

GSI Facility Aspects and Requirements SPARC

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Ion Facilities at GSI Used by APPA

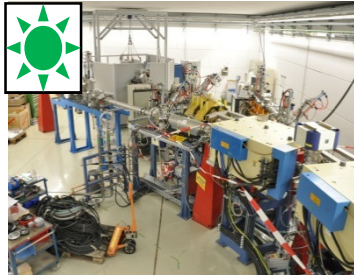


Since 2009, in operation

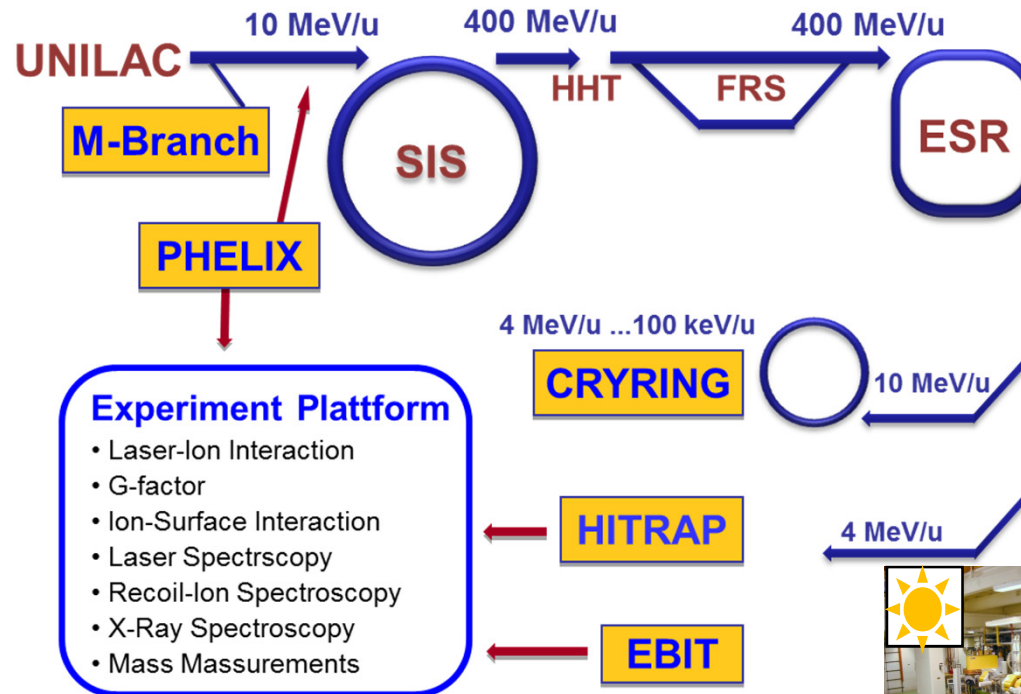
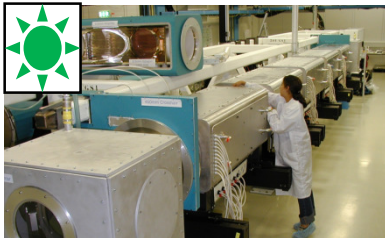


New

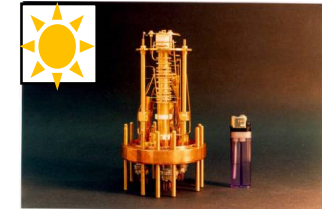
M-branch UNILAC



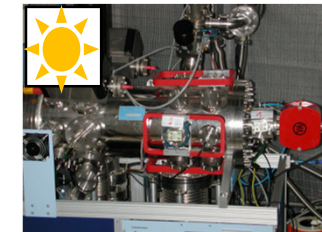
Petawatt laser PHELIX



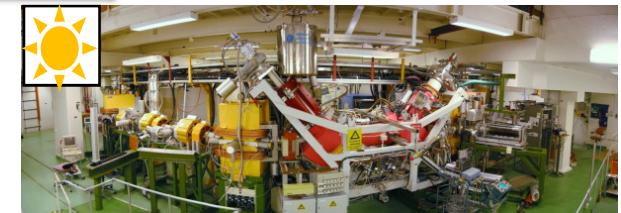
ion trap facility HITRAP



Super-EBIT



CRYRING



Serving the user communities / R&D beam experiments for FAIR (2015-2017)

UNILAC, PHELIX, SEBIT, and CRYRING will stay in operation

Serving the user communities / R&D beam experiments for FAIR (2017 and beyond)

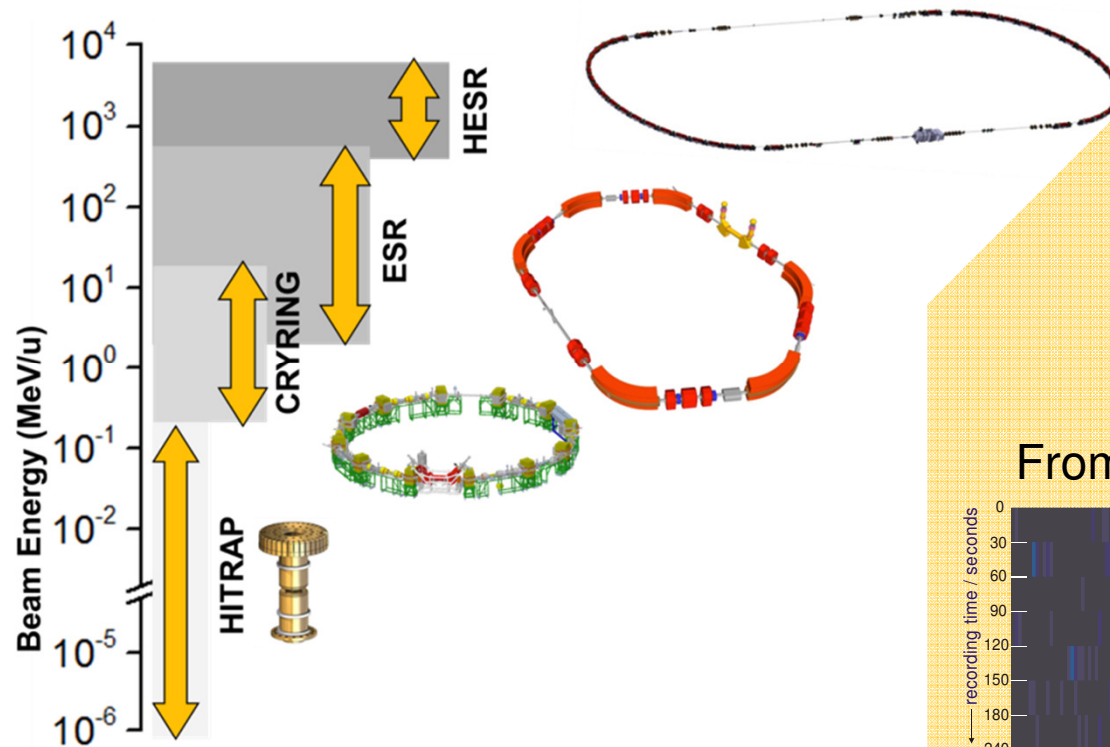
UNILAC, PHELIX, SIS18, HITRAP, CRYRING, ESR, CAVE A, CAVE M

Ion Beam Facilities / Trapping & Storage

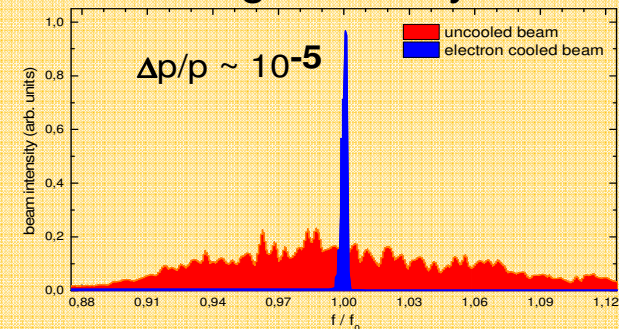
Worldwide
Unique !

Stored and Cooled

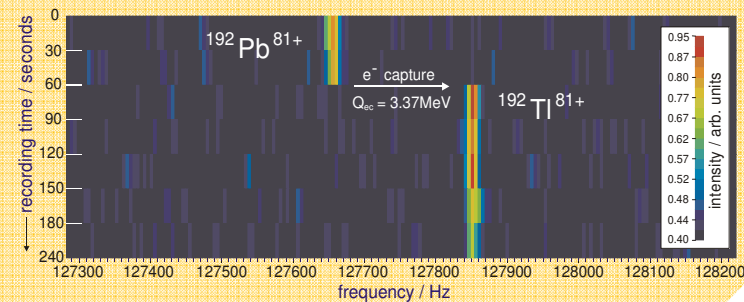
Highly-Charged Ions (e.g. U^{92+}) and Exotic Nuclei
From Rest to Relativistic Energies (up to 4.9 GeV/u)



Cooling: The Key for Precision



From Single Ions to Highest Intensities



What is essential?

- **Efficient transmission from SIS18→ESR (cooling in SIS-18!!)**
- **Efficient transmission SIS18→FRS→ESR**
- **Nearly universal options for stripping**
- **Efficient cooling in the ESR**
- **Stacking in the ESR**

- **Quick slowing down in the ESR**
- **Efficient transmission ESR→CRYRING**
- **Efficient transmission ESR→Cave-A**
- **Efficient transmission ESR→HITRAP**

- **Flexible control system**

- **More space in the ESR ;-(**

ESR Experiments in the last years

| # | Spokesperson | Short Title | PR | FRS | beam |
|------|-----------------------------------|---|------|-----|--|
| E028 | Egelhof, P. | Response of Calorimetric Low Temperature Detectors to Energetic Heavy Ions | 10.4 | | |
| E039 | Beyer, Heinrich F., P. Indelicato | Precision x-ray spectroscopy in one- and two-electron heavy ions | 45 | | |
| E040 | Schatz, Hendrik | Nuclear Astrophysics Studies at the FRS-ESR: Ground State and Decay Properties of Neutron-Rich Nuclei in the ^{132}Sn Region | 20 | FRS | |
| E046 | Stöhlker, T. | Inverse Photoionisation Studied via Radiative Electron Capture into Highly Charged Ions | 12 | | |
| E053 | Schramm, U. | Laser cooling of C^{3+} ion beams at relativistic energies | 4 | | |
| E055 | Scheidenberger, C. | Experimental program for direct mass measurements at FRS-ESR using isochronous and time-resolved Schottky mass spectrometry | 2 | FRS | |
| E061 | Silver, Eric | Excited states in He-like uranium: accurate transition energy measurements utilizing a ^{238}U ion source | 6 | | |
| E064 | Chartier, M. | Light-ion induced reactions in storage rings | 8 | | |
| E067 | Saathoff, Guido | Experimental test of time dilatation at the ESR | 24 | | |
| E069 | Hagmann, S., H. Rothard | Bremsstrahlung during electron transfer to continuum | 8 | | |
| E071 | Hagmann, S. | Atomic fragmentation and multi-electron continua in strongly perturbing collisions | 7 | | |
| E072 | Ros, David | X-Ray Laser Spectroscopy of Li-like Heavy Ions at the GSI Reinjection Channel | 42 | | |
| E073 | Musumarra, Agatino | Electron Screening and alpha-decay | 31 | FRS | U |
| E074 | Warczak, A. | Radiative Double Electron Capture (RDEC) in collisions of bare heavy ions with carbon solid target | 6 | | |
| E076 | Warczak, A., A. Braeuning-Demian | Radiative Double Electron Capture in collisions of bare heavy ions with carbon solid target (Appendix to the Research Proposal 2074) | 29 | | |
| E078 | Litvinov, Yuri | Influence of hyperfine interaction on the nuclear electron capture decay | 21 | FRS | |
| E079 | Brandau, C., C. Kozhuharov | Isotope shift in the dielectronic recombination of L-shell ions | 26 | | U |
| E081 | Hagmann, S., H. Rothard | Inelastic Electron Scattering in Inverse Kinematics: A versatile Tool for Spectroscopy and Collision Dynamics | 22 | | |
| E082 | Litvinov, Yuri, F. Bosch | Single-Ion Spectroscopy of Two-Body β -Decays | 62 | FRS | Sm |
| E083 | Nörtershäuser, Wilfried | Laser spectroscopy of lithium-like bismuth at the ESR - A test of QED theory in the magnetic sector of photon-matter interaction | 21 | | |
| E084 | Knöbel, Ronja, Baohua Sun | Mass measurements of neutron-deficient short-lived nuclides | 42 | FRS | |
| E085 | Ros, David | Spectroscopy of Li-Like Heavy Ions at the ESR | 0 | | |
| E086 | T. Faestermann, C. Brandau | Test of the ESR as High Resolution Spectrometer for Knockout Reactions aiming at NESR Experiments | 9 | | |
| E087 | P. Woods | Breakout from the hot CNO cycles in X-ray bursters: determination of the $^{150}(\text{a,g})^{19}\text{Ne}$ reaction rate via a (p,t) study on the NESR | 24 | | ^{21}Ne , $^{20,21}\text{Ne}$ |
| E089 | M. Bussmann, U. Schramm | Laser cooling of C^{3+} ions at the ESR: preparation for the NESR and the SIS300 | 12 | | |
| E090 | S. Hagmann | Bremsstrahlung during electron transfer to continuum | 15 | | |
| E092 | S. Tachenov | Photon-Photon correlation and polarization studies of radiative transitions into bare heavy ions | 21 | | |
| E093 | D. Thorn, T. Stoehlker | Measurement of the polarization of electron and proton impact-excitation produced Lyman-alpha-1 transitions in H-like uranium | 21 | | |
| E096 | C. Brandau, C. Kozhuharov | Dielectronic recombination of heavy three-electron radioisotopes | 27 | | |
| E048 | Walker, P. M. | Exploring Long-Living K-Isomers via Schottky-Mass-Spectrometry at the ESR | 0 | FRS | |
| E062 | Heil, Michael | ESR measurements of proton-induced reaction rates in the Gamow window of the astrophysical p process | 0 | | |
| E075 | Kester, Oliver | HITRAP Decelerator Commissioning | 0 | | |

General requirements

- All kinds from light to Uranium (and beyond ☺)
- Mostly moderate intensities (10^9 particles/spill)
- Highest intensities for the cases involving FRS
- Mostly long measurement times after injection

**We would like to thank the ESR team
for the excellent
work together
over the last 25 years!**