ISOLDE high intensity proton beams – Yield measurements

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SY-STI-RBS

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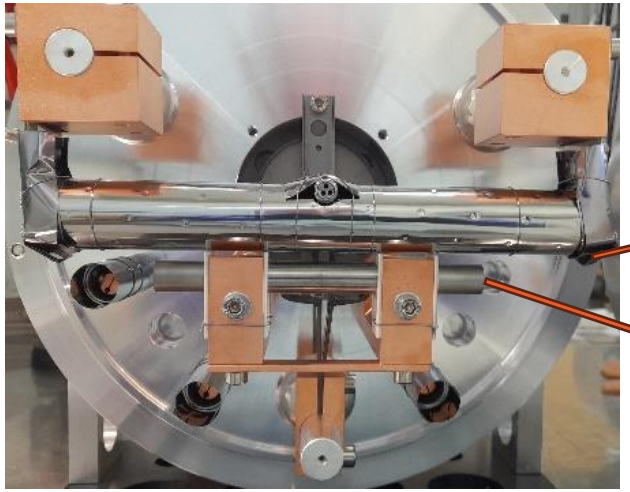
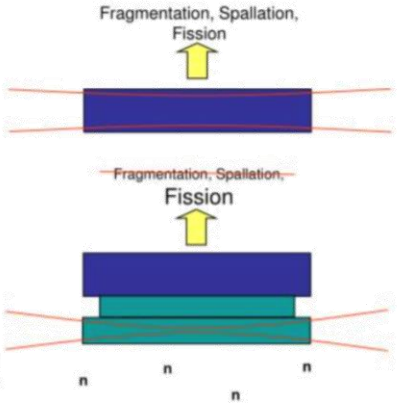


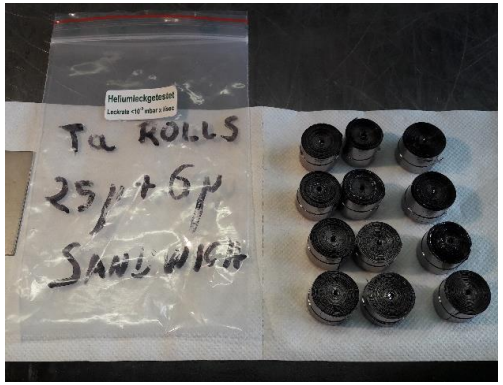
Proton beam focusing

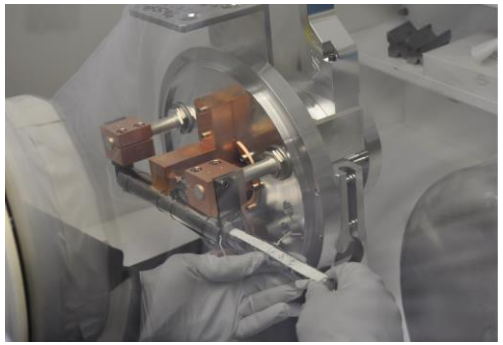
- Standard focus
- Waist of beam at target (converter targets)



$$Beam\ Int. = \sigma \cdot j \cdot N_t \cdot \varepsilon$$

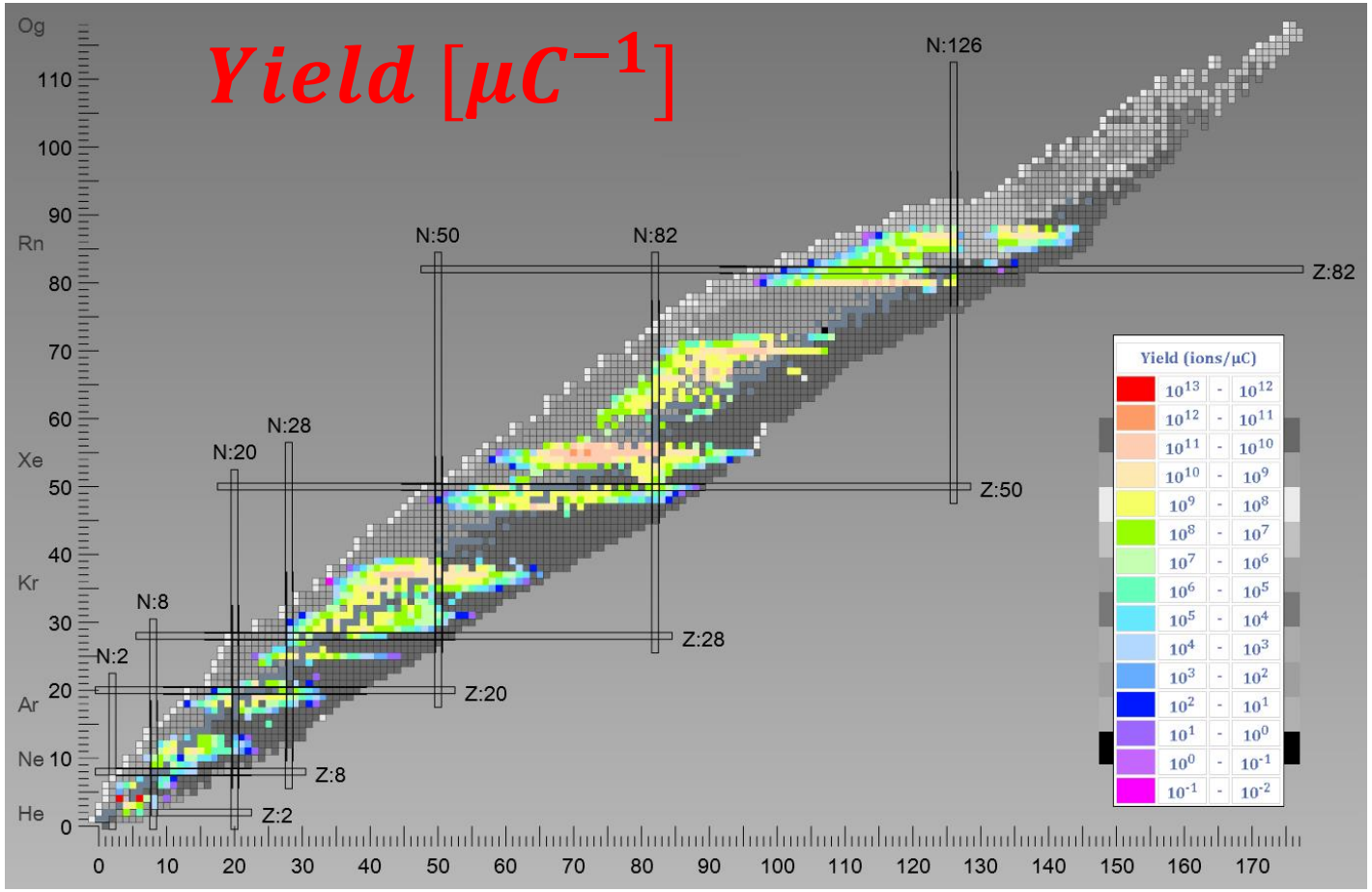
$$= \boldsymbol{Yield}\left[\boldsymbol{\mu C^{-1}}\right] \cdot I$$

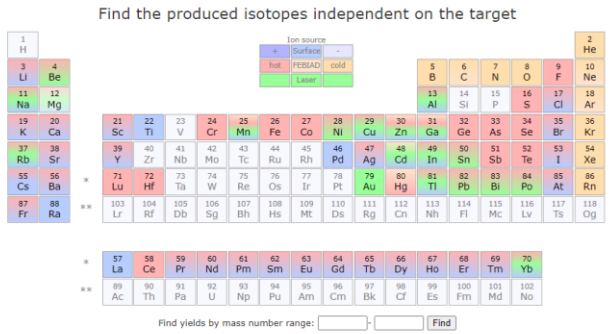




N_t – Nr of exposed atoms [dim]
j – Proton flux [cm^{-2}]
σ – Cross section [mb]
ε – Efficiency [%]
I – Proton intensity [μC]

ISOLDE radioactive beams





Isotopes Predicted **~6000**

Discovered **~3000**

ISOLDE **~1000**

Elements 76

~1500 user

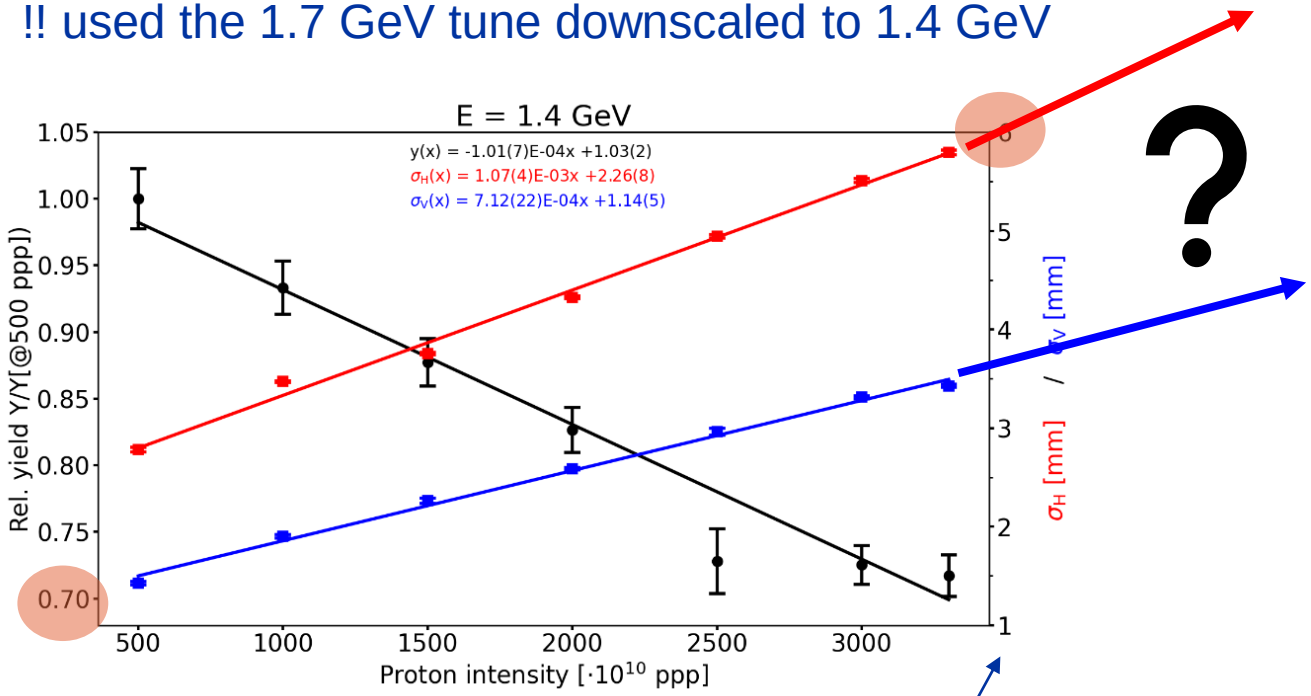
>150 active experiments

https://isoyields2.web.cern.ch/IsoldeYieldChart.aspx

J.Ballof *et.al,* Nuclear Inst. and Methods in Physics Research B 463 (2020) 211

Beam size vs yield during 1.7 GeV study 2022

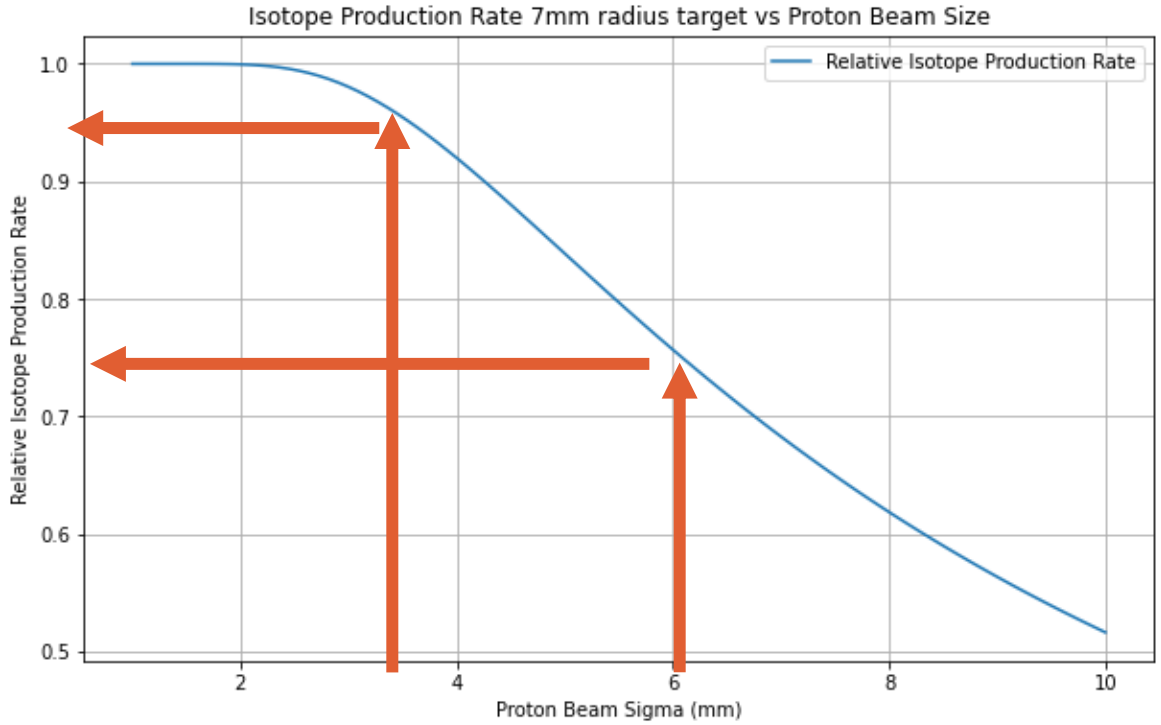
!! used the 1.7 GeV tune downscaled to 1.4 GeV



?

- Measured at fixed semgrid before target

Theory (heavyside x gaussian)



3.5 mm 6 mm

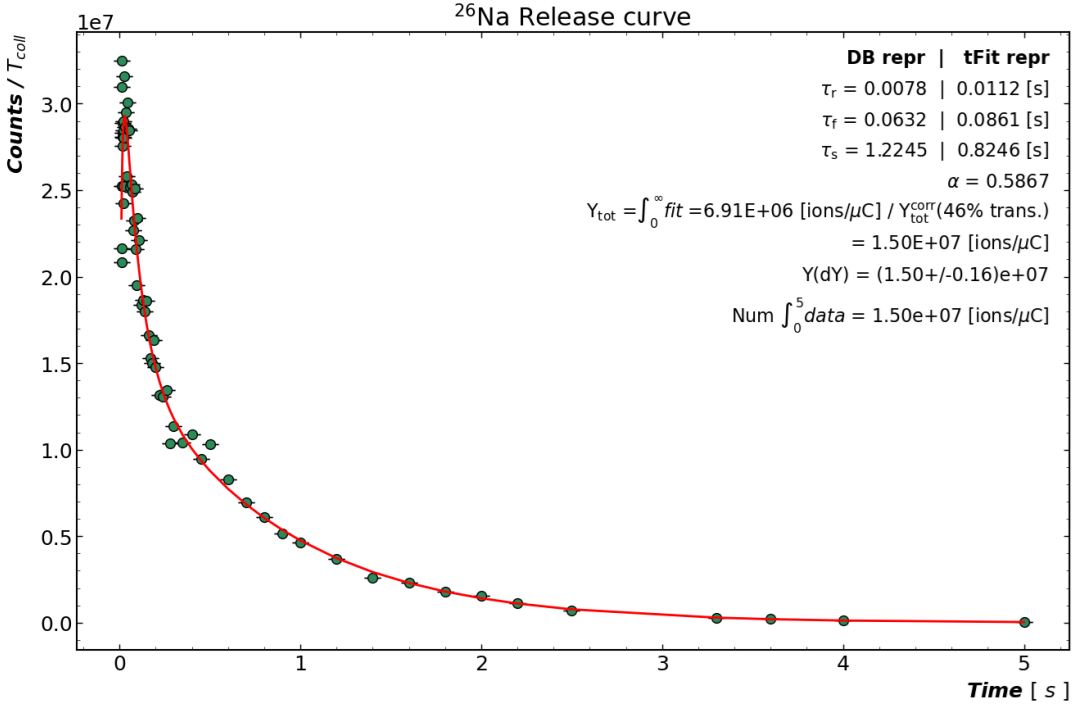
Beam size **on target** should stay <=3.5 mm sigma x,y
Larger beam size should not be compensated with intensity
-> Suggests MD to find a balance

High intensity p-beams @ ISOLDE - Yield vs Proton Intensity

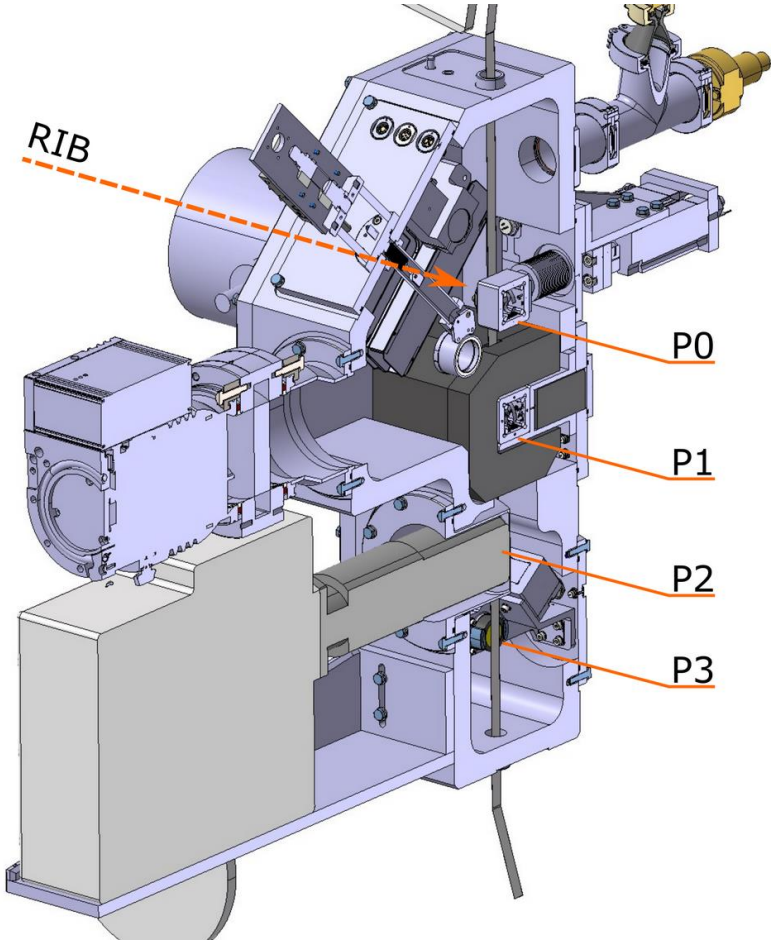
Target #878 UC-Ta-MK1 @ ISOLDE GPS [Nov 2024]

26Na yields obtained from release curve using the tape station

- Proton intensity (**50-5000)E10 ppp**

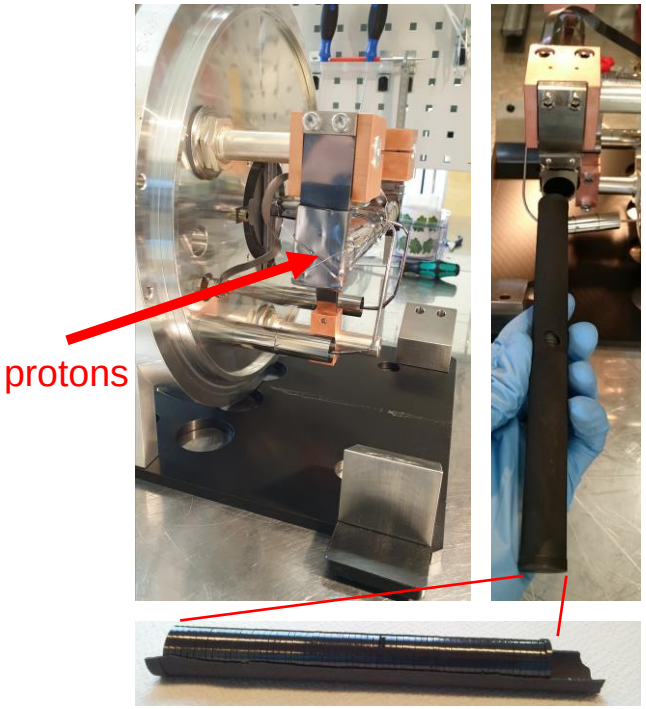


- Measure release of radioactive ion beam produced after proton impact
- Time refers to time after proton impact

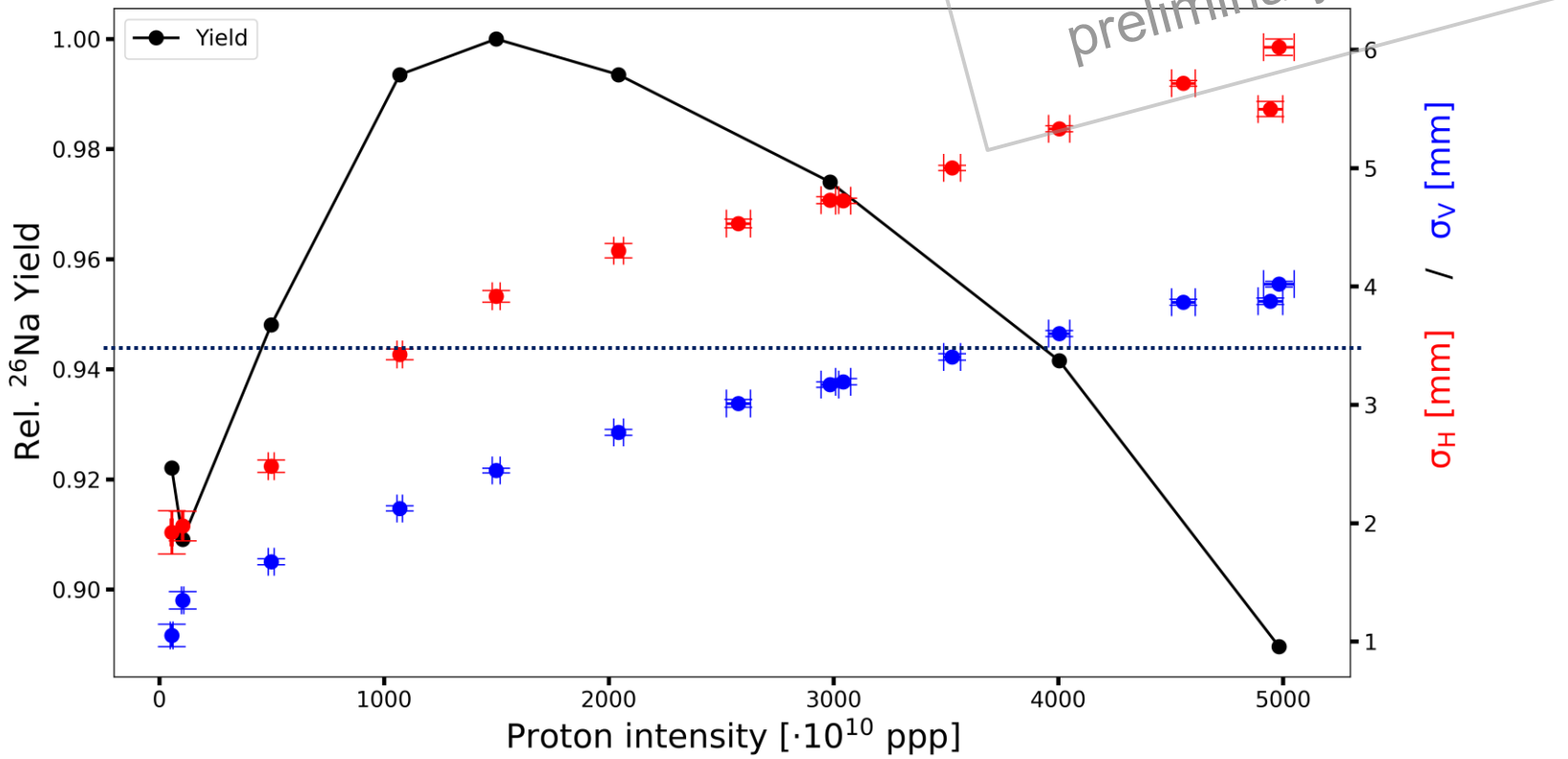


High intensity p-beams @ ISOLDE - Yield vs Proton Intensity

- Yield **Changes up 12 % due to p-delivery**



14 mm UCx pills

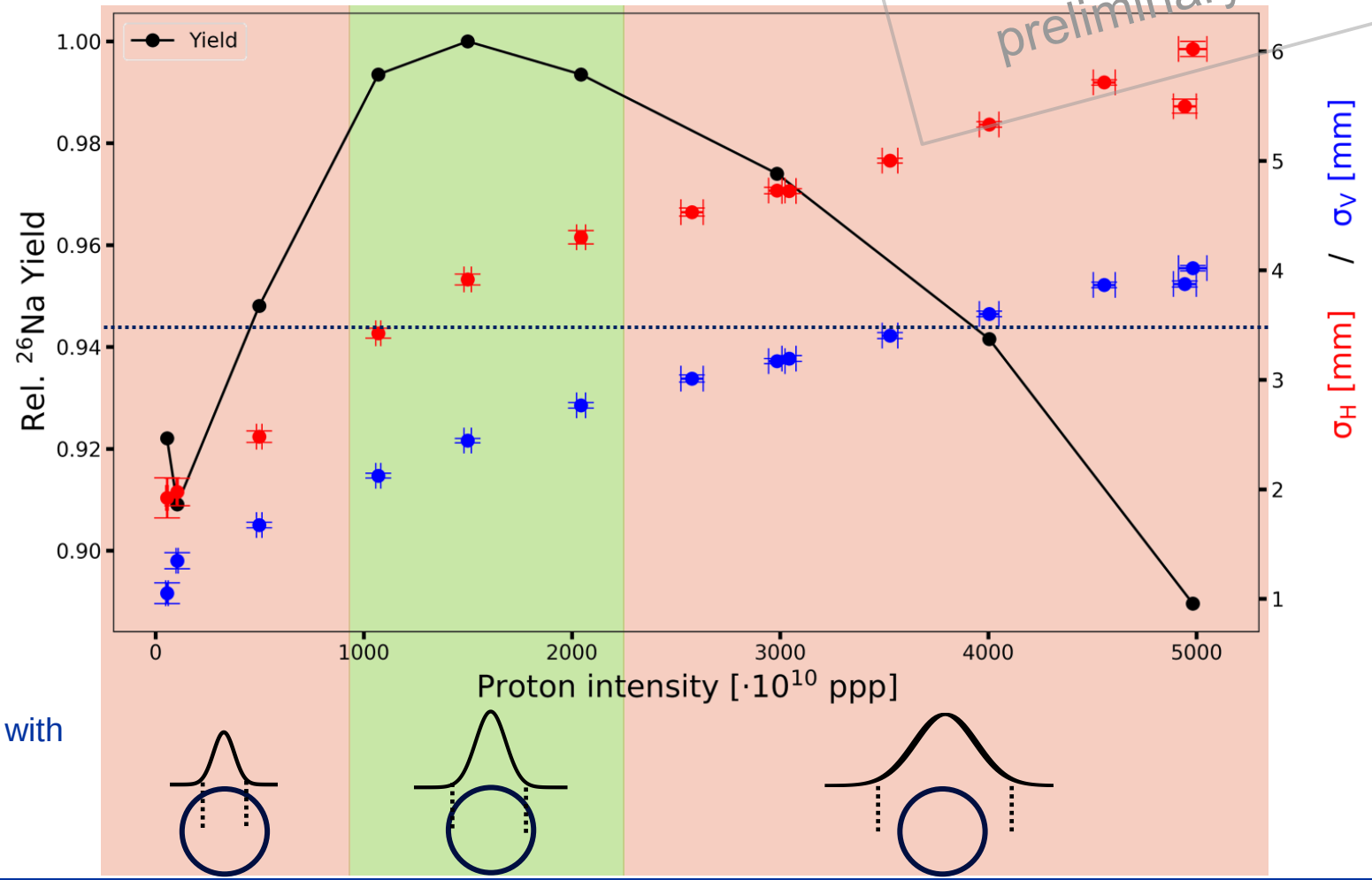


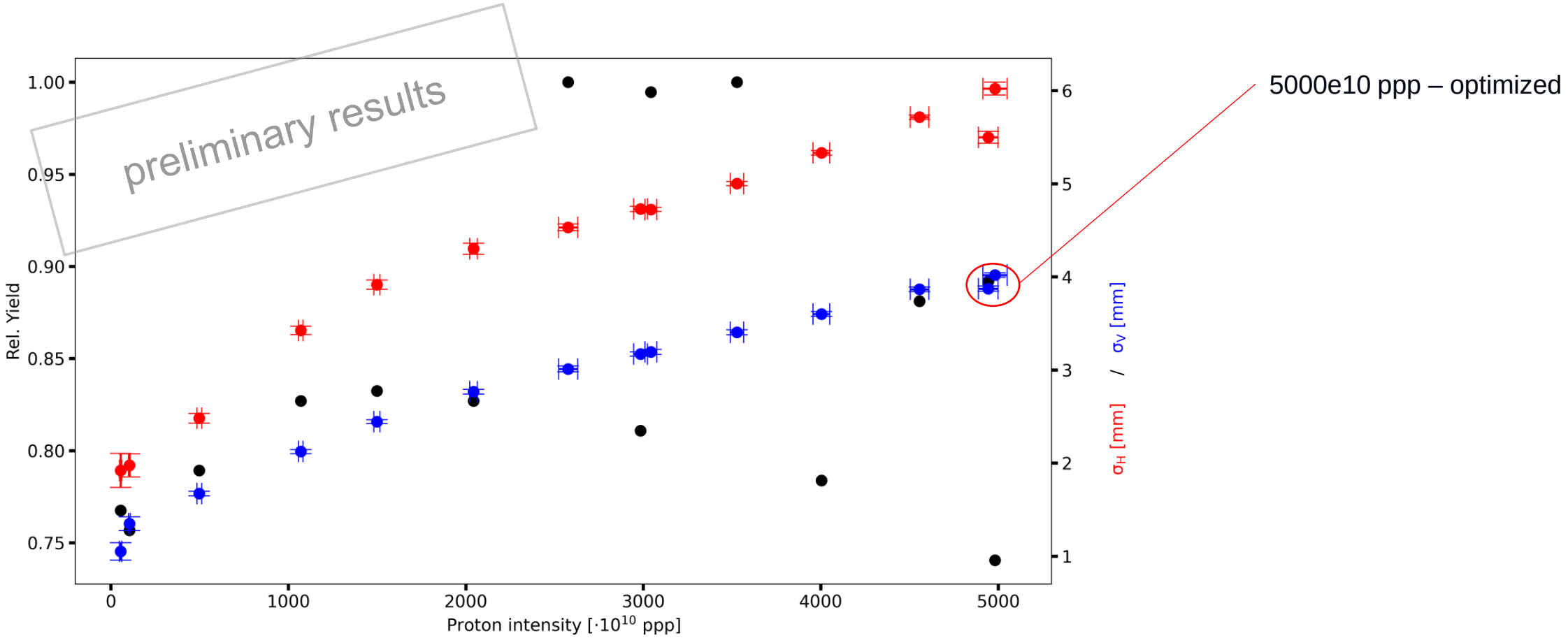
High intensity p-beams @ ISOLDE - Yield vs Proton Intensity

- Yield **Changes up 12 % due to p-delivery**

14 mm UCx pills

- Equals beam spot size with $\sigma = 3.5$ mm
- Best target envelop overlap?





- Strange outliers (?)
- Measurement sequence:
  1. 1000 – 5000 even numbers
  2. 5000 with PSB optimized settings
  3. 50-500
  4. 1500 – 4500 odd ones + 3000 repetition

- Did something change after (2)?

Next steps

- **Repeat high intensity study for 1.4 GeV**
  - **Optional using 1.7-GeV protons**
- **Investigate high intensity beams on neutron converter (Ø 12.7 mm)**
- **Manual focusing with last magnets in BTY (BTY.QF0210, BTY.QDE209)**
  - Using an optimizer with tape station as input?
- **Measure high int. beam size with Semgrid-target during start-up?**

Thank you