NEWS-G Neutron Beam Solid Transmission Monte Carlo Simulations

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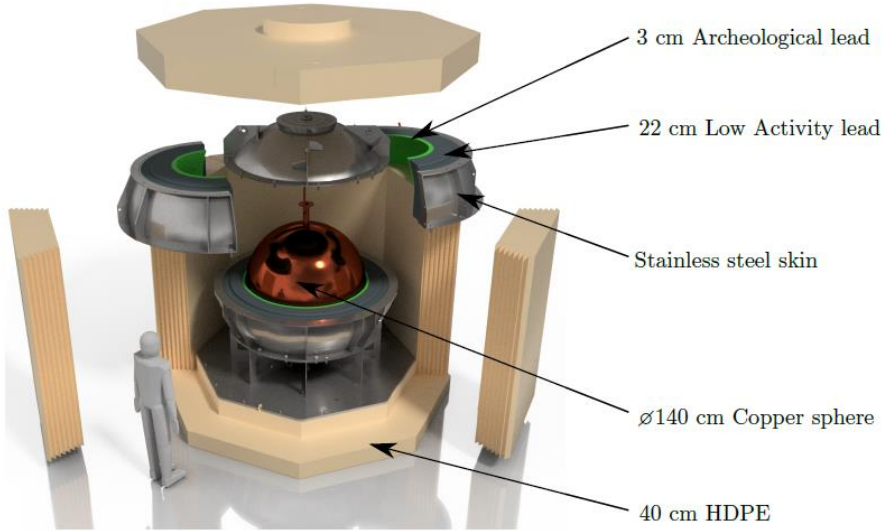
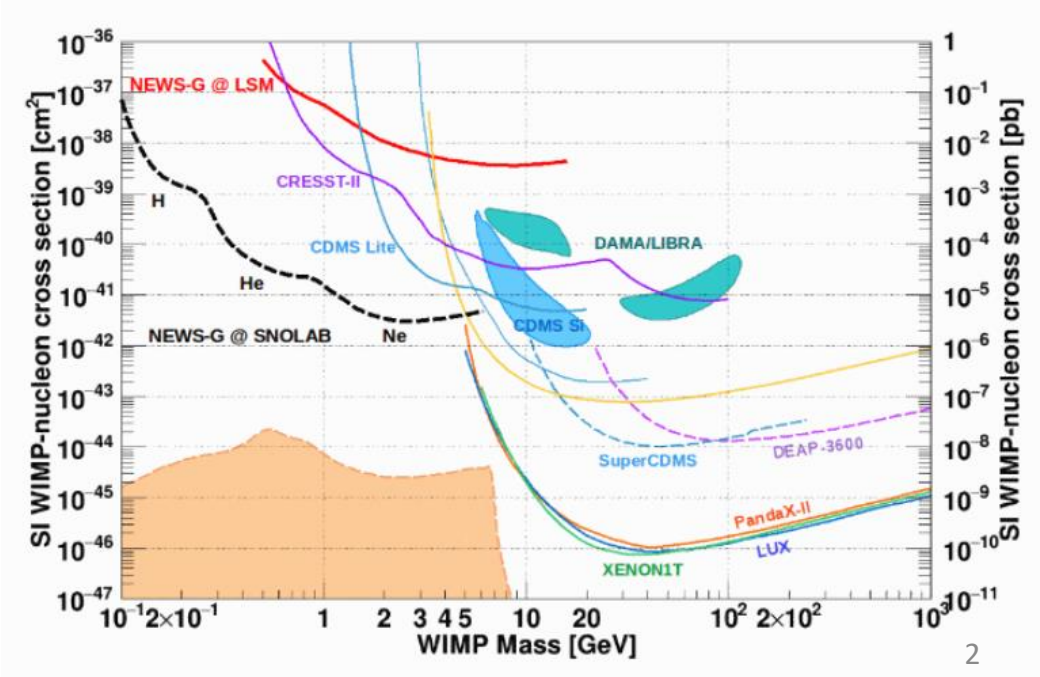
NEWS-G Dark Matter Search

- Trying to detect low energy WIMPS using light gasses in SPCs
- Currently running at 2km underground at SNOLAB called SNOGLOBE

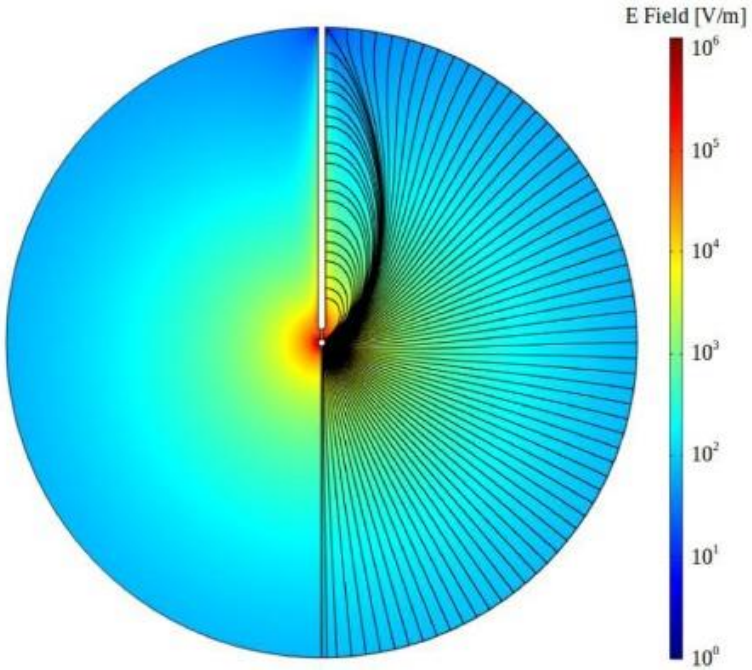


Expected SNOGLOBE Sensitivity



What are SPCs

- Spherical Proportional Counters (SPC) are spheres filled with light gases filled used to detect WIMPs



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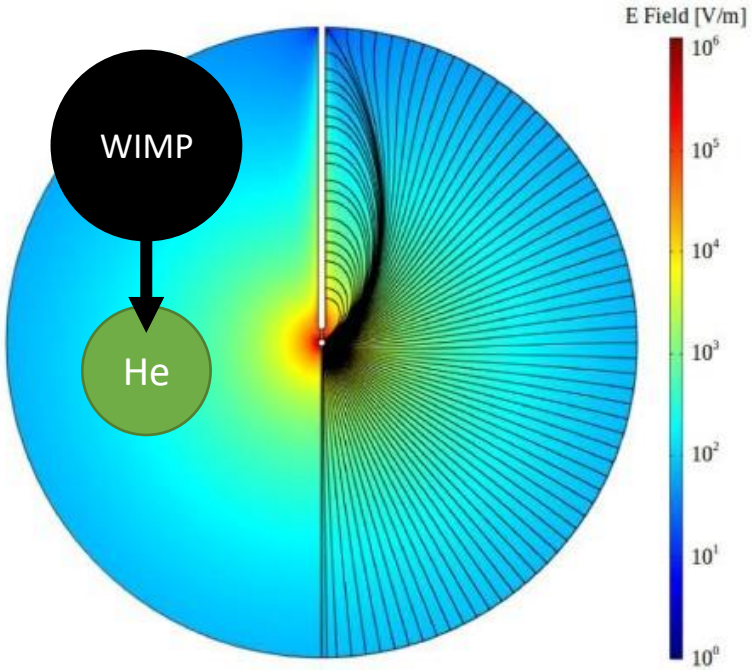

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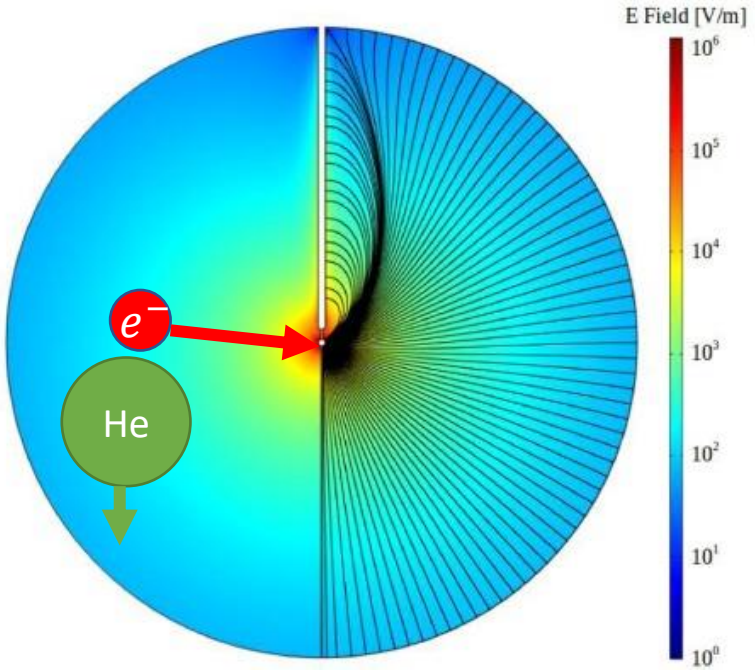
- WIMP interacts with gas via nuclear recoil
- This ionizes the gas and electrons drift to diode through electric field



What are SPCs

- Spherical Proportional Counters (SPC) are light gases filled spheres used to detect WIMPs
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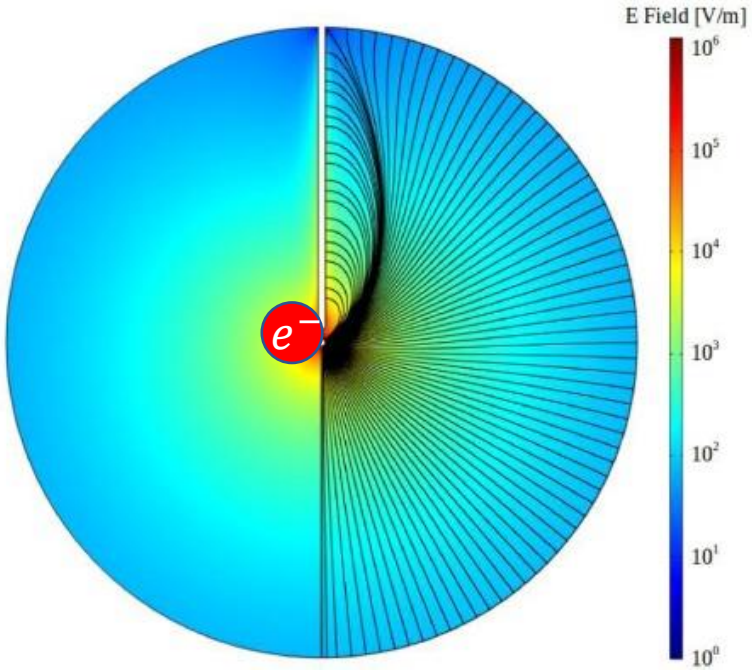
- Each gas has a unique amount of ionization from deposited energy (quenching factor)

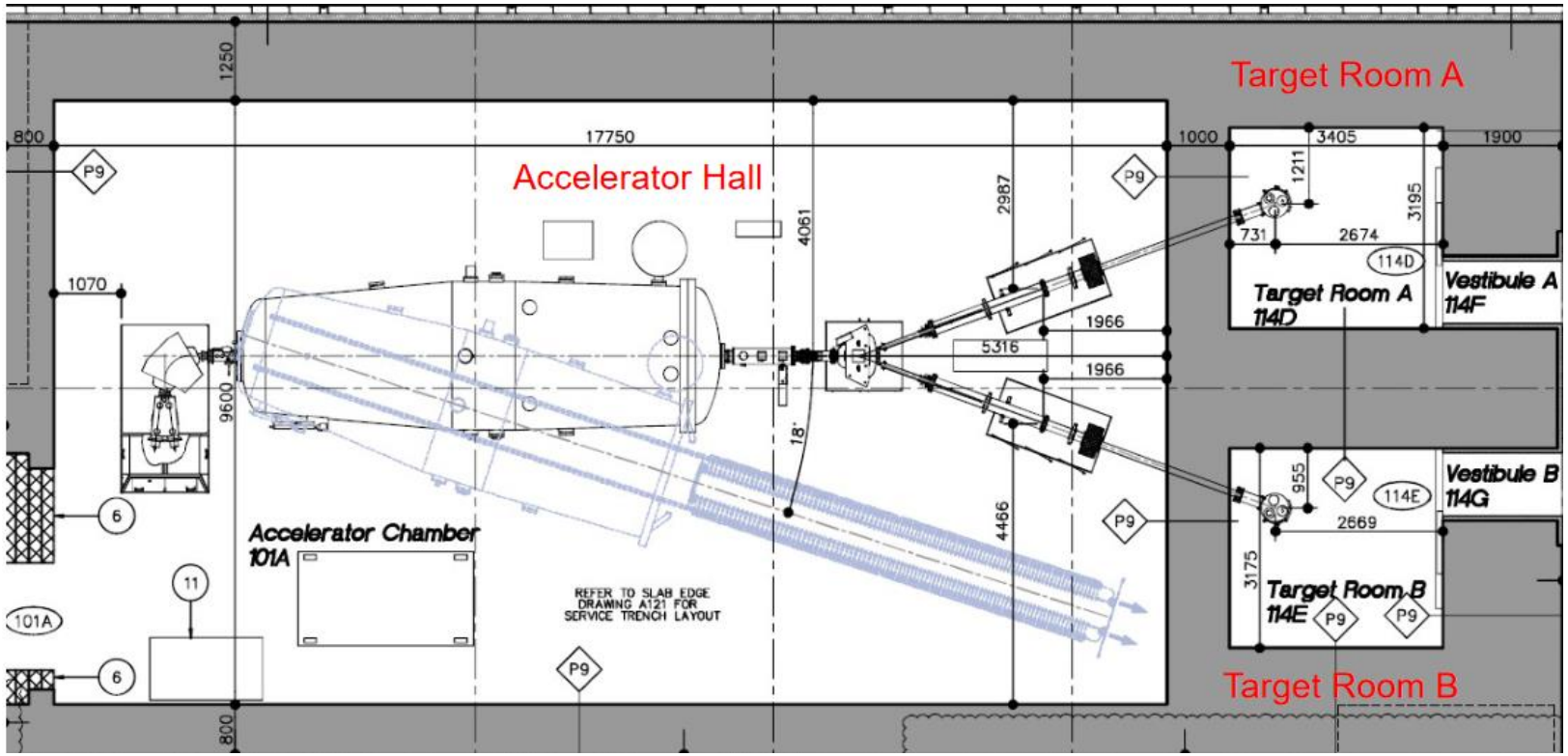


Quenching Factor

- Quenching Factor allows us to determine the mass of WIMP by using the relationship:
  - $QF = \frac{E_{nr}(n_e-)}{E_{ee}(n_e-)}$ ← Don't know this for DM
    ← Known value for a gamma source
- E is the deposited energy due to the nuclear recoil (nr) and electronic equivalent (ee)
- Since QF to a first order approximation is constant for each gas then we can use neutrons to calibrate.
- Can use QF to find the deposited dark matter energy:
  - $E_{DM} = E_{nr}(n_e-) = \frac{E_{ee}(n_e-)}{QF}$

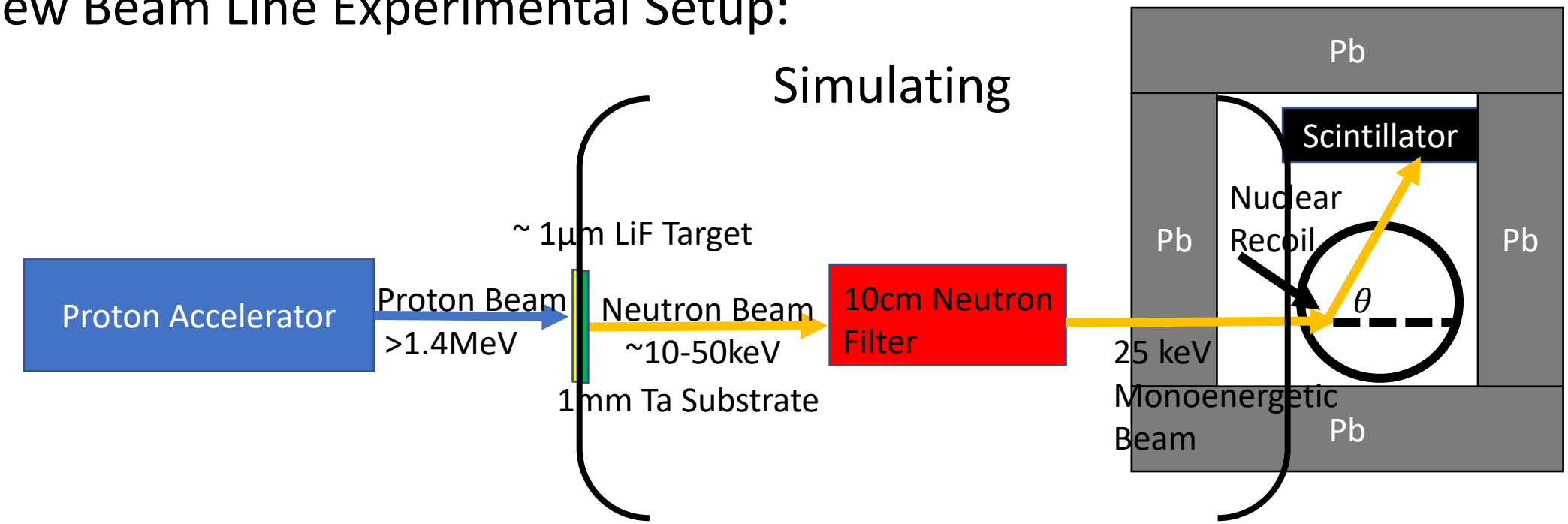
Quenching Factor Experiment At RMTL

- Measuring the ionization quenching factor at Reactor Materials Testing Laboratory's proton accelerator.

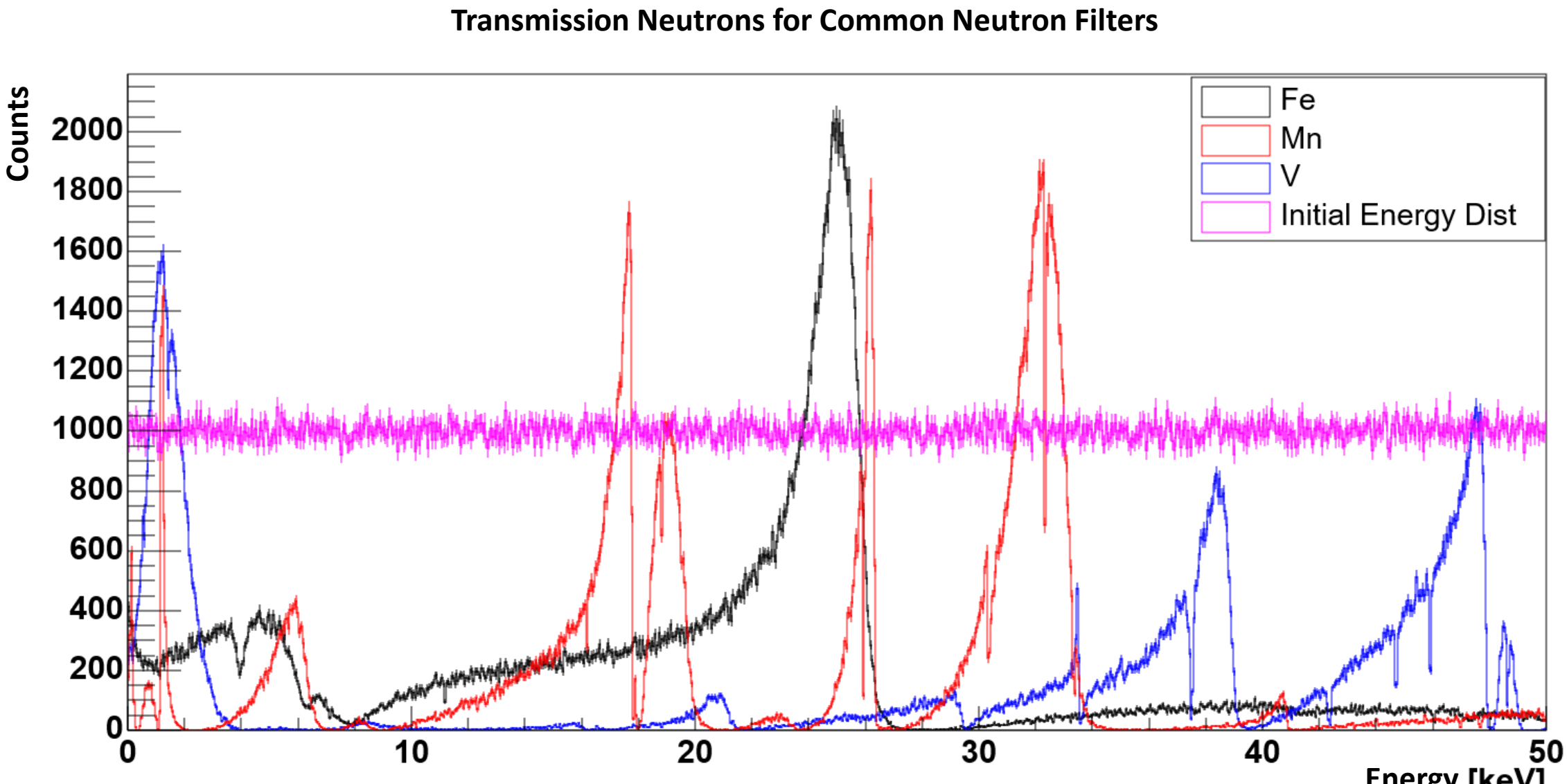


Quenching Factor Experiment At RMTL

New Beam Line Experimental Setup:

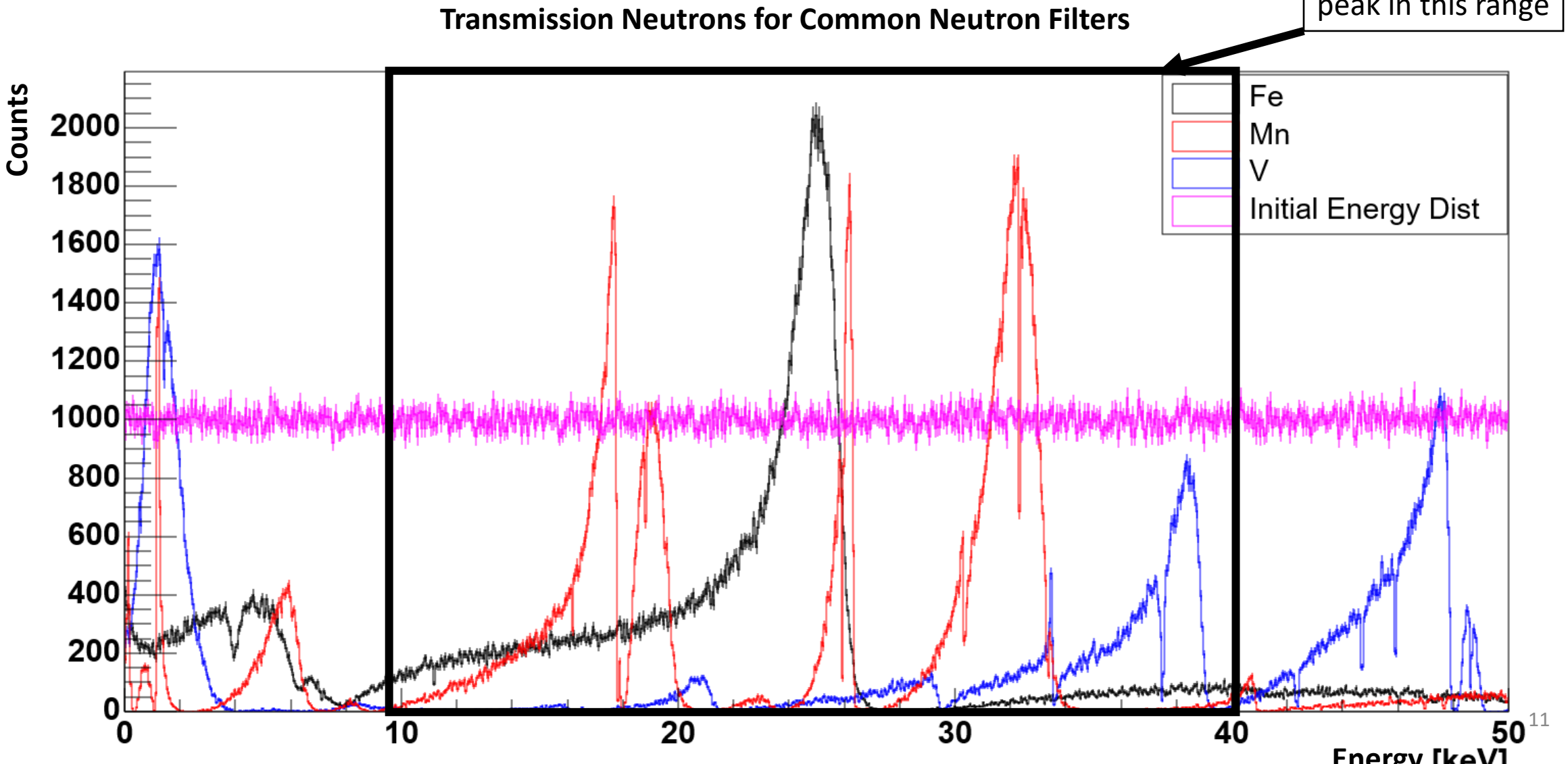


Neutron Filter Simulations in GEANT4



Neutron Filter Simulations in GEANT4

We want monoenergetic peak in this range



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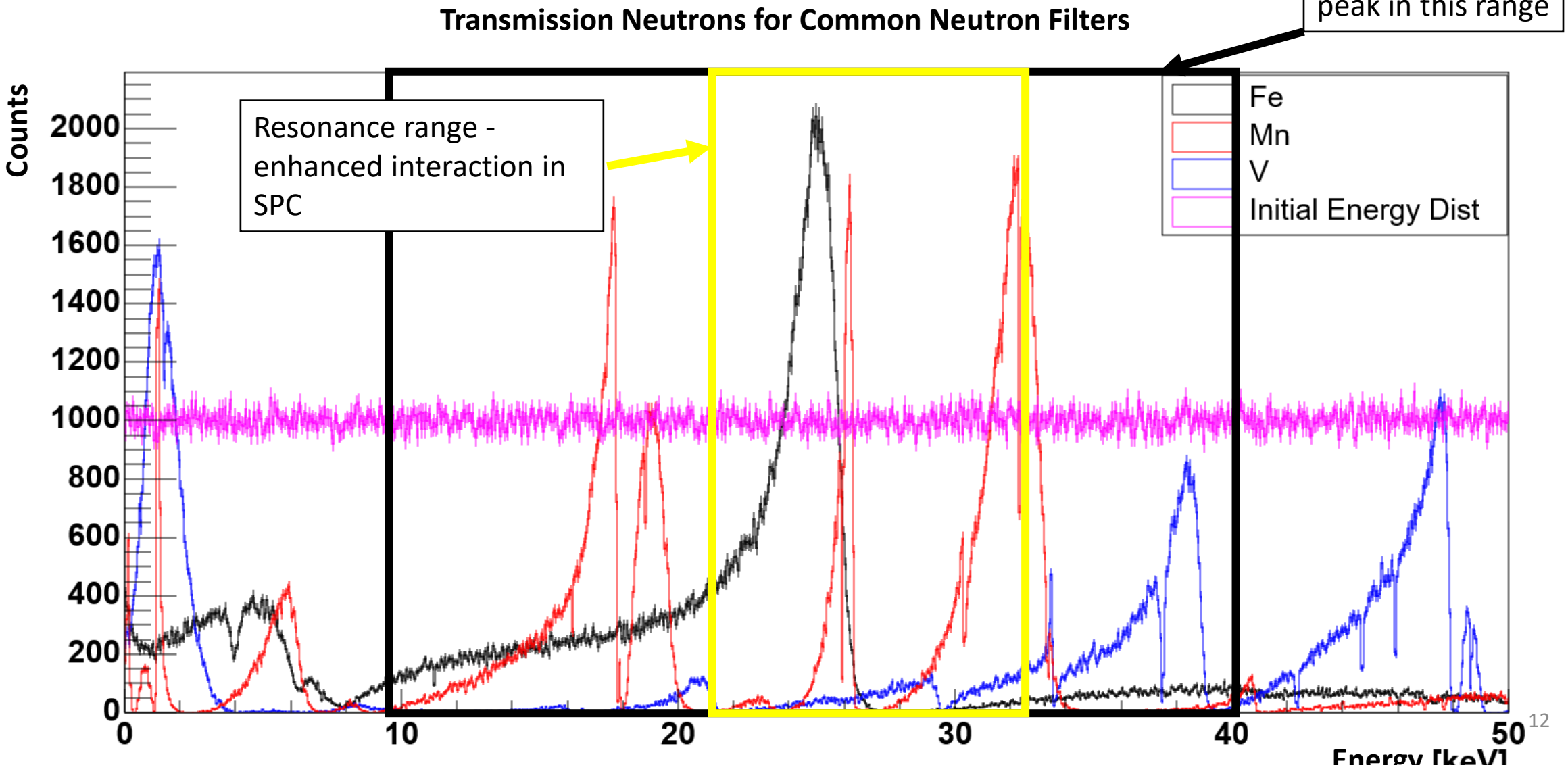
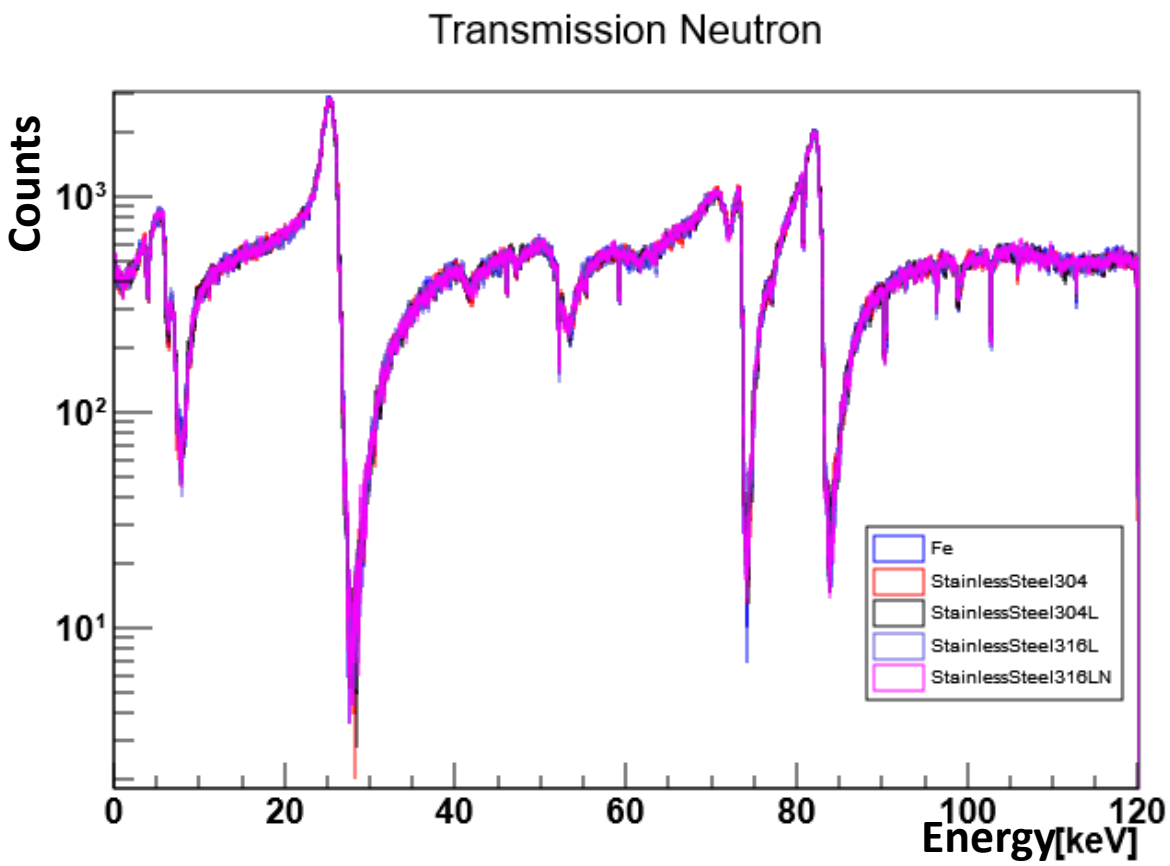
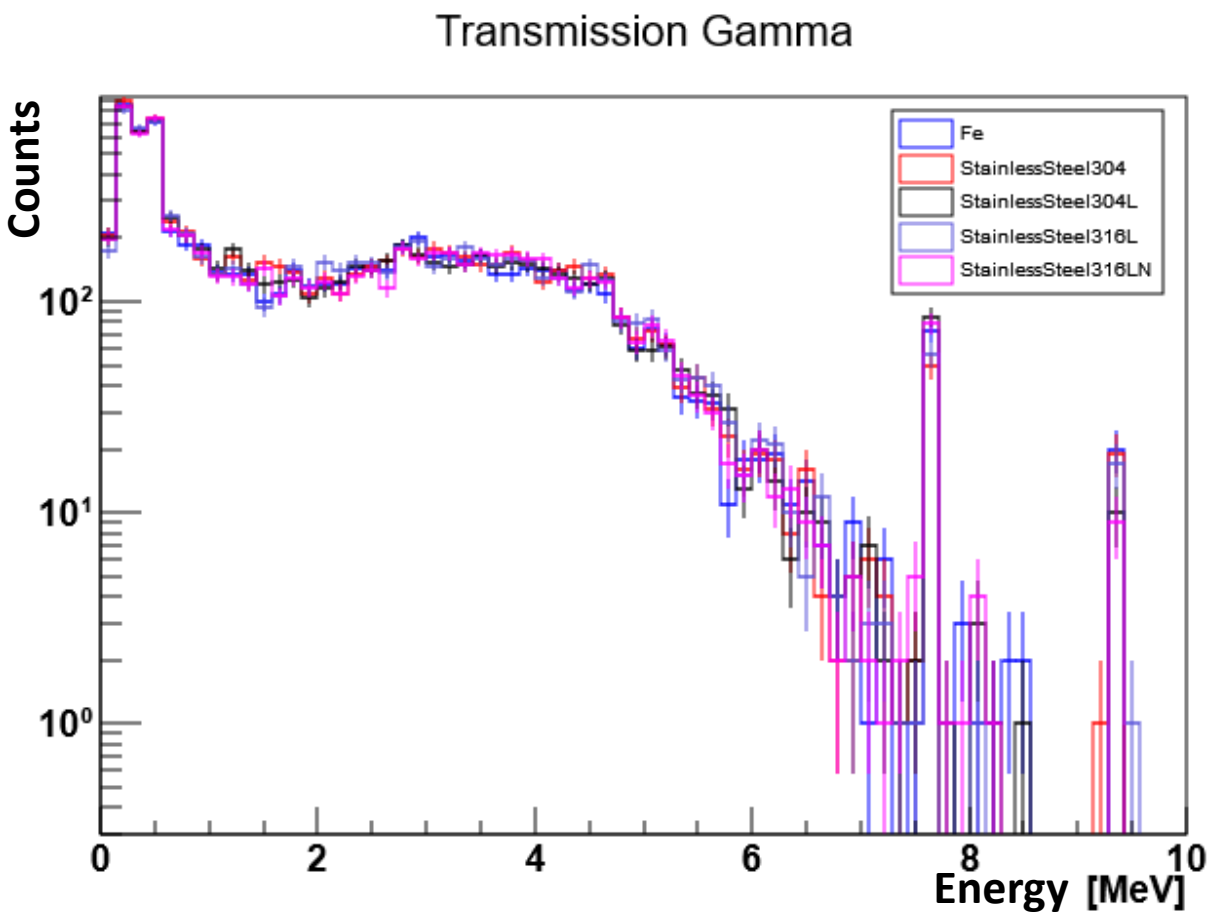


New Beamline Materials

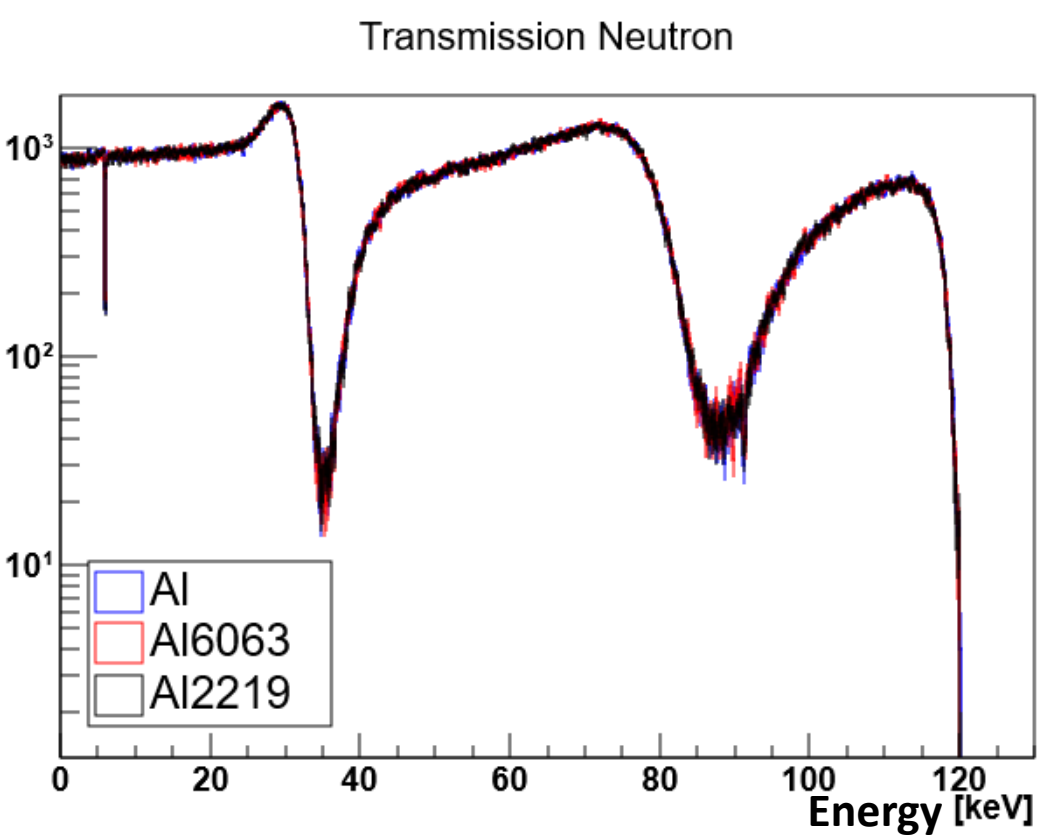
- When making the new beamline the alloys we choose will have different gamma backgrounds produced.
- The beamline will be made out of stainless steel and Al alloy

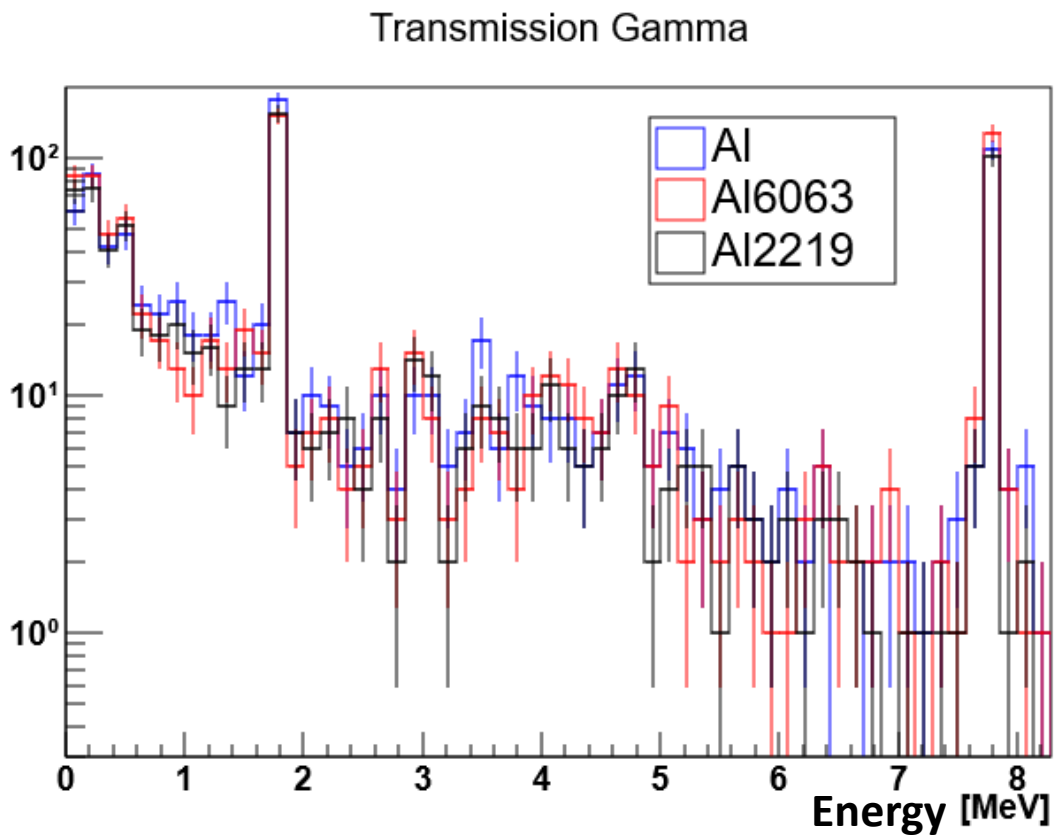
Stainless Steel Simulations





Al Alloy Simulations





Simulation Results

	Alloy					
	Stainless Steel				Al	
	304	304L	**316L**	316LN	6063	2219
Alloy Gamma Output/Pure Material Gamma Output	1.00	1.08	**0.97**	1.03	0.95	0.85
Standard Deviation	0.76	0.89	**0.48**	0.72	0.44	0.47

- The 316L has the lowest average (less gamma output than Fe) and the smallest spread and so should be used for the target holder.
- Both Al alloys have lower gamma outputs than pure aluminum and both will be used.

Conclusion

- We are going to conduct the Ionization quenching factor for methane in the next couple of months at RMTL
- The neutron filter used for the new experiment will be Fe
- The target holder should be made out of stainless steel 316L as it has the lowest produced gamma background

Questions?