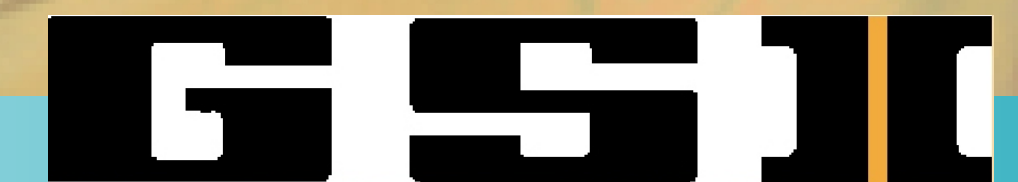


Exotic Nuclei Studied in the new Storage Rings of the Future International Accelerator Facility FAIR

H. Weick for the ILIMA and EXL collaborations, presented by H. Geissel

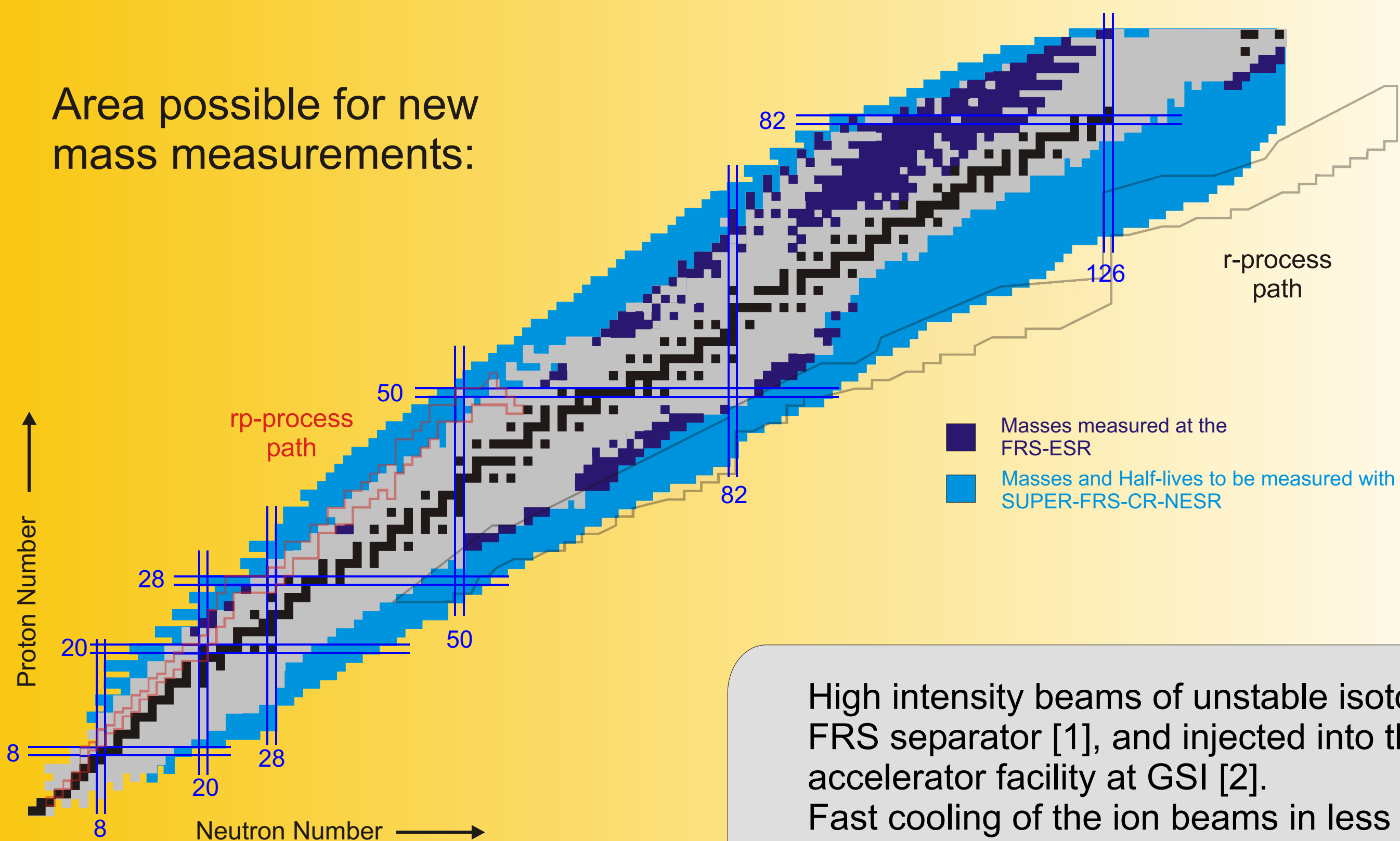


ILIMA

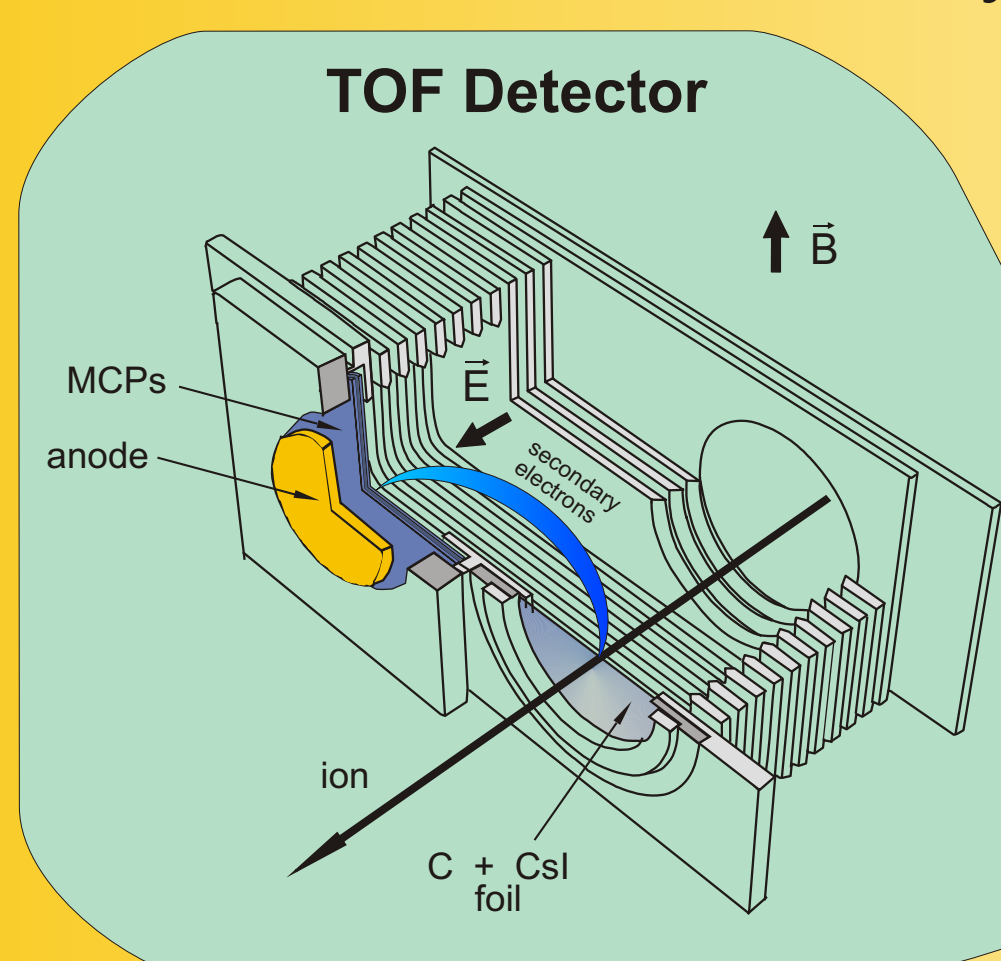
Study of **I**someric beams, **L**ifetimes and **MA**sses

- Mass and half-life measurements of large regions on the chart of nuclides
- Extraction of physical information relevant for nuclear structure and astrophysics
- Half-lives and decay modes of highly charged ions
- The production of and investigations with pure isomeric beams

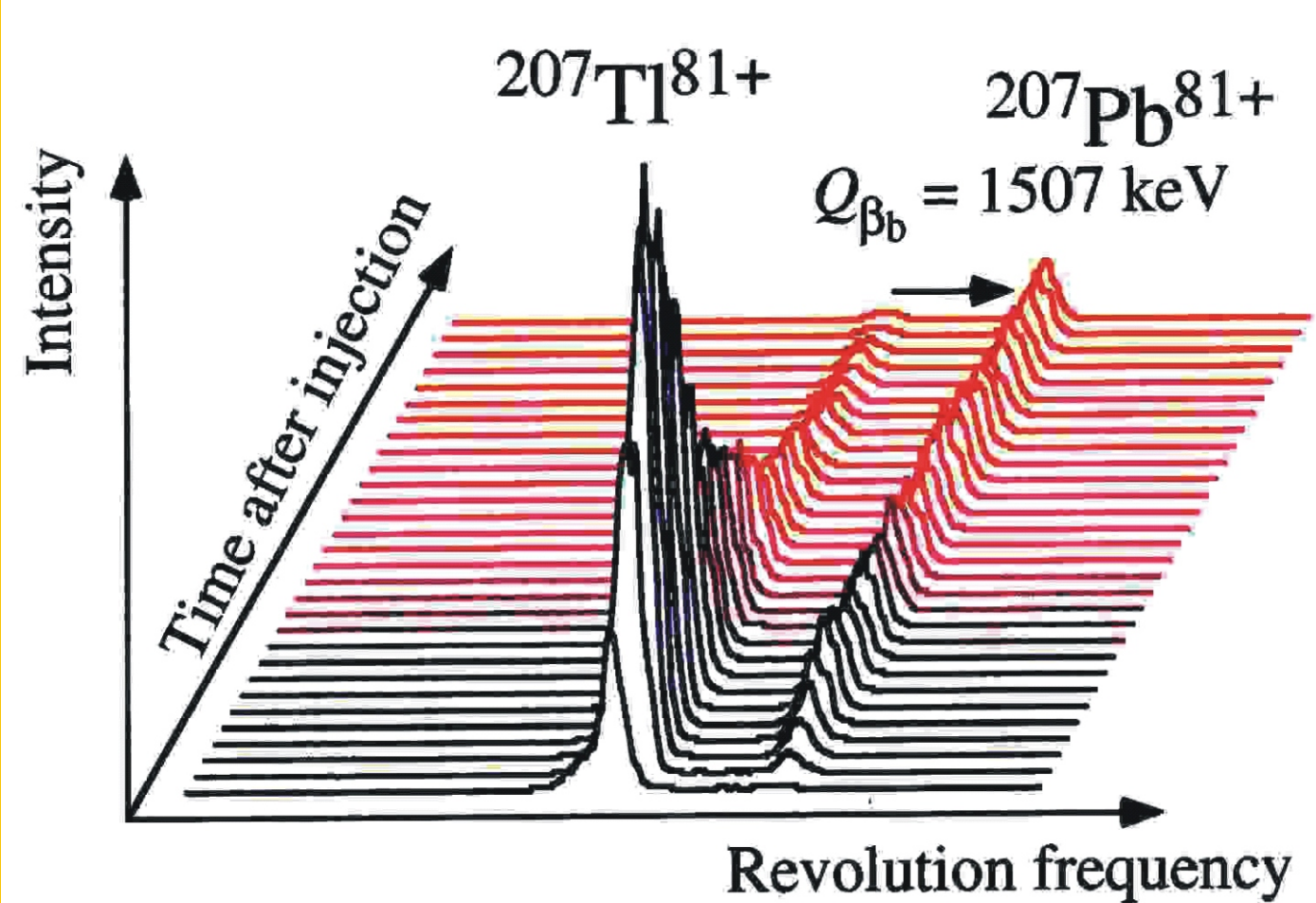
Area possible for new mass measurements:



Short-lived nuclides ($>10^{-10}$ s) can be investigated in the isochronous CR without cooling by a special TOF detector or a resonant Schottky pick up.



Longer lived nuclides (>1 s) can will be cooled and investigated in the NESR with many Schottky pickups.



Example: Bound-state beta decay of ^{207}Tl observed in ESR.

The ILIMA Collaboration

- GSI, Darmstadt, Germany
- Technische Universität München, Germany
- PNPI and State University, St. Petersburg, Russia
- Justus-Liebig Universität Giessen, Germany
- Soltan Institute of Nuclear Studies, Warsaw, Poland
- University of Surrey, Guildford, UK
- Los Alamos National Laboratory, USA
- Johannes Gutenberg Universität Mainz, Germany
- University of Manchester, Manchester, UK
- Niigata University, Niigata, Japan
- CSNM-IN2P3-CNRS, Orsay, France
- Saitama University, Saitama, Japan
- Aristotle University, Thessaloniki, Greece
- Tsukuba University, Tsukuba, Japan
- Michigan State University, USA
- University of York, York, UK

spokesperson: Yu.N. Novikov, PNPI
deputy: Yu.A. Litvinov, GSI

References:

- [1] H. Geissel et al., Nucl. Instr. and Methods in Phys. Research B 204 (2003) 71.
- [2] FAIR Conceptual Design Report, GSI (2001). <http://www.gsi.de/zukunftsprojekt>
- [3] ILIMA and EXL Letters of Intent to FAIR management. <http://www.gsi.de/documents/DOC-2004-Apr-89-1.pdf>

EXL

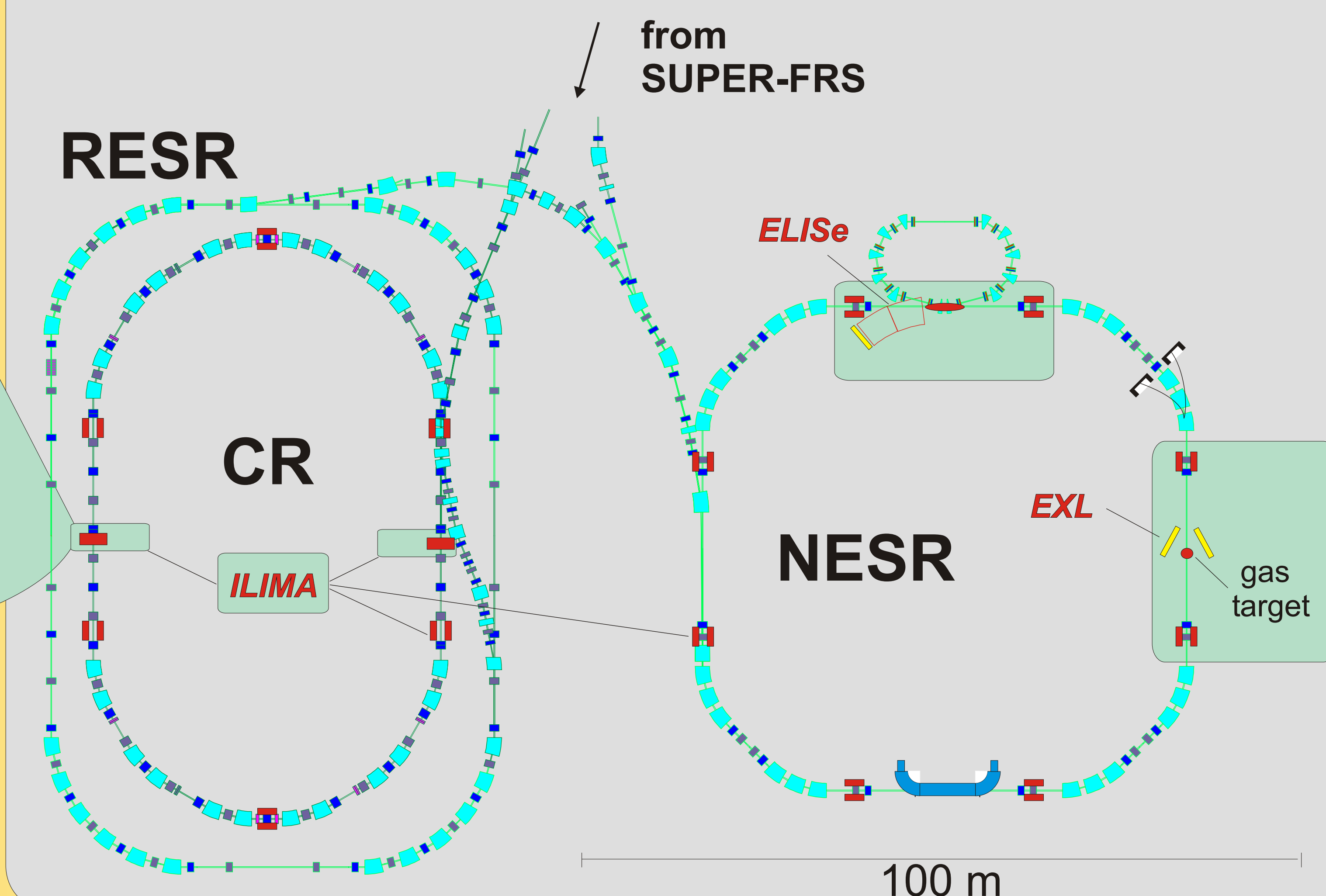
EXotic nuclei studied in **L**ight-ion induced reactions at the NESR storage ring

Study the structure of unstable exotic nuclei in light-ion scattering experiments at intermediate energies. EXL capitalizes on light-ion reactions in inverse kinematics by using novel storage-ring techniques and a universal detector system providing high resolution and large solid angle coverage in kinematically complete measurements.

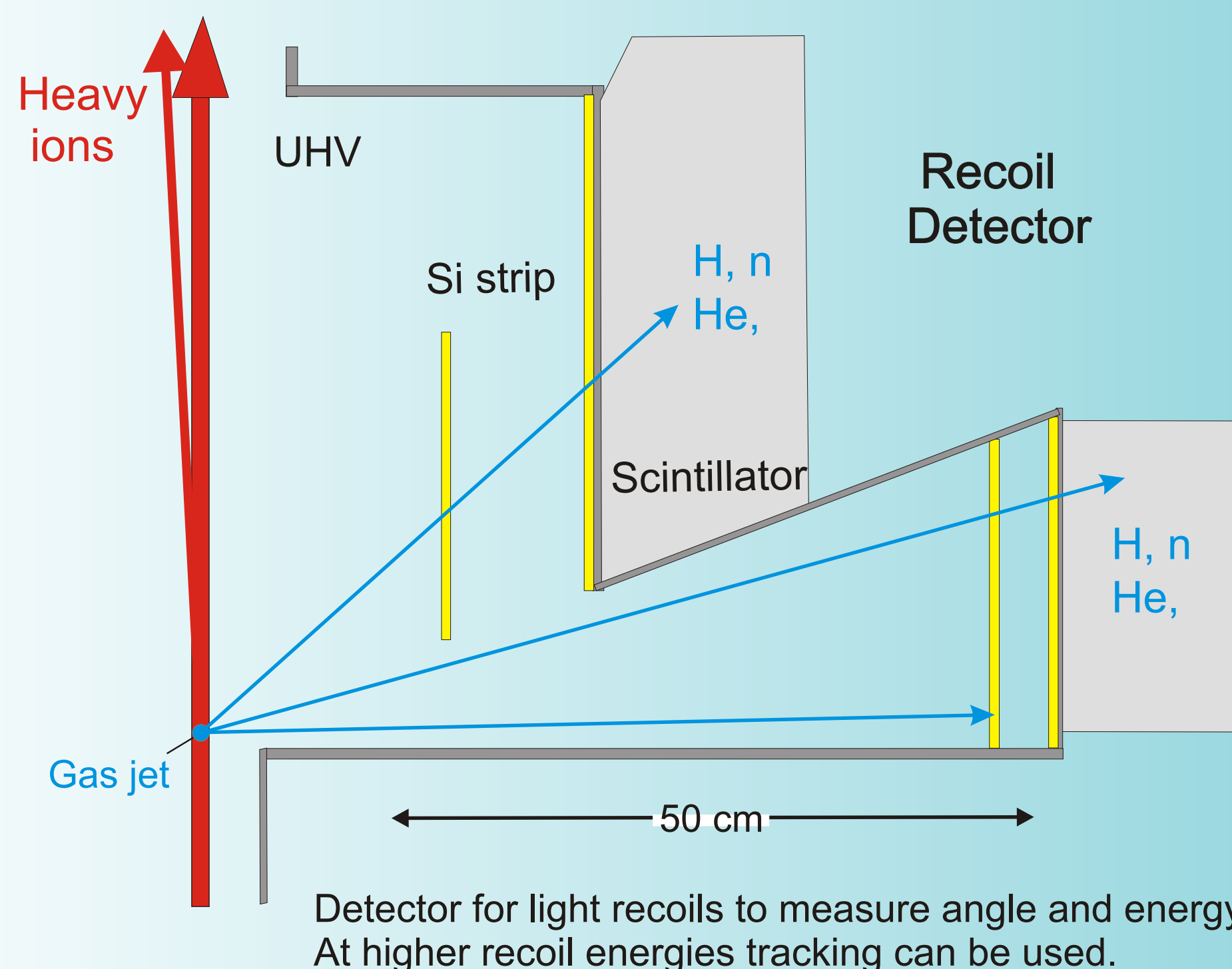
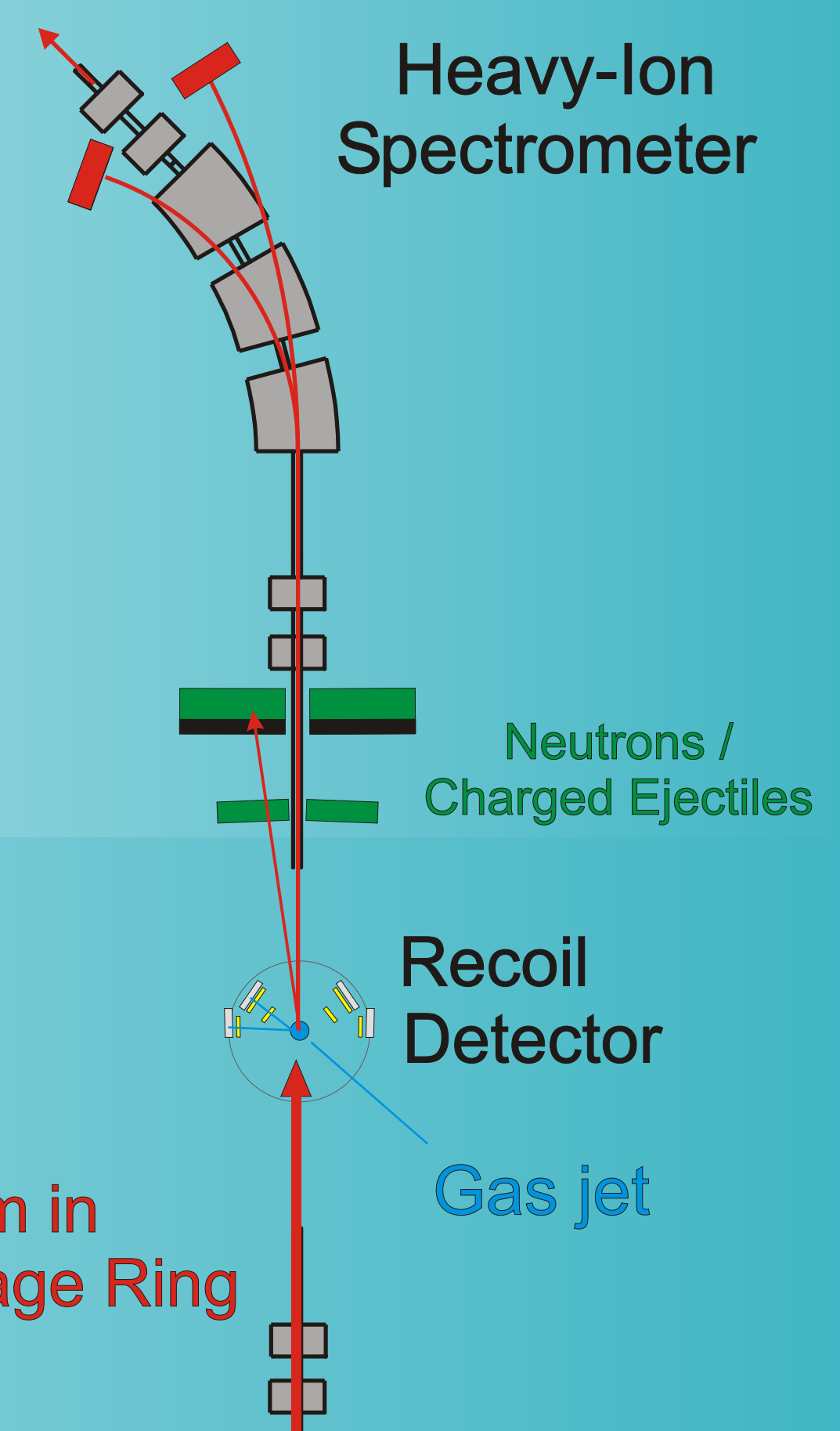
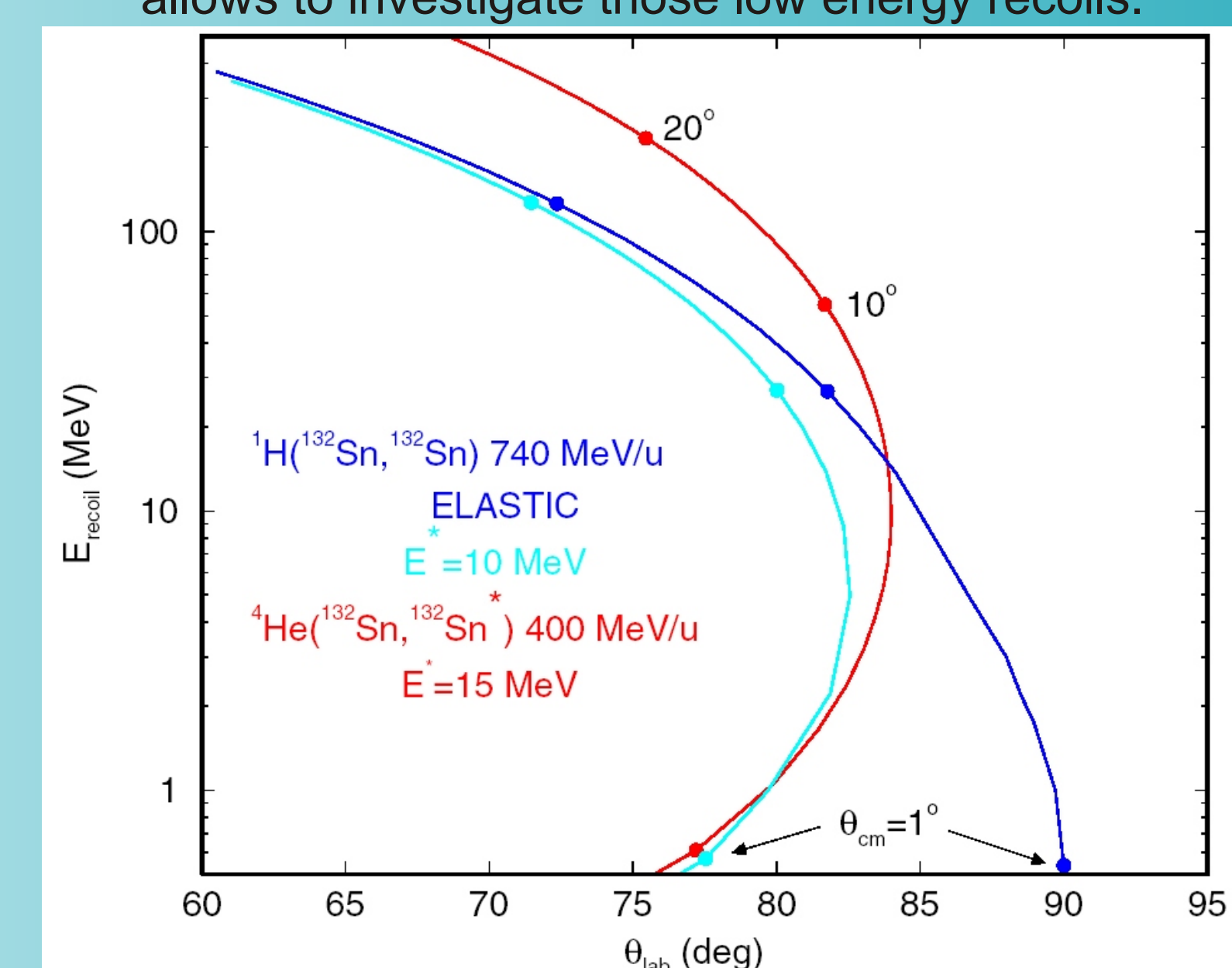
Nuclear structure information from intermediate-energy scattering off light nuclei

Method (reactions)	Physical observables	Related effects in exotic nuclei
elastic scattering (p,p); ($^4\text{He},^4\text{He}$);	nuclear matter radii and distributions	halo; neutron skin; central density; optical potential
inelastic scattering (p,p'); (\bar{p},p'); ($^4\text{He},^4\text{He}'$)	surface collective states; electric giant resonances; isovector magnetic excitation for (p,p'); analyzing powers	bulk properties in N-Z asymmetric matter; proton/neutron deformation; nuclear compressibility; threshold strength; soft modes
charge exchange (p,n); (d, ^3He); ($^3\text{He},t$)	spin-isospin excitations; Gamow-Teller; Spin-dipole resonance	(stellar) weak interaction rates; spin excitations; neutron skin
transfer reaction (p,d); (d, ^3He); (p,t); (d,p)	Spectroscopic factors; Single particle (hole) states; Pair transfer	single-particle structure; spin-orbit; pairing interaction
quasi-free scattering (p,2p); (p,np); (p,p $^+$ He)	single-particle spectral function; cluster knockout	single-particle structure; nucleon-nucleon and cluster correlations; in-medium interactions

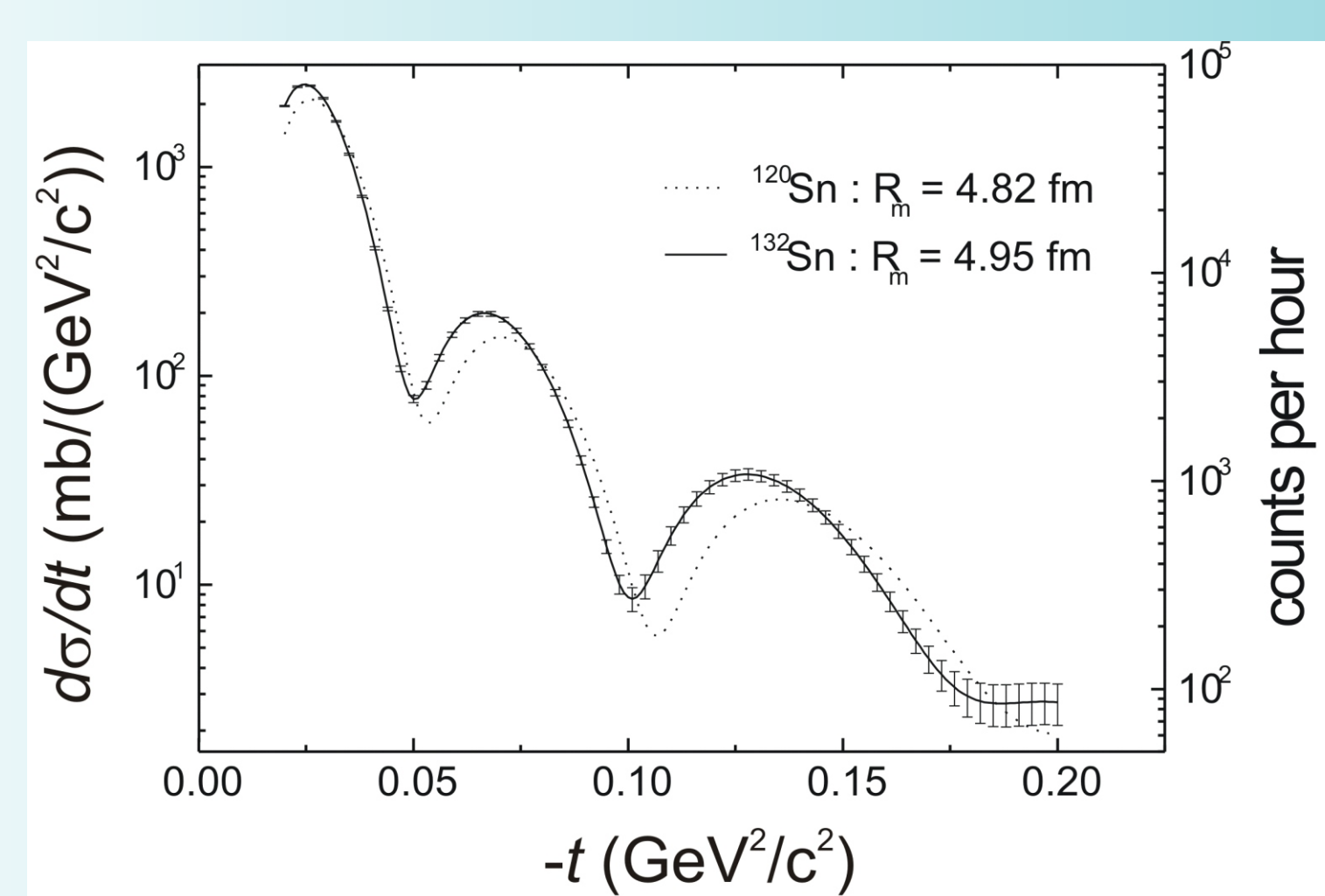
High intensity beams of unstable isotopes will be produced, separated in-flight in the Super-FRS separator [1], and injected into the new storage ring complex of the future international accelerator facility at GSI [2]. Fast cooling of the ion beams in less than a second and accumulation will be achieved by a system of storage rings consisting of a collector ring (CR) with stochastic cooling, a ring for deceleration (RESR), and the new experimental storage ring (NESR) with an electron cooler.



Kinematics: Recoils receive low momentum transfer. A thin target used efficiently in a storage ring allows to investigate those low energy recoils.



Detector for light recoils to measure angle and energy. At higher recoil energies tracking can be used.



Simulated angular distribution of elastically scattered protons for two different RMS radii of ^{132}Sn .

The EXL Collaboration

- Universität Basel, Switzerland
- Birmingham University, United Kingdom
- Daresbury Laboratory, United Kingdom
- Technische Universität Darmstadt, Germany
- Gesellschaft für Schwerionenforschung, Darmstadt, Germany
- Institute of Nuclear Research, Debrecen, Hungary
- Joint Institute of Nuclear Research, Dubna, Russia
- Institut für Kernphysik, Forschungszentrum Jülich, Germany
- University of Liverpool, United Kingdom
- Lund University, Sweden
- Instituto de Estructura de la Materia (CSIC), Madrid, Spain
- Universidad Complutense, Madrid, Spain
- Johannes Gutenberg Universität, Mainz, Germany
- Università da Milano and INFN, Italy
- Russian Research Centre, Kurchatov Institute, Moscow, Russia
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- Riken, Hirosawa, Saitama, Japan
- CEA Saclay, France
- St. Petersburg Nuclear Physics Institute, Gatchina, and St. Petersburg State University, Russia
- University of Surrey, Guildford, United Kingdom
- The Svedberg Laboratory, Uppsala, Sweden
- University of York, Heslington, United Kingdom

spokesperson: M. Chartier, Univ. Liverpool
deputy: J. Jourdan, Univ. Basel

EXL is also a European JRA as a part of EURONS including KVI Groningen