The MINIBALL Experiment at ISOLDE

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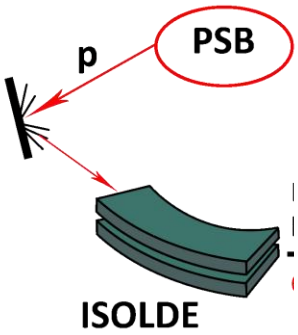
The ISOLDE facility

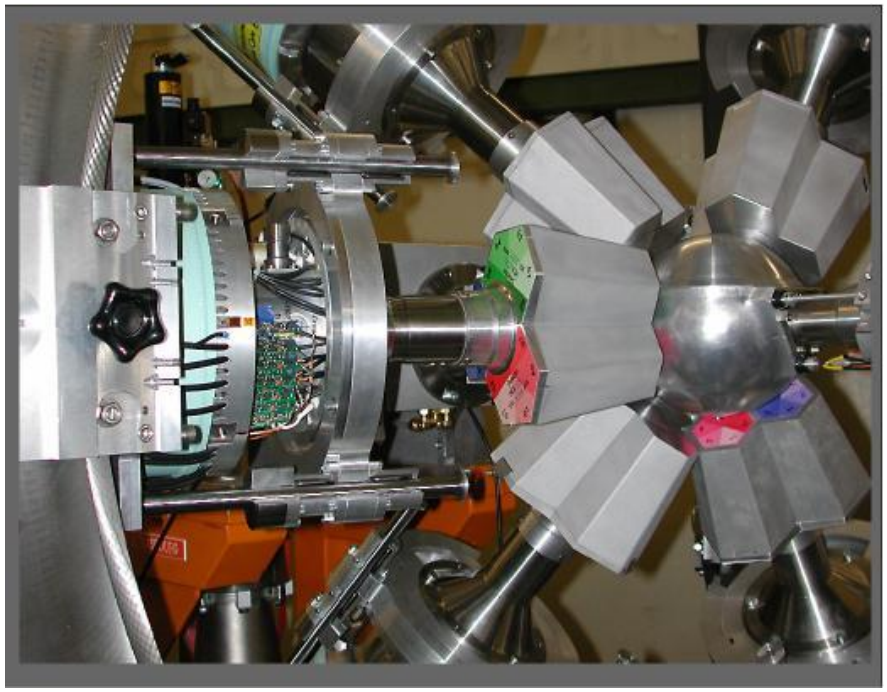
Factory for production of Radioactive Ion Beams (RIBs)



MINIBALL

REX-ISOLDE

MINIBALL

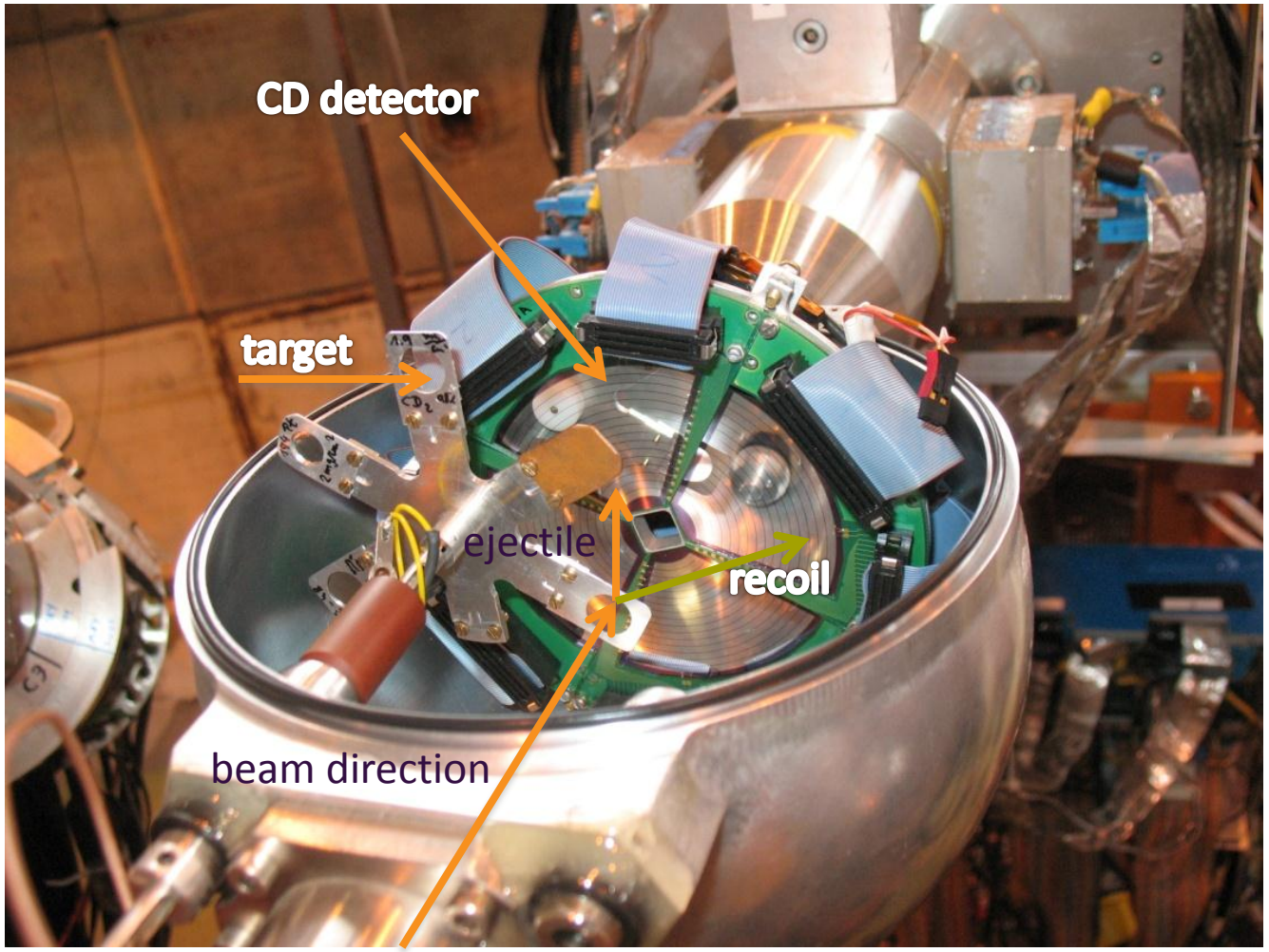


CoulEx and transfer reactions:

small cross-sections, β ~ 10%

- High efficiency:
  - ε ~ 7% @ 1.3 MeV
  - ~ 65% of 4π
- High granularity:
  - HPGe - 144 segments
  - CD – 1536 pixels
- Compact and versatile detector system

MINIBALL



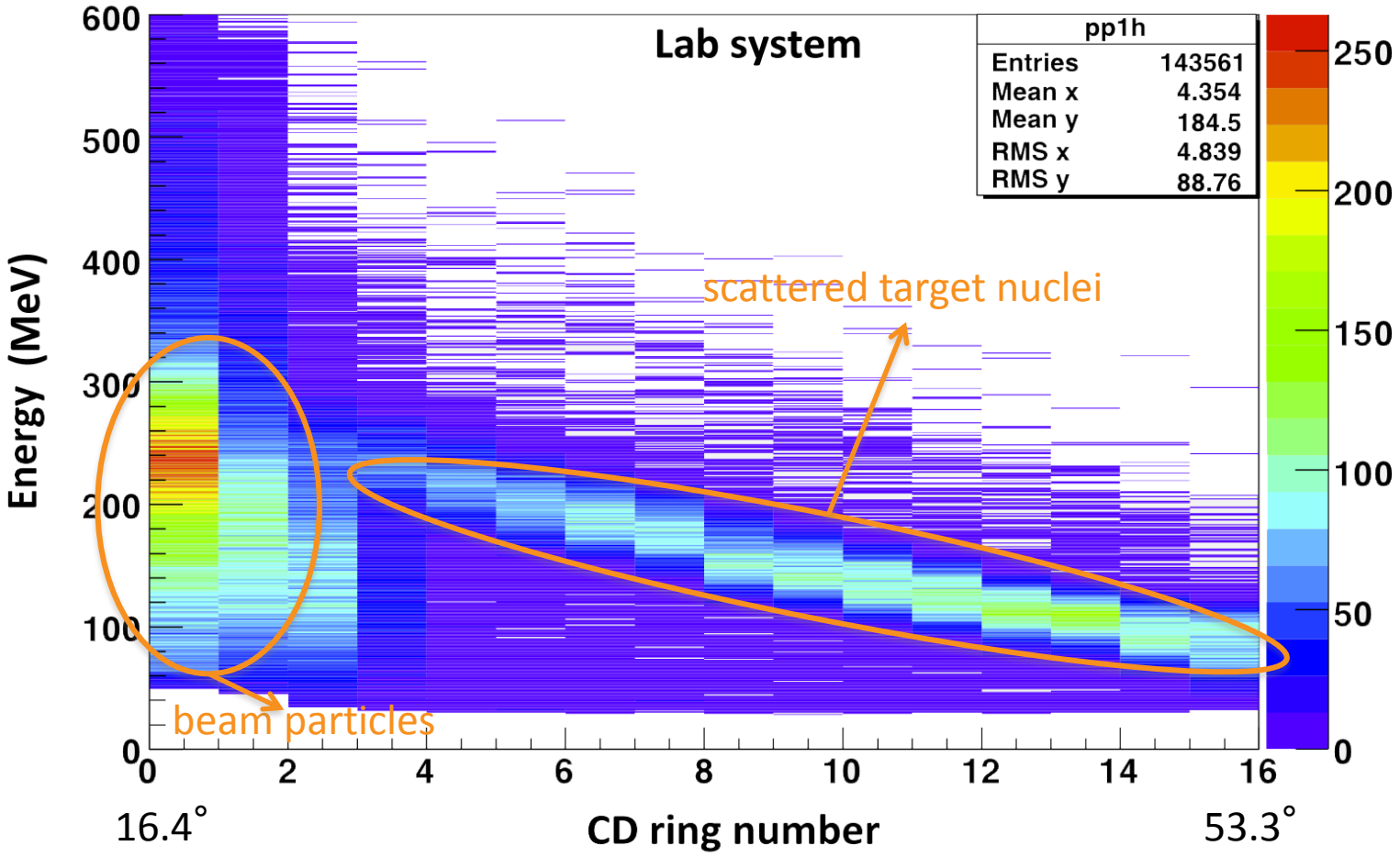
Coulomb Excitation

- nuclear excitation resulting from electromagnetic interaction between two nuclei
- at MINIBALL – CoulEx of RIBs
- experimental observable – excitation cross-section
- final goal – transition matrix elements
- how?

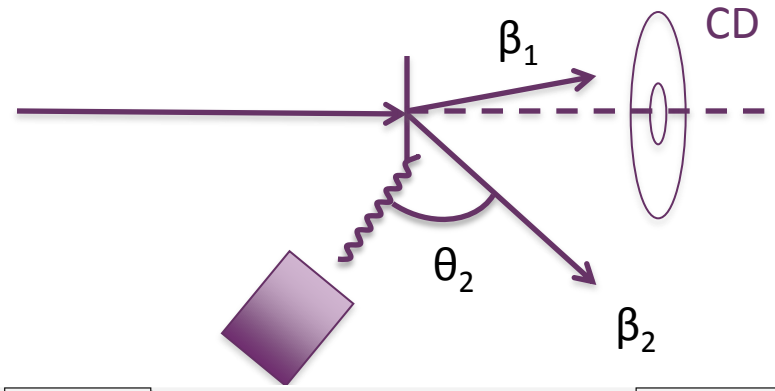
$$\sigma \propto \mathrm{B}(\pi\lambda; |i\rangle \rightarrow |f\rangle)$$

CoulEx kinematics

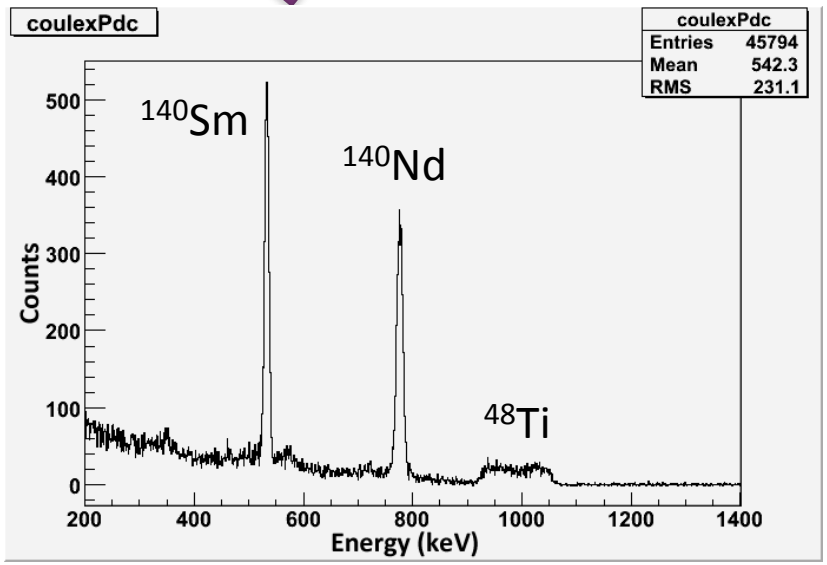
^{140}Nd @ 2.85 MeV/u -> 1.4 mg/cm^2 ^{48}Ti



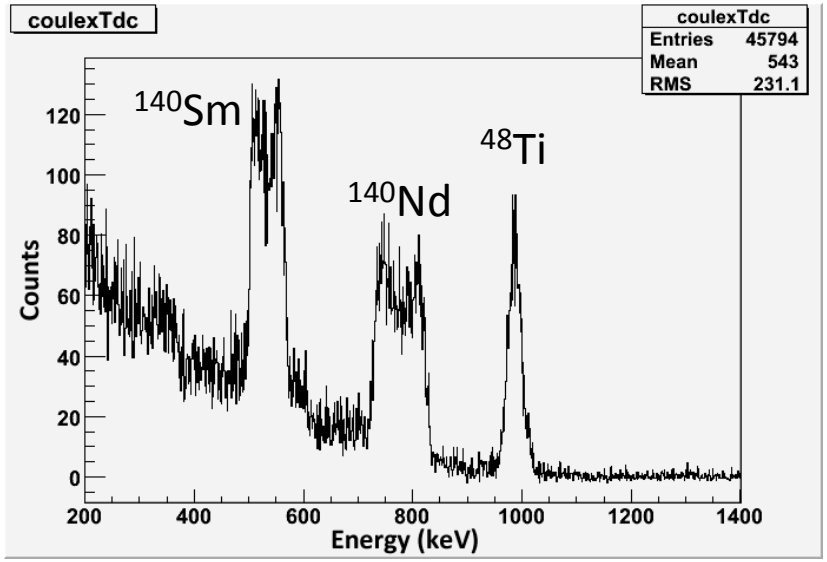
Doppler correction



$$E_\gamma = E_{\gamma_{lab}} \frac{[1 - \beta cos(\theta)]}{\sqrt{1 - \beta^2}}$$



Doppler correction for beam particles



Doppler correction for target recoils

Further steps of the analysis

$$\sigma^{p}_{CE} = \sigma^{t}_{CE} \times \frac{\epsilon^{t}_{\gamma}}{\epsilon^{p}_{\gamma}} \frac{b^{t}_{\gamma}}{b^{p}_{\gamma}} \frac{W^{t}_{\gamma}}{W^{p}_{\gamma}} \frac{N^{p}_{\gamma}}{N^{t}_{\gamma}}$$

Known from previous experiments

Measure in the current experiment

However, it is a bit more complicated…

- *exact position of HPGe crystals*
- *precise efficiency calibration*
- *beam composition*
- *….*

Conclusions:

- The coulomb excitation is a powerful technique for nuclear structure studies
- The MINIBALL array combined with the REX-ISOLDE post-accelerator allow this technique to be applied on radioactive ion beams

Thank you for your attention!

Special thanks to:

Dr. Janne Pakarinen and Christopher Bauer

ISOLDE group

Summer student team