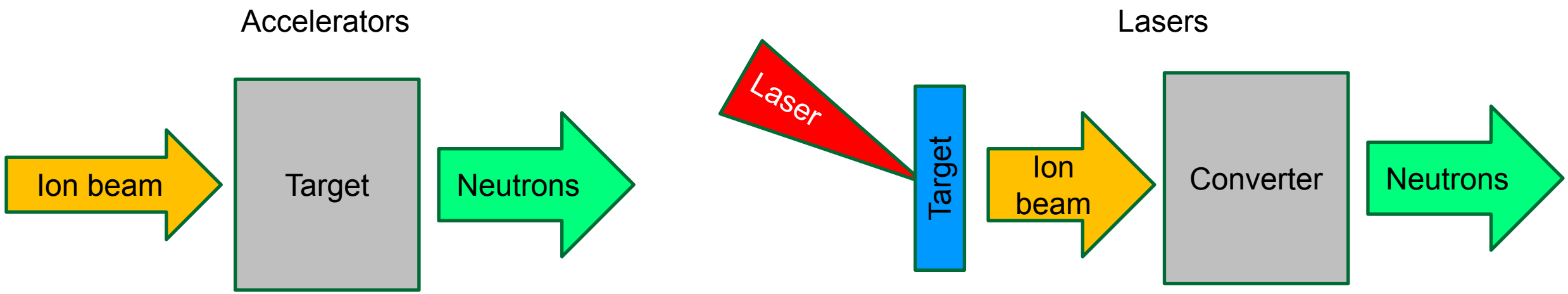
Targets and converters

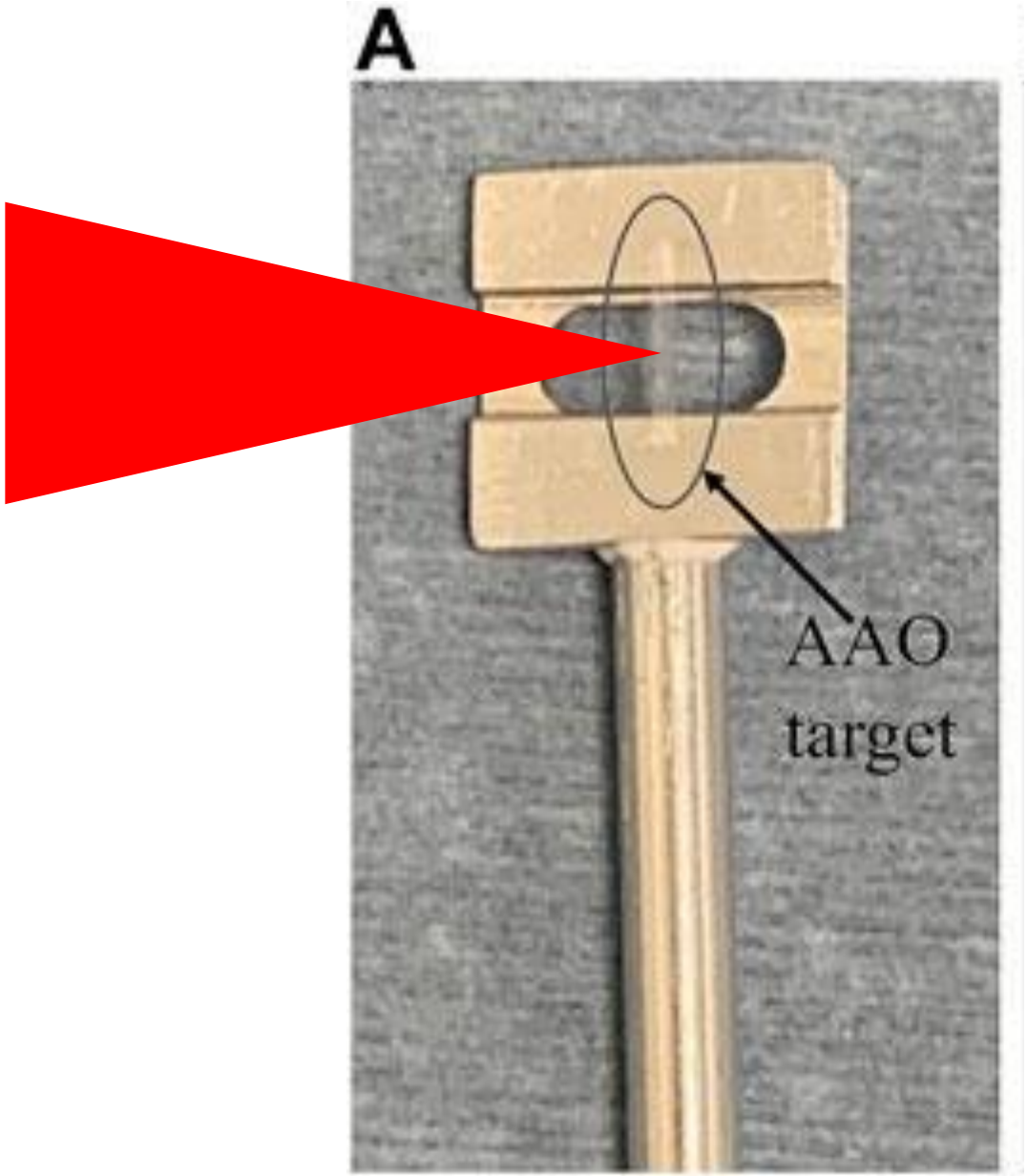
FOCUSED ENERGY

What is a target? What is a converter?

Different definition between Laser and accelerator based neutron sources



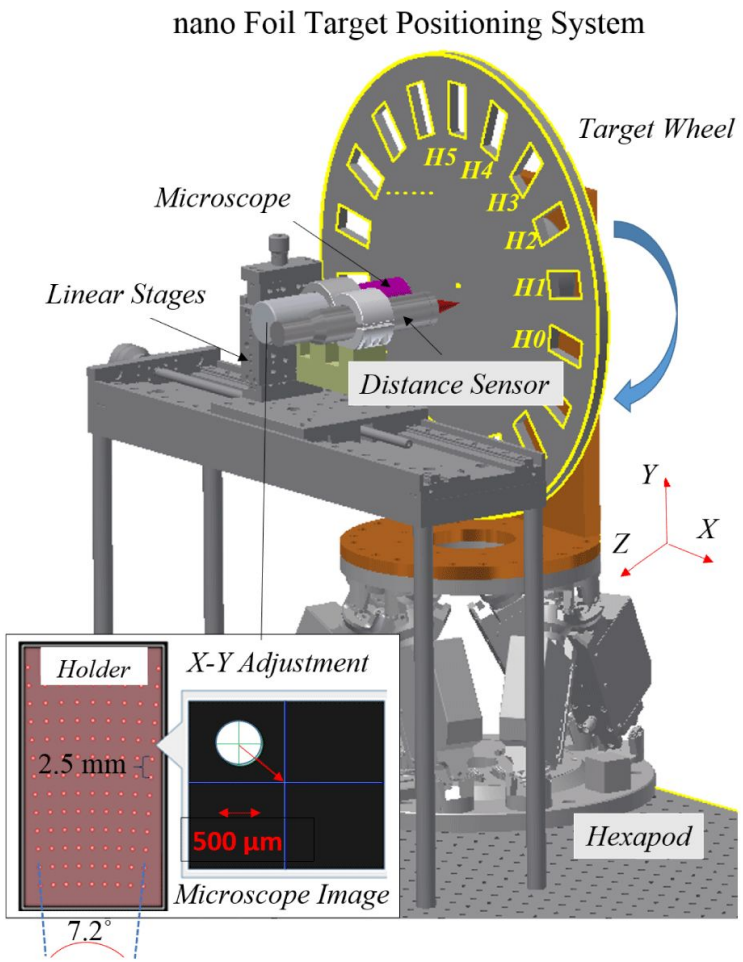
Laser Targets: Solid foil targets

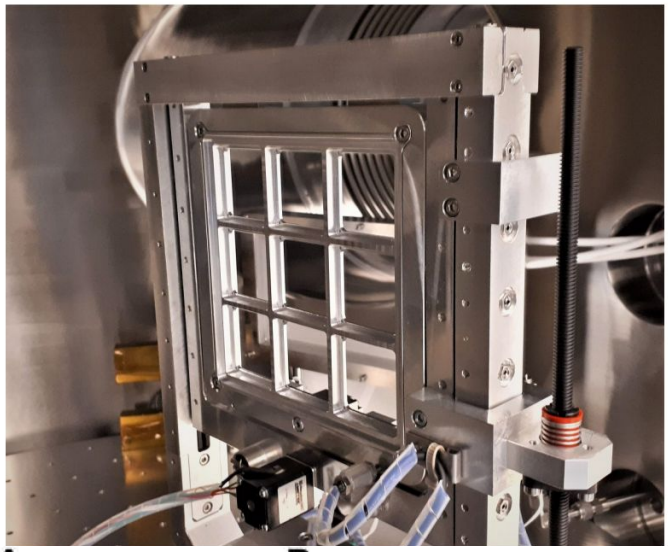


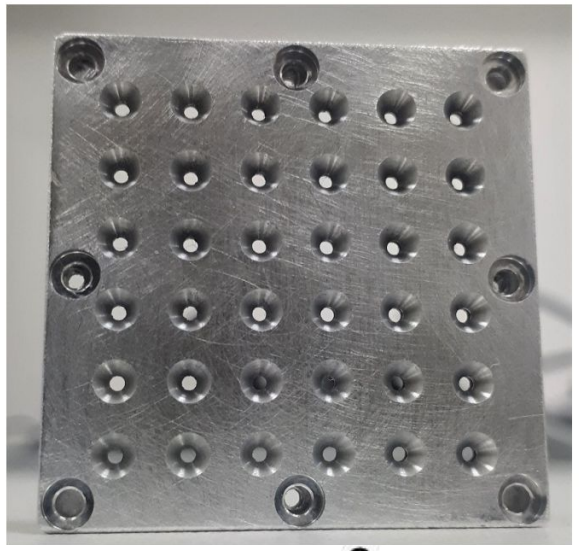
Downsides of Previous Target systems

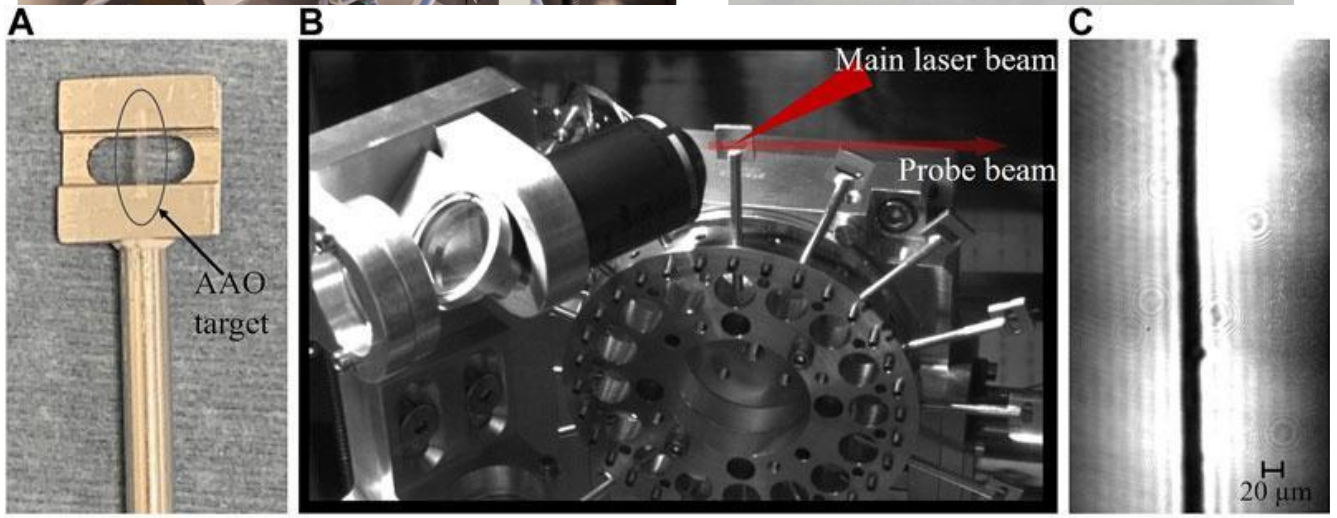
- Single shot targets
- Manual replacement after each shot (~ 1 h)
  - Vent vacuum chamber (10 min)
  - Take out targetholder (1 min)
  - Insert new target (3 min)
  - Pump down vacuum chamber to 1e4 mBar (30 min)
  - Align new target (10 min)
  - Prepare for next shot (10 min)
- Ech target has to prepared in advance and characterized

Laser Targets: Solid foil targets at repetition rate.

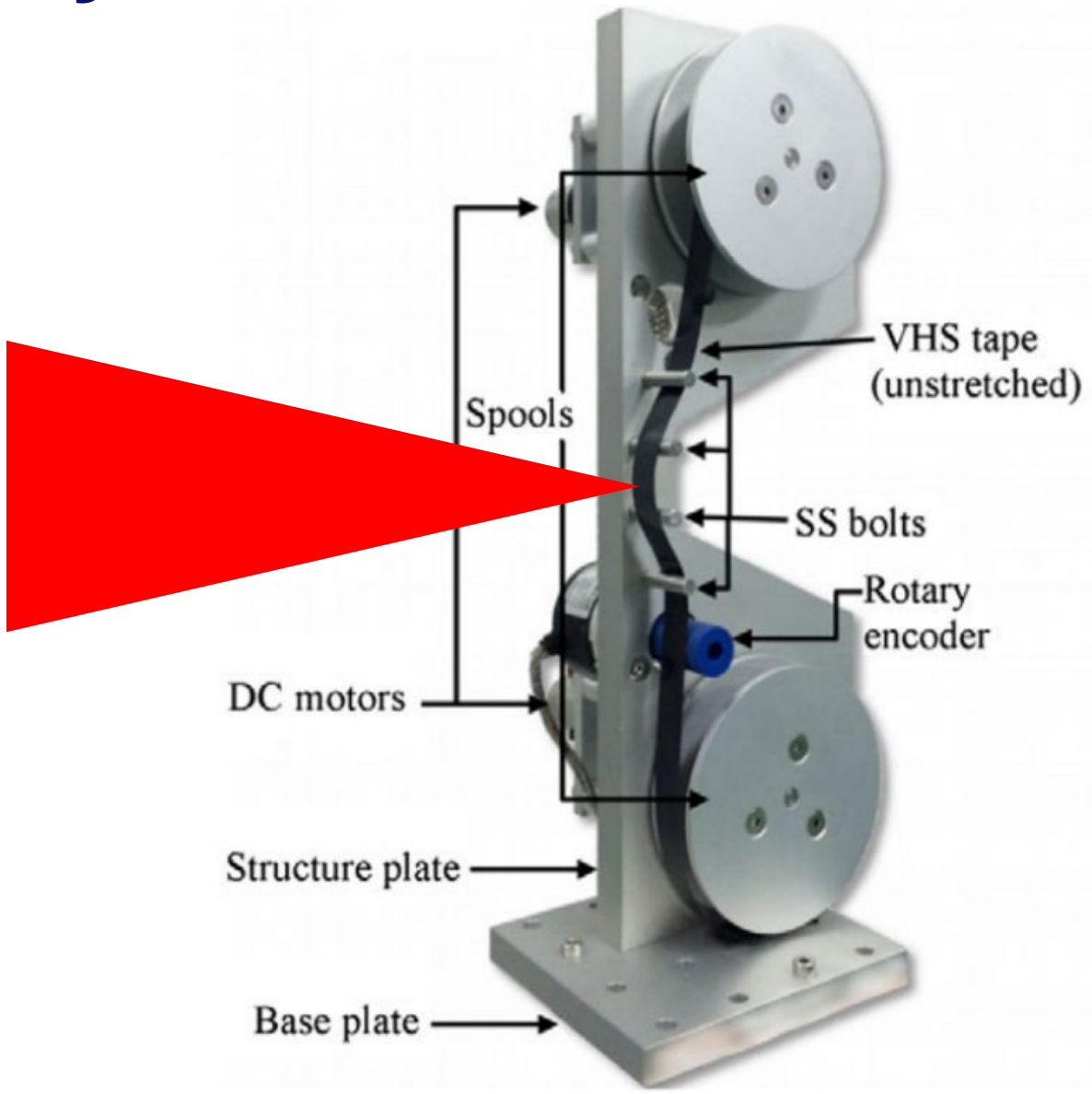


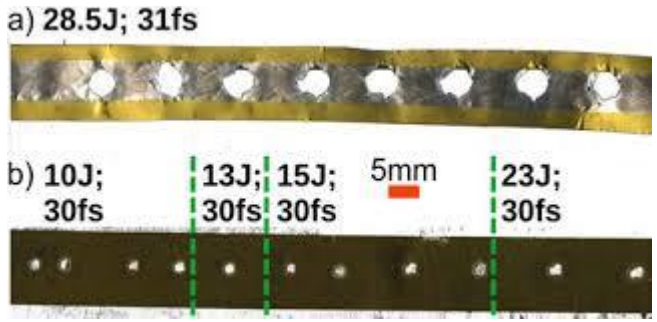




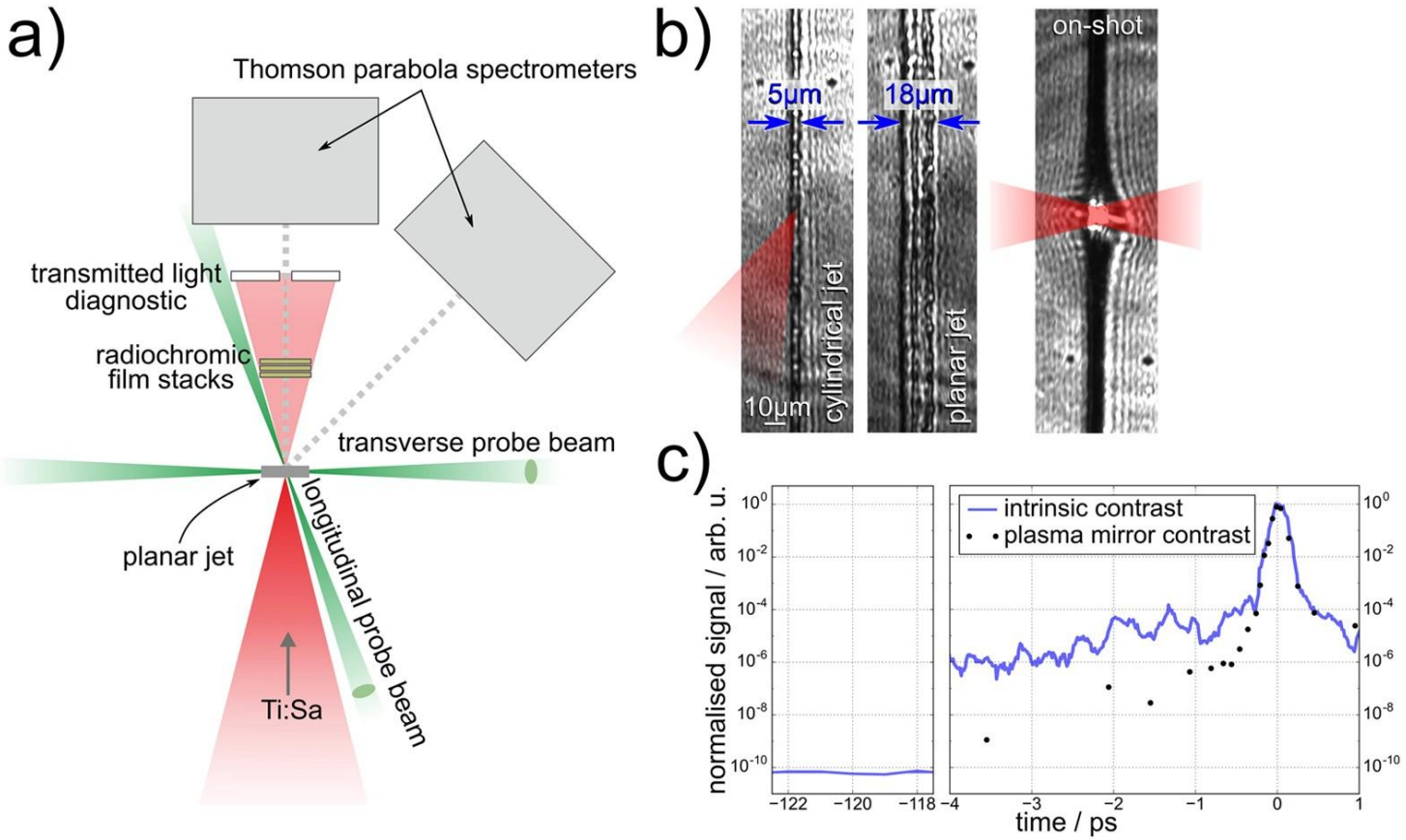


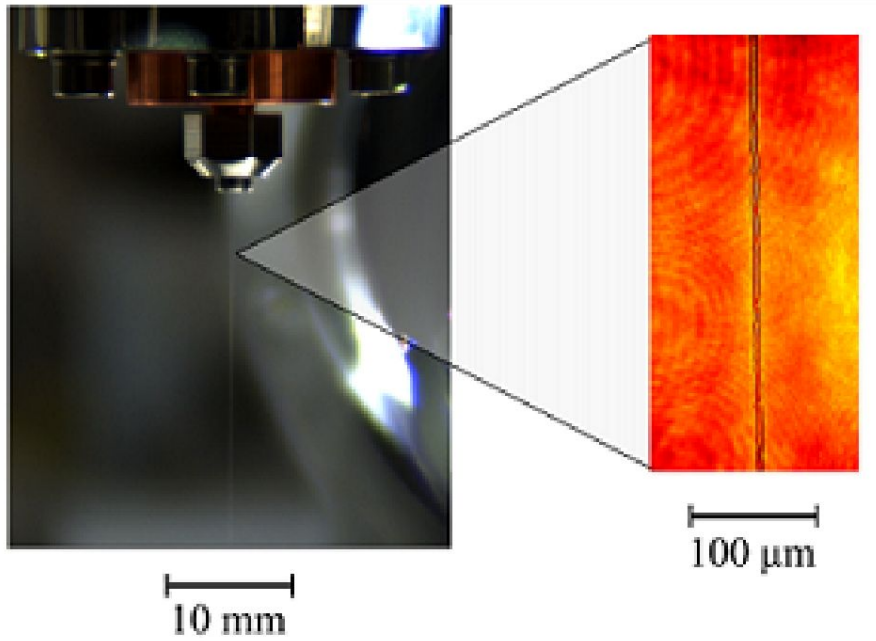
Tape Drive Targets



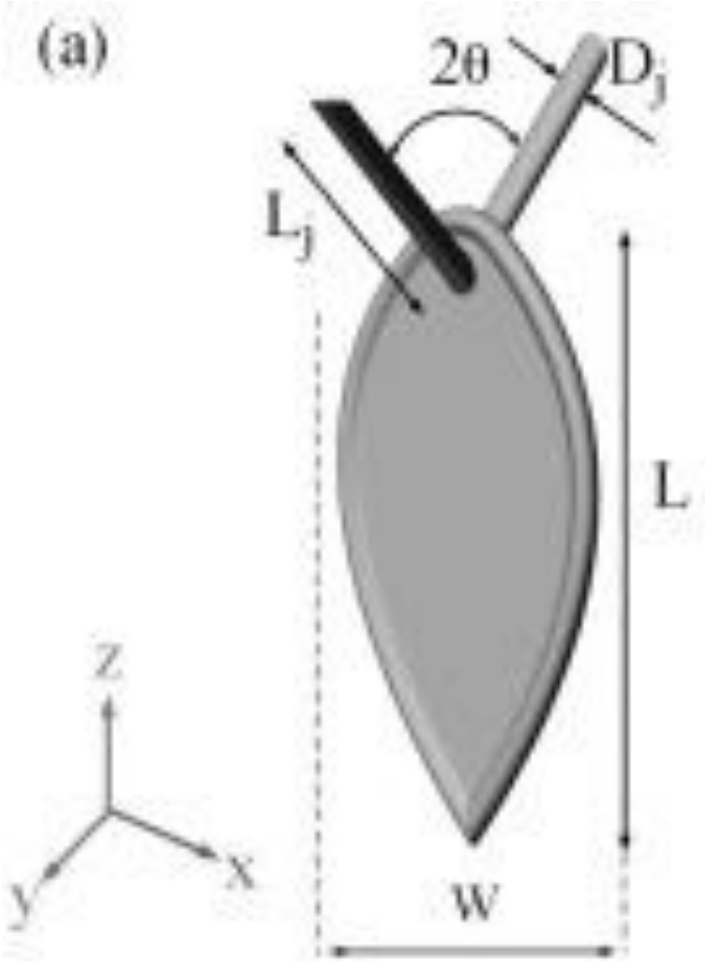


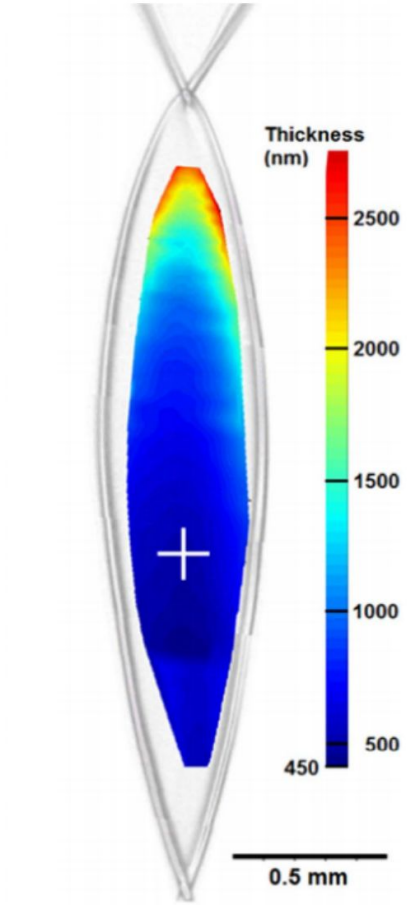
Pure cryogenic Hydrogen target





Laser Targets:
Colliding water jets form Liquid Leaf Target





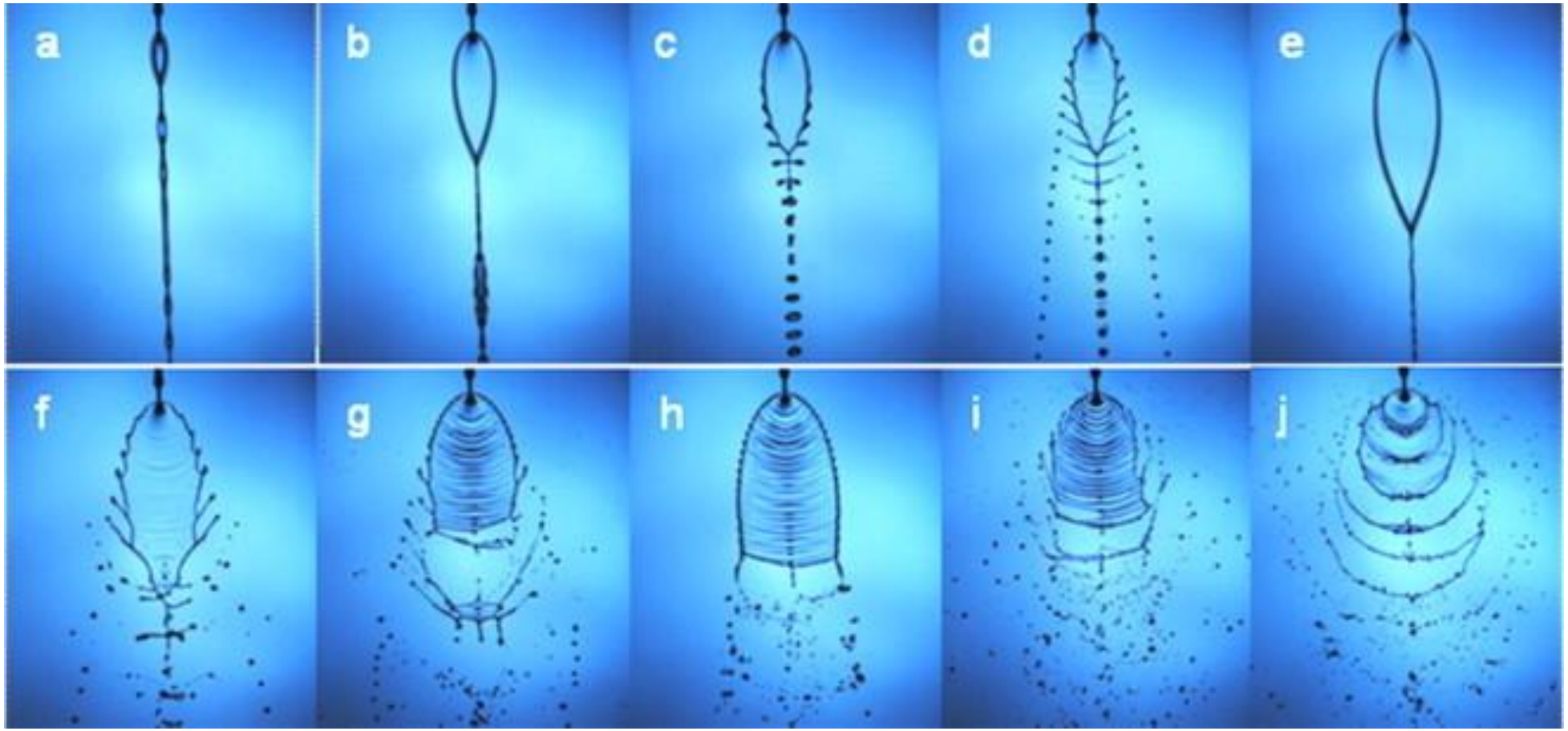
Liquid leaf performance:

- Demonstrated up to 18 MeV
- Have been shown up to kHz at mJ
- Around 1 Hz in J range
- Self rewewing

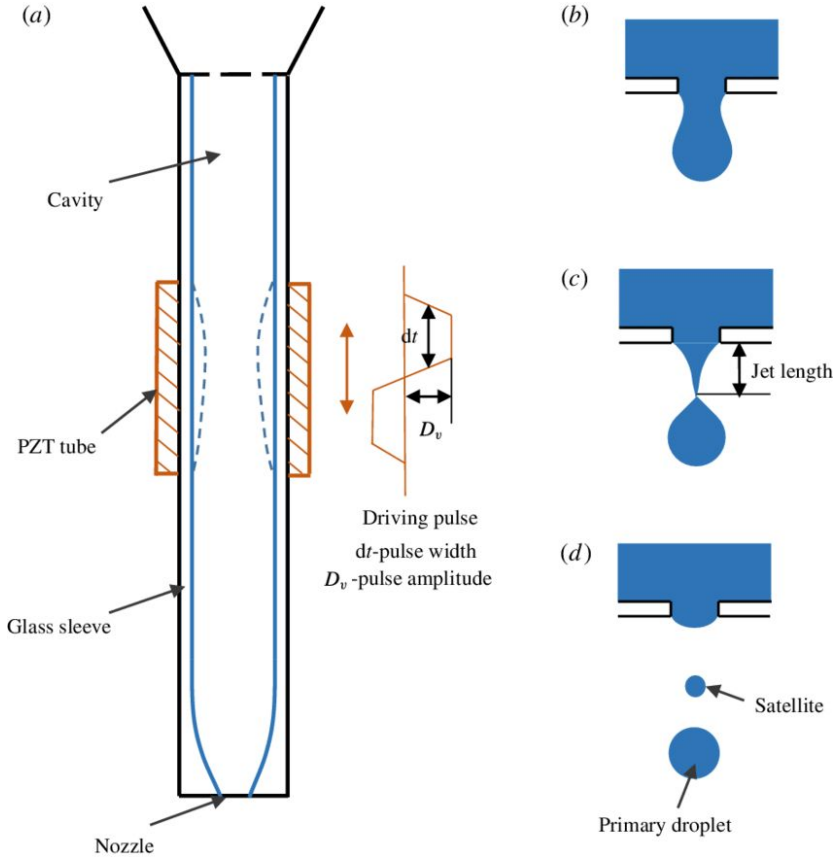
Downsides:

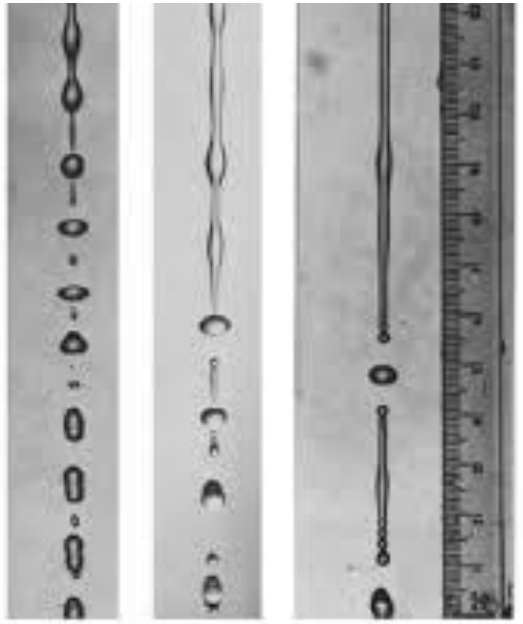
- Outgasing in vacuum
- Tendency to freeze unintentionally
- Start operation in vacuum is still not fully solved

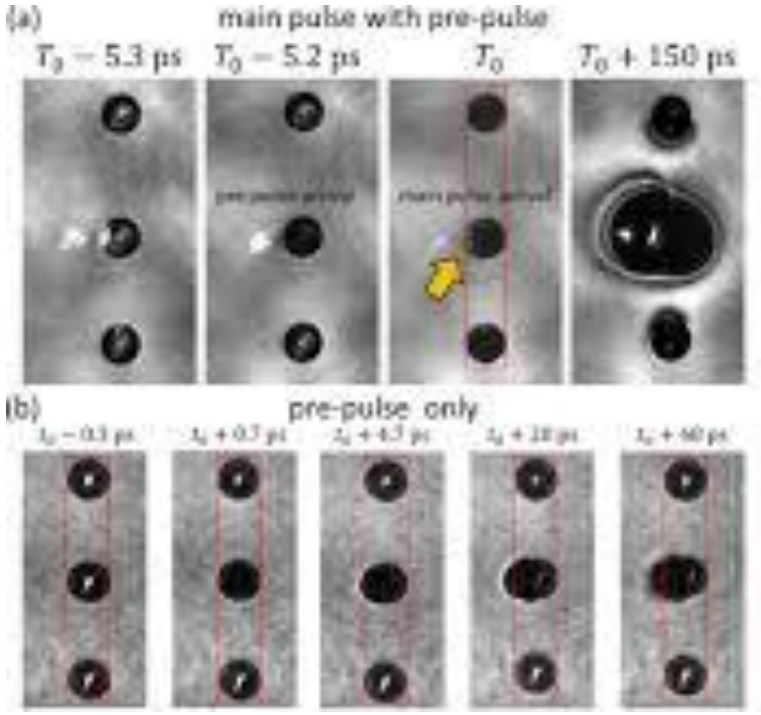
Liquid Leaf Targets:
Stability is not ealily achieved

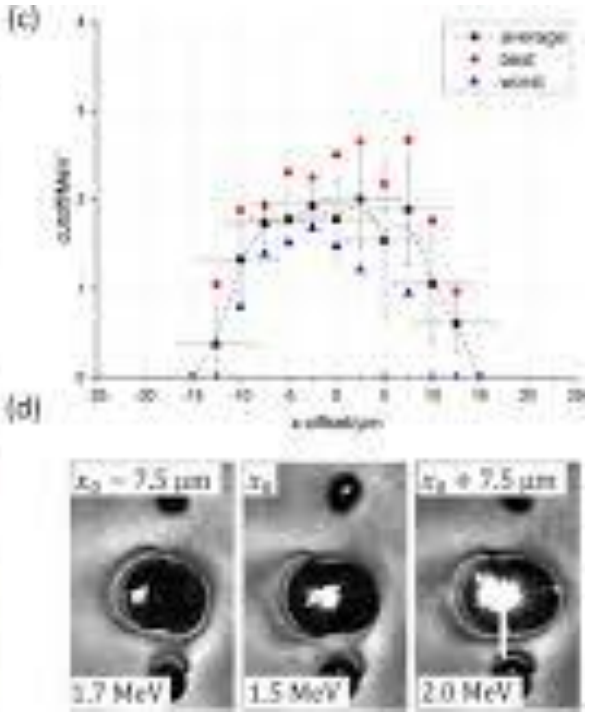


Liquid Droplet Target



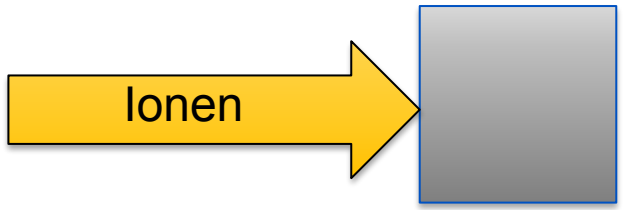




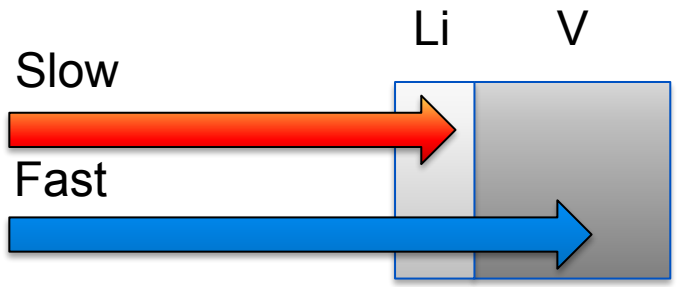


Neutrons on single converter

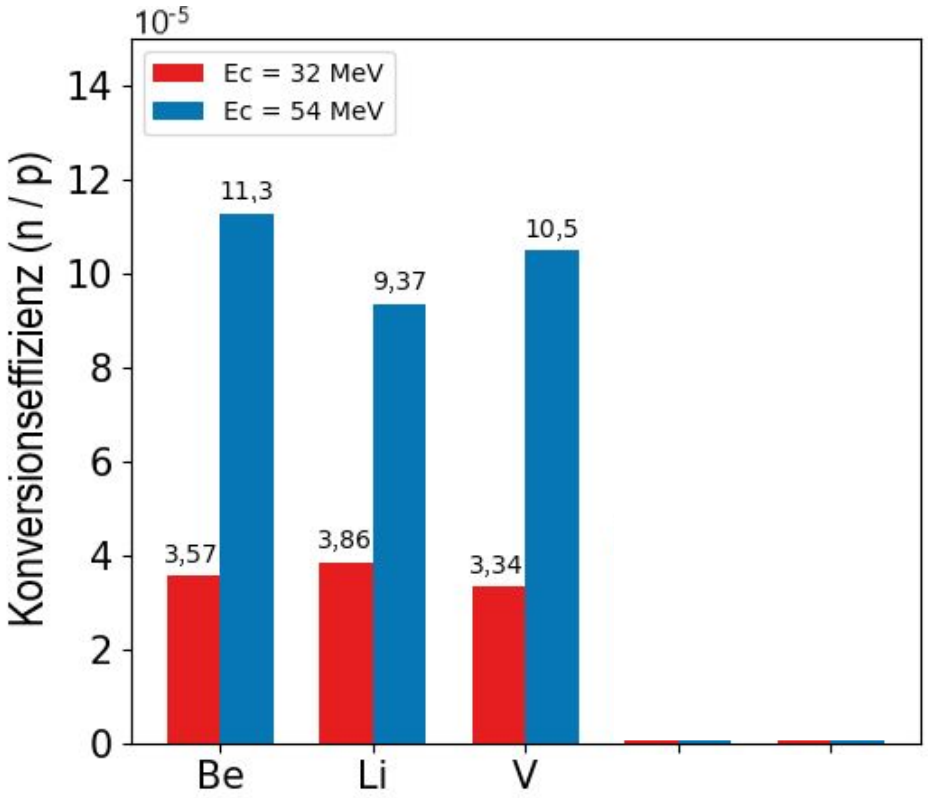
Li, Be oder V



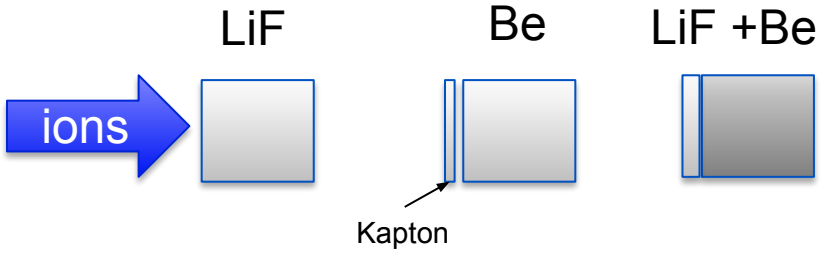
Optimization: Stacked Converter



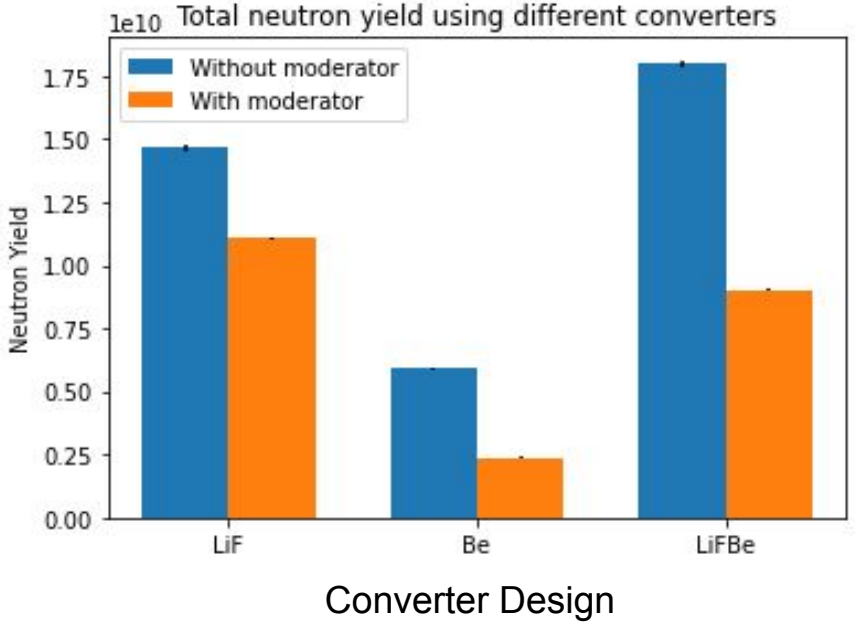
Konversion efficiency for different converters



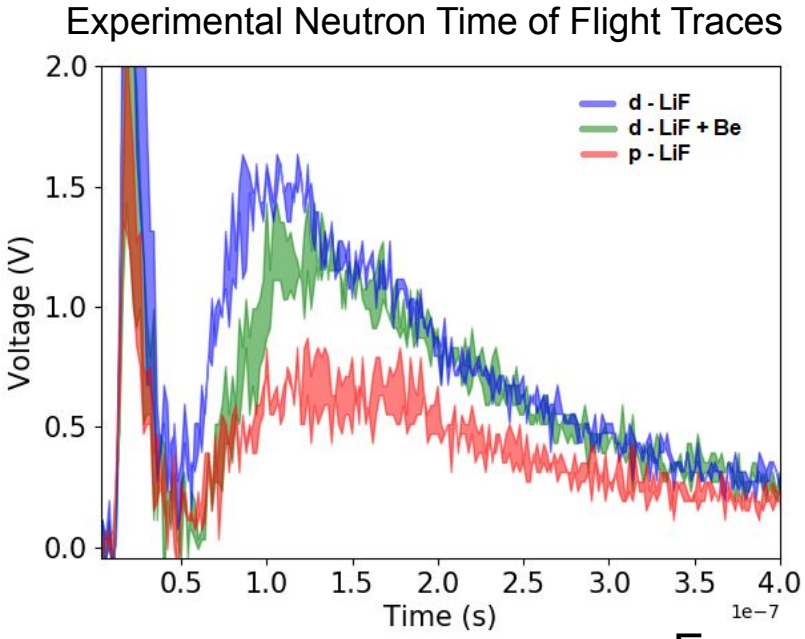
Converter Desing:
Experimental tests at a Laser Facility



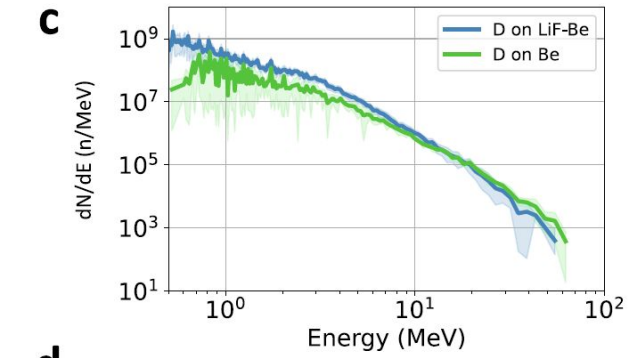
Deuterium on Lithium Flouride produces fastest neutron spectrum

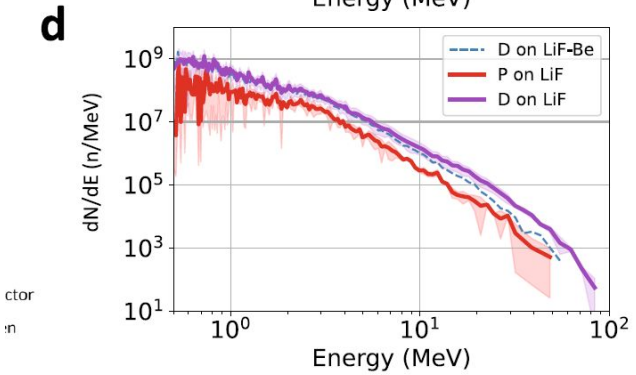


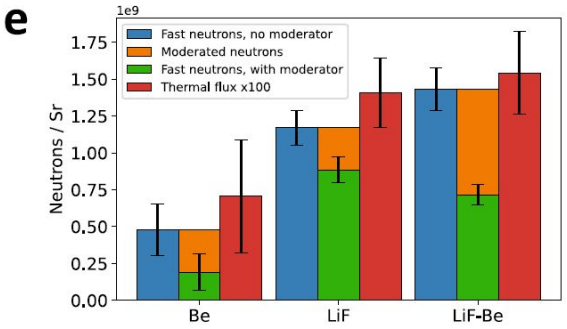
Converter Design



Energy

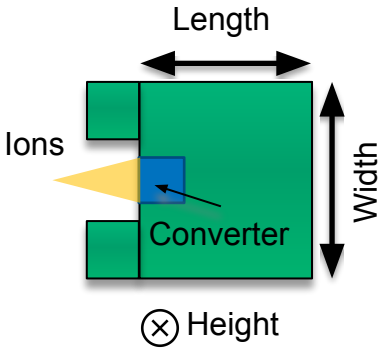






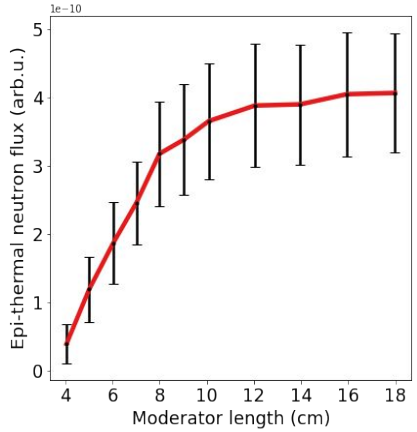
Moderator optimization and source characterization

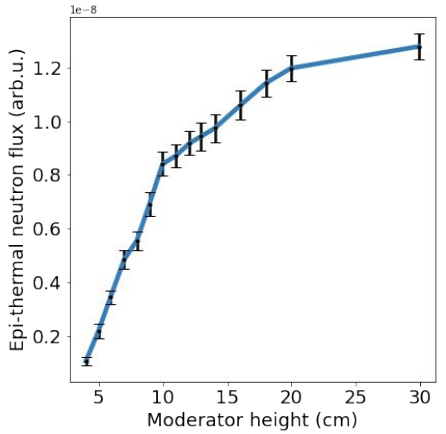
Increasing epi-thermal neutron flux

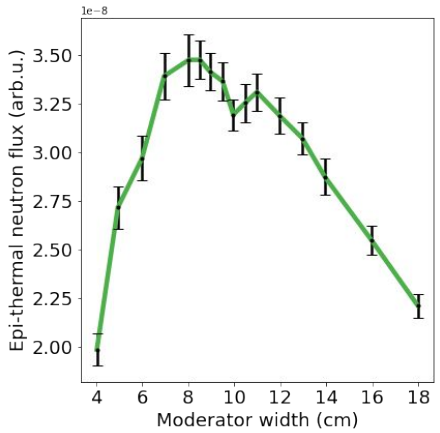


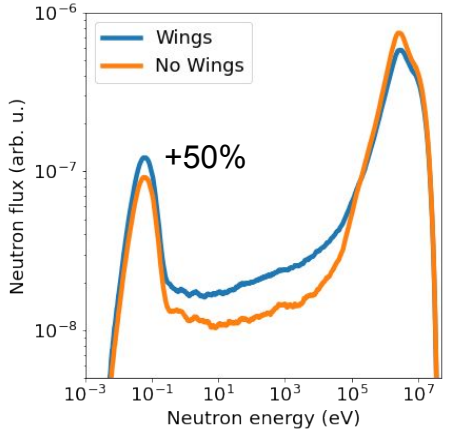
After optimization: 5x increase in epi-thermal flux

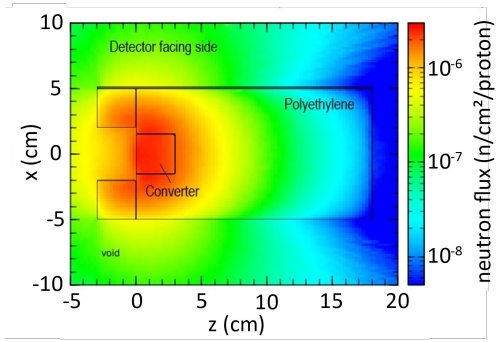
Epi-thermal flux for different moderator dimensions







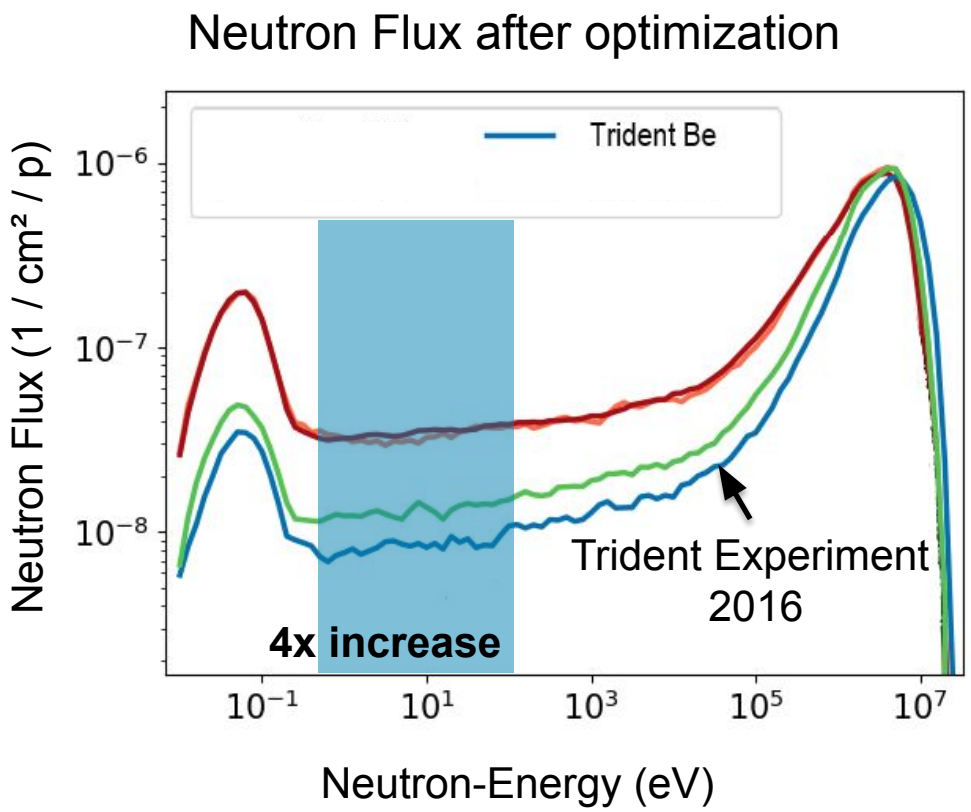


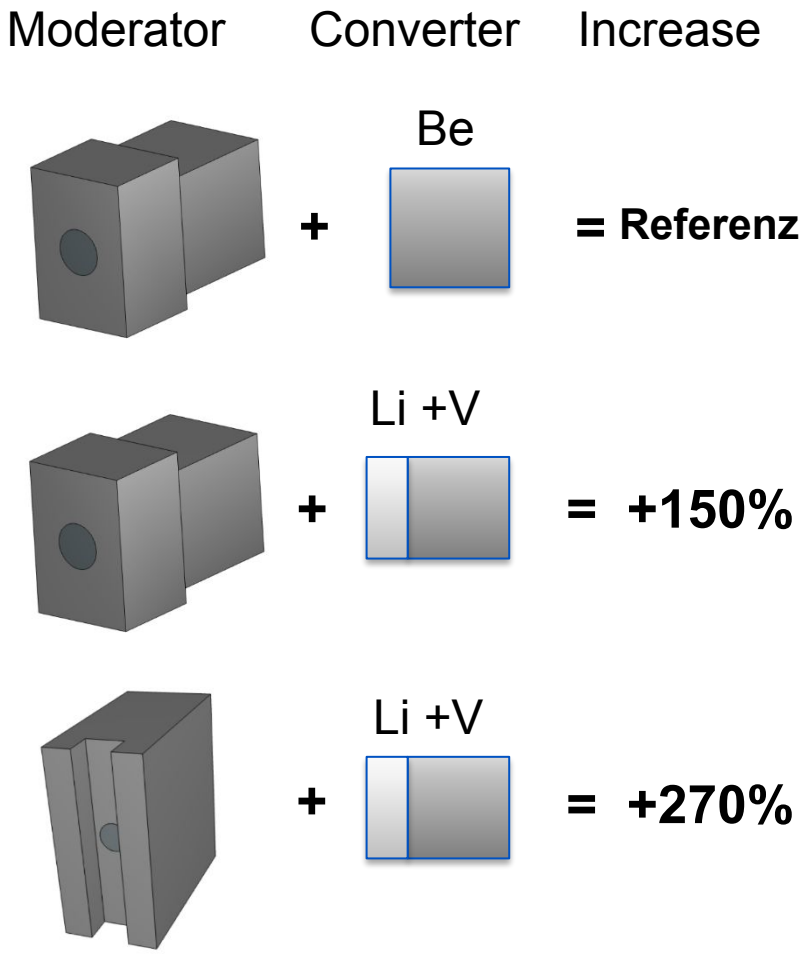


Neutron pulse width

[M. Zimmer, Nature Comm., accepted, 2022]

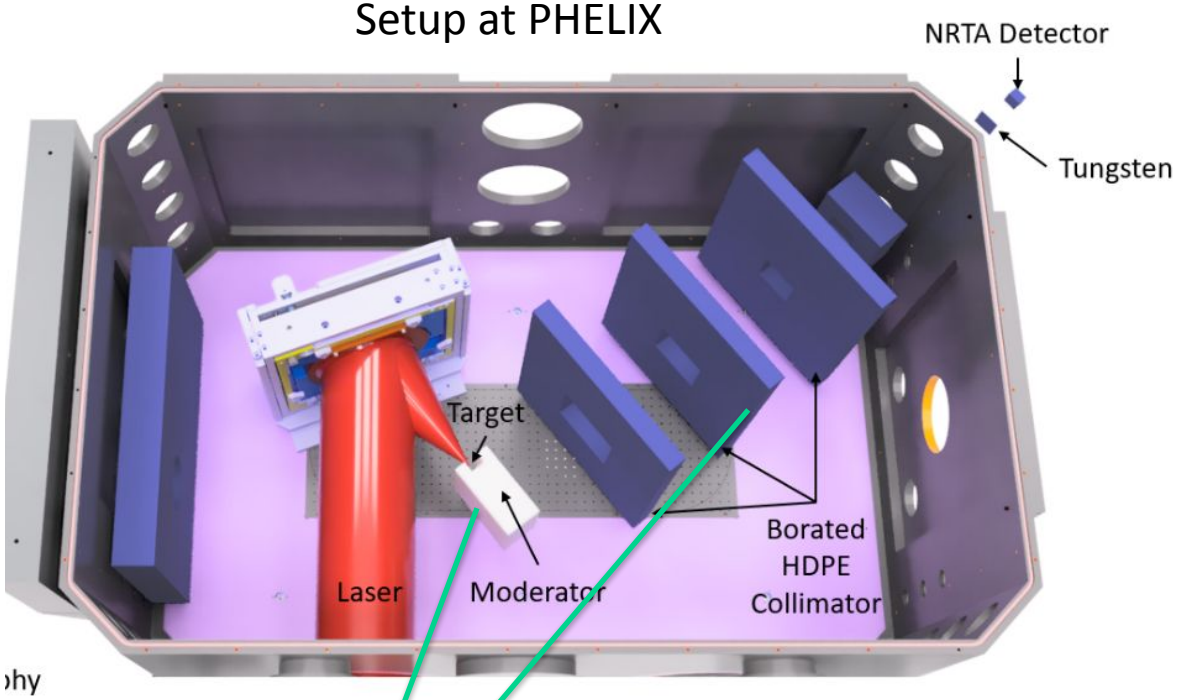
Effects of Neutron setup optimization

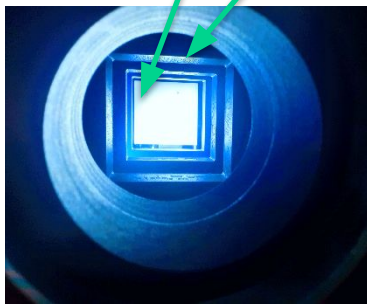




Collimator Design

Setup at PHELIX





View from detector

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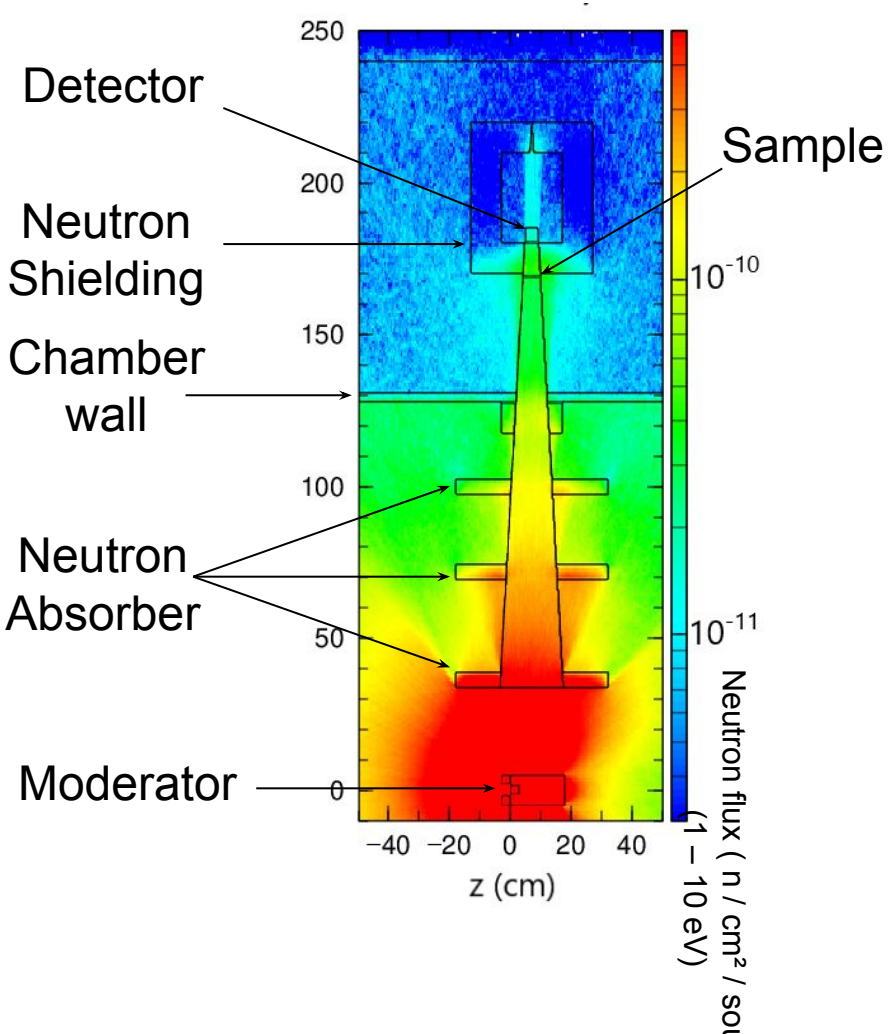
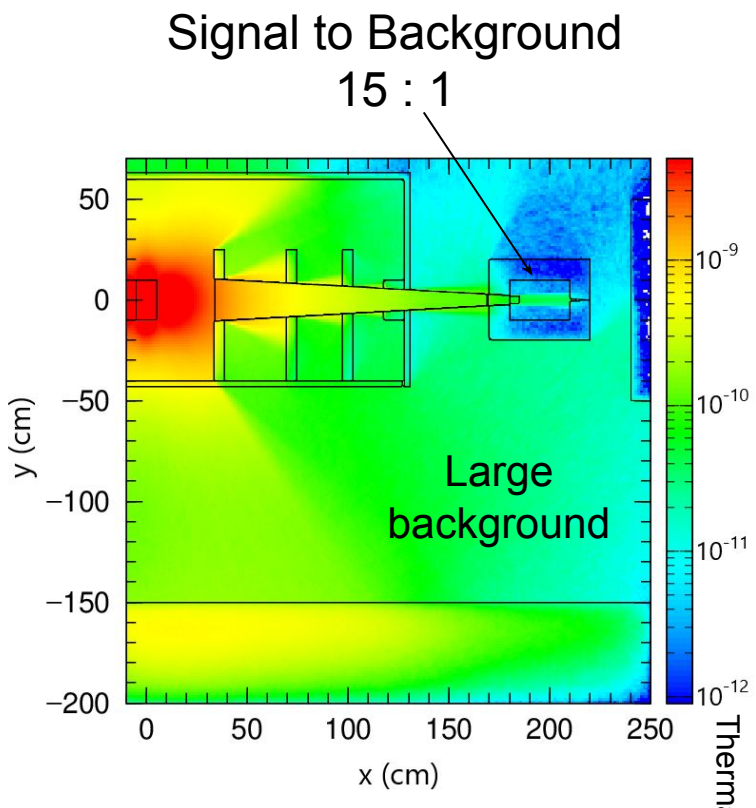
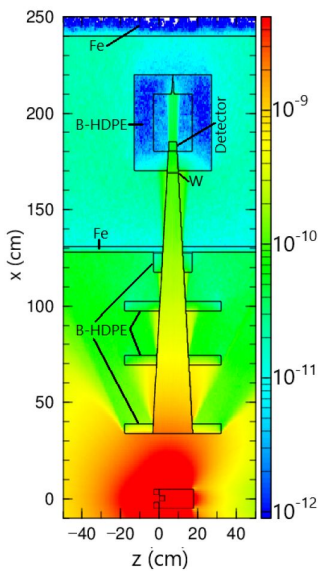
Top view

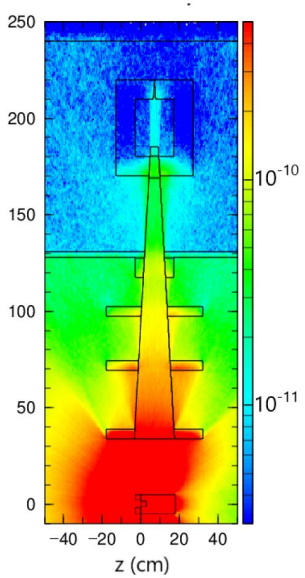


Side view

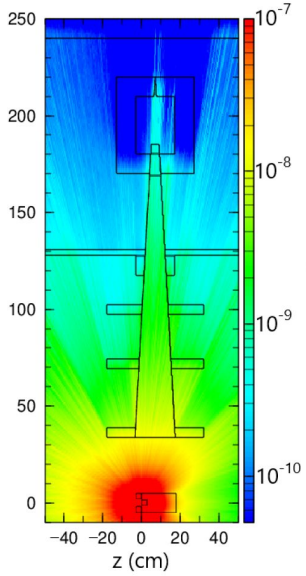




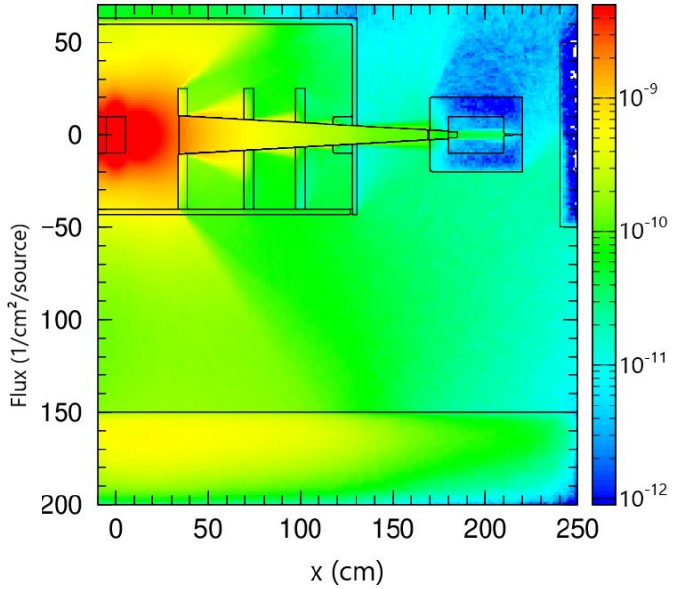
(a) Thermal



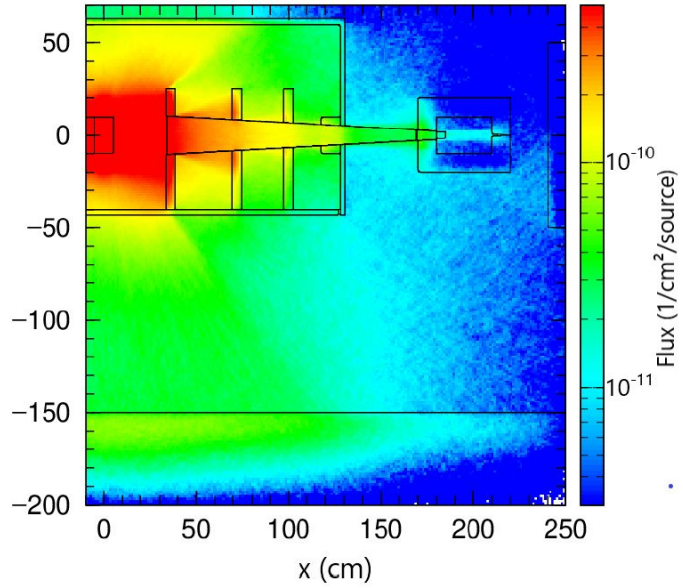
(b) Epi-thermal



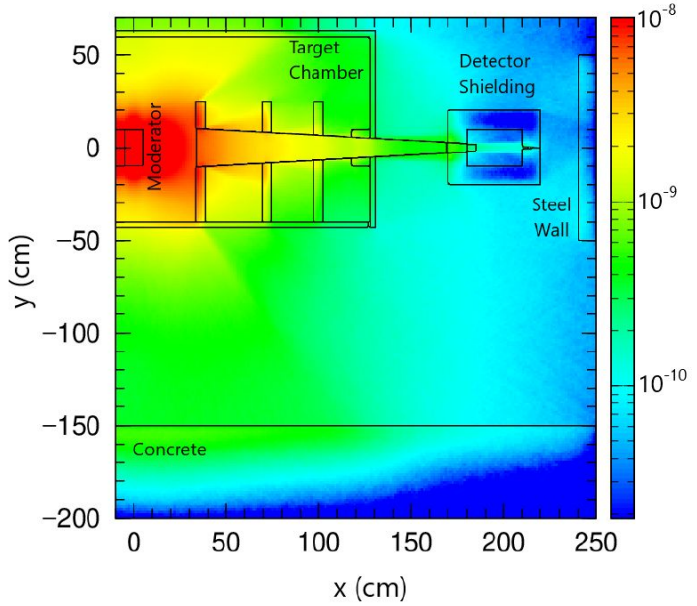
(c) Above 1 MeV



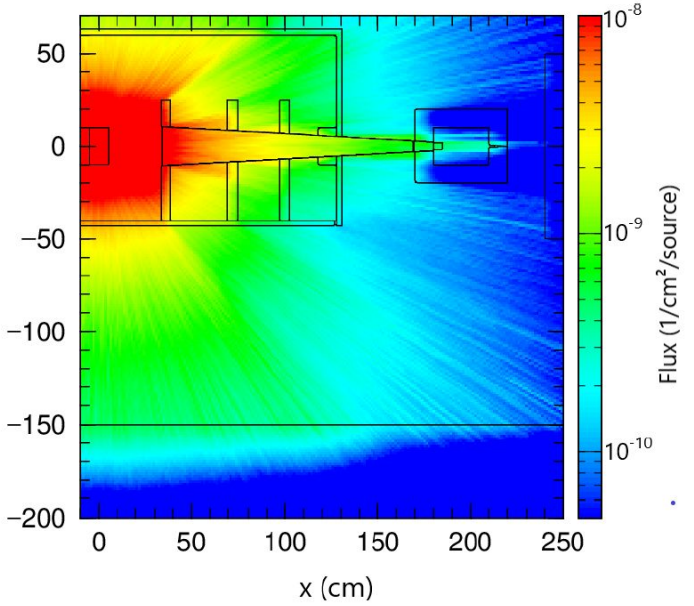
(a) Thermal



(b) Epi-thermal



(c) 10 eV to 1 MeV



(d) Above 1 MeV

Thank you for your attention

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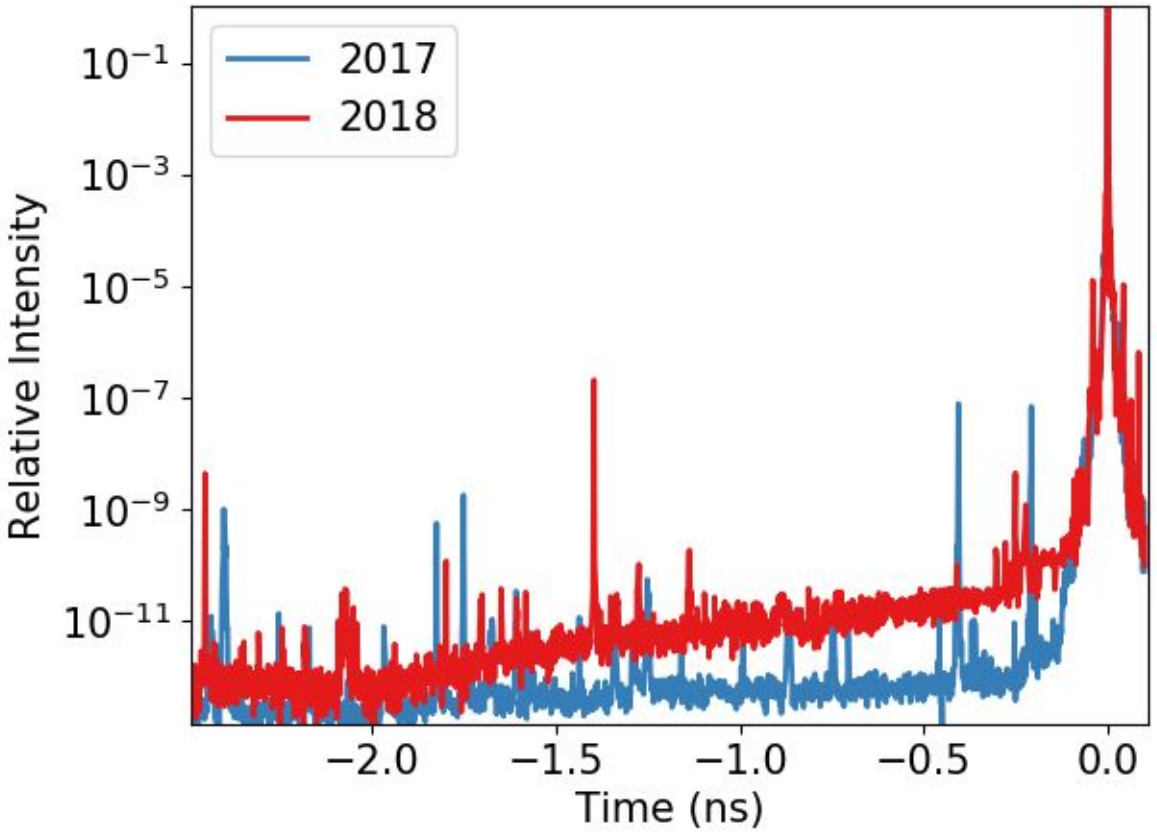

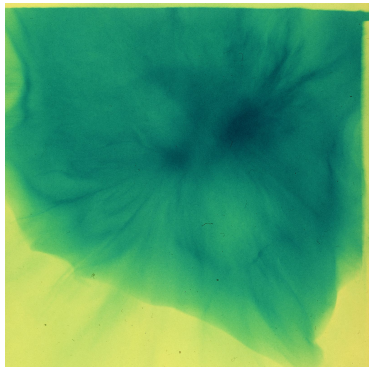

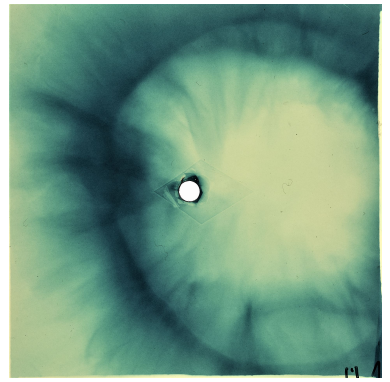

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Ion spectrum is impinging on converter

Li, Be or V

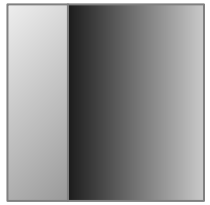
Ions

Utilize benefits from both materials

Li V

Slow

Fast



Conversion Efficiency