LA-UR-15-28926
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Title: Design of the Fifth-Generation Target-Moderator-Reflector-Shield Assembly

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Intended for: Twelfth International Topical Meeting on Nuclear Applications of Accelerators (AccApp'15), 2015-11-10 (Washington DC, District Of Columbia, United States)

Issued: 2015-11-16

Design of the Fifth-Generation Target-Moderator-Reflector-Shield Assembly

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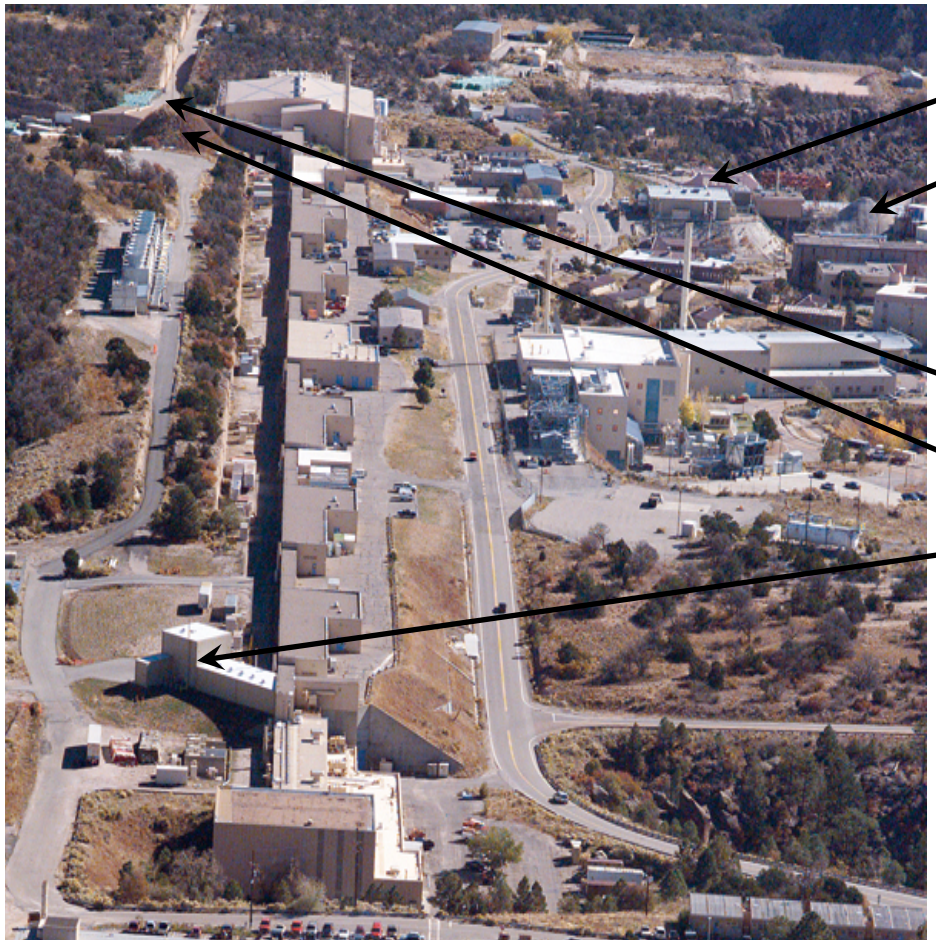
LANSCE Weapon Physics Group

13 Nov. 2015

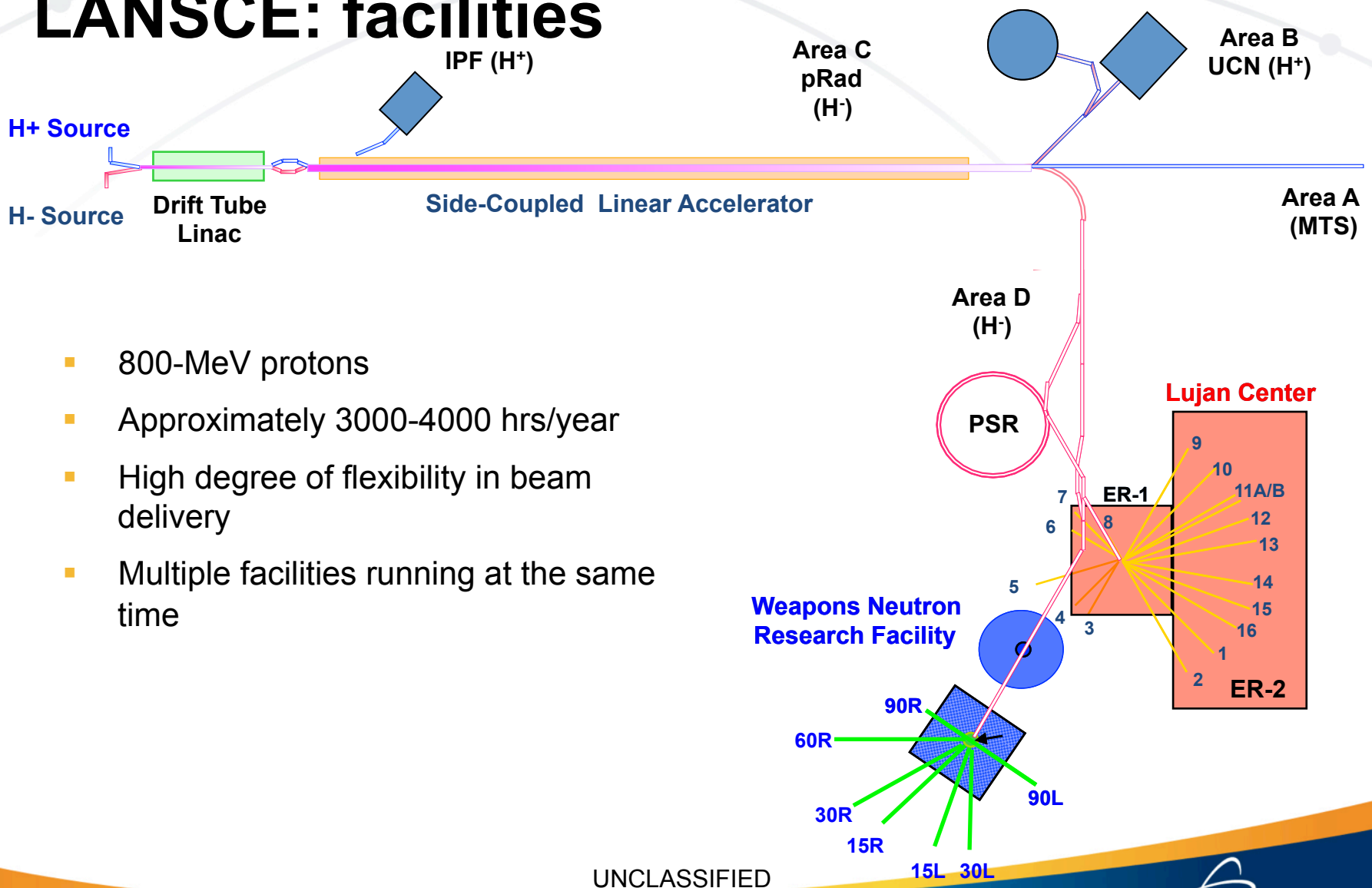
LANSCE: introduction



- Los Alamos Neutron Science CEnter
- Lujan Center
- WNR facility

- **Ultra Cold Neutron source**
- **Proton RADiography**
- **Isotope Production Facility**

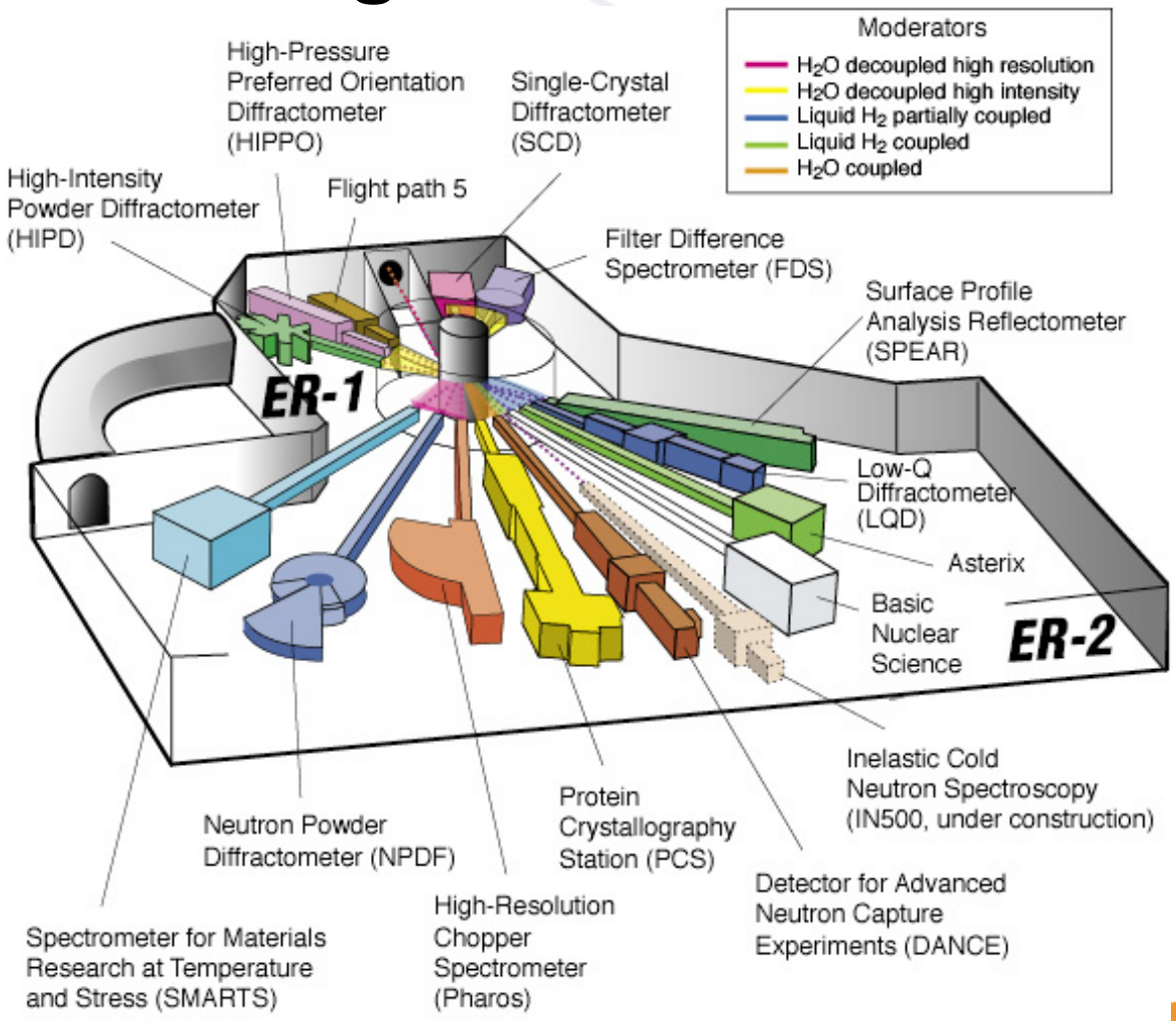
LANSCE: facilities



- 800-MeV protons
- Approximately 3000-4000 hrs/year
- High degree of flexibility in beam delivery
- Multiple facilities running at the same time

Lujan Center: 1L target

- Complex TMRS system
- Split solid tungsten target
- 6 moderators (4+2)
- 16 neutron FPs
- Average 100 μA

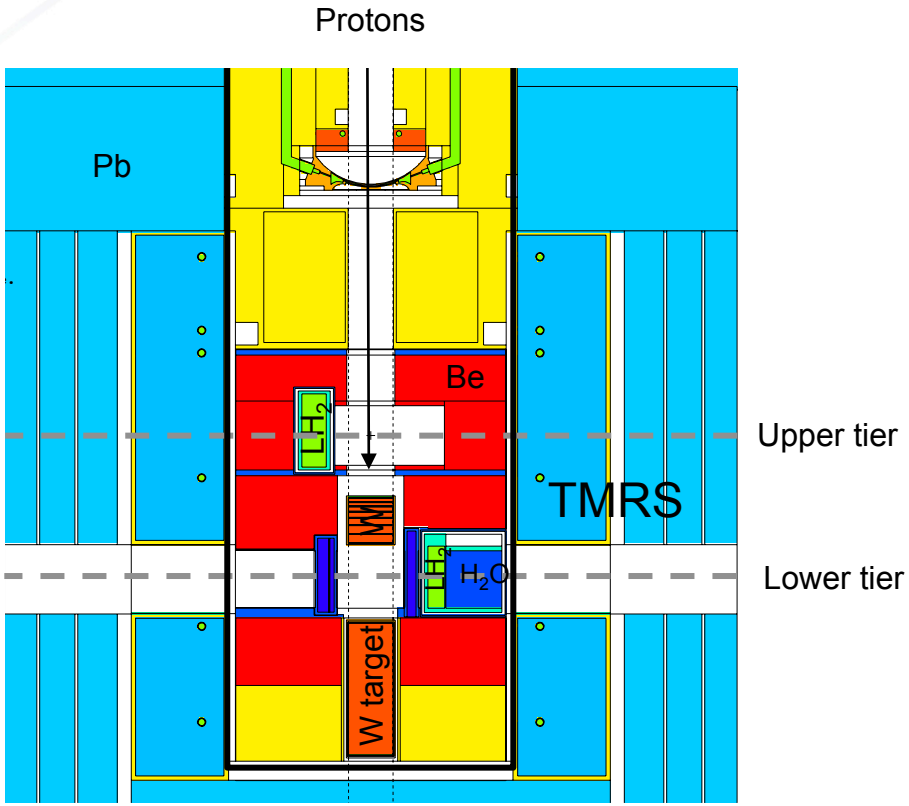


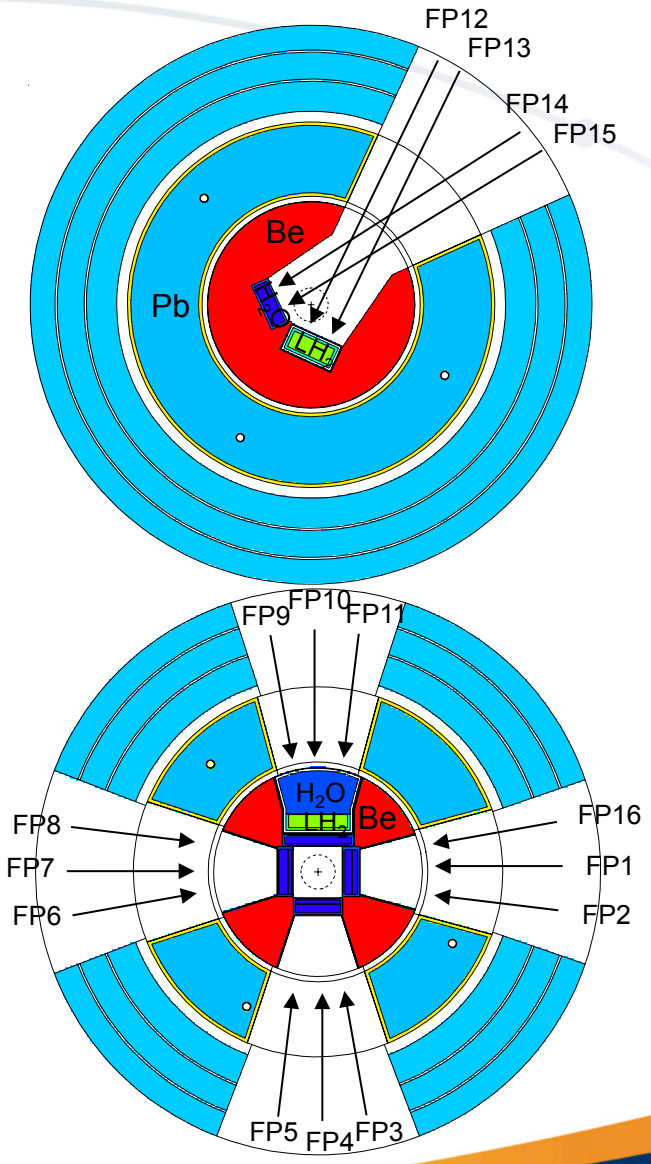
Motivation

- Change of program direction from basic energy science to defense program applications such as nuclear science.
- The target is being redesigned so that the Flight Paths (FP) in the upper tier provide a higher intensity in the epithermal and medium energy range.

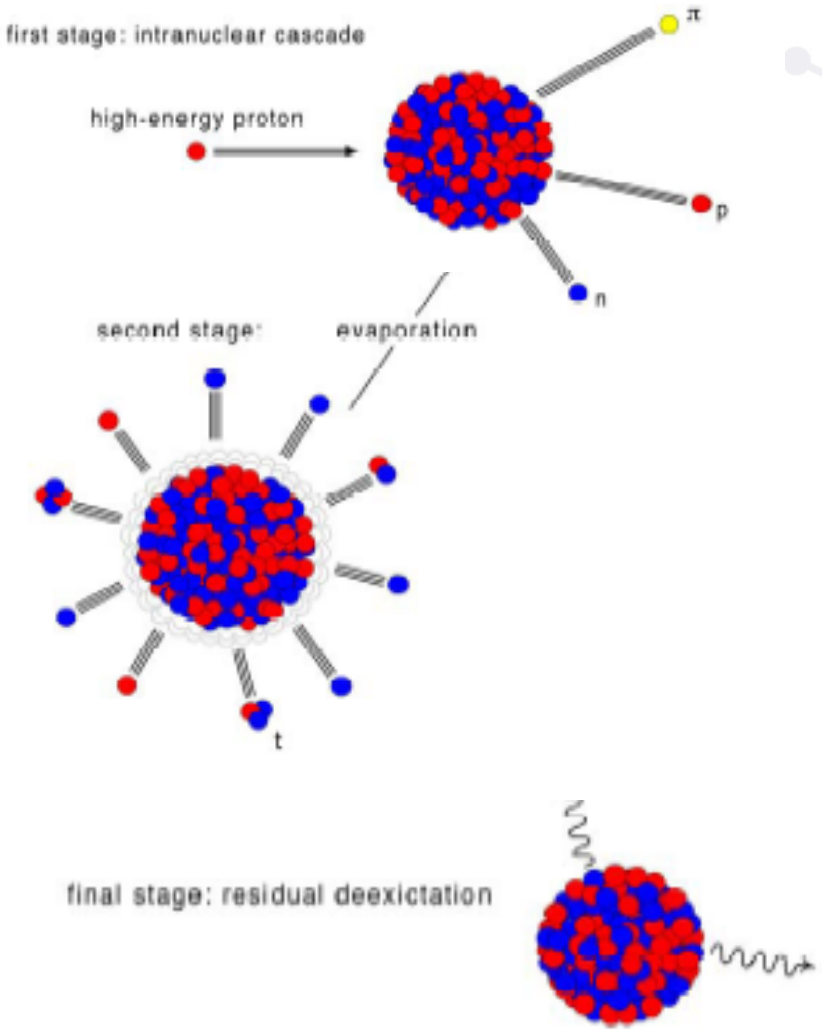
	Energy ranges
Cold neutrons	< 5 meV
Thermal neutrons	5 meV - 0.4 eV
Low energy range	0.4 eV – 100 eV
Epithermal energy range	100 eV -10 keV
Medium energy range	10 keV – 1 MeV
Fast energy range	1 – 100 MeV

Current design: Mark III



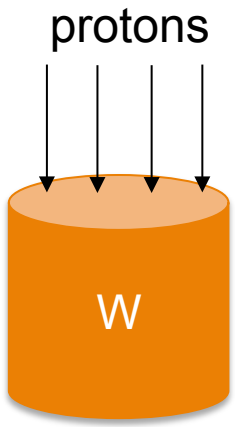


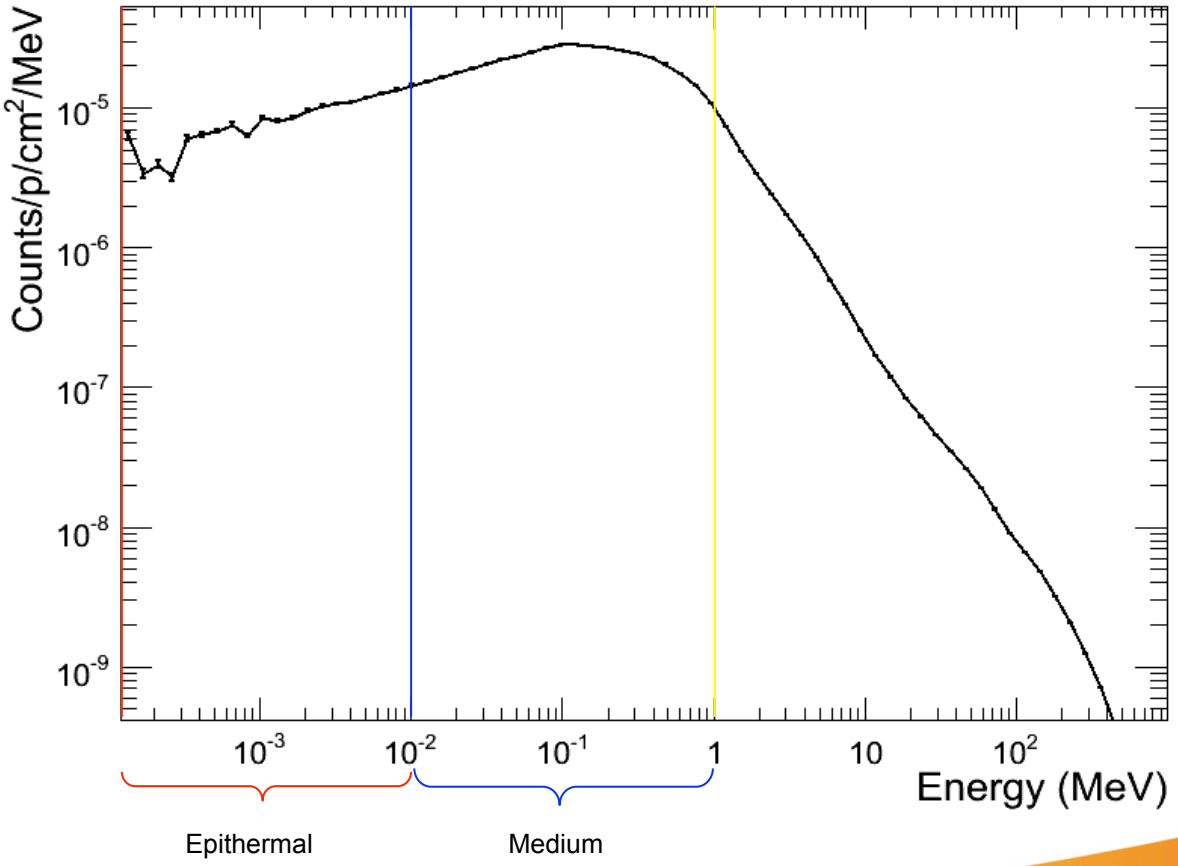
Spallation process



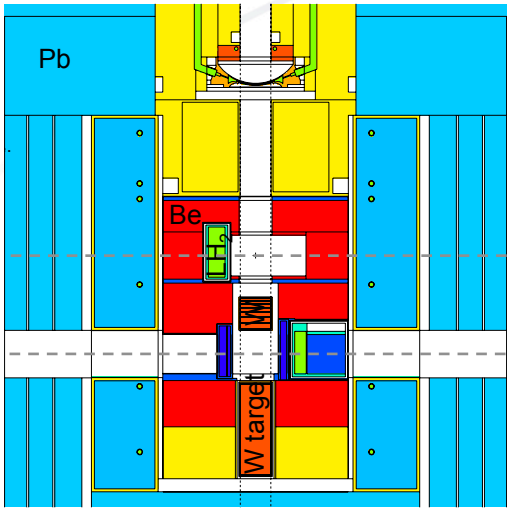
- Typically light energetic projectile impinging onto a heavy nucleus forcing it to disintegrate
  - Neutron production
  - Transmutation (waste or RI production)
- Understanding
  - Projectile nuclear cascade (~10^{-23} s)
  - Evaporation of excited residues (~10^{-17} s)

Raw spallation spectrum

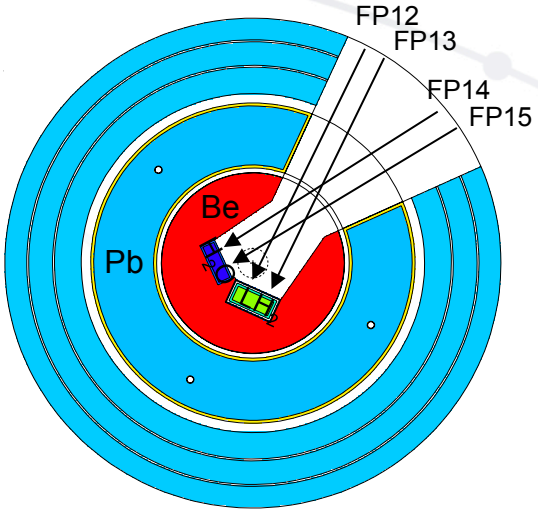


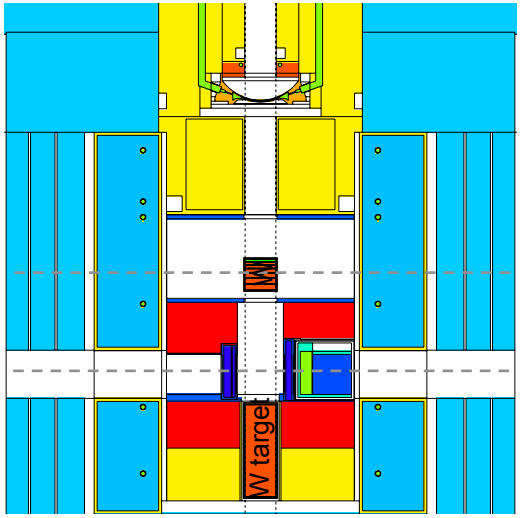


Proposed Design

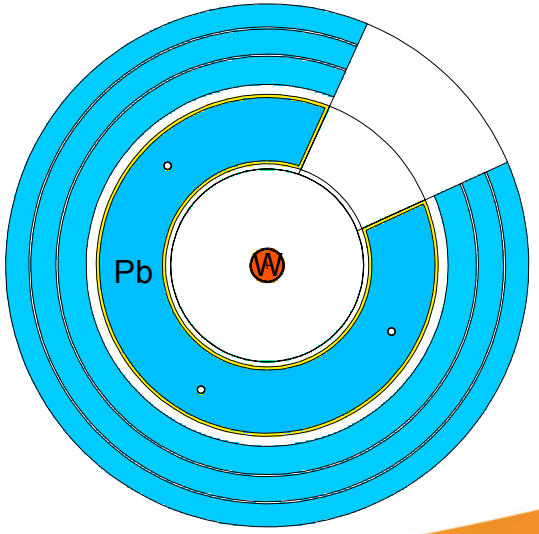


Current design



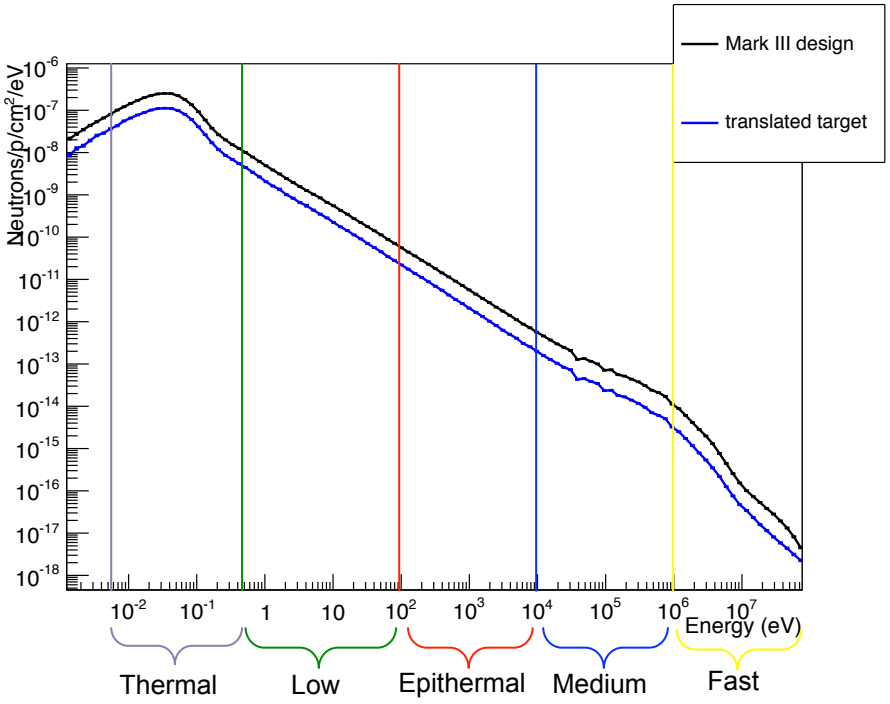


- LH_2 and H_2O moderators removed
- W target was translated

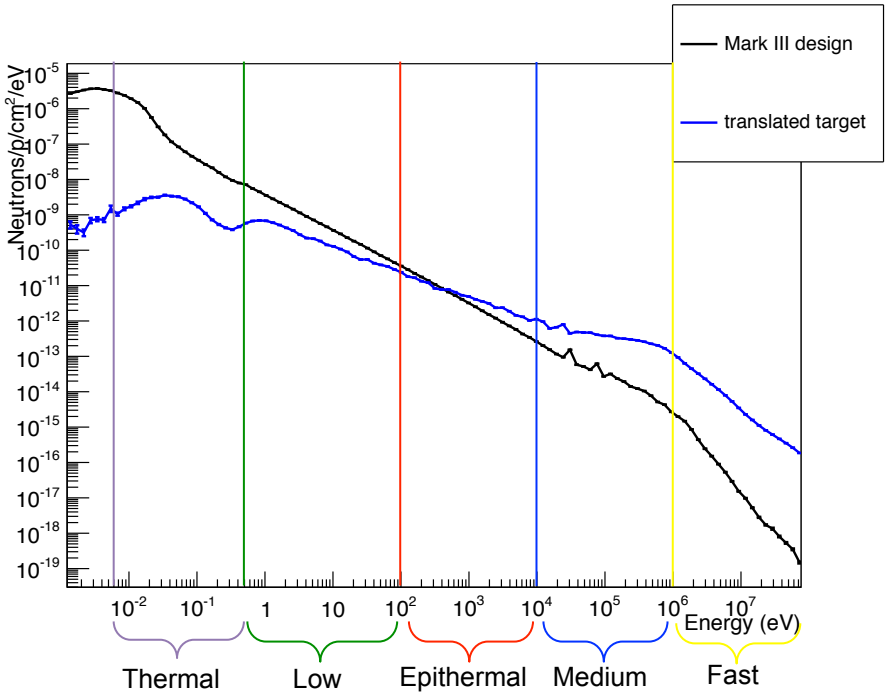


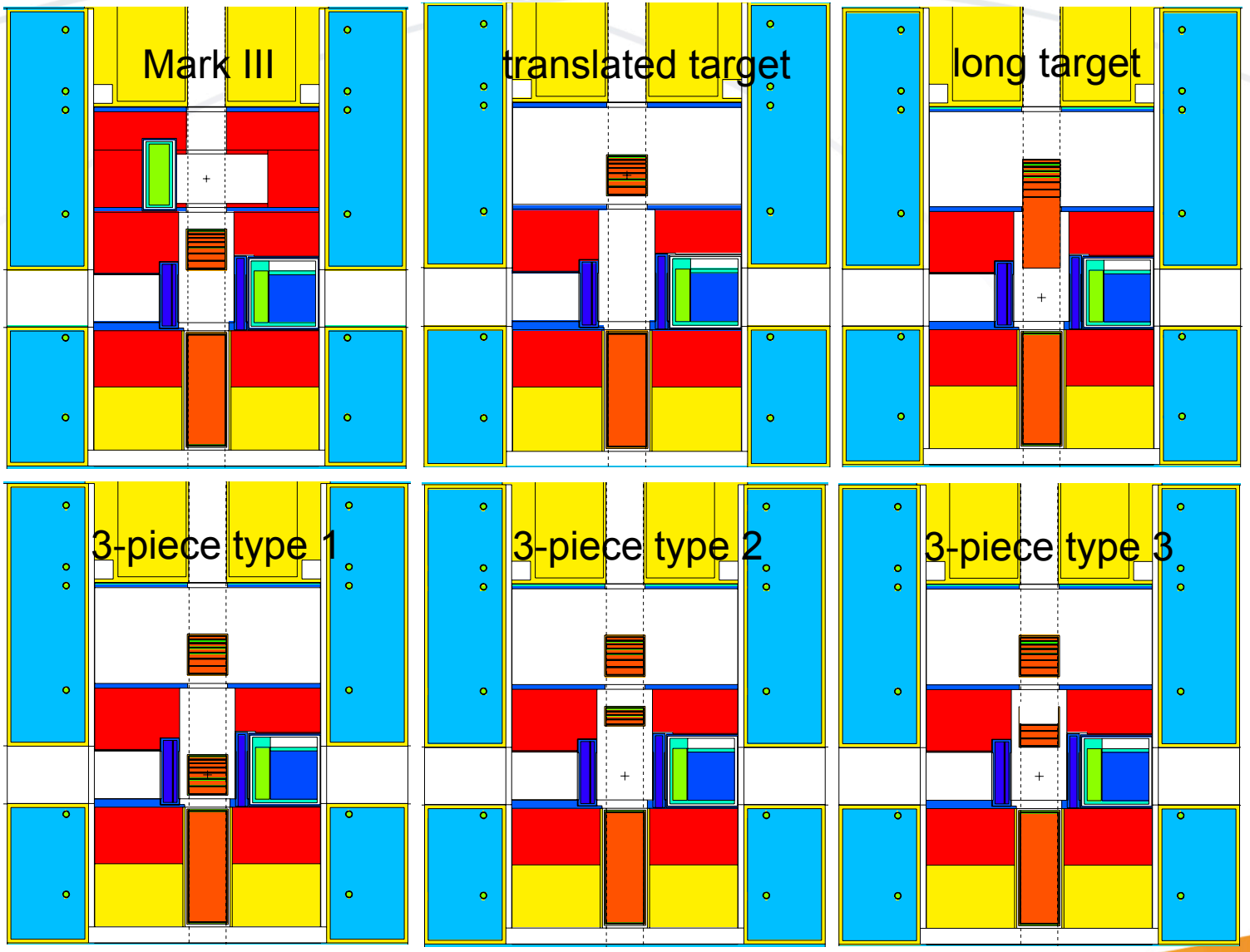
Neutron intensity results

lower tier

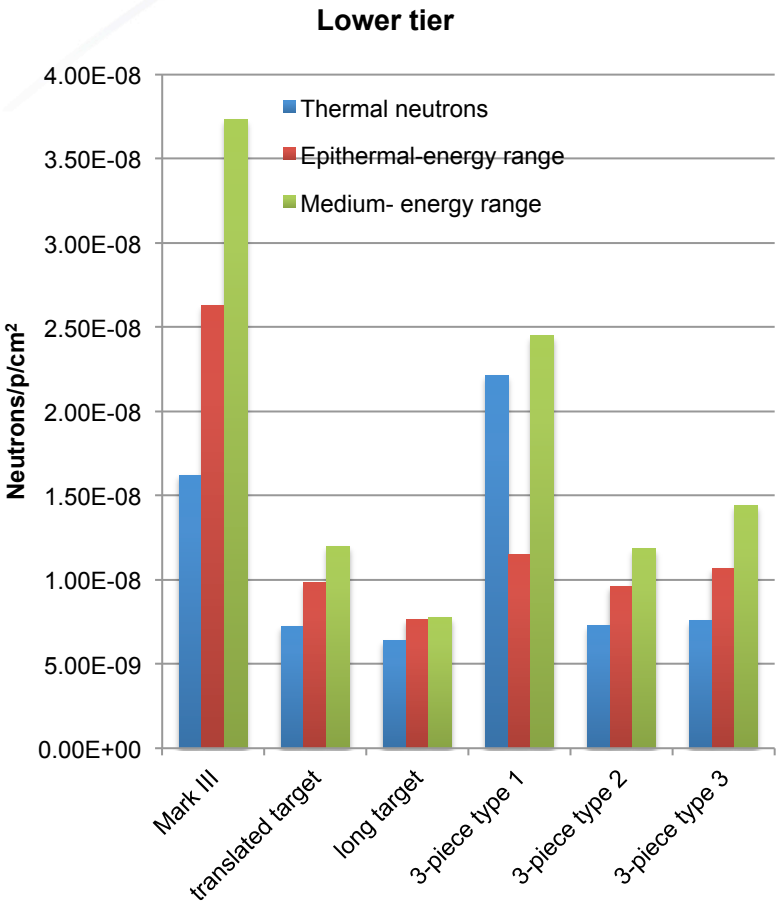


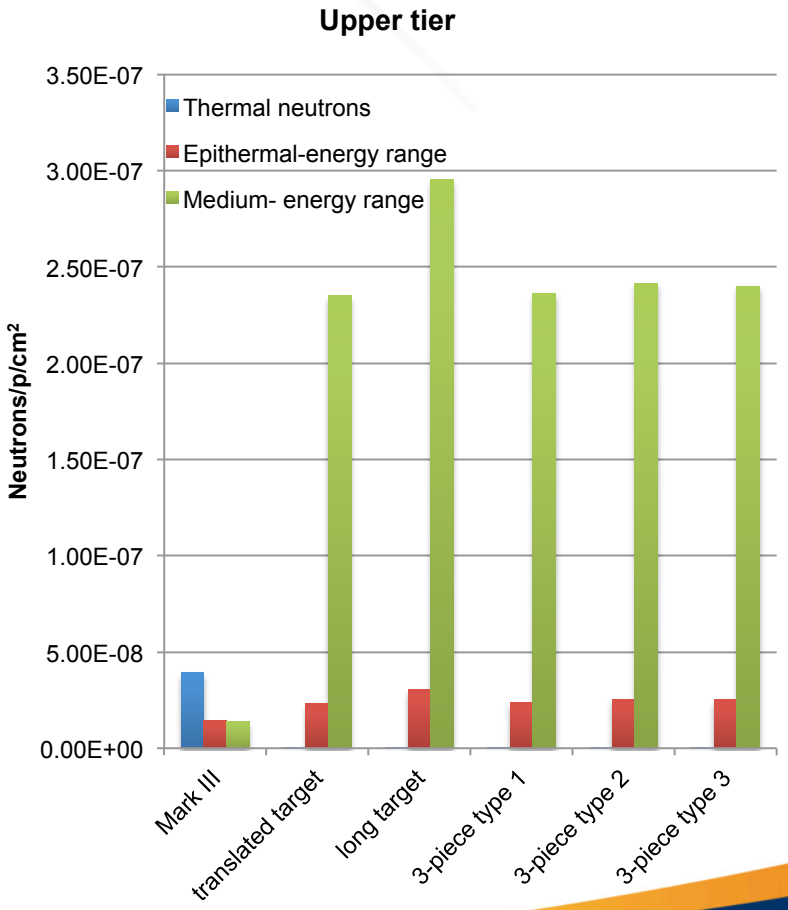
upper tier




Mark III
translated target
long target
3-piece type 1
3-piece type 2
3-piece type 3

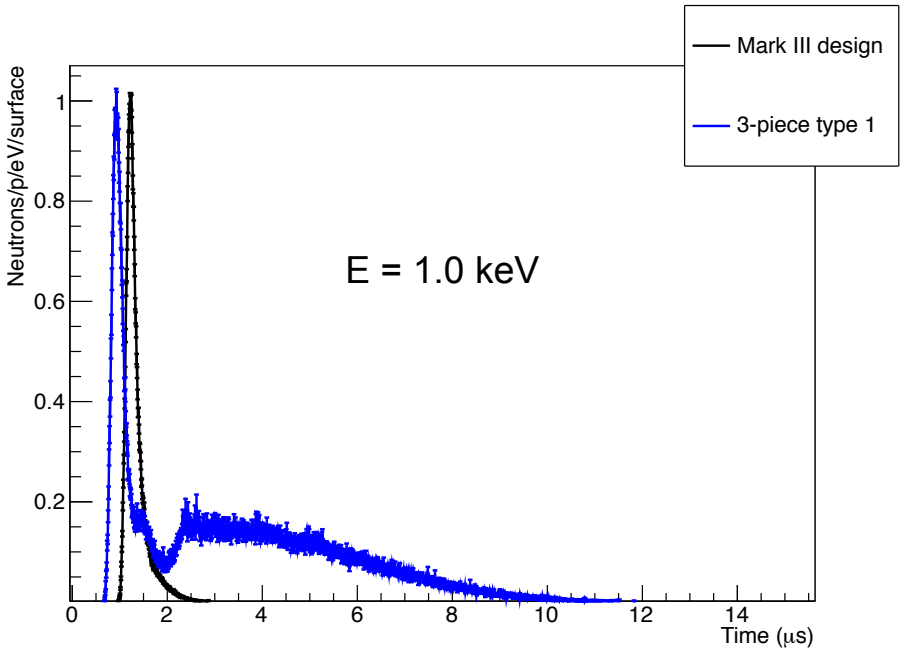
Integral results

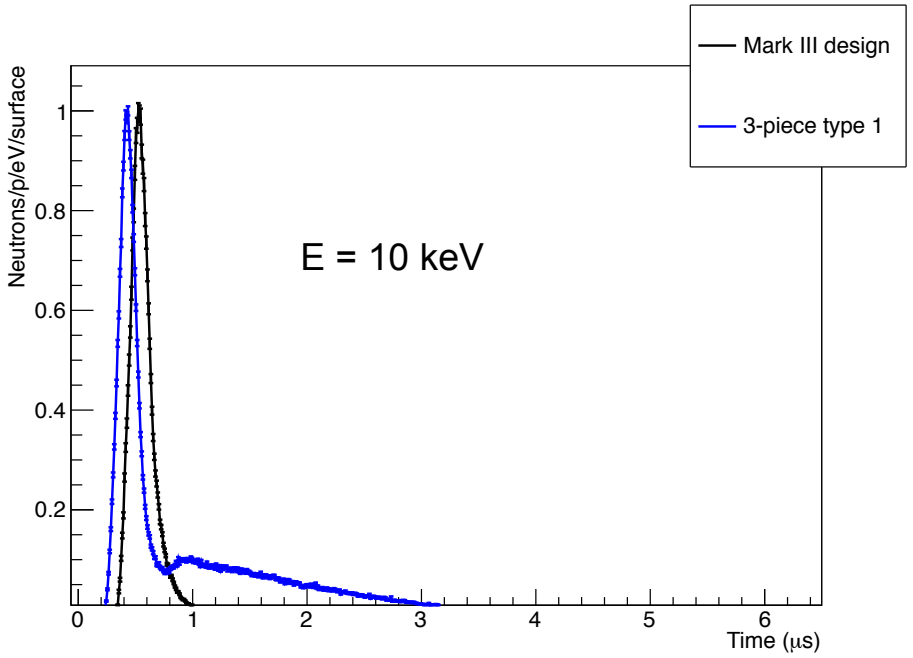




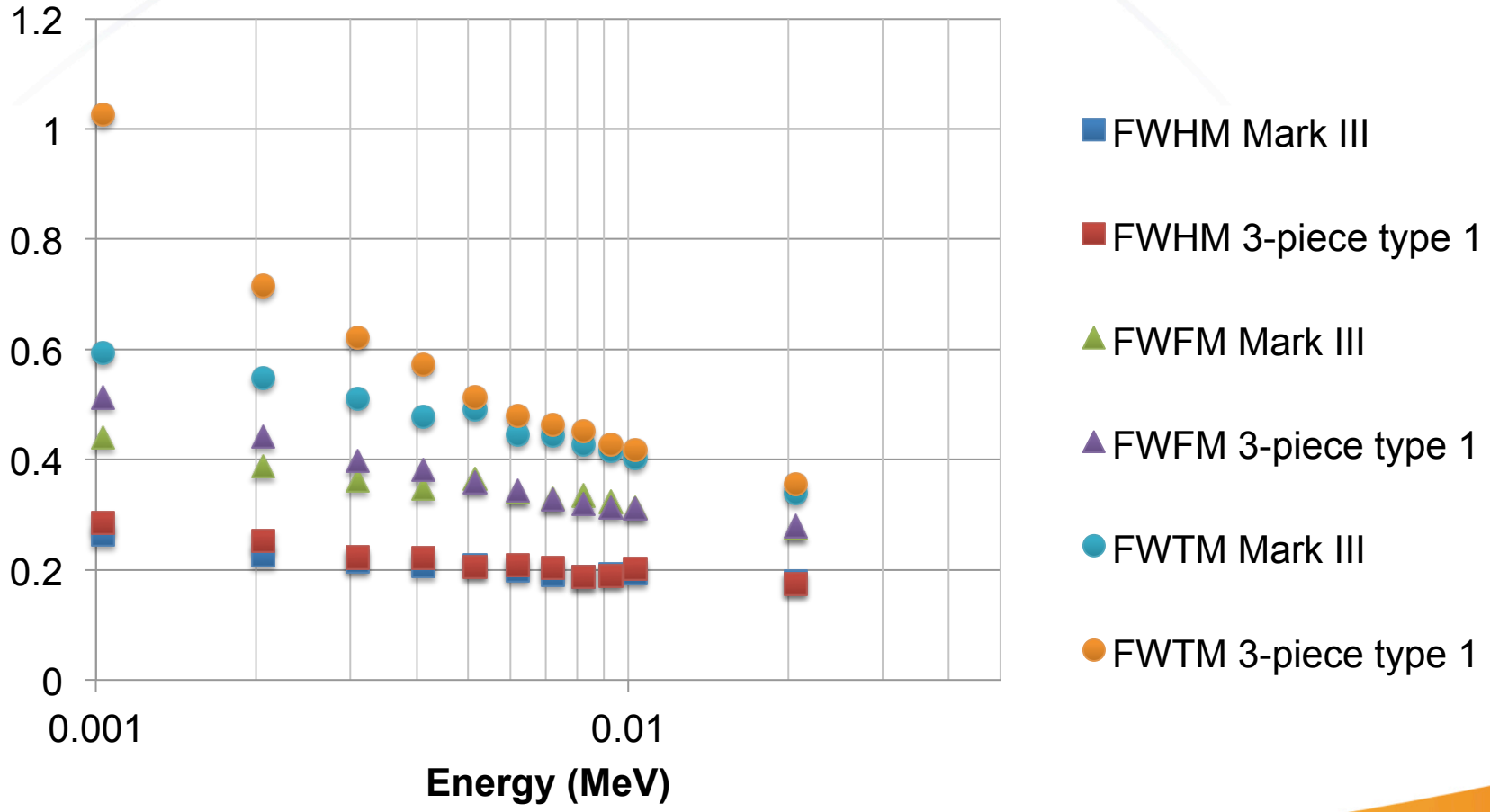
in012 in005 in010

Timing emission spectra





Analysis


1.2
1
0.8
0.6
0.4
0.2
0
0.001
0.01
Energy (MeV)
FWHM Mark III
FWHM 3-piece type 1
FWFM Mark III
FWFM 3-piece type 1
FWTM Mark III
FWTM 3-piece type 1

Conclusion

- 3-piece type 1 design looks promising:
  - Intensity in epithermal and medium energy range in upper tier is an order of magnitude higher than current Mark III.
  - Intensity in the thermal energy range is higher in the lower tier than current Mark III.
- Time emission spectra show a bump due to the scattering of fast neutrons. We are currently investigating that hypothesis.
- Other investigations such as the addition of wings around the upper target will be conducted.

Thank you!

Questions?

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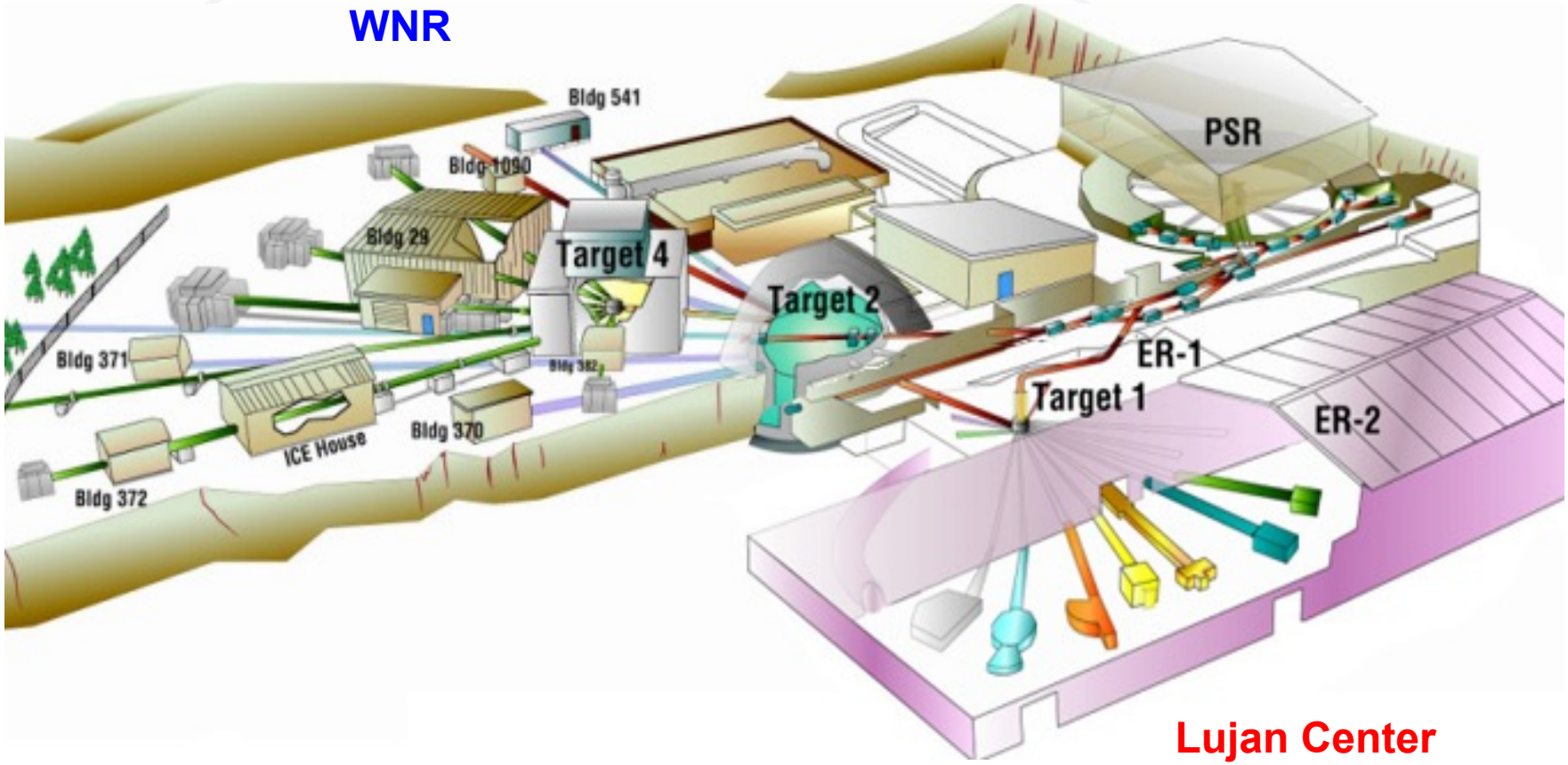
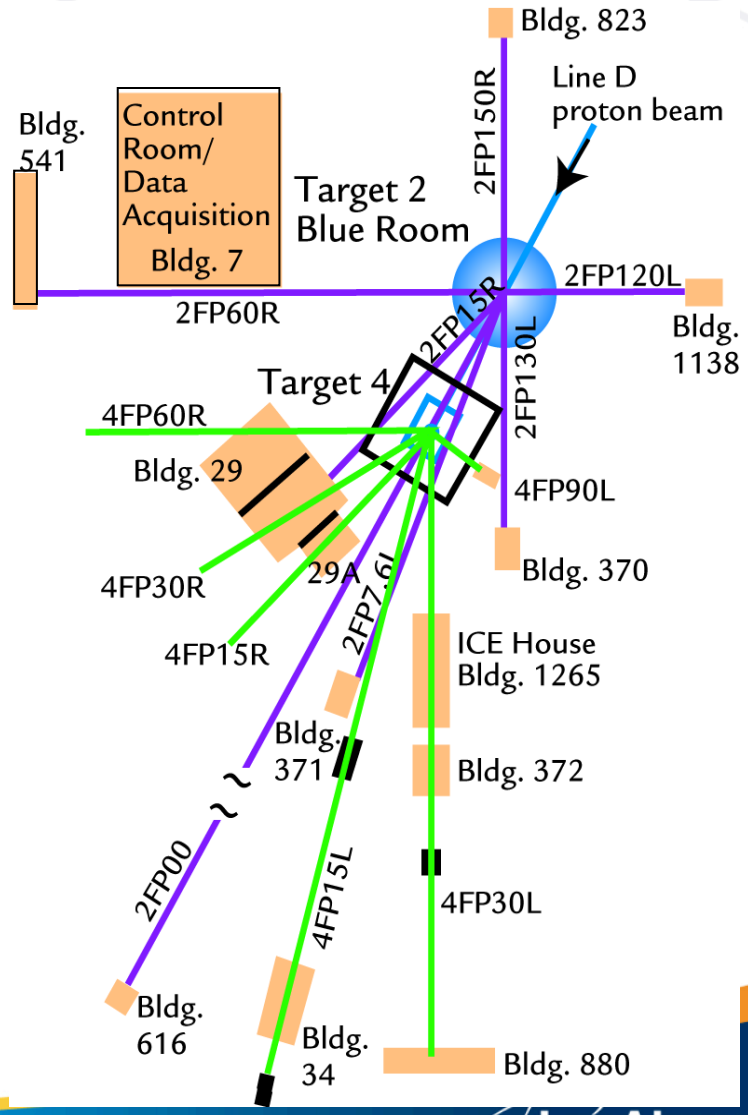
Back up slides

Lujan Center and WNR facilities



WNR

- Target 2:
  - Access to the proton beam
  - Target/moderator experiments
  - Irradiation experiments
- Target 4:
  - Bare spallation target
  - Neutrons 100 keV - 600 MeV



Importance set 0 -> bump goes down