ИсследованиЕ реакций протонного захвата в GSI

Status on the proton-capture campaign at GSI

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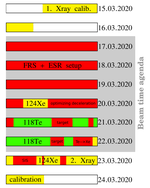
E127 experiment

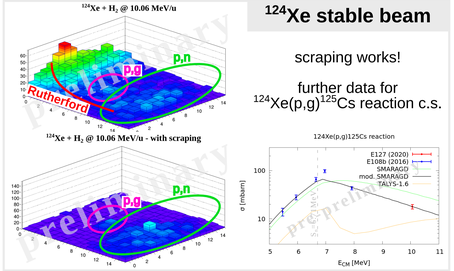
the first proton-capture experiment using highly-charged radioactive ion beam

15 shifts of beam time in middle March 2020

measurement of the ^{118}Te(p, γ)^{119}I reaction

COVID-19, difficulties at preparation, malfunctions during beamtime → only 20% of measurement time



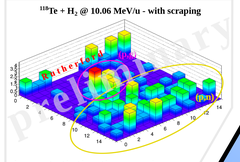


^{124}Xe stable beam

scraping works!

further data for ^{124}Xe(p,g)^{125}Cs reaction c.s.

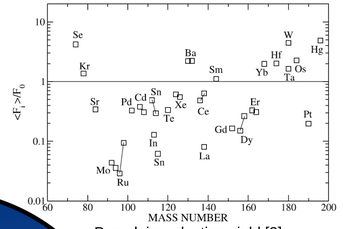
^{118}Te radioactive beam



low statistic, the peak of interest is visible

excellent proof-of-principle

Motivation



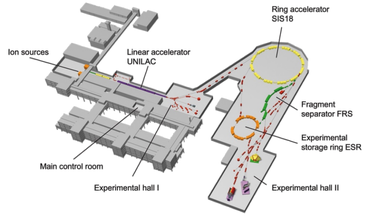
P-nuclei production yield [3].

~35 rare p-nuclei: mainly γ-process [1], rp-process [2]

The simulated p-nuclei production yield to the solar abundance ratios has large deviations.

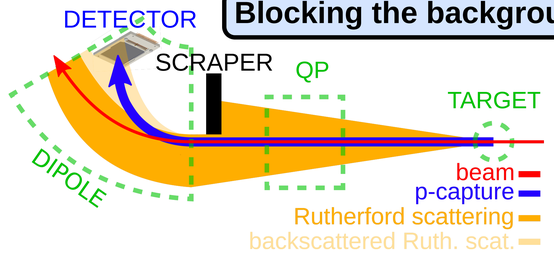
The storage rings at GSI, the Experimental Storage Ring (ESR) and the Cryring, provide unrivaled opportunity allowing for the corresponding reaction studies.

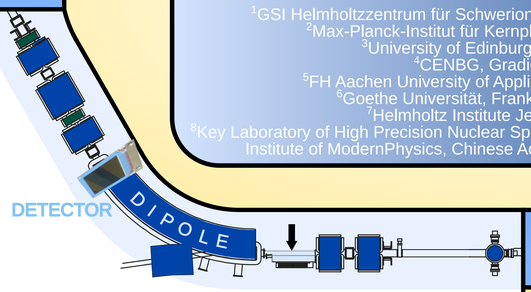
Reaction studies in a heavy ion storage ring are realized through measurements in inverse kinematics. Access to nuclides which are hardly possible to prepare in form of a solid target.



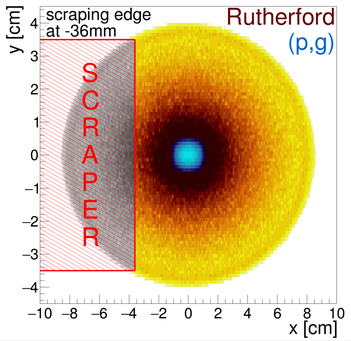
GSI accelerator complex for ion research in Darmstadt, Germany

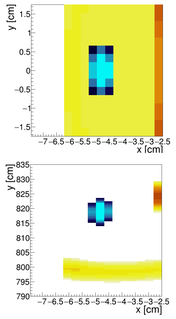
Blocking the background





SIMULATION

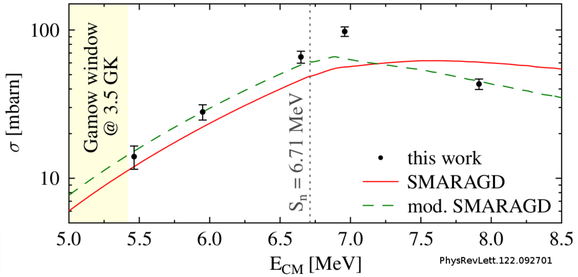




forward scattered (dominant) part of the Rutherford scattering is eliminated nearly background free detection of the p-capture products

$$\left(\frac{d\sigma}{d\Omega}\right)_{\text{Rutherford}} = \frac{\alpha^2}{16E_K^2 \sin^4\theta/2}$$

Possible improvements for signal-to-background ratio at low beam energies:
- separating (p,g) products by blocking Rutherford channel
- make use of the energy resolution of the Si detector



p-capture campaign

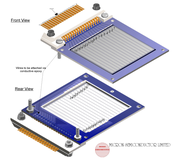
^{96}Ru(p,γ) in 2009 [4]

detector pockets = E barrier for ions, no penetration < 10 MeV/u

To reach Gamow-window

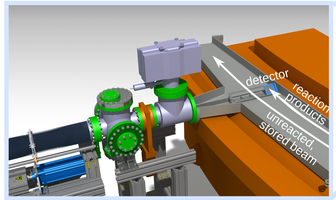
^{124}Xe(p,γ) in 2016 [5]

In-vacuum detectors

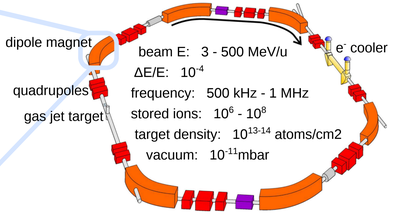


The UHV compatible DSSSD

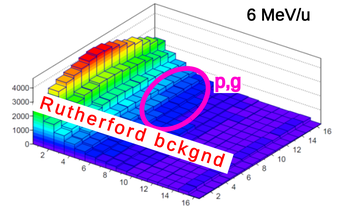
Detector mount:
-keeps stored the unreacted beam
-(p,g) products are detected on the inner tracks.

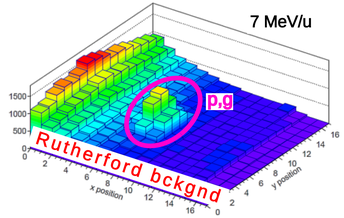


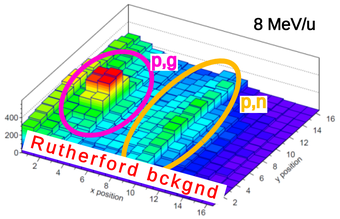
The ion detection system is placed at the end of the first dipole after the gas jet target in the ESR.



The ESR at GSI







Proton-capture events establish a narrow cluster of ions visible on the top of the smooth background of Rutherford scattering. When decreasing the interaction energy, the sensitivity for the p-capture products decreases drastically.

[1] M. Pignatari et al., Int. J. Mod. Phys. E 25 (2016) 1630003.
[2] H. Schatz et al., Phys. Rev. Lett. 86 (2001) 3471.
[3] W. Rapp et al., AP. J. 653 (2006) 474
[4] B. Mei et al., Phys. Rev. C 92 (2015) 035803.
[5] Glorius J et al 2019 Phys. Rev. Lett.122 092701

This project has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement No 682841 „ASTRUm")