Study of the di-nuclear system

^{A}Rb + ^{209}Bi ($Z_1 + Z_2 = 120$)

Proposal for a HIE-ISOLDE experiment

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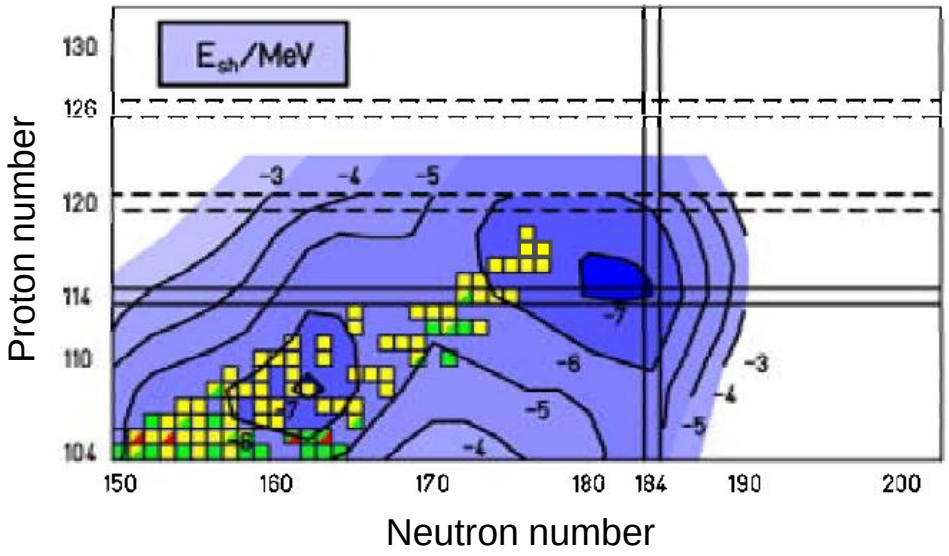
Where are the Next Magic Shells above ^{208}Pb?

Calculations: A. Sobiczewski



Z = 114, 120 or 126

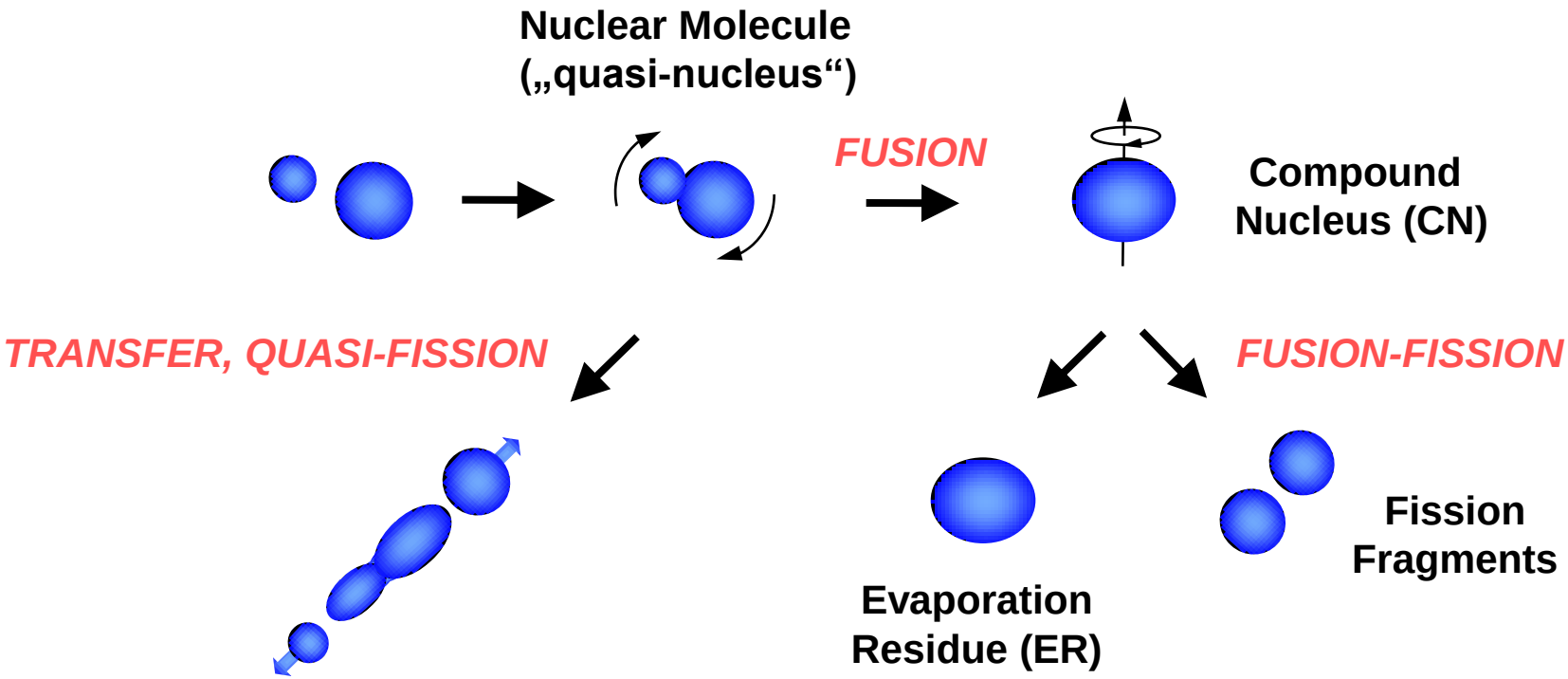
N = ~~172~~, 184 ? ?

Shell closures are indicated by an increase of fission barriers and half-lives

- **Nuclei with N ≈ 184 are not reachable with stable beams**
- **Nuclei with Z > 118 are still unknown**
- **The expected residue cross-sections are very low (σ << 0.1 pb)**

But: Influence of shell closures is also expected in *quasi-nuclei*

Nuclear Reactions in Heavy Systems



Fusion residue cross-section:

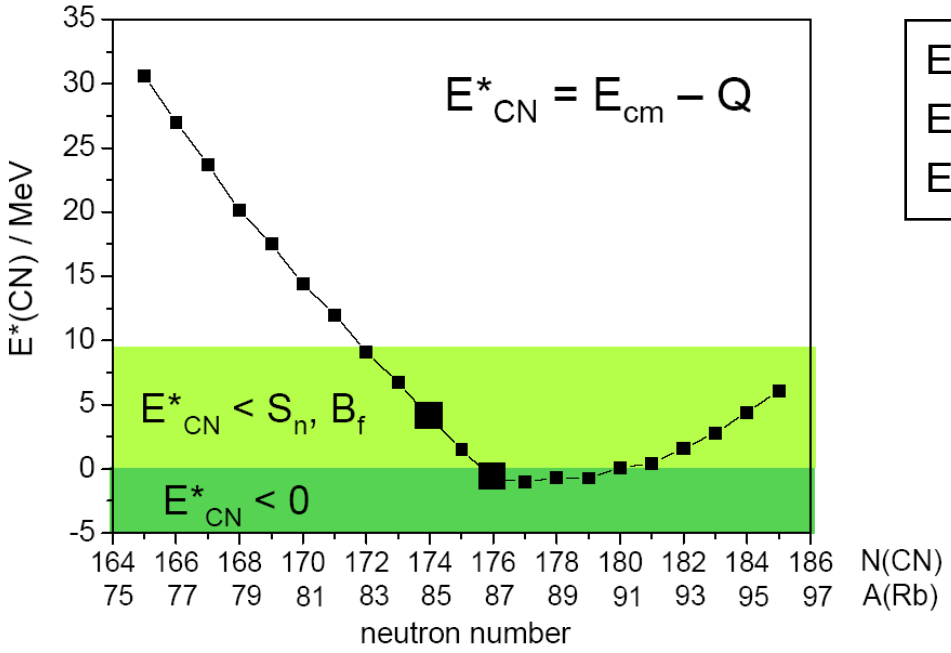
$$\sigma_{ER} = \sigma_{capture} \times P_{CN} \times P_{survival}$$

The system ^{A}Rb + ^{209}Bi

$^{95}Rb + {}^{209}Bi \rightarrow Z_1 + Z_2 = 120,\ N_1 + N_2 = 184$

→ is the only accessible system to reach N = 184

→ is the only accessible system which provides CN excitation energies < 5 MeV



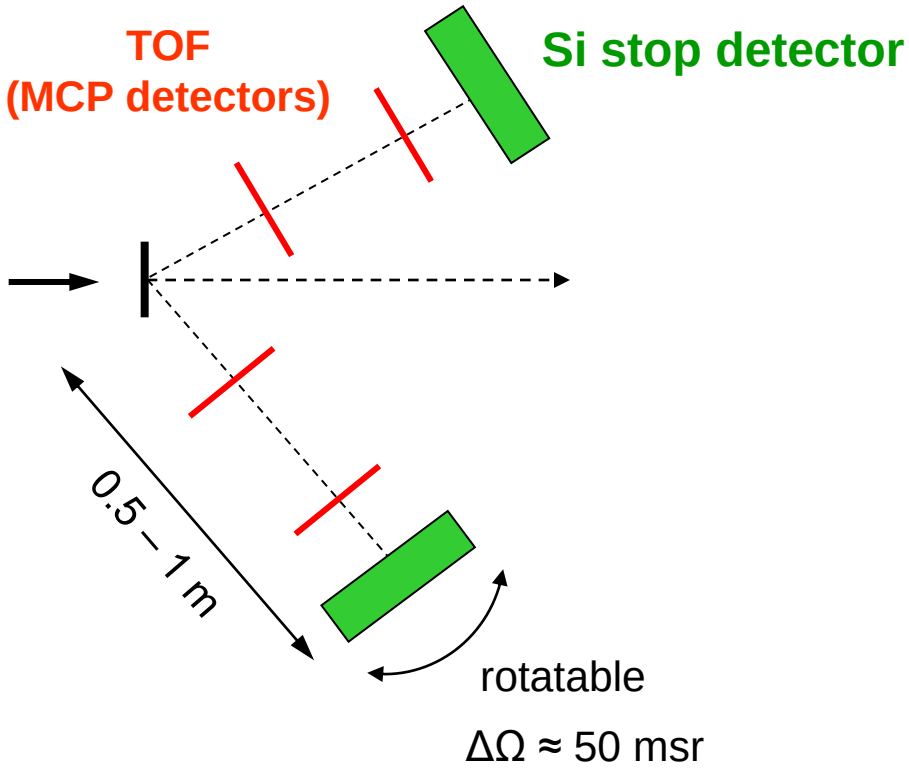
$E^*_{CN} < S_n \approx 10$ MeV → no neutron evaporation

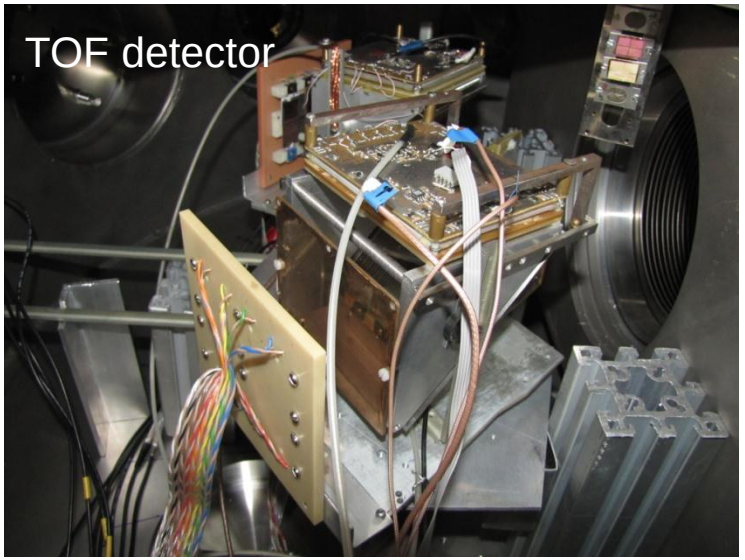
$E^*_{CN} < B_f \approx 5$ MeV → no CN fission?

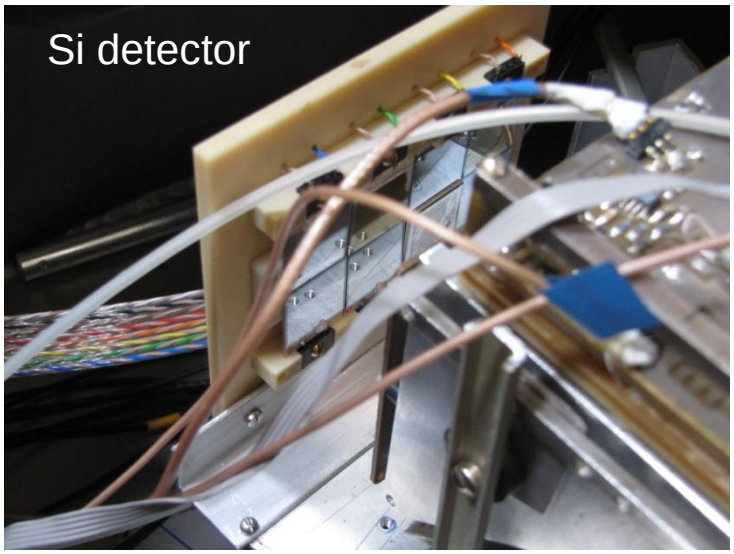
$E^*_{CN} < 0$ → no CN formation?

→ low excitation energies are equally expected in the nuclear molecule Rb + Bi

The CORSET Spectrometer



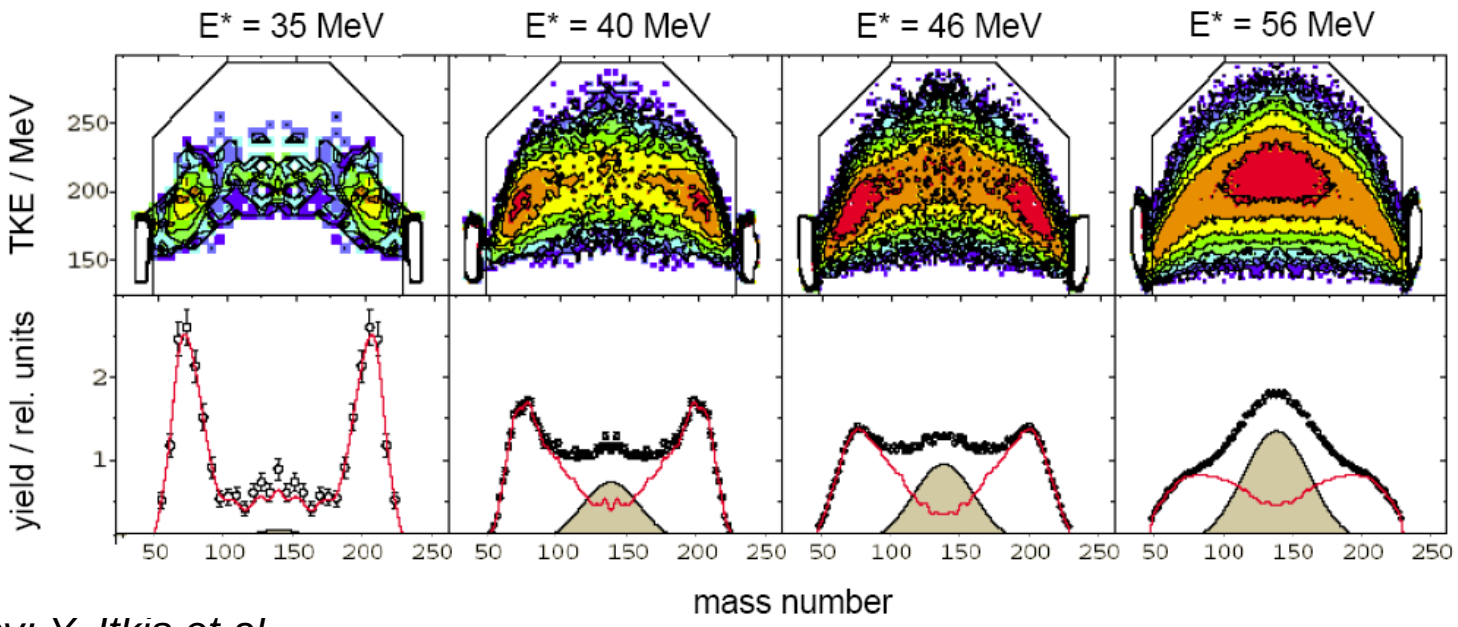




- observables: TOF, E → A, TKE
- mass resolution: ΔA / A = 1.5 %

Example for CORSET Spectra

$^{36}S + ^{238}U \rightarrow ^{274}Hs\ (Z = 108)$



courtesy: Y. Itkis et al.

Asymmetric component → transfer, quasi-fission

Symmetric component → fusion-fission

Proposed Experiment and Beamtime Request

Study of quasi-fission and fusion-fission with ^{94,95}Rb projectiles:

a) Study of the capture cross-section at three beam energies; for comparison with stable Rb (here: $\sigma_{capture} \approx \sigma_{QF}$ because $P_{CN} << 1$)

b) Study of the contribution of fusion-fission reactions

Beamtime request:

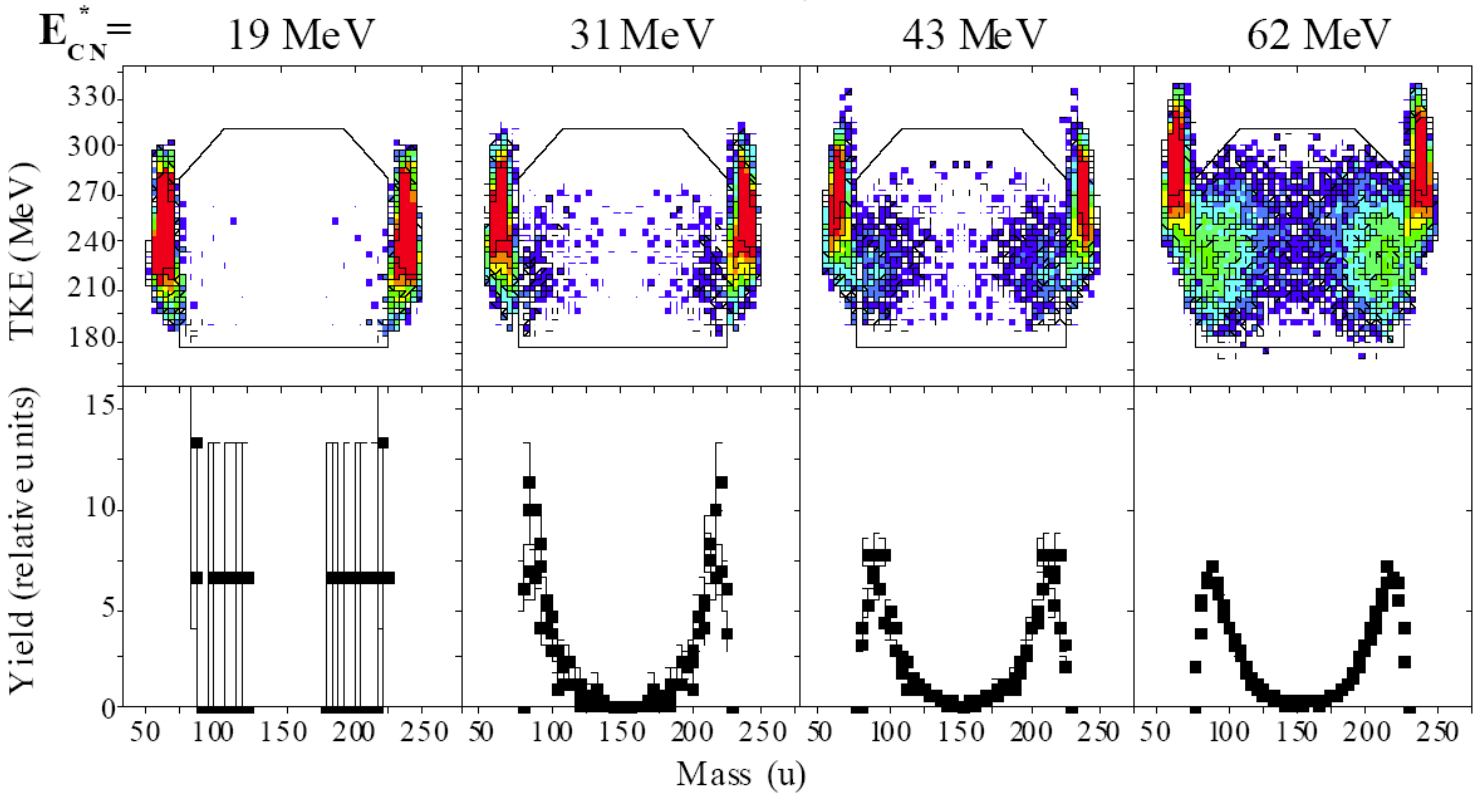
Target: 500 µg/cm^2, ^{209}Bi

Projectile	^{94}Rb (or ^{85,87}Rb)	^{95}Rb (~2×10^6 pps)
beam energy	≈ 5 MeV/u	(4.0 – 5.5) MeV/u
experiment	Tuning of the setup	Excitation functions for capture and FF (Бcap = 10 – 100) mb)
shifts	6	3 x 12
Expected events		(1000 – 10000) / d

Summary of requested shifts: 42

CORSET Spectra

$^{64}Ni + ^{238}U \rightarrow ^{302}120^{*}$



Decay Chains of Z = 108 Isotopes