Closing remarks

Key qestions:

Location of SHE shell and SHE nuclear structure

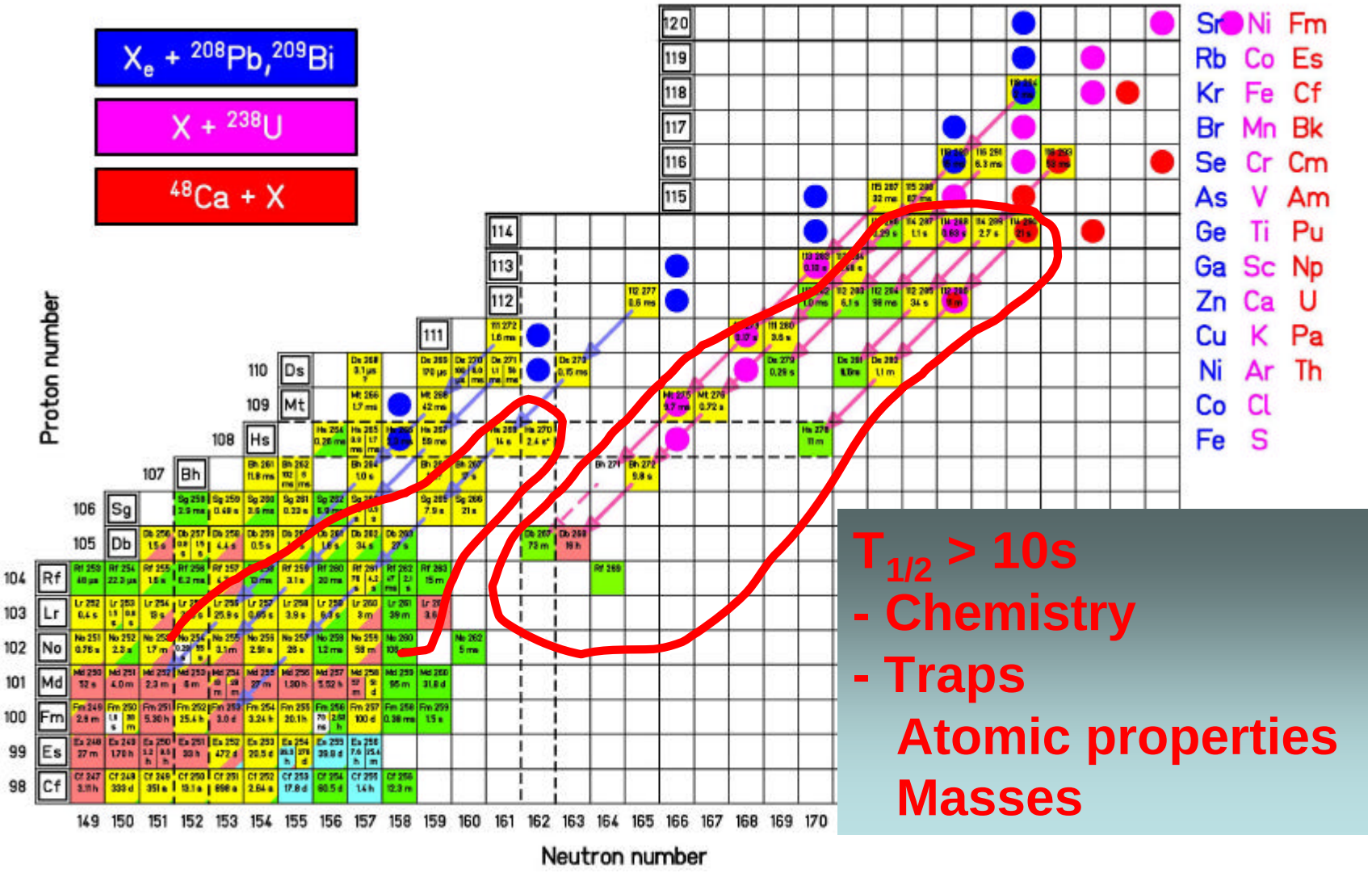
Atomic properties and relativistic effects

Breakdown of Mendelejev systematic

New approaches

Long halflives of transactinides

➔ application of new experimental methods


X_e + ^{208}Pb,^{209}Bi
X + ^{238}U
^{48}Ca + X
Proton number
Neutron number
Sr Ni Fm
Rb Co Es
Kr Fe Cf
Br Mn Bk
Se Cr Cm
As V Am
Ge Ti Pu
Ga Sc Np
Zn Ca U
Cu K Pa
Ni Ar Th
Co Cl
Fe S
$T_{1/2}$ > 10s
- Chemistry
- Traps
Atomic properties
Masses

Predictions for element 112

Relativistic

K.S. Pitzer,
J. Chem. Phys.
63, 1032 (1975)

V. Pershina et al.,
Chem. Phys. Lett.,
365, 176 (2002)

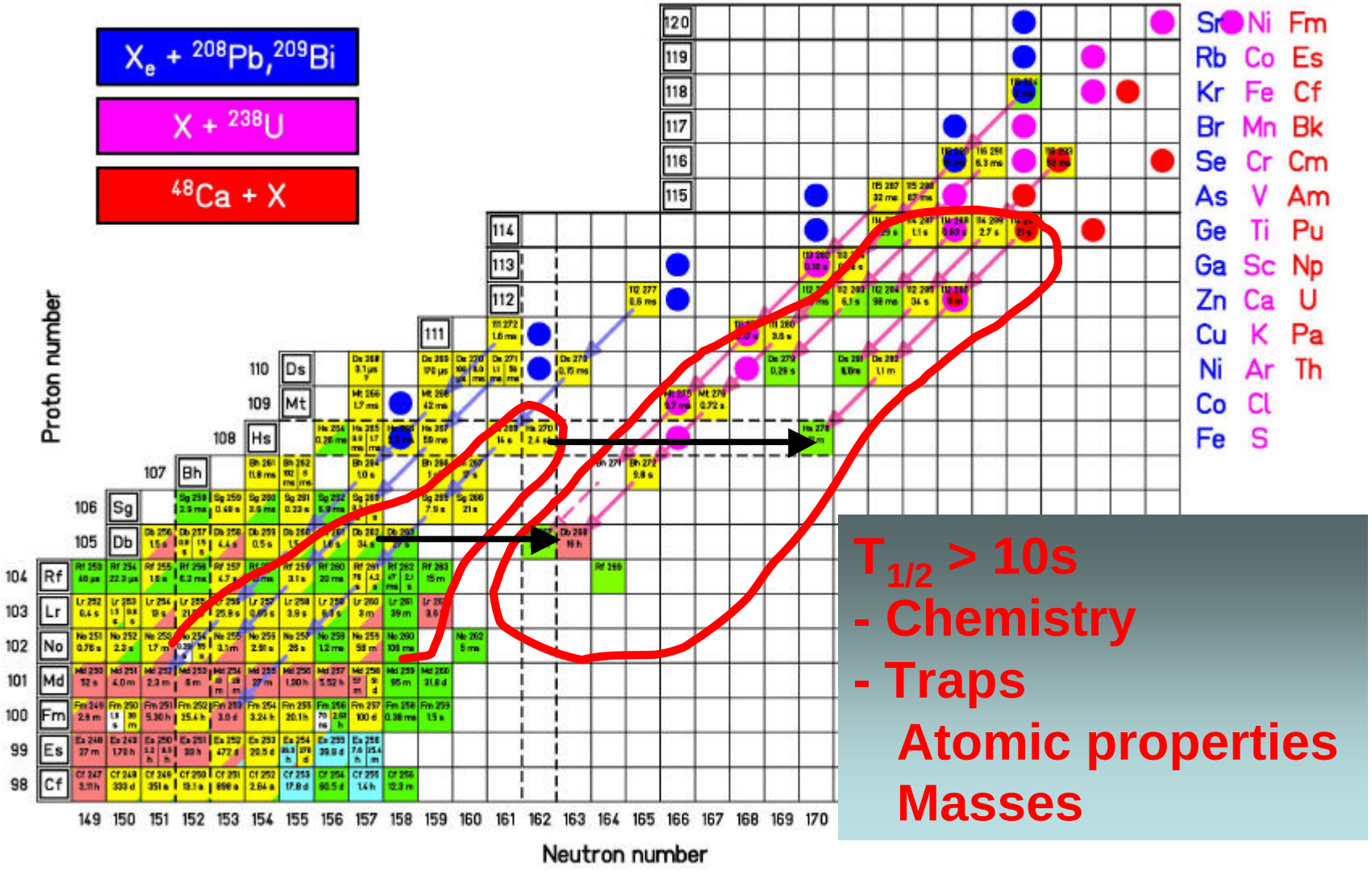
Extrapolations

B. Eichler,
Kernenergie 10, 307 (1976)

B. Eichler,
PSI Report 03-01, Villigen (2000)

Noble gas like

Volatile metal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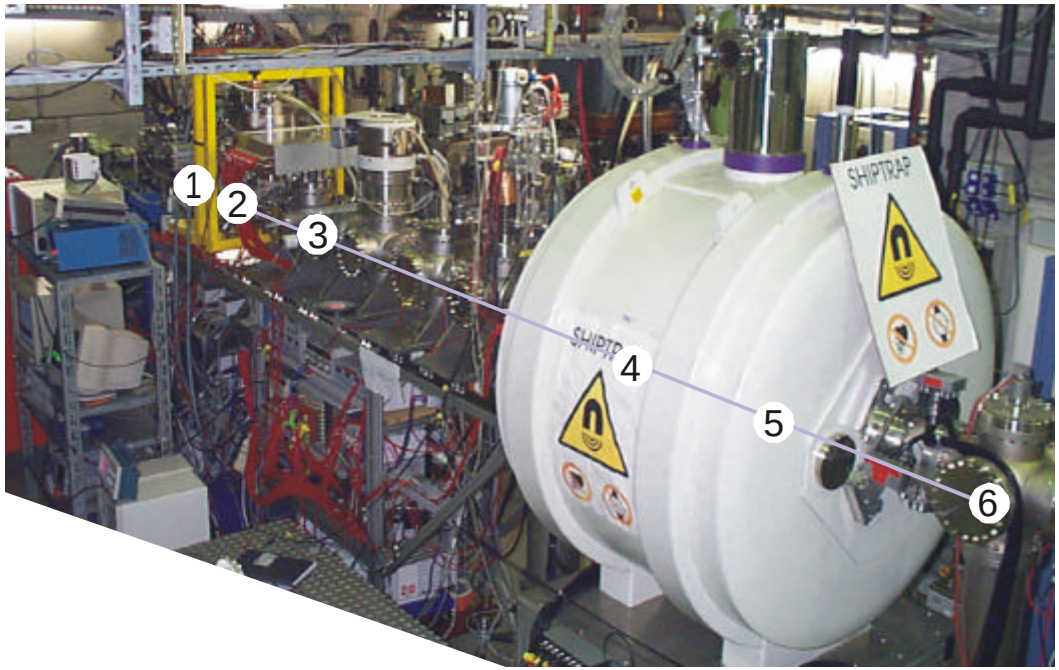
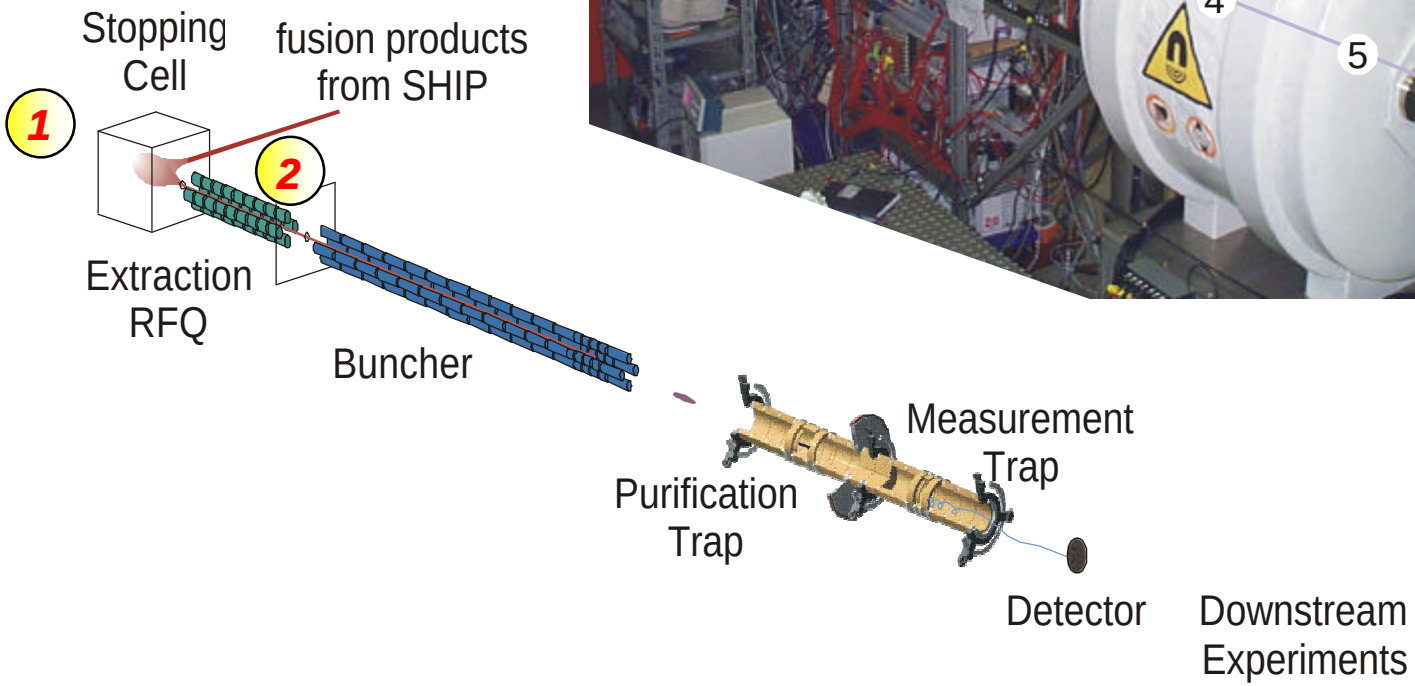
Masses

SHIPTRAP

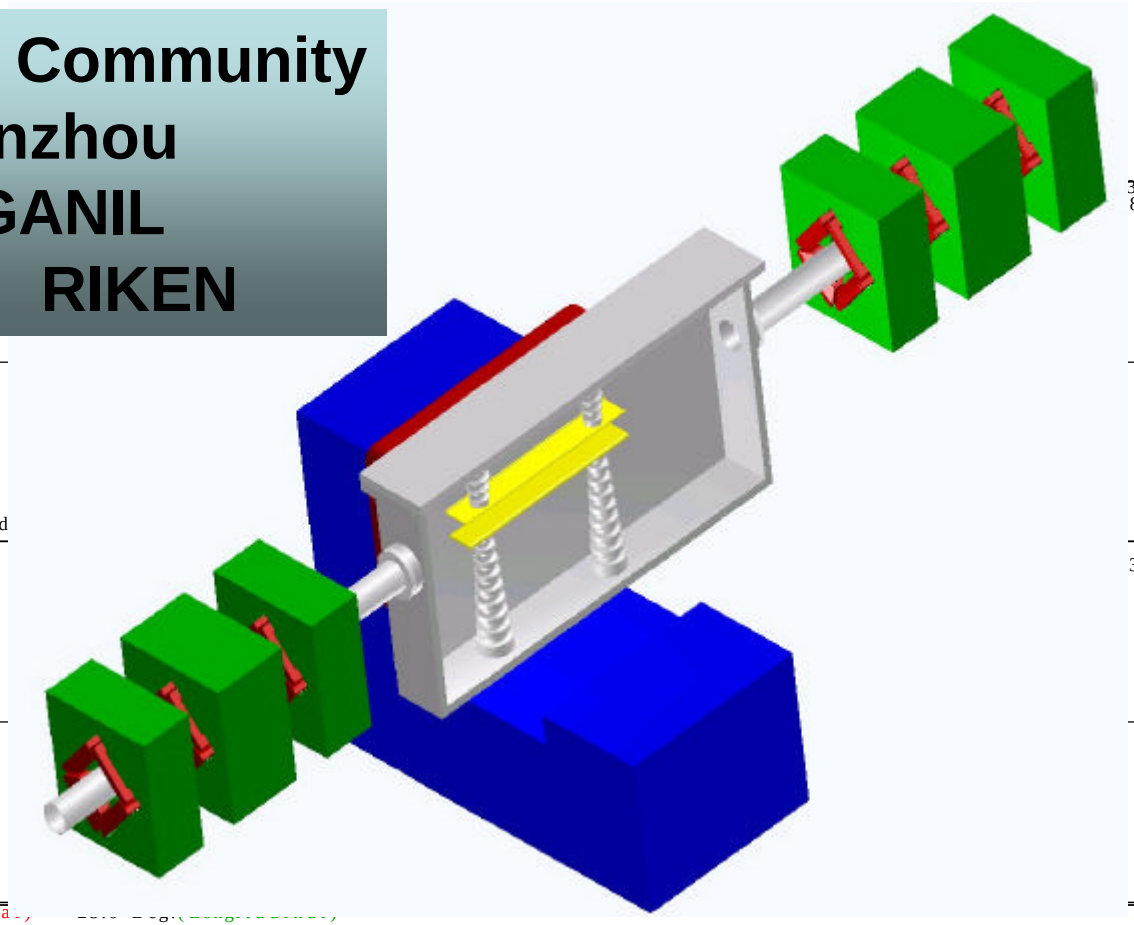
Determination of Mass Number (A)
Mass Measurements
Ionisation potentials (Z)
Single-atom chemistry





Wien Filter at RIBLL

Growing Community
Lanzhou
GANIL
RIKEN

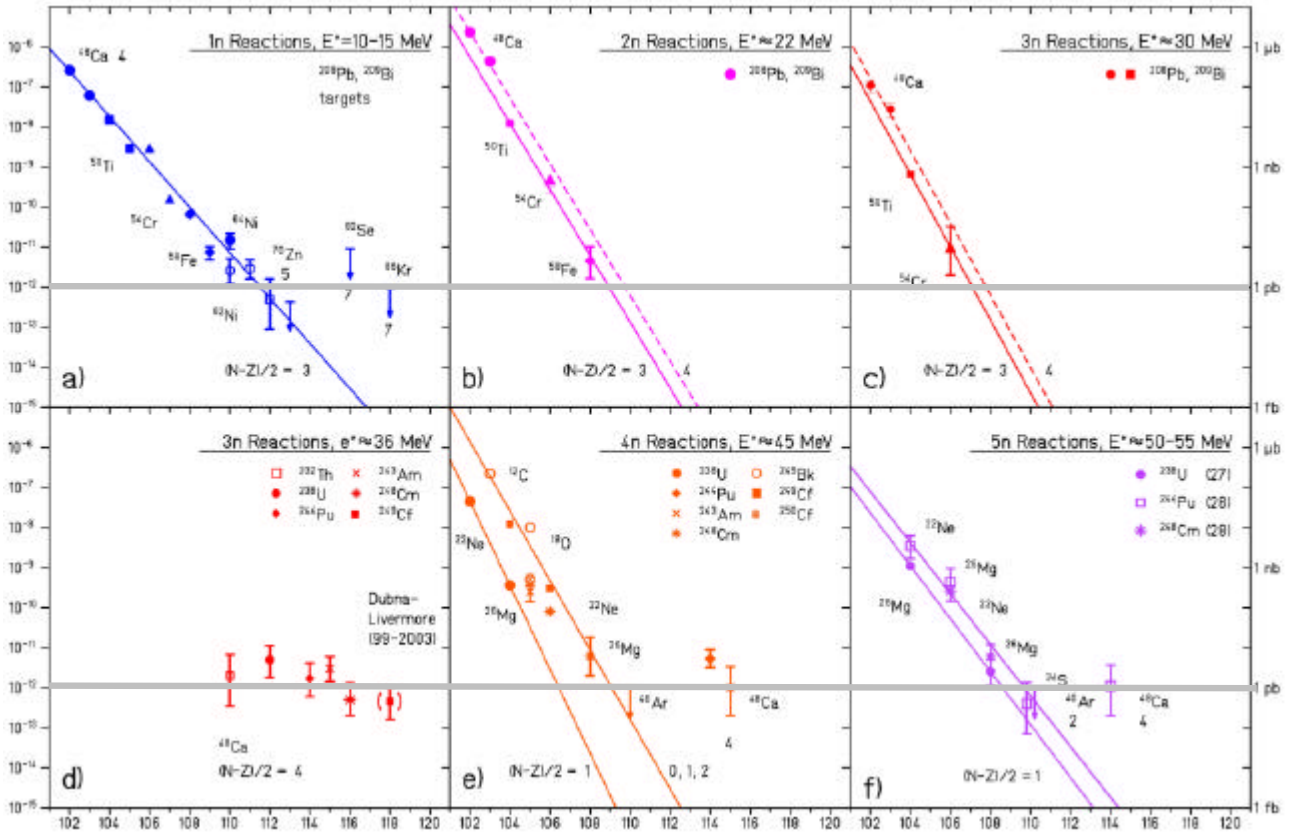


Compilation of cross-sections

- **Cold fusion (GSI)**
- based on Pb and Bi targets

Hot fusion (JINR)

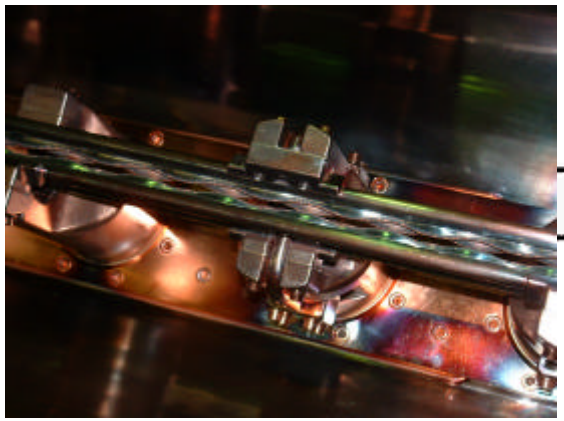
based on actinide targets



Surprising high cross-sections (0.5 – 5 pb) for synthesis of spherical SHE

1pb: currently 1 atom/ 10 days

Upgrade of High Charge State Injector
28 GhZ ion source, new RFQ



50% duty cycle big improvement ,

but: => e. g. **bad use of rare isotopes**

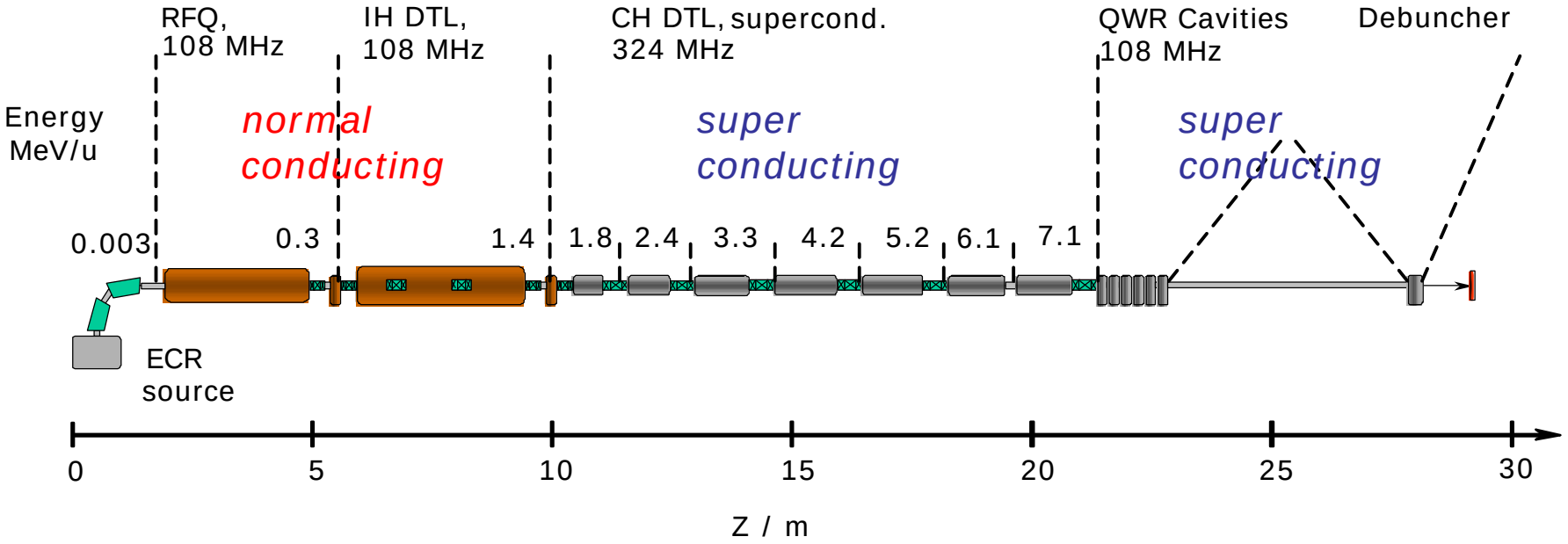
Project for a superconducting CW-linac

U.Ratzinger et al., University of Frankfurt

- **dc beam**
- $1 < A/q < 7$
- E_{beam}: 4-7.5 MeV/u
- $DE_{beam} < \pm 3$keV/u

Intensity gain:

• Duty cycle 30% ® 100%	3.5
• 28 (40)GHz ECR-source	2-10(?)
• increased stability (65% ® 85)%	1.3
• shorter shutdowns (107 d/y ® 47 d/y)	1.2
Total gain	11-55(?)



B) Open Problems - Theory

- (1) Further exploration of collective potential energy surface - systematics
- (2) Collective mass surface - systematics
- (3) Determination of " best forces" within meson field theory
- (4) Fusion-fission-dynamics - Theory
- (5) Stability - Lifetimes - ... of higher islands of stability
- (6) Theoretical study of other important degrees of freedom; e.g. neck dynamics, collective mass transfer

Support for theory mandatory, otherwise we will not understand what we are doing

Consumption
of ^{48}?? (68%) - 0.5 mg/ [0.25mg/h]

beam
intensity - $5 \cdot 10^{12}$/s [$5 \cdot 10^{13}$/s]

beam time - 2000 h/y [6000h/y]

Isotopes:

U[238], Np[237], Pu[244], Cm[247] + ^{48}Ca[...^{64}Ni] → Z = 114 - 122

technology of the
target preparation - 0.3 mg/cm^2 [1.0 mg/cm^2]

isotope enrichment - 98-99% [99.9%]

Separation of super heavy nuclei and
detection of their radioactive decay

now: SHIP, DGFRS, SAASY, GARIS,....

new facilities.....

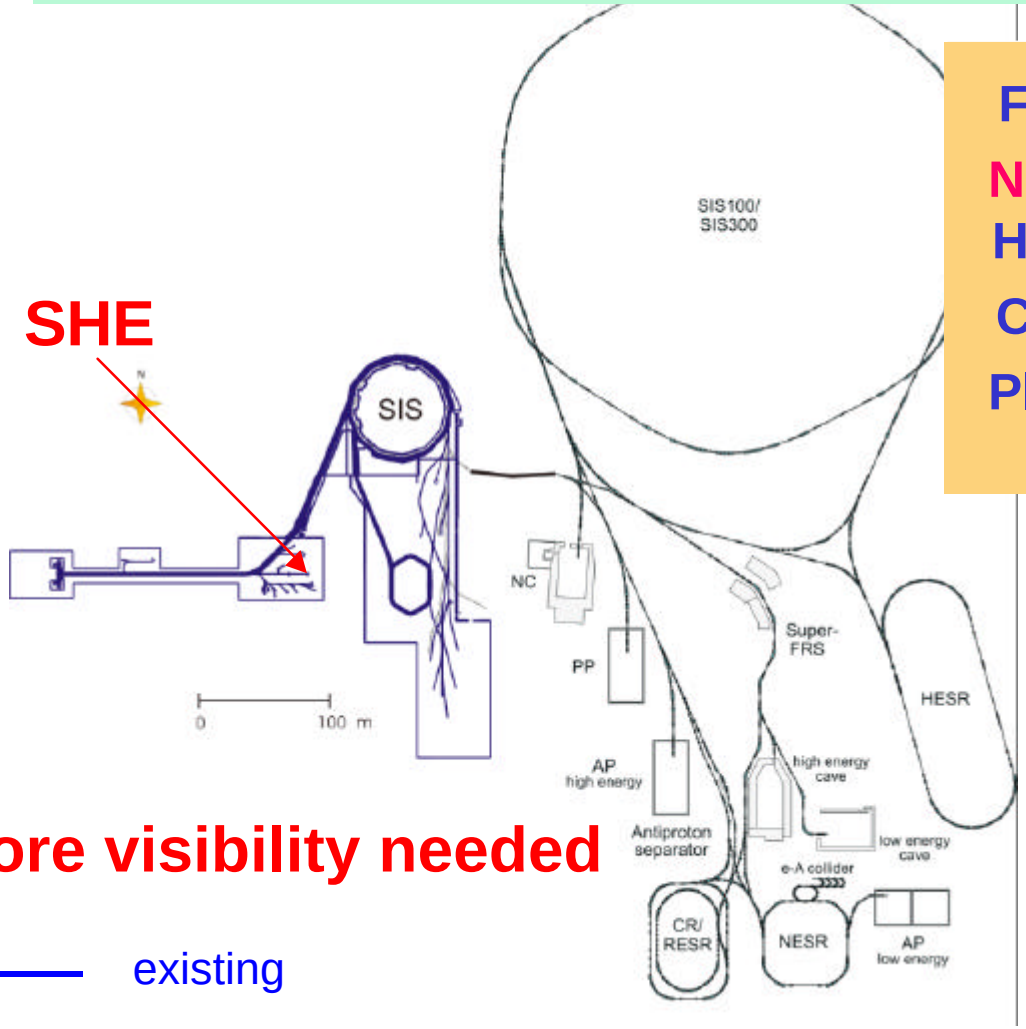
such as MASHA but more fast!

+ neutron and γ-arrays: DEMON, EUROBALL,
AGATA,....

RI beams ???

Atomic properties:
fast chemistry and traps

The New GSI Accelerator Facility for Beams of Ions and Antiprotons



Four major research areas:

Nuclei far from stability

Hadron spectroscopy ($\bar{p}$)

Compressed nuclear matter

Plasma and Atomic Physics

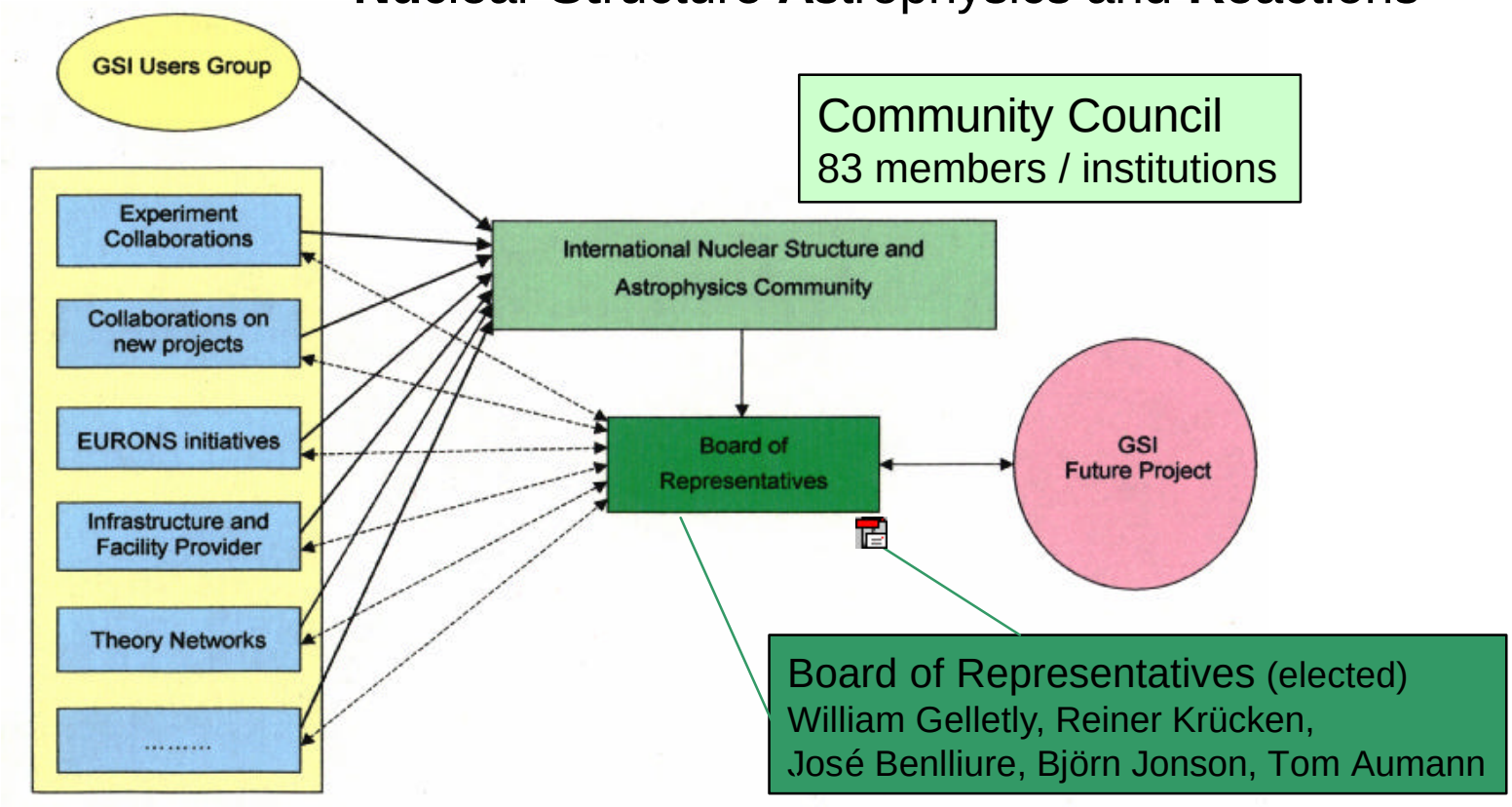
More visibility needed

existing

planned

NUSTAR

Nuclear **St**ructure **A**strophysics and **R**eactions



- Super-FRS
- Low Energy Branch
- High Energy Branch
- Ring Branch

SHE ?