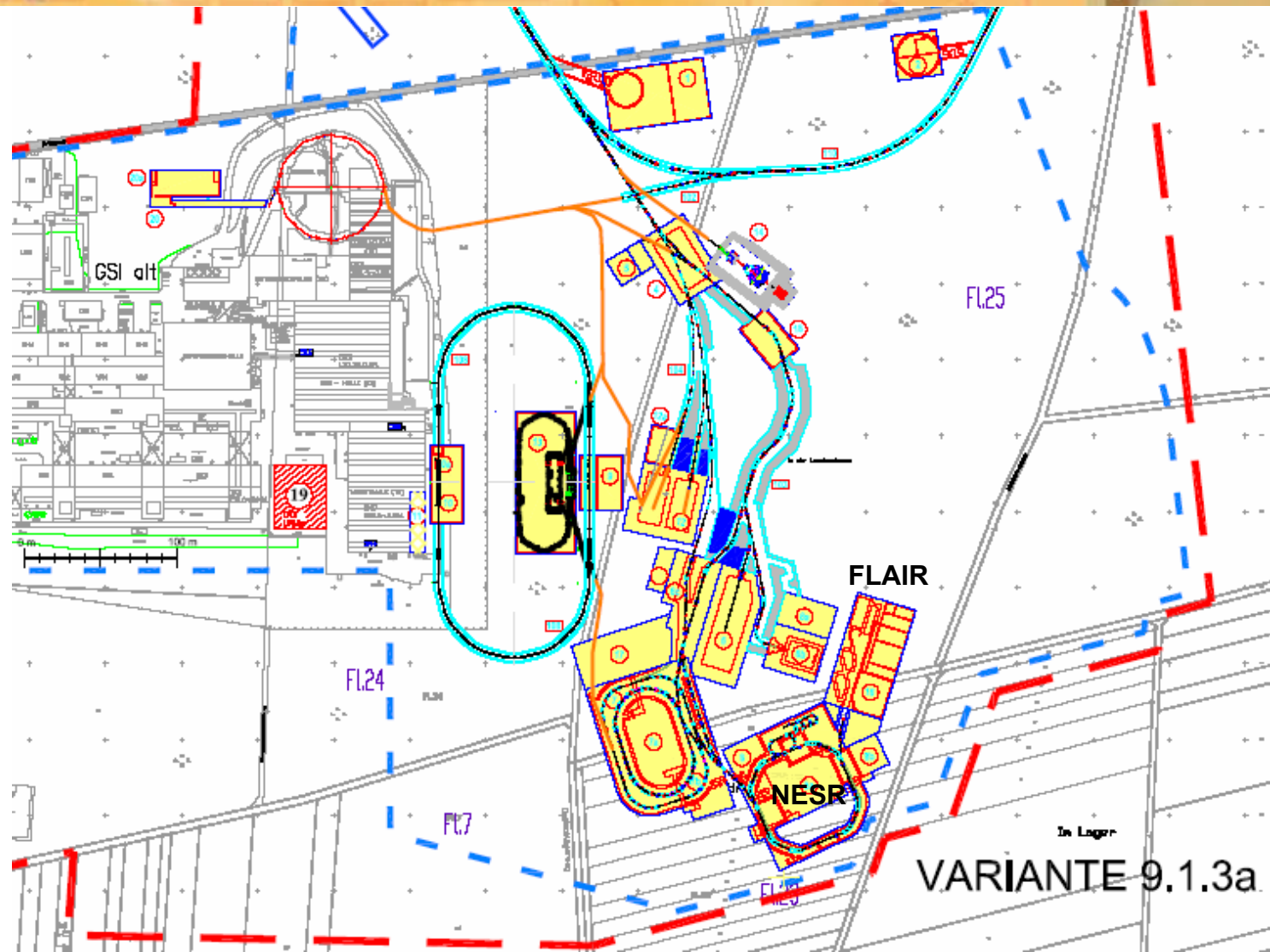


HITRAP at the GSI Accelerator Facility

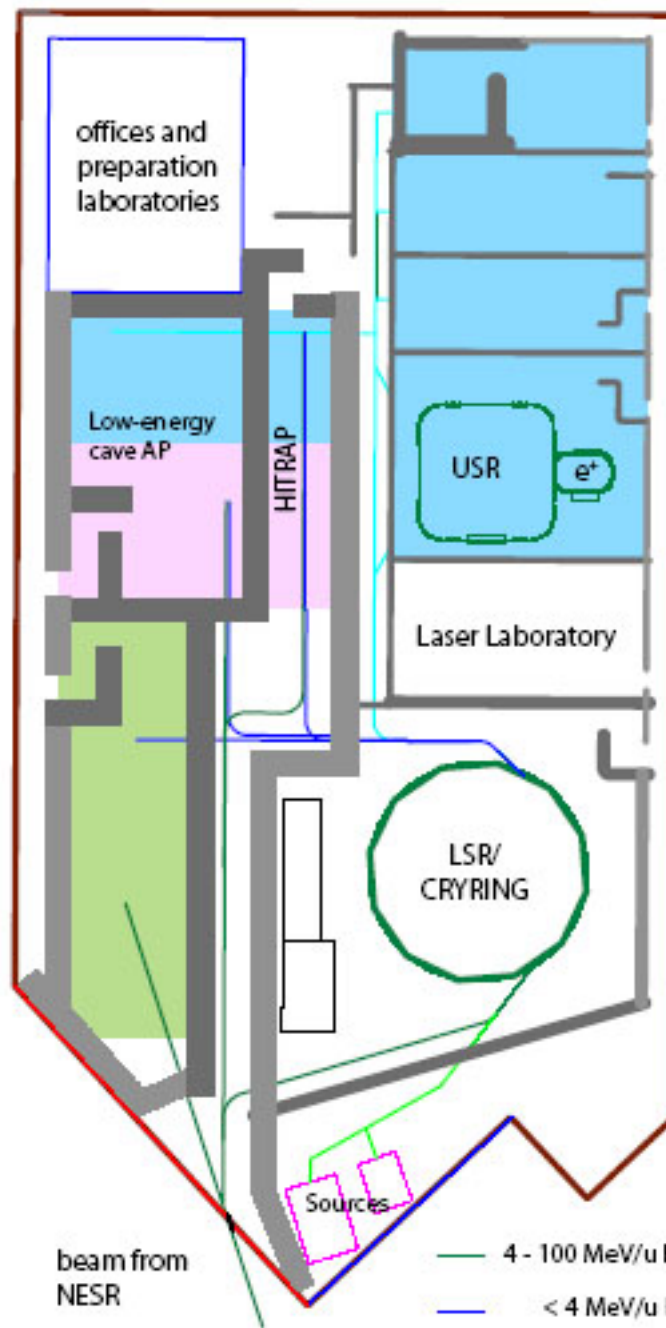


HITRAP in the FLAIR building

Facility for Low-energy Antiproton and Ion Research



FLAIR Building



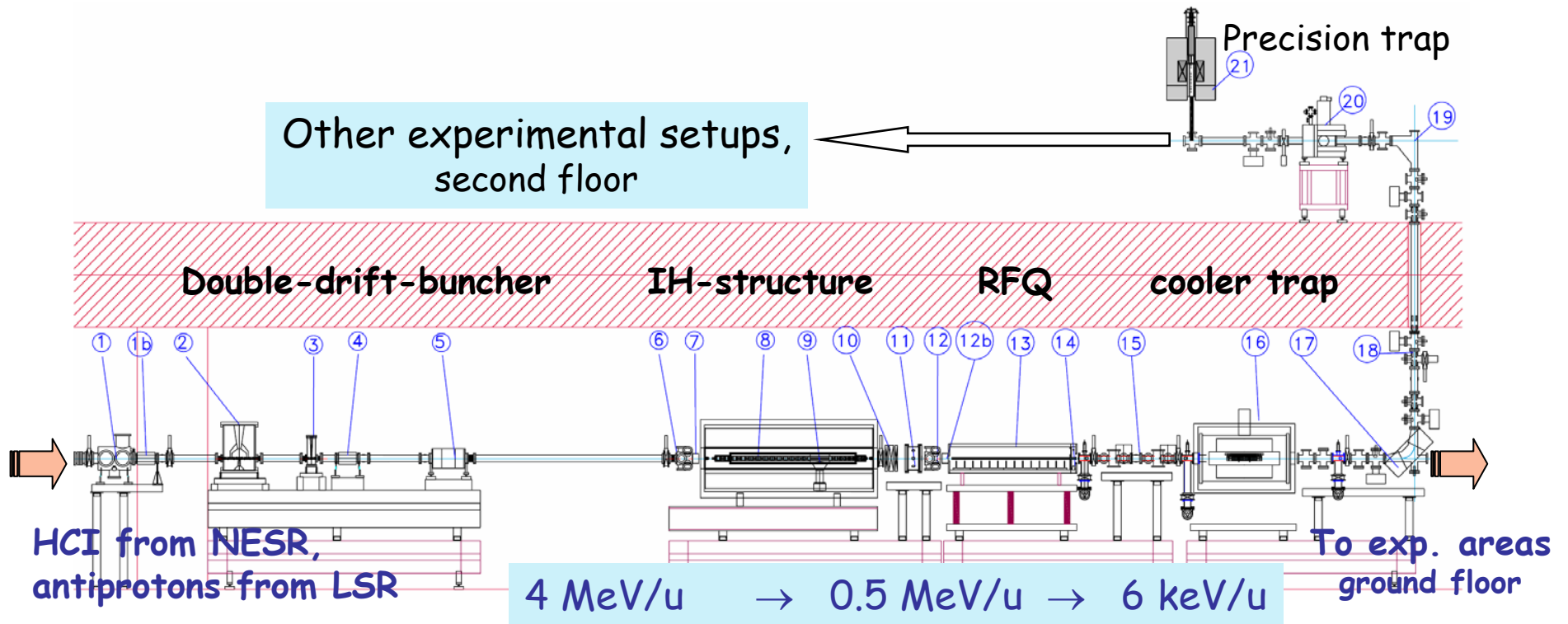
- low-energy \bar{p}
- low-energy HCl
- high-energy \bar{p}



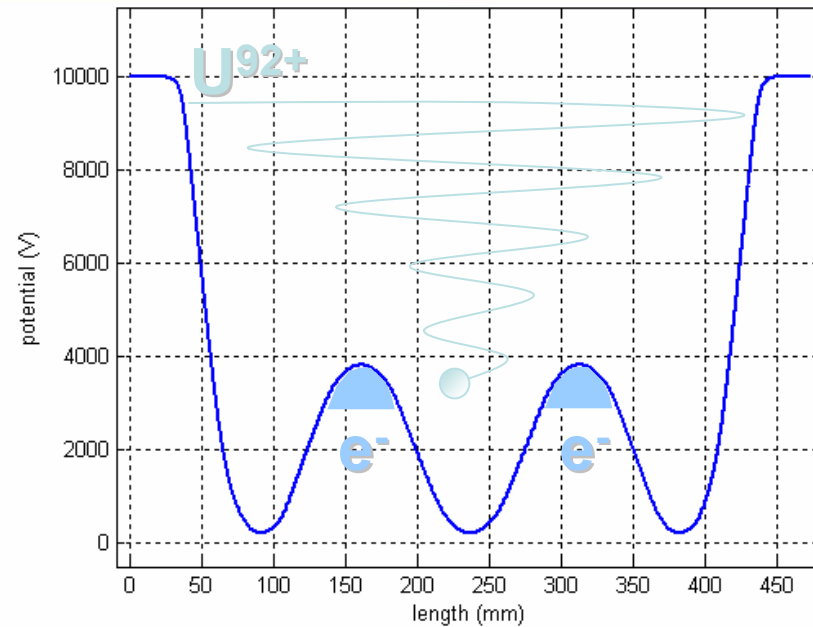
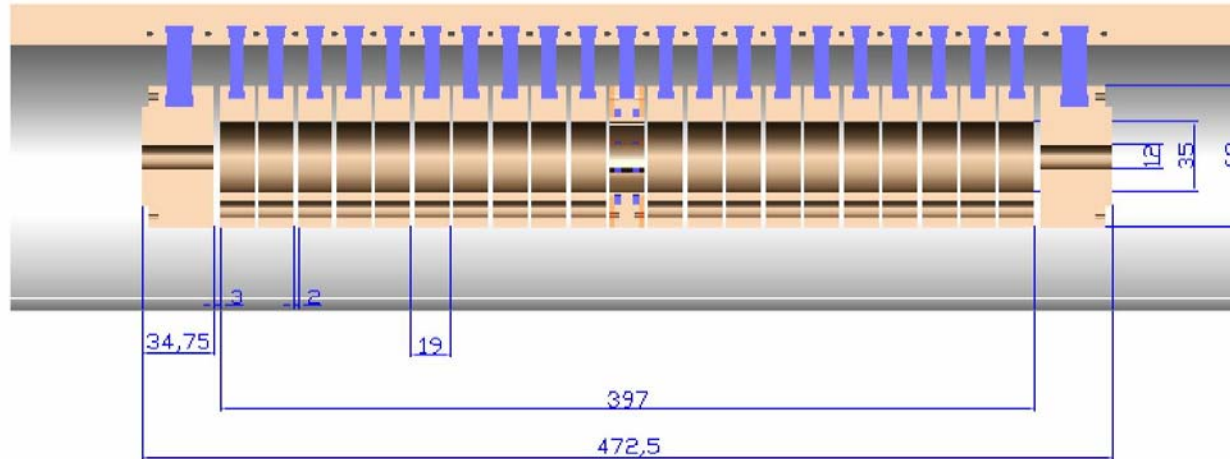
beam from NESR

- 4 - 100 MeV/u HCl 30 - 400 MeV \bar{p}
- < 4 MeV/u HCl 0.3 - 30 MeV \bar{p}
- < 0.1 MeV/u HCl 0.005 - 0.3 MeV \bar{p}

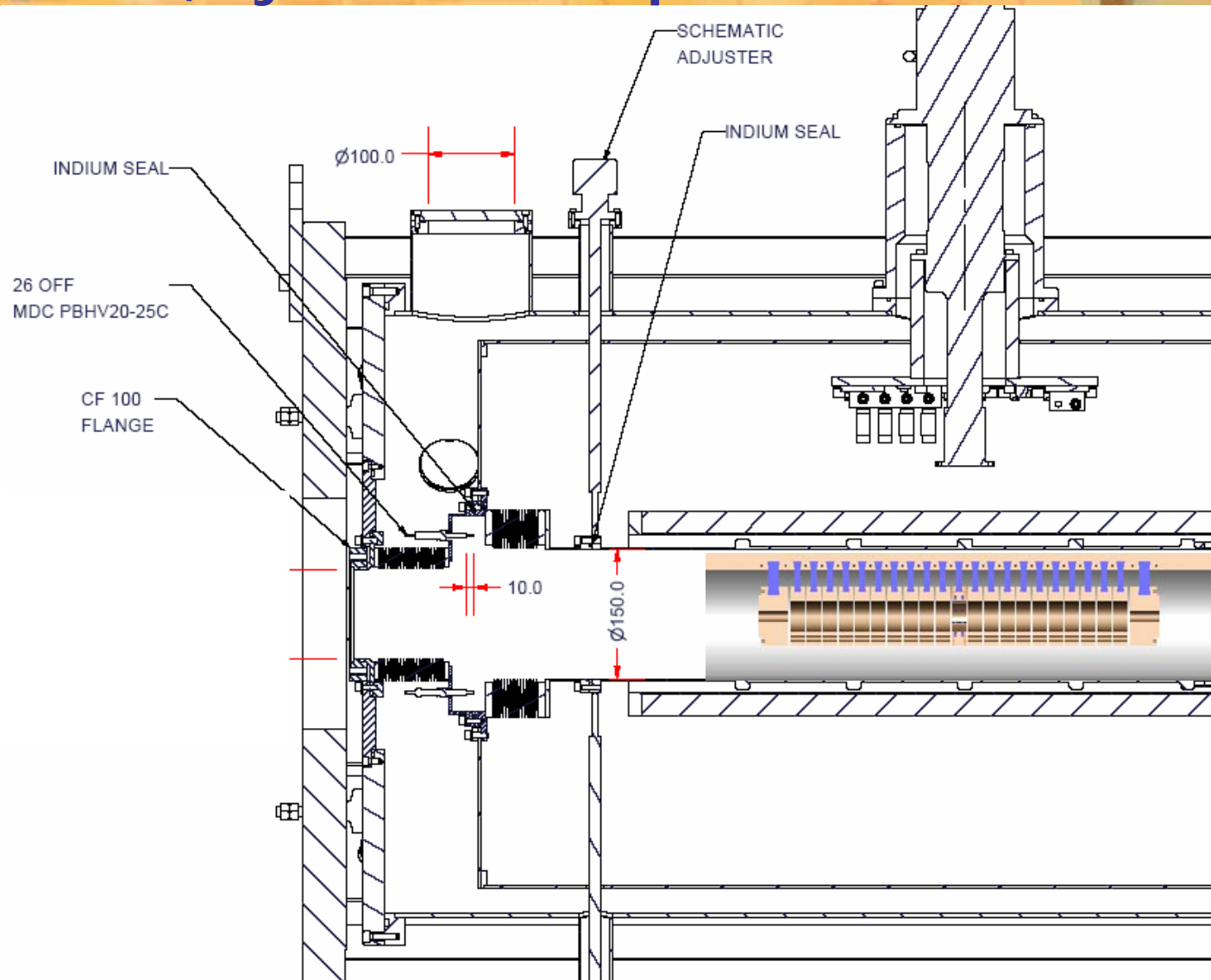
The HITRAP Facility in the FLAIR Building



Cooler trap: Cylindrical trap electrodes

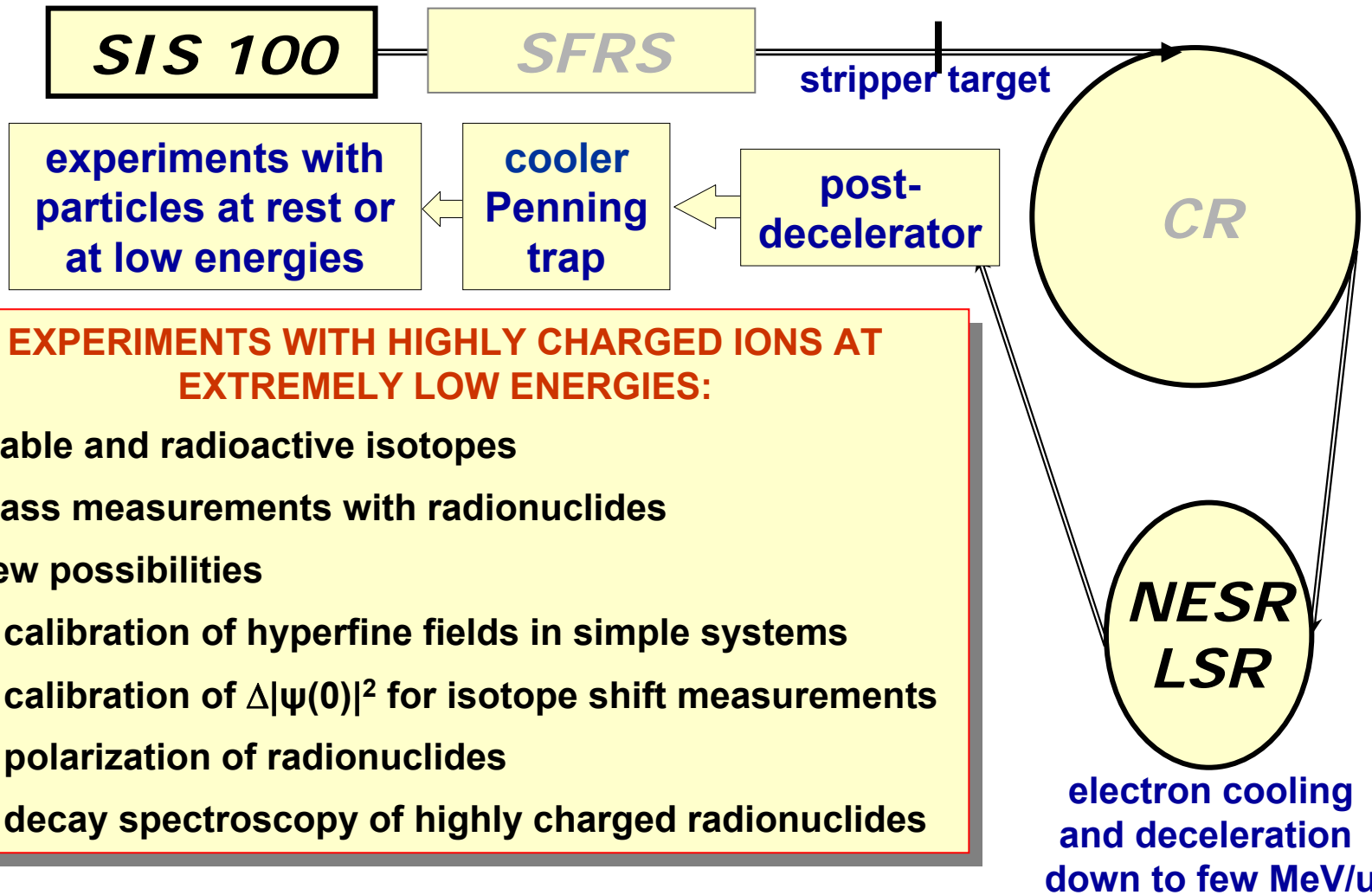


Cooler trap: Superconducting magnet with 1.5 W@4K cryocooler, cylindrical trap electrodes

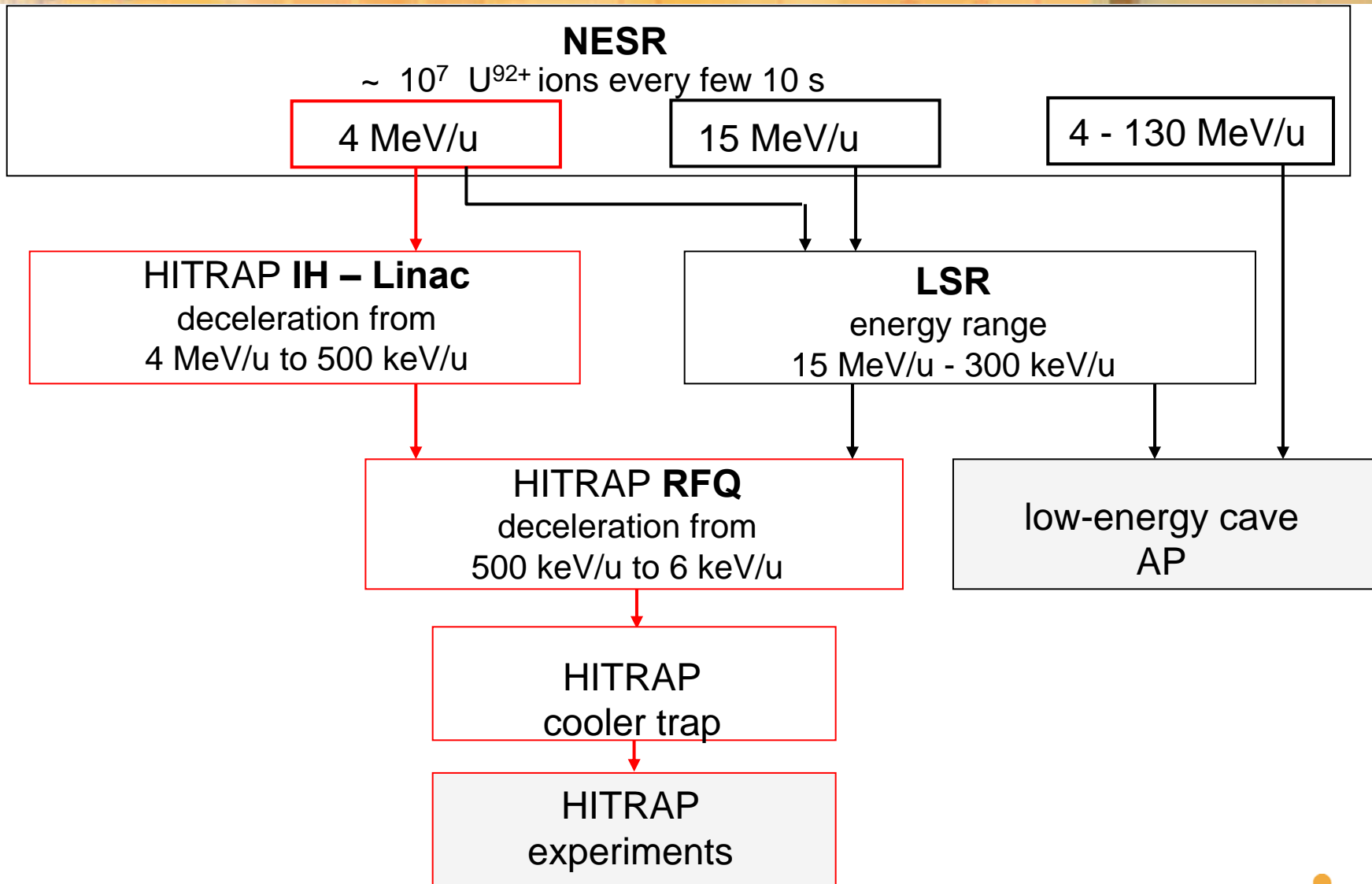


SPARC:

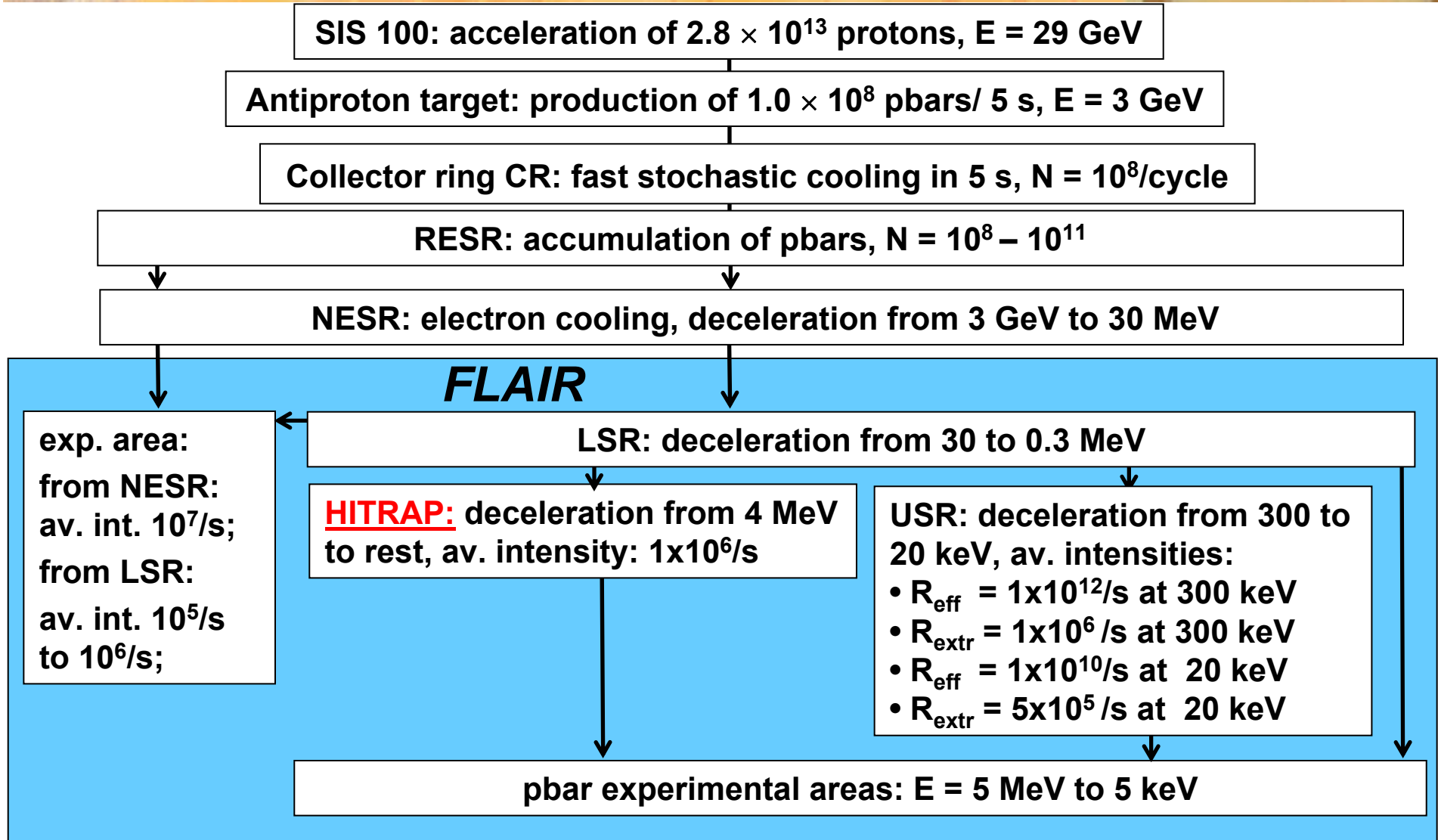
HITRAP for Stable and Radioactive Highly Charged Ions



HITRAP: possible deceleration schemes for HCl at NESR/FLAIR

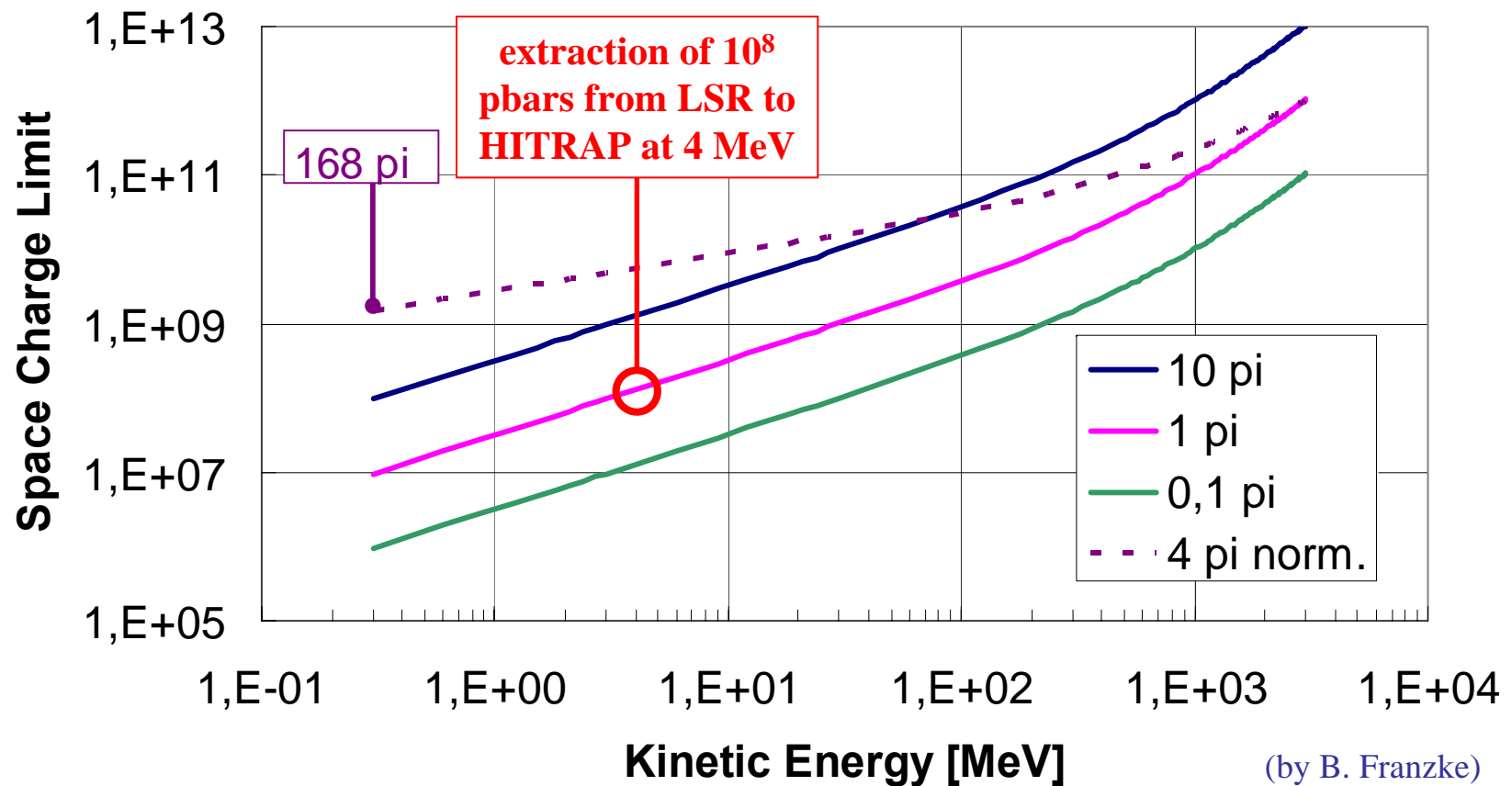


FLAIR: Antiproton Intensities



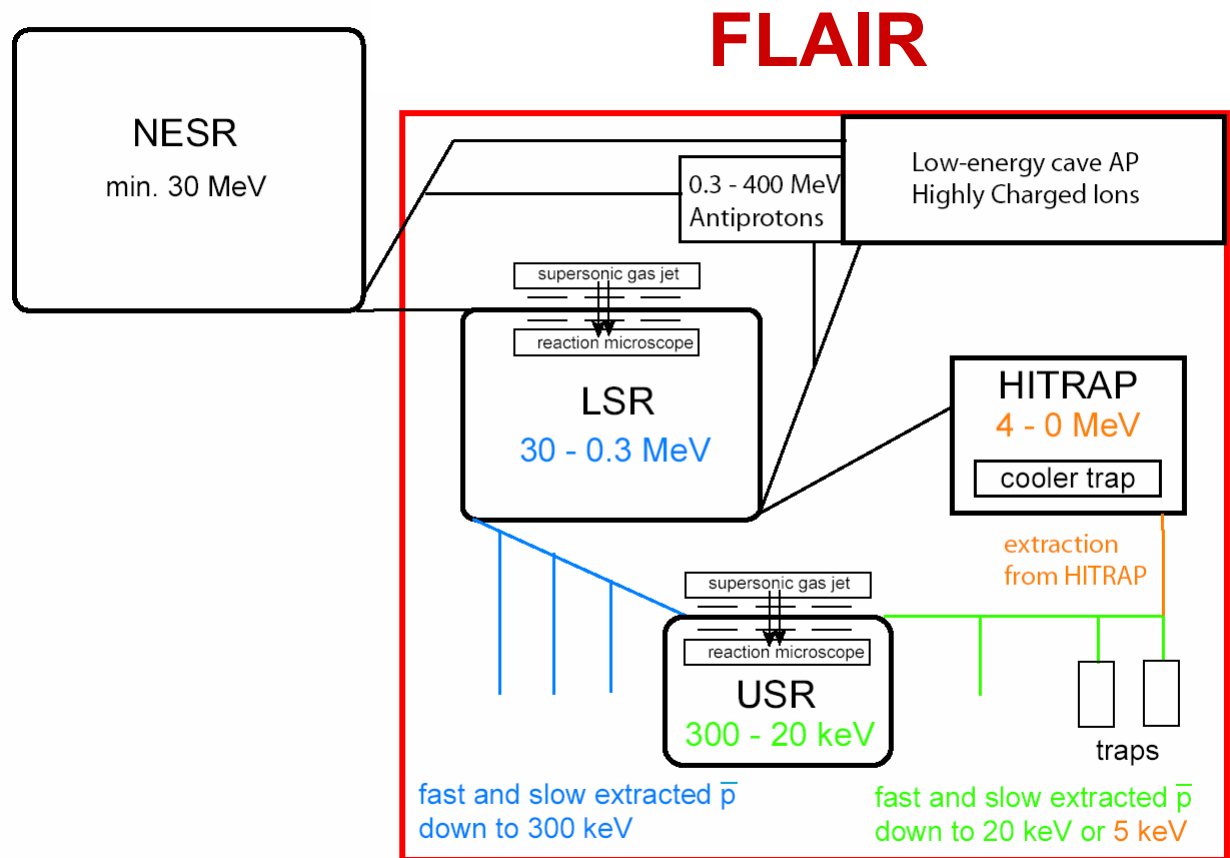
Space Charge Limits in Rings

Laslett Tune Shift = -0.05



FLAIR - Facility for Low-energy Antiproton and Ion Research

- **NESR:**
 - Pbar & Ions
- **LSR:**
 - Magnetic ring
 - $E_{\min} = 300 \text{ keV}$
- **USR:**
 - Electrostatic ring
 - $E_{\min} = 20 \text{ keV}$
- **Atomic phys. cave:**
 - ions
- **HITRAP:**
 - Pbar and ions
 - extracted at 5 keV



Factor 100 more pbar trapped or stopped in gas targets than now

HITRAP at FLAIR – a high-intensity source of low-energy antiprotons

Physics Topics with Antiprotons:

- **Spectroscopy for tests of CPT and QED**
 - Antiprotonic atoms (\bar{p} -He, \bar{p} -p), antihydrogen
- **Gravitation of antimatter**
 - Trapped and laser-cooled antihydrogen
- **Atomic collisions**
 - Ionization, energy loss, antimatter-matter collisions
- **Antiprotons as hadronic probes**
 - X-rays of light antiprotonic atoms: low-energy QCD
 - X-rays of neutron-rich nuclei: nuclear structure (halo)

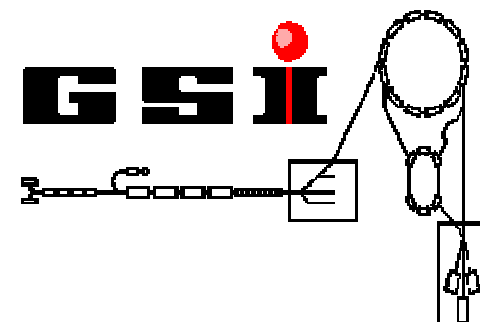
HITRAP Collaborators and EU RTD-Network

HITRAP-Facility:

Univ. Frankfurt (U. Ratzinger, A. Schempp)

Univ. Mainz (K. Blaum, J. Walz)

GSI



GANIL



Imperial College
London

Experiments:

R. Morgenstern, Groningen

J.-P. Grandin, Caen

J. Ullrich, Heidelberg

A. Warczak, Kraków

G. Werth, K. Blaum, Mainz



R. Schuch, Stockholm
R. Thompson, London
J. Burgdörfer, Wien
GSI-AP Division