Experimental cross section of the $^3He(\alpha,\gamma)^7Be$ reaction around E_{cm} = 3 MeV

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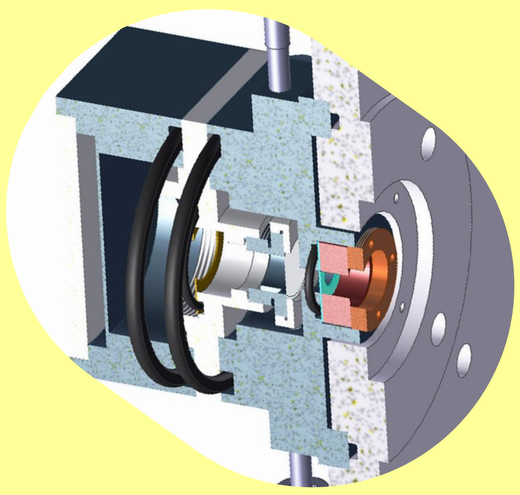
Motivation

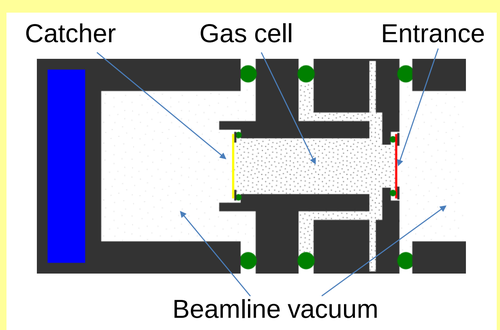
- The reaction is important both in the solar pp-chain and in the BBN
- Scarce dataset in this energy region

Two experimental campaigns

- Different gas cell targets
- Different beamlines
- Different HPGe detectors
- Different systematics

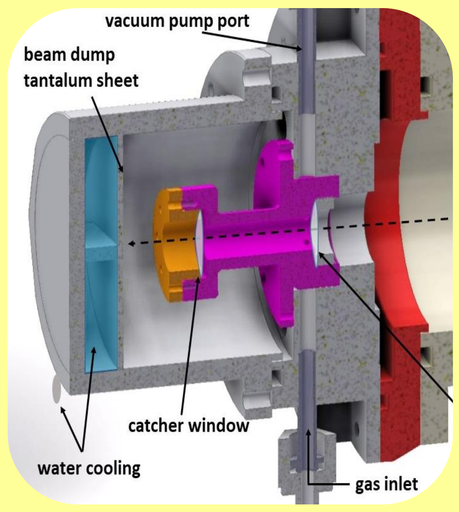
1st campaign (2017)

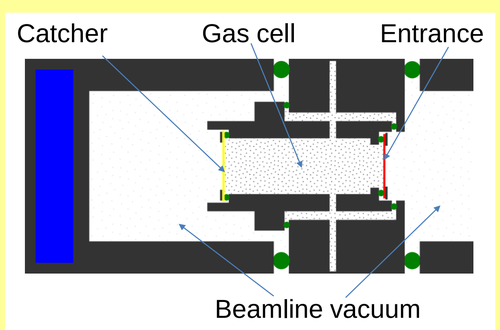




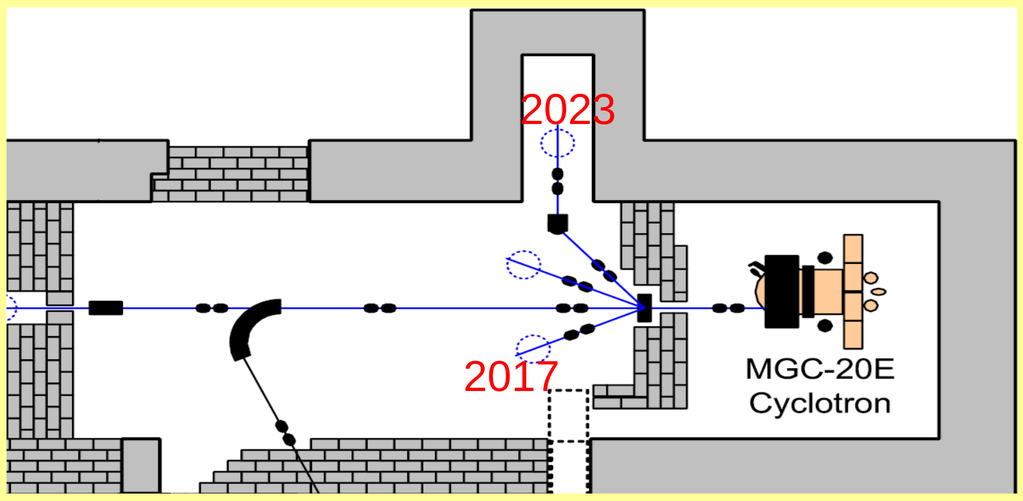
- Same cell as in Szücs *et al.* (2019)
- O-ring between beamline vacuum and cell at the entrance foil
- Glued catcher
- O-ring between cell and outside atmosphere
- At the 22.5° short beamline
- Better energy definition (ΔE_p = ~30keV)

2nd campaign (2023)





- New cell, same as in Tóth *et al.* (2023)
- O-rings between beamline vacuum and cell at both foils
- No glue anywhere
- Complete cell surrounded by the beamline vacuum
- At the long 90° beamline (2 x 45°)
- Worse energy definition (ΔE_p = ~100keV)



Beamlines at the cyclotron accelerator of Atomki (Biri *et al.* (2021))

Method: activation

Targets:

- Thin windowed gas cell target:
  - 6.5 or 10 μm nominal thickness Al entrance foils
  - 10 μm nominal thickness 99.999% Al catcher foils
  - 100 mbar 99.999% isotopically enriched ^3He gas
  - ~42 mm long gas cell
  - ~50 keV energetic width (E_α)

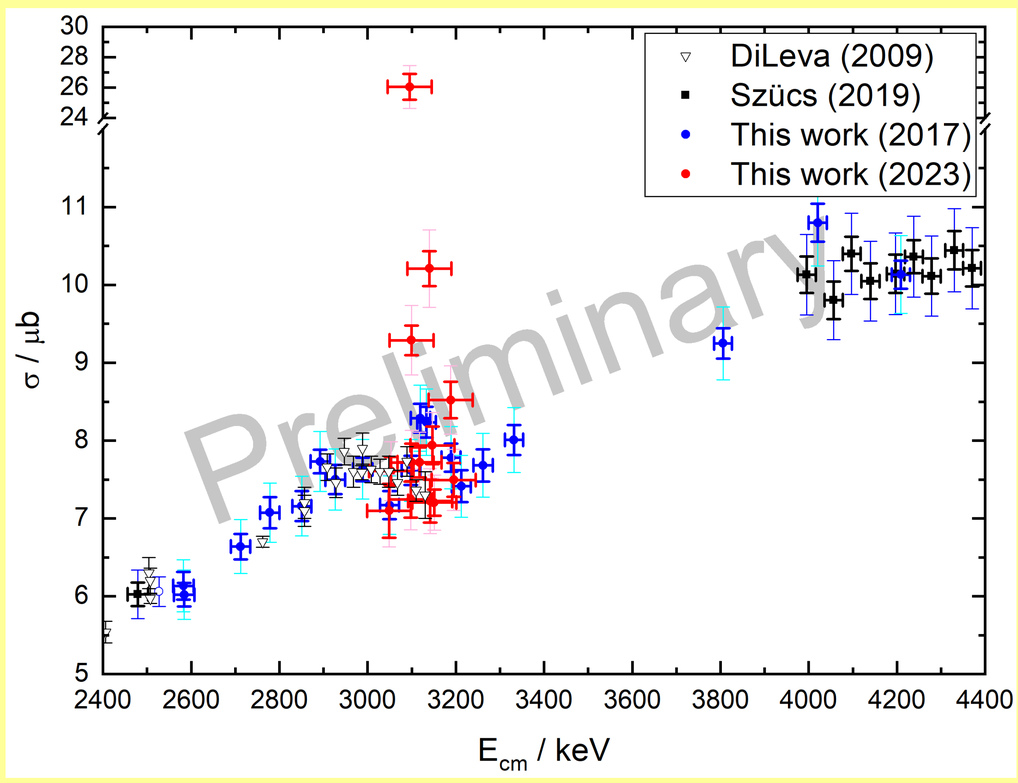
Irradiations:

- α beam provided by the cyclotron of Atomki
- Average beam current: 1 μA.
- Irradiation lengths: 12-24 hours

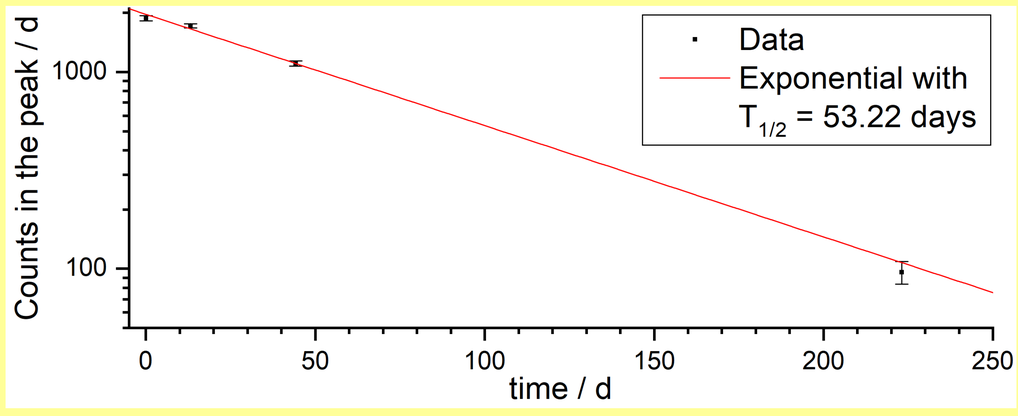
Countings:

- 100% relative efficiency coaxial HPGe detectors
- 10 cm lead shielding layered with cadmium and copper
- Total counting length for each sample is about 2 weeks

Preliminary results: Cross section excess



- A cross section excess is observed.
- The beam energy uncertainty in the 2023 dataset is ~50keV (in cm energy), thus exact energy of the phenomenon is uncertain.
- It is ^7Be (see decay curve below), no alternative reaction is found to explain the excess.



References

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