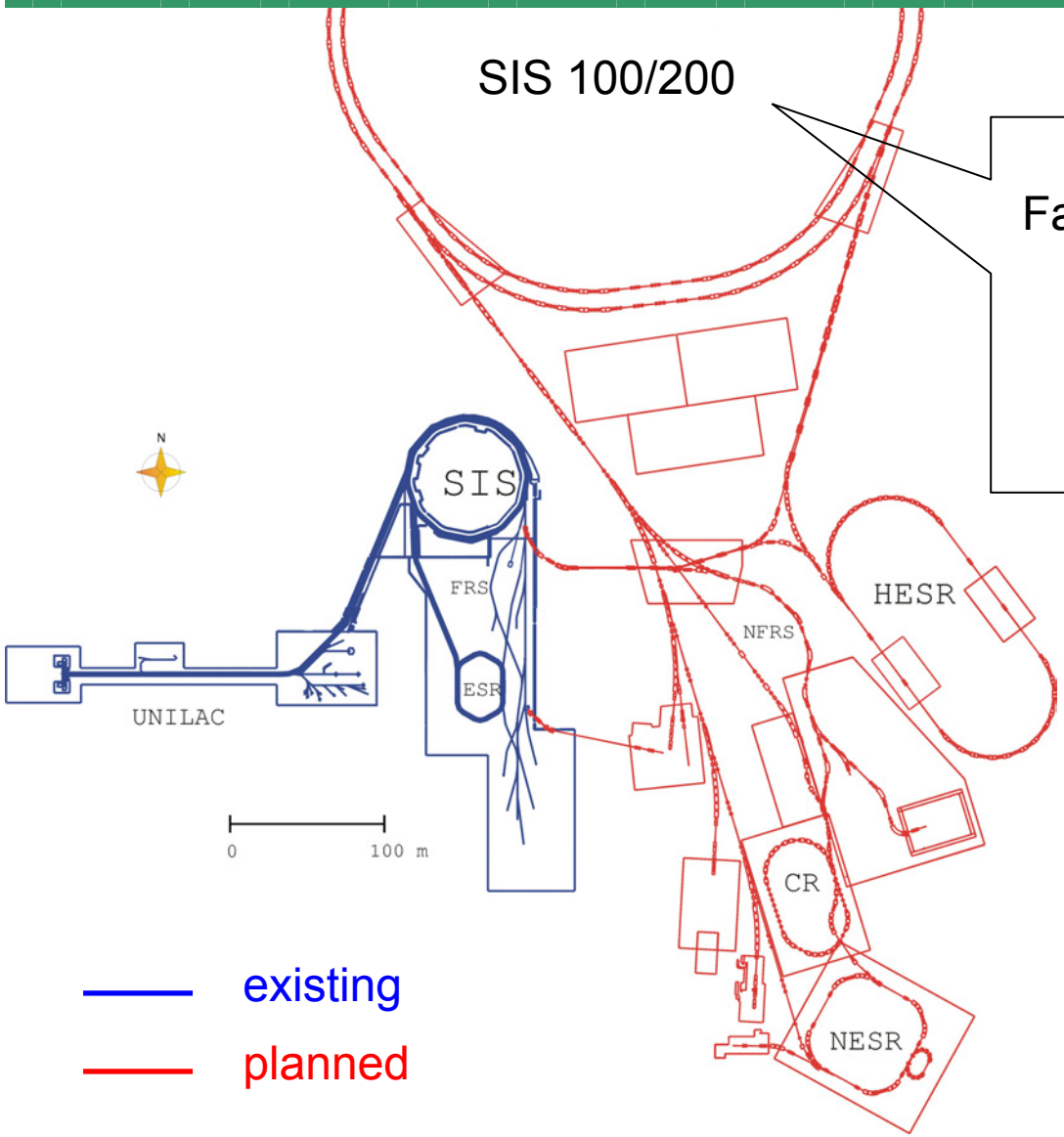
The future GSI radioactive beam facility

- High – energy branch:

Reactions with
relativistic
beams of
exotic nuclei

The New GSI Accelerator Facility for Beams of Ions and Antiprotons



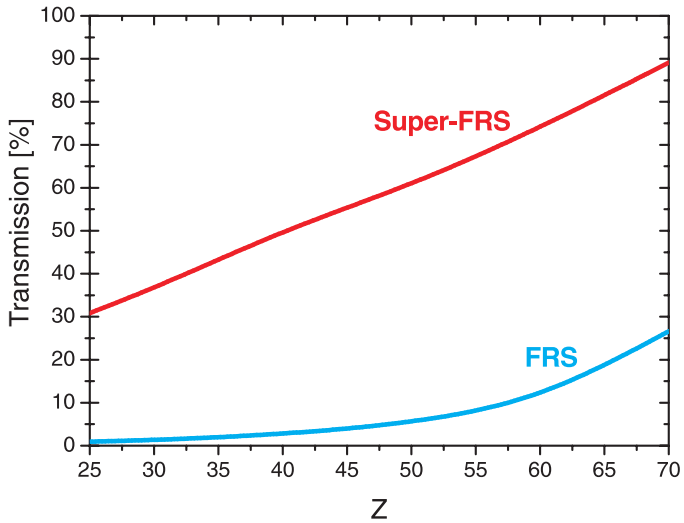
High-Intensity Synchrotron
Fast cycling superconducting magnets
60 GeV protons
23 GeV/u U^{92+}
30 GeV/u Ne^{10+}
1 GeV/u U^{28+}

Four major research areas:

- **Nuclei far from stability**
- Hadron spectroscopy ($\bar{p}$)
- Compressed nuclear matte
- Plasma and Atomic Physic

A New In-Flight Exotic Nuclear Beam Facility

I High intensity primary beams from SIS 200 (e.g. 10^{12} ^{238}U / sec at 1 GeV/u)



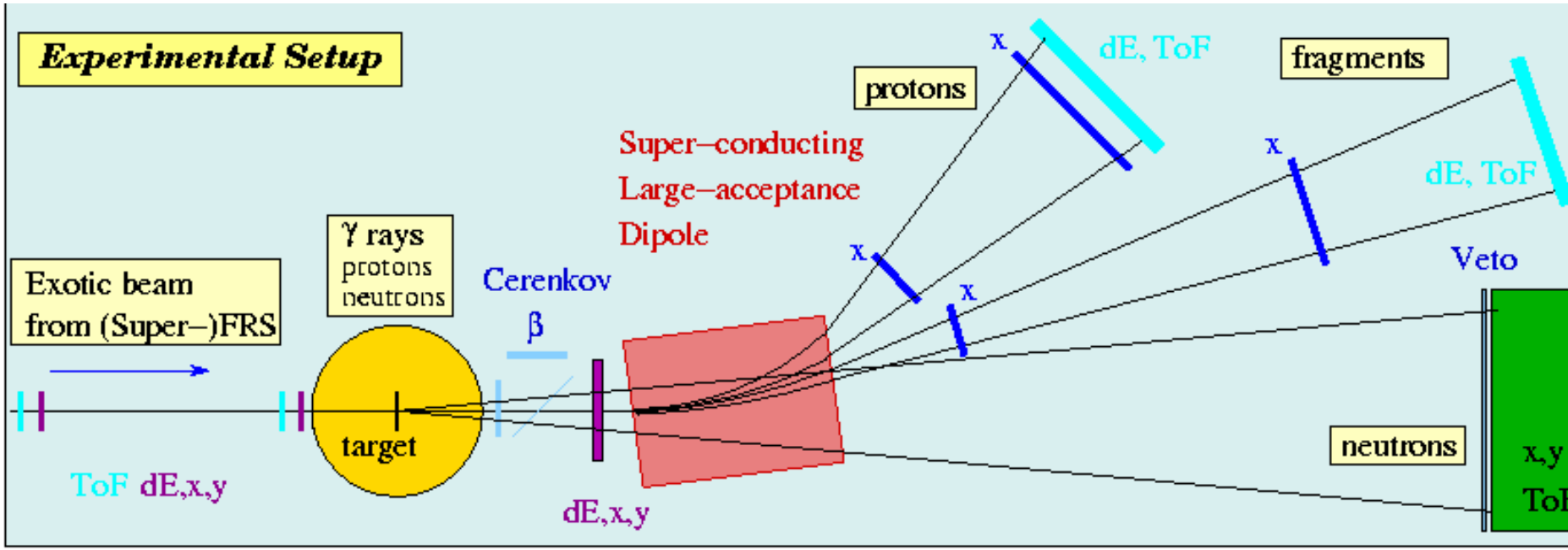
II Superconducting large acceptance Fragmentseparator

Optimized for efficient transport of fission products

III Three experimental area

RHIB: Reactions with High-Intensity Beams of exotic nuclei

Goal: Kinematically complete measurements of reactions with secondary beams



★ Electromagnetic excitations ▸ single-particle structure ▸ astrophysical S-factor
▸ soft modes ▸ giant resonances ▸ B(E2)

★ Knockout / quasi-free scattering ▸ single-particle structure, spectral functions
▸ unbound states, spectroscopy beyond dripline

★ Charge exchange (p,n) ▸ GT strength ▸ spin dipole resonance ▸ neutron skin

★ Other reactions: Fission, Fragmentation, Multifragmentation, Spallation

A large-acceptance spectrometer for RHIB

- Present limitations for kinematically complete reaction measurements due t
  the small field integral of ALADIN (~2 Tm) in beam energy (Bρ<10 Tm) and
  in bending angle (~12° for 10 Tm)

New magnet design with 5 Tm field integral and high-resolution detectors

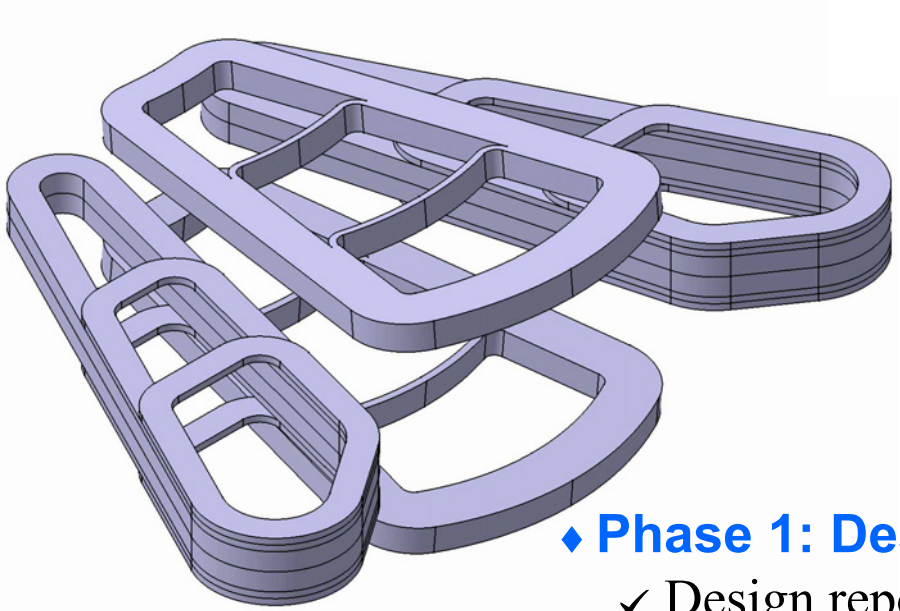
⇒ Higher beam energies

→ higher neutron efficiency (~95% for E_n>400 MeV)
→ precise reaction theory
→ higher excitation energies (higher Fourier components)
→ better beam transport efficiency (up to a factor 5)

⇒ Larger bending angle (e.g. 18° for 15 Tm beam) plus tracking

→ higher momentum resolution
  → fragment mass identification also for heavy nuclei
  → better momentum resolution for knockout reactions
→ bending angles up to 40° possible
  → coincident measurement of fragments and protons)

A large-acceptance spectrometer for RHIB



- ❖ **Superconducting coils**
- ❖ **Active shielding**
- ❖ **High field integral**
- ❖ **Large acceptance**

♦ **Phase 1: Design study (completed)**

✓ Design report available

✓ Positive evaluation by international review committee

✓ Funding: EU (R^3B)

♦ **Phase 2: Model coil (duration ~ 24 months)**

⇒ Test of superconductor

⇒ Test mechanical stress

⇒ Test of quench-protection system

Design: CEA Saclay

♦ **Phase 3: Construction of full-size magnet (duration ~ 36 months)**

Reactions with High-Intensity Beams of exotic nuclei
RHIB Joint research project within I3NS (6th EU framework program)

Detector development for reaction experiments including the development of electronics and readout

i) High-resolution tracking detectors for heavy ions and/or protons (TU München, GSI)

ii) Large-area and high-resolution detectors for light charged particles (CEA Saclay, Krakow, TU München)

iii) Compact proton recoil tracking system (GSI, TU Darmstadt, U Mainz)

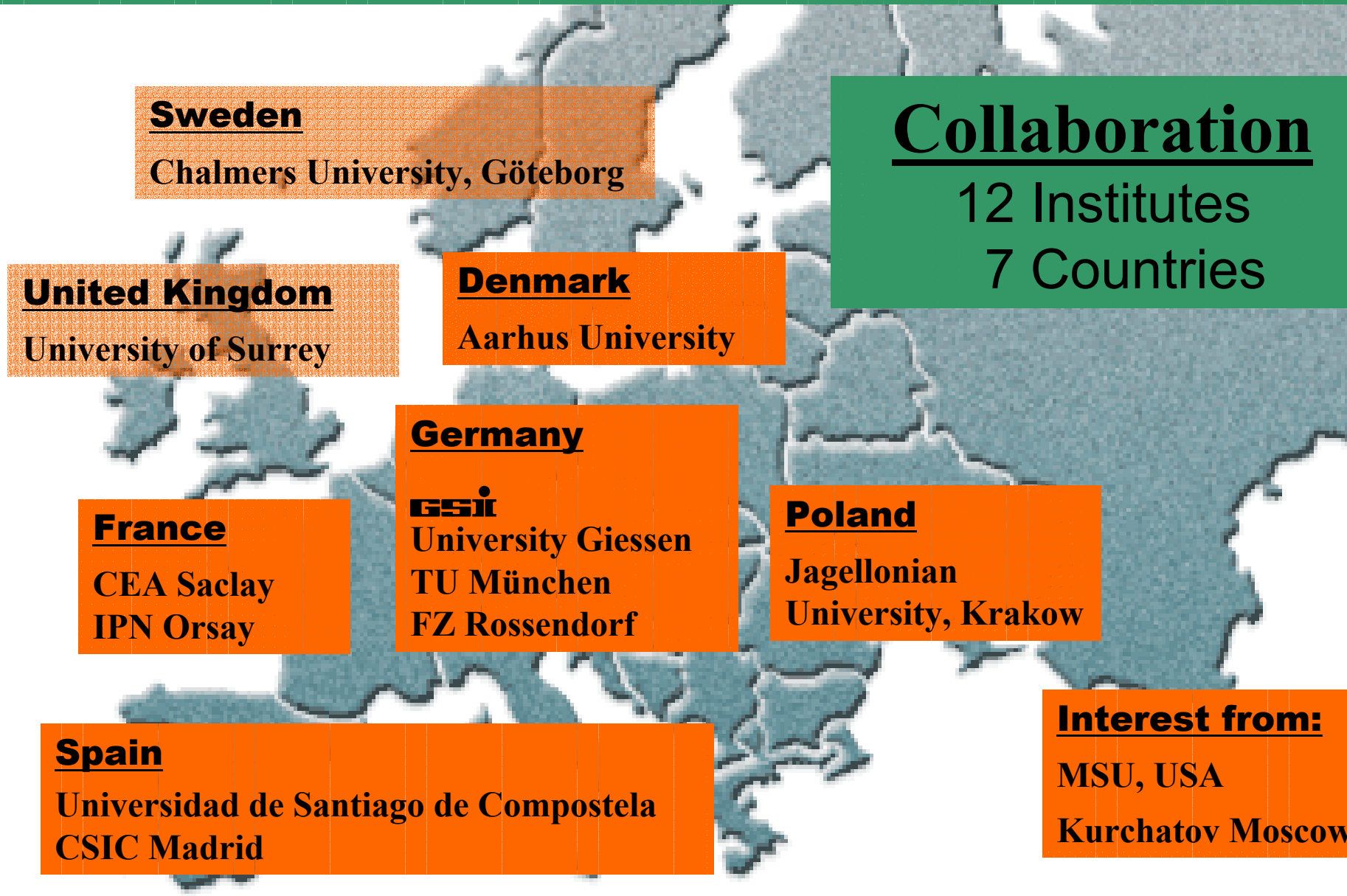
iv) Fast-timing ToF wall and neutron detector (Santiago de Compostela, GSI)

v) Position-sensitive high-resolution ToF detector (FZ Rossendorf)

vi) Frontend electronics (TU München, Krakow)

RHIB

Reactions with High-Intensity Beams of exotic nuclei



Sweden

Chalmers University, Göteborg

United Kingdom

University of Surrey

Denmark

Aarhus University

Germany

GSI

University Giessen

TU München

FZ Rossendorf

France

CEA Saclay

IPN Orsay

Poland

Jagellonian University, Krakow

Spain

Universidad de Santiago de Compostela

CSIC Madrid

Collaboration

12 Institutes

7 Countries

Interest from:

MSU, USA

Kurchatov Moscow