

Motivations to receive a 2 GeV proton beam at ISOLDE / HIE-ISOLDE:

Impact on radioisotope beam availability and physics program

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Motivation for PSB energy upgrade for ISOLDE

Facility Figures of Merit:

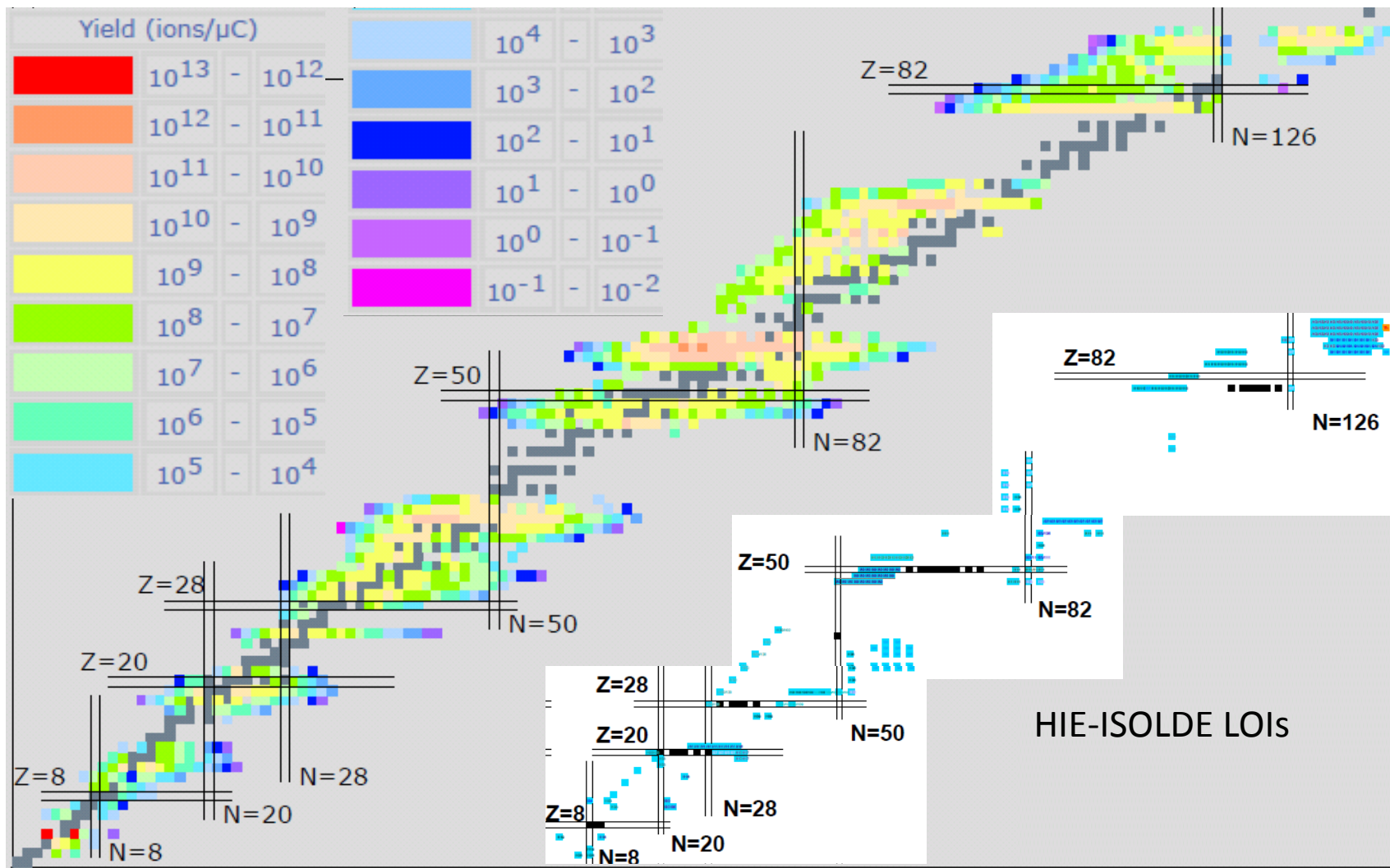
- Beam intensity
- Beam quality:
 - Purity
 - Emittance
- Yearly availability of the facility
- For ISOL-type facility => diversity of available beams

Aim of proposal

Proton energy increase for ISOLDE:

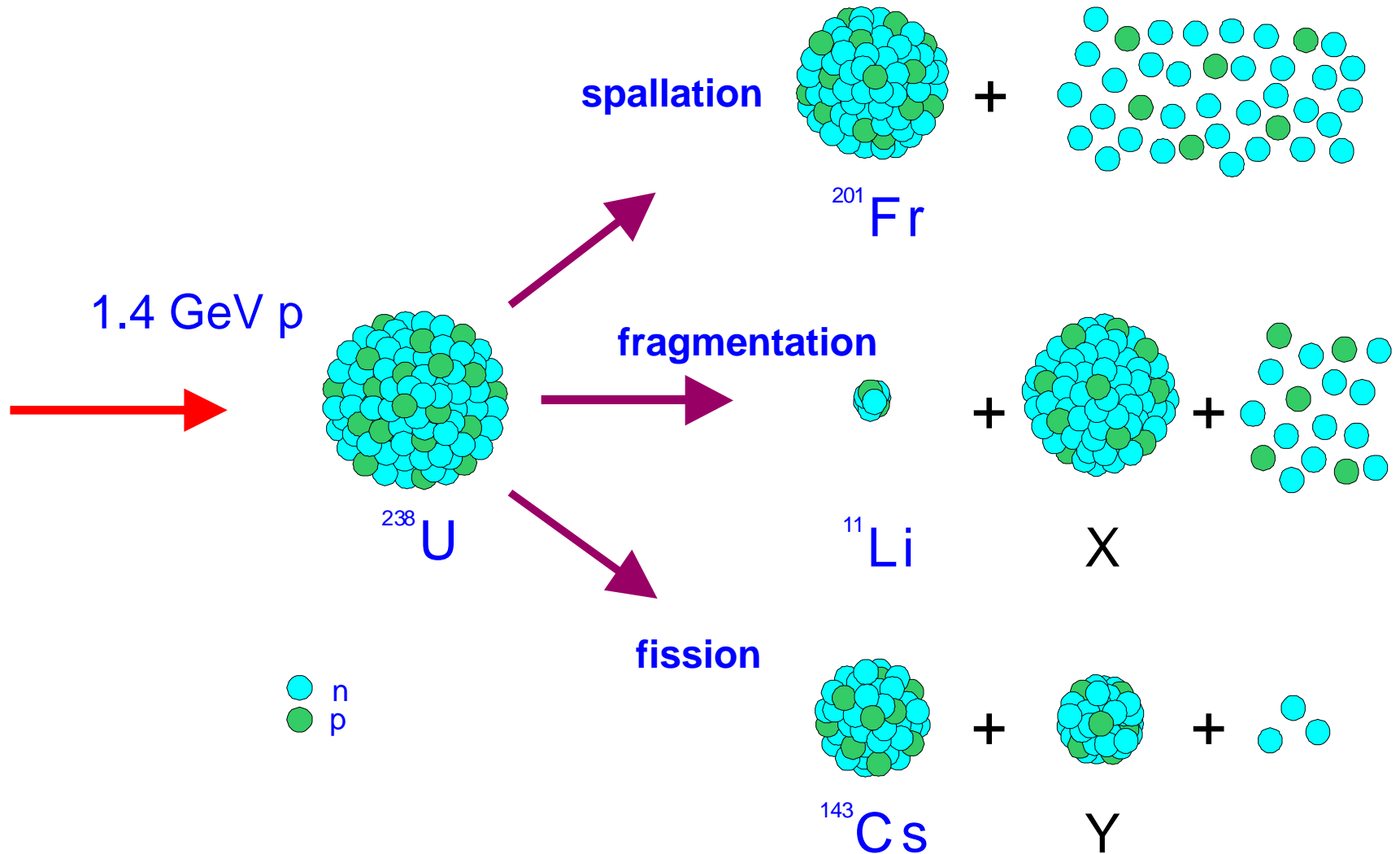
- Increases diversity of available beams
- Increase s beam intensity

Present ISOLDE beams

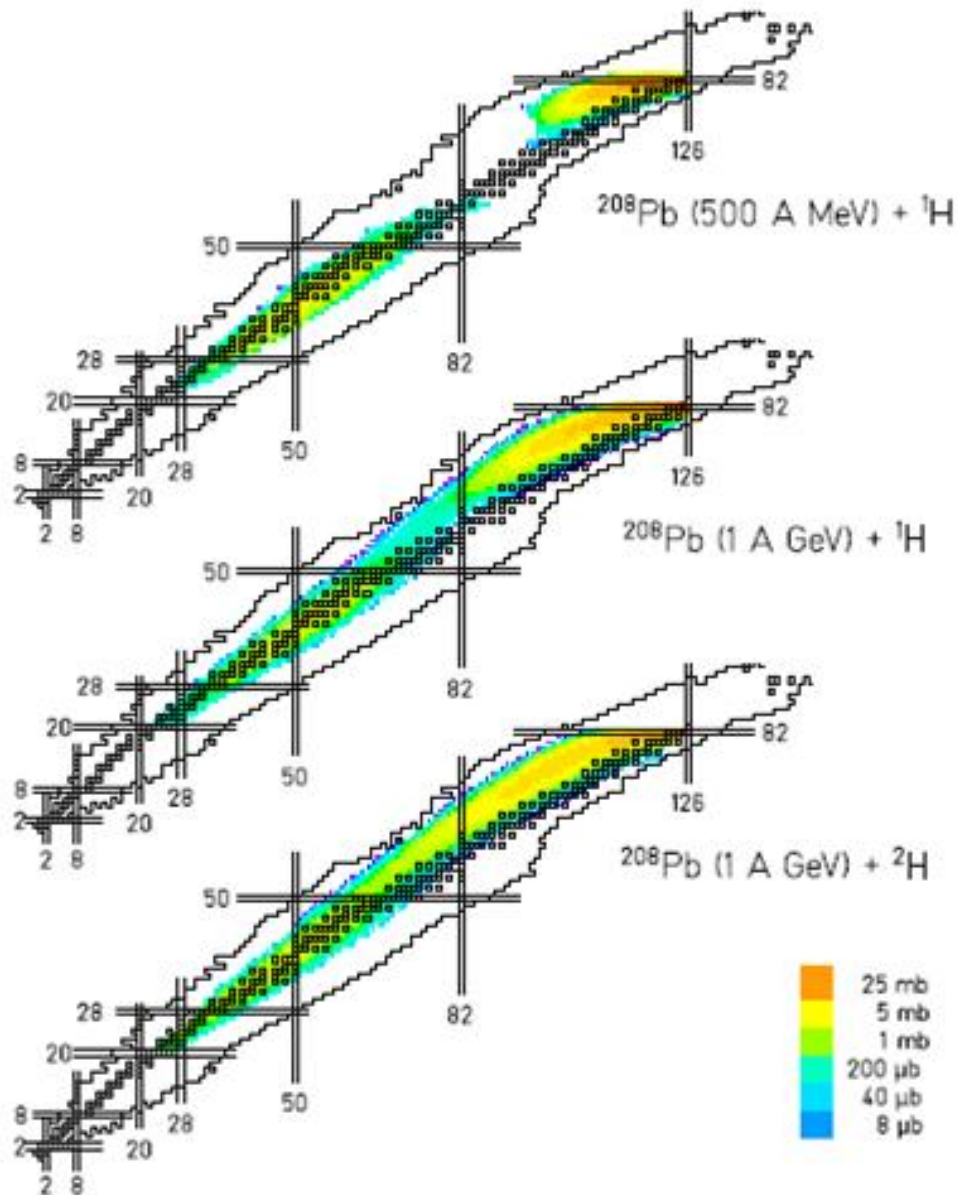


- Nearly 1000 isotopes of over 70 chemical elements – largest choice for any ISOL facility

ISOTOPE production channels at ISOLDE

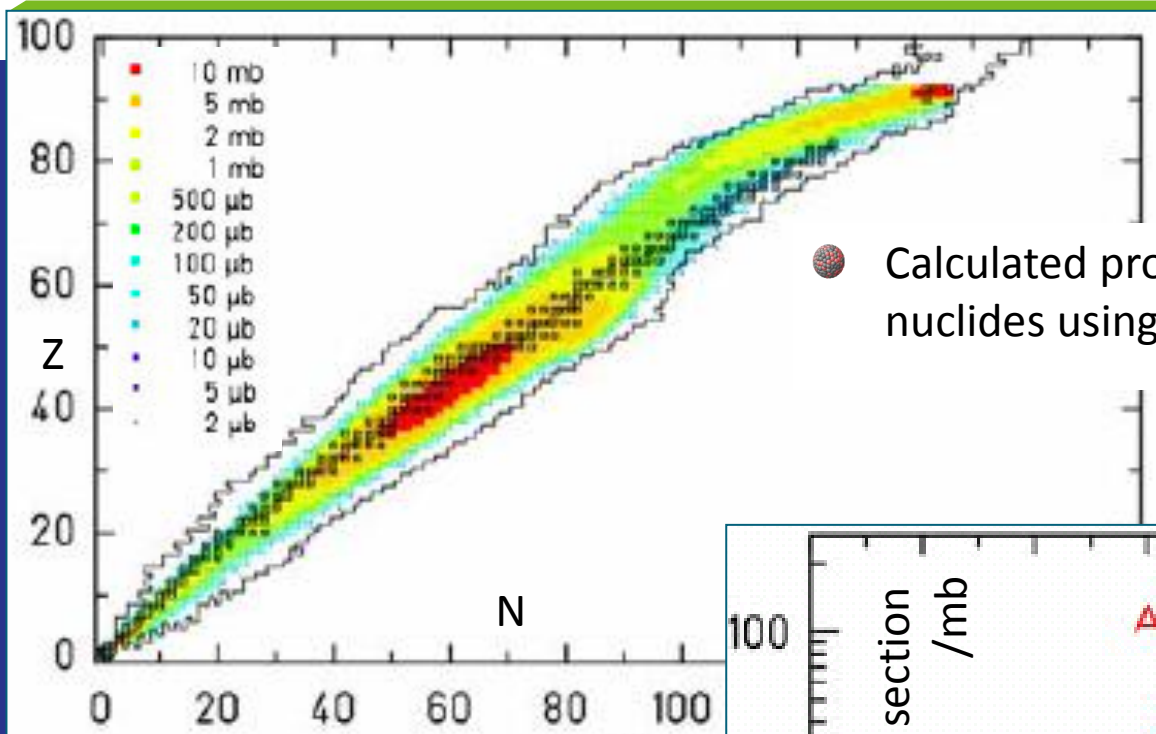


Measurement in GSI

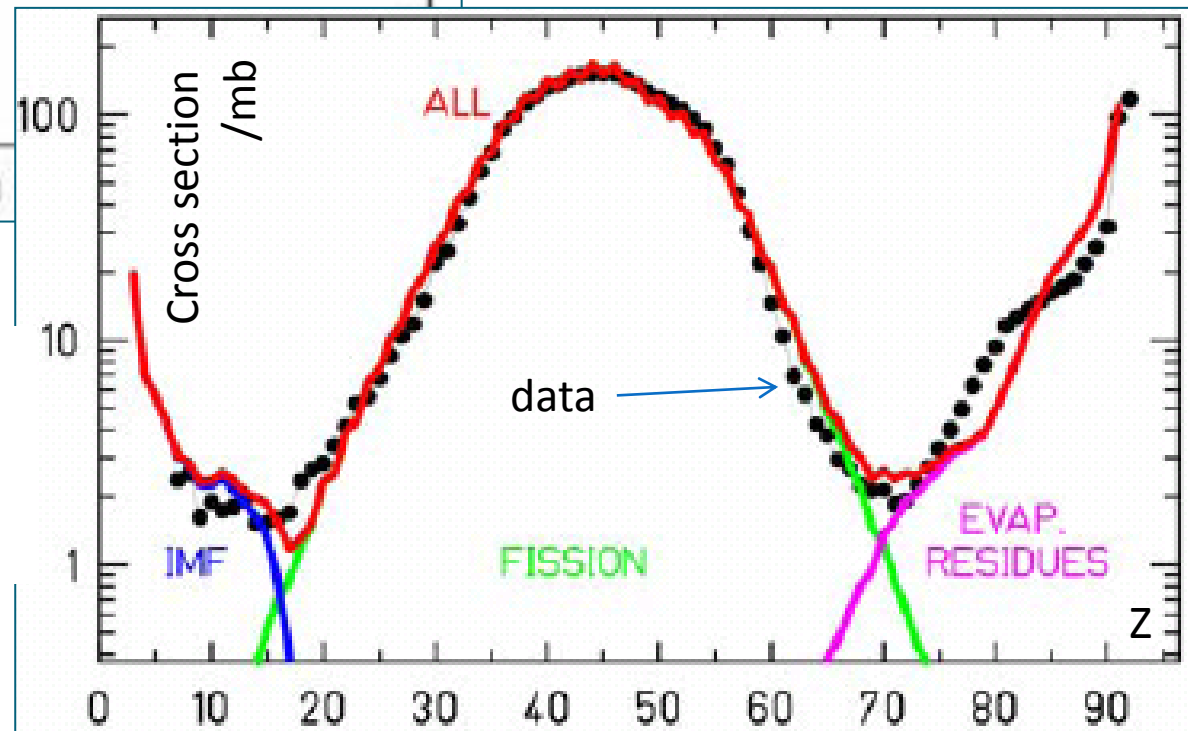


Measurement of
production of protons
on Lead in inverse
kinematics

Production cross sections



● Calculated production cross-sections of various nuclides using 1 GeV protons on U-238 target



● Contribution of fragmentation, fission, and spallation in the calculations and comparison with experimental data

Gain in yield due to p energy increase

Yield: $Y = I X \sigma \epsilon_{\text{rel}} \epsilon_{\text{ion}} \epsilon_{\text{sep}} \epsilon_{\text{transp}}$

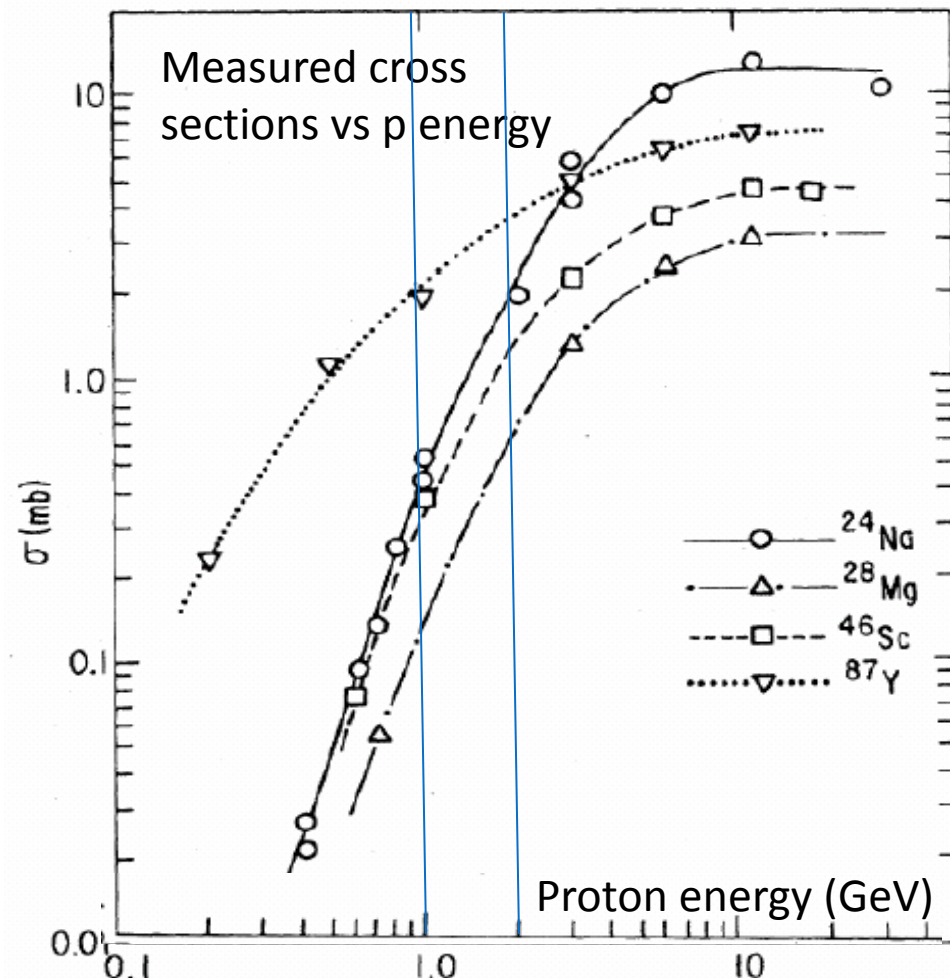
Proton beam intensity

Target thickness

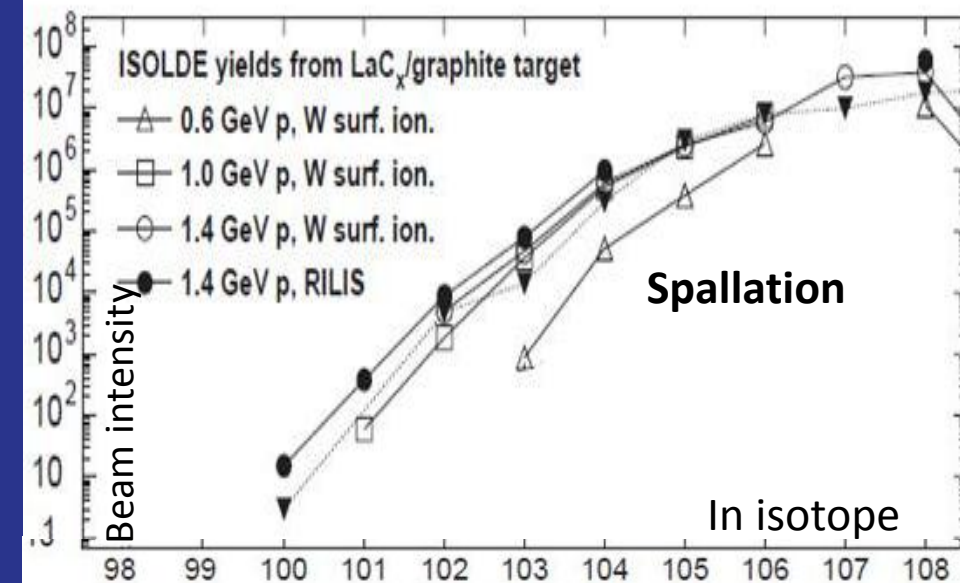
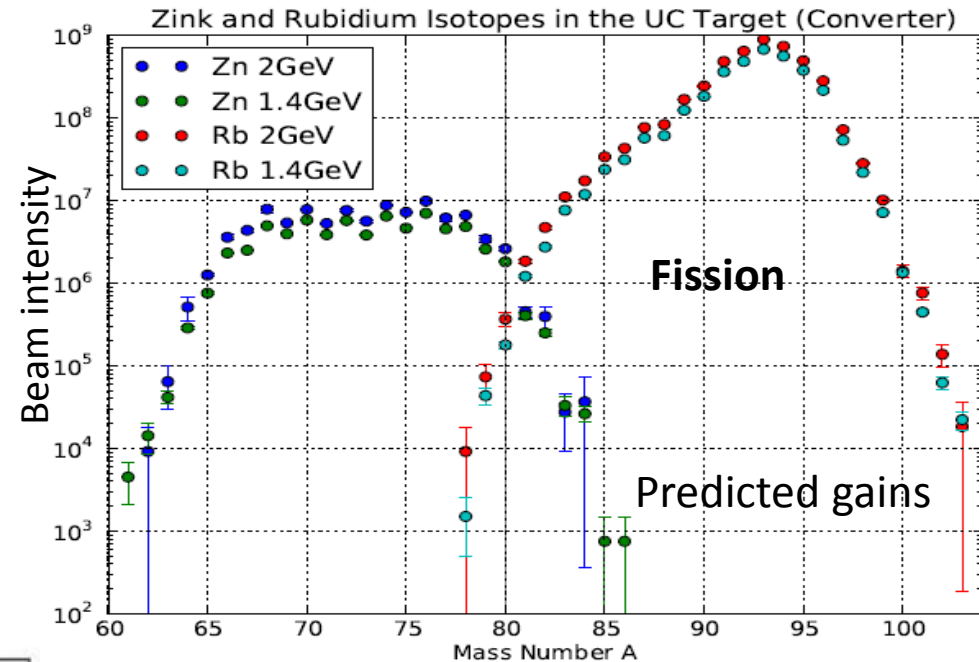
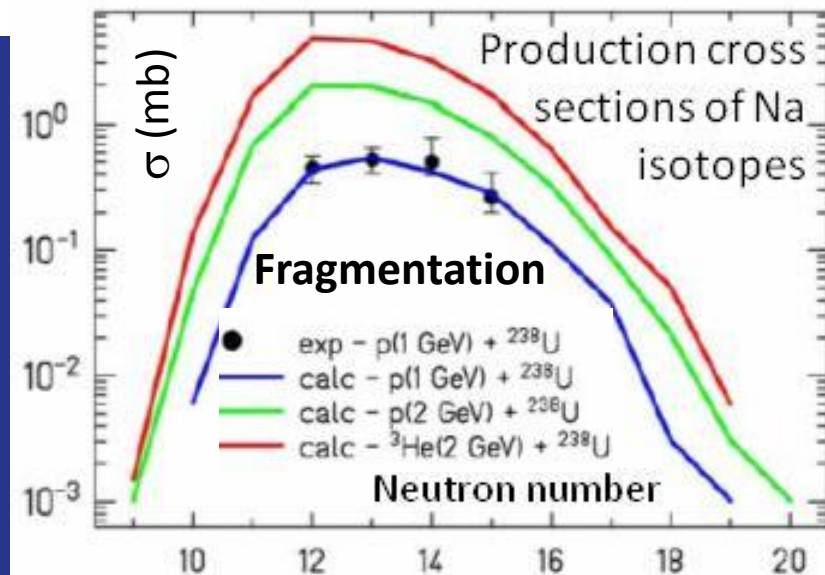
Production cross section

Efficiencies (release, ionization, mass-separation, transport)

- Increase in proton energy from 1/1.4 GeV to 2 GeV will **increase the cross section (σ)**, and thus **the yield**



Expected cross section/yield increase



Expected gains:

- fission products: 1.4 on average;
- fragmentation products: x2 to x5;
- spallation products: over x6

2GeV proton driver will better recreate the EURISOL target

Impact on physics

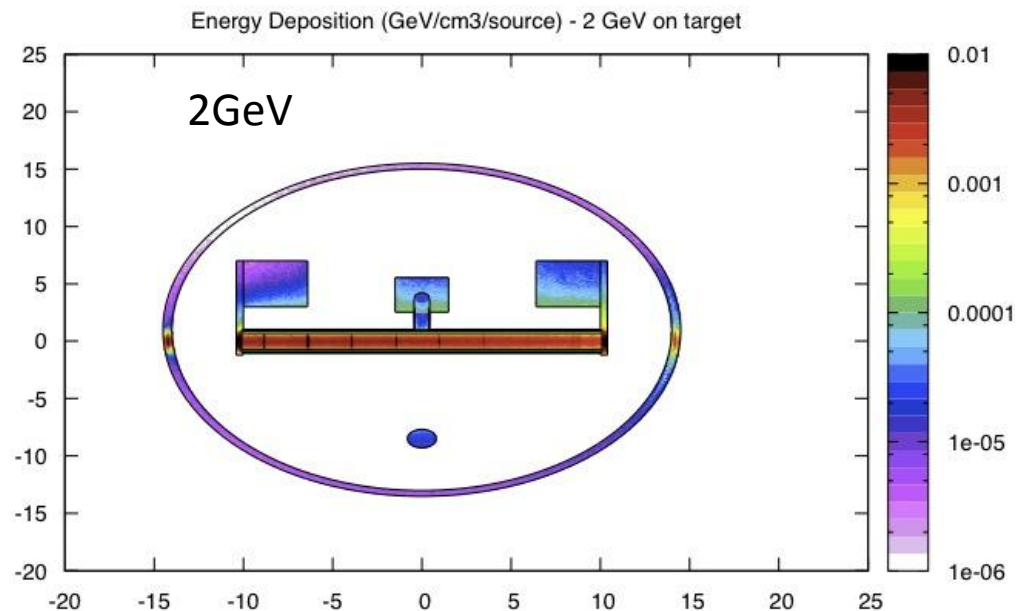
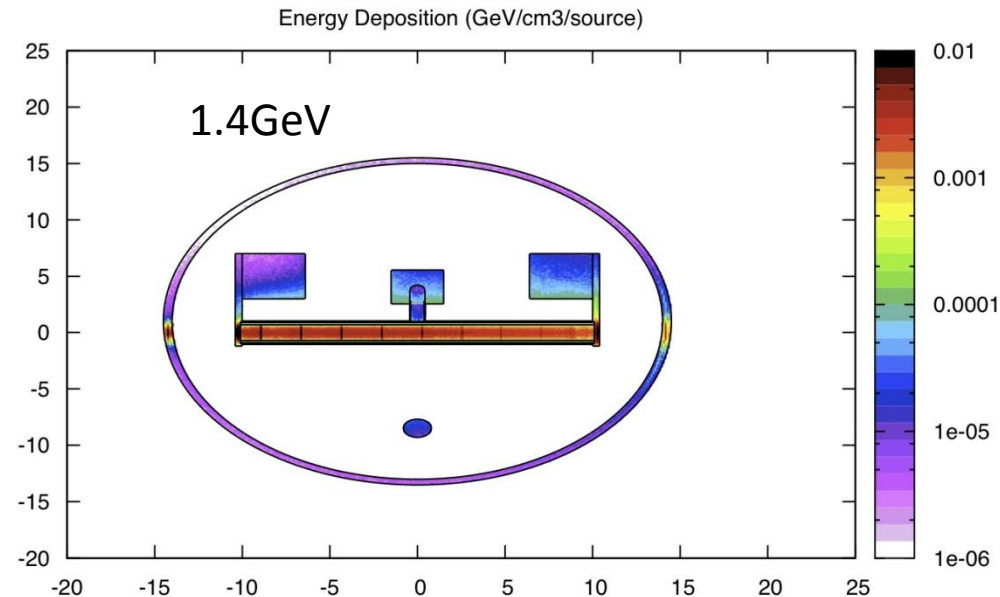
- Most of HIE-ISOLDE proposals suffer from low intensity => unnecessary prolongation of beamtimes
- New and more exotic species will be available with the increase of intensities: from 1.4 for fission to almost an order of magnitude for spallation

Possible cases:

- Increase in neutron deficient nuclei: ^{20}Mg , ^{31}Ar , ^{35}Ca , ^{100}Sn , ^{114}Cs
- Study of particle-gamma branches of states of astrophysical relevance for will become available
- Many examples were presented in HIE-ISOLDE proposals => number of requested shifts at the limit of target lifetime (due to low production)
- Detailed spectroscopy of neutron-rich nuclei, such as ^{54}Ca , will become available

Technical aspects

- Less heat deposition
- Larger beam dump
- Increased shielding and air activation



Summary

- The unique position of ISOLDE in the map of the worldwide facilities results from
 - Longstanding R&D program on target and ion sources -> new intense beams
 - The primary proton beam characteristics received from the Proton Synchrotron Booster.
- The 2GeV proton beam will be developed for LHC and injected around 2017-2018
- AIM: **To receive a 2GeV proton beam at ISOLDE** to reinforce the leading position of ISOLDE/HIE-ISOLDE in the World map of the facilities by increasing still more the intensity

Expected gains:

- fission products: 1.4 on average;
- fragmentation products: x2 to x5;
- spallation products: over x6
- Slight reduction in near-spallation products