Solar Neutrino and Dark Matter Detection with CLEAN

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CLEAN stands for:

Cryogenic
Low
Energy
Astrophysics
Noble Gasses

Neutrino-electron scattering events:

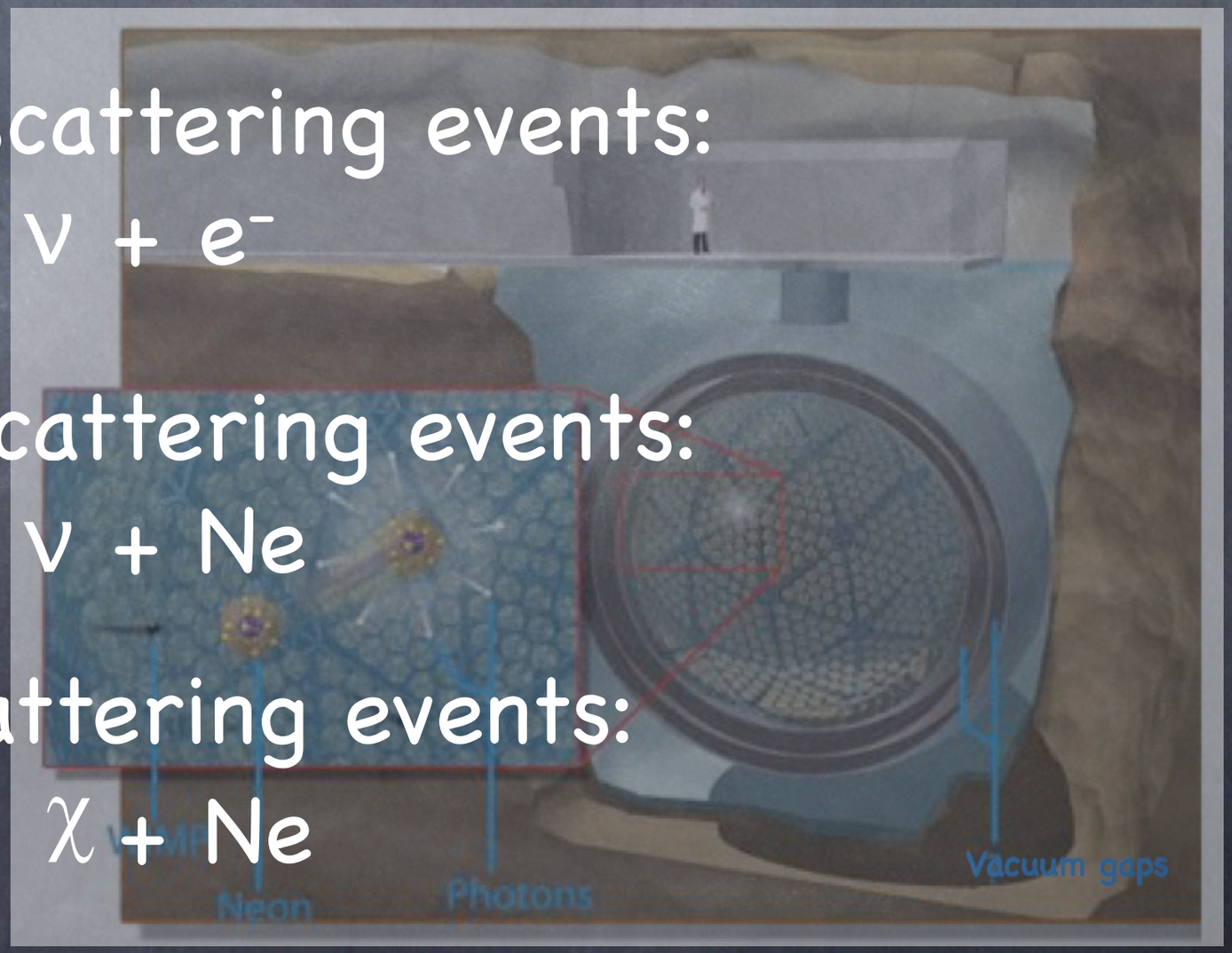
$$\nu + e^- \rightarrow \nu + e^-$$

Neutrino-nucleus scattering events:

$$\nu + Ne \rightarrow \nu + Ne$$

Wimp-nucleus scattering events:

$$\chi + Ne \rightarrow \chi + Ne$$



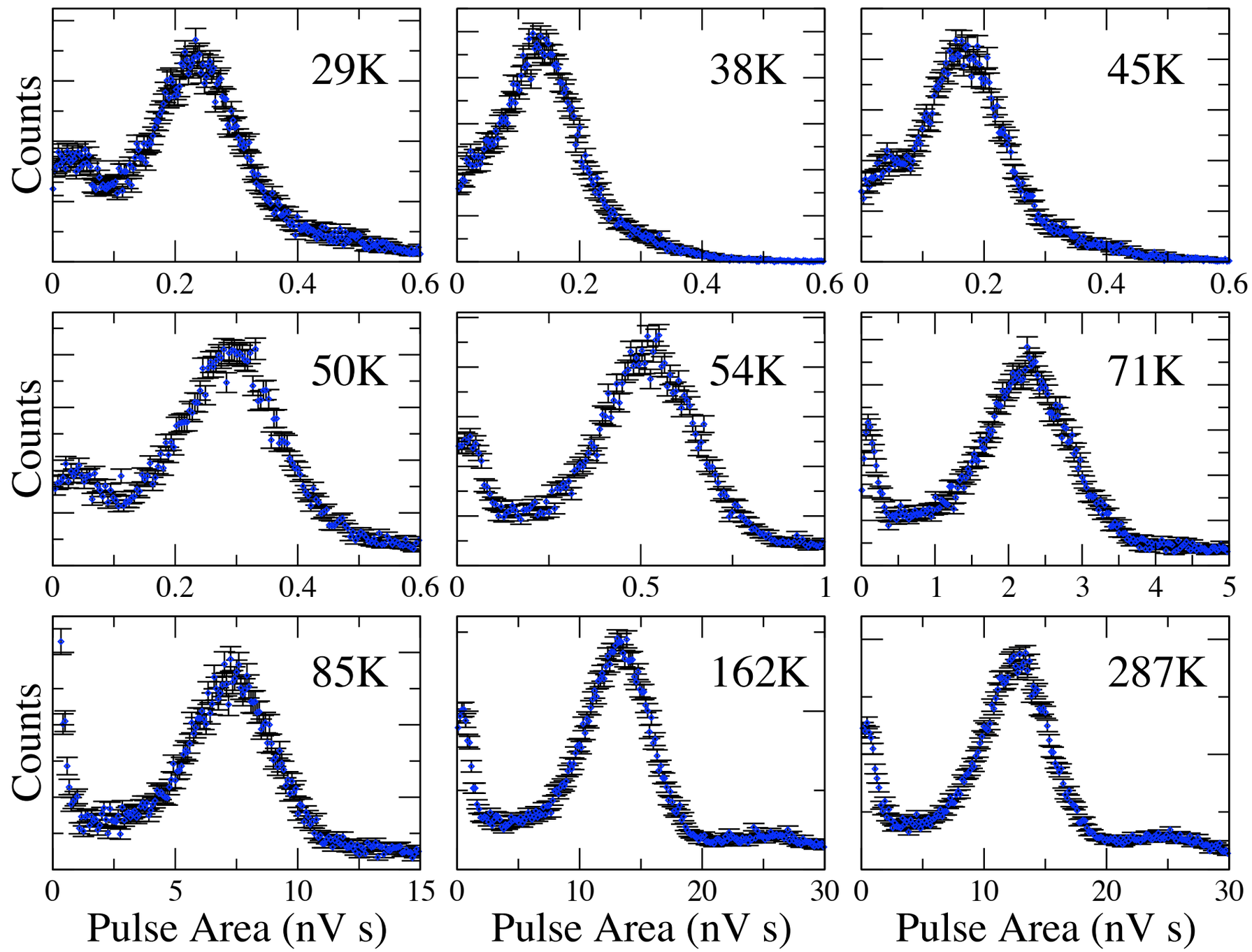
Why neon?

- Has no long lived radioactive isotopes
- Can be purified with cold traps
- Relatively inexpensive
- Transparent to its own scintillation light
- Denser than Helium

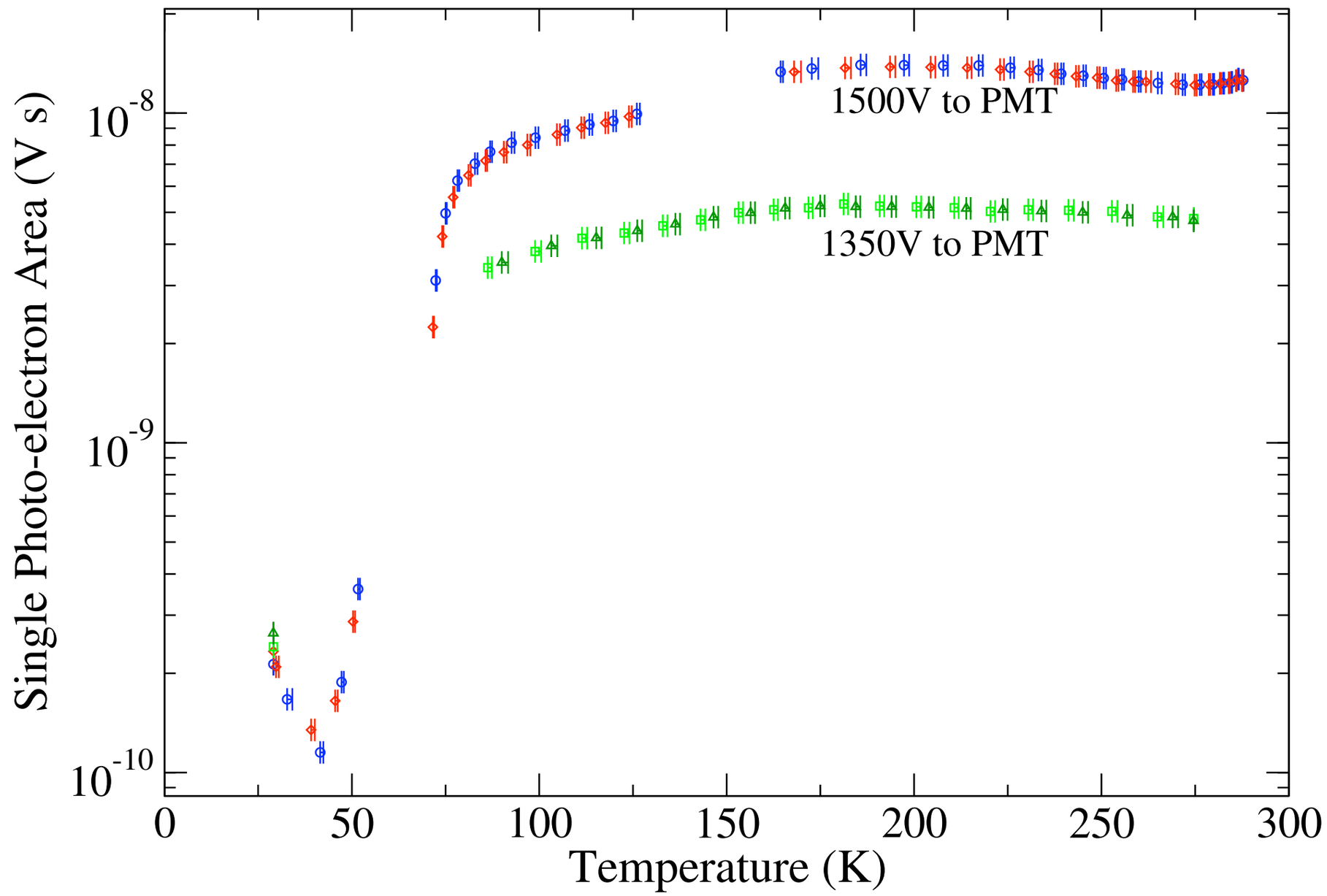
PMT Testing

- Hamatsu R5912
  - Gain
  - QE
- Electron Tubes 9357FLA
  - Pending

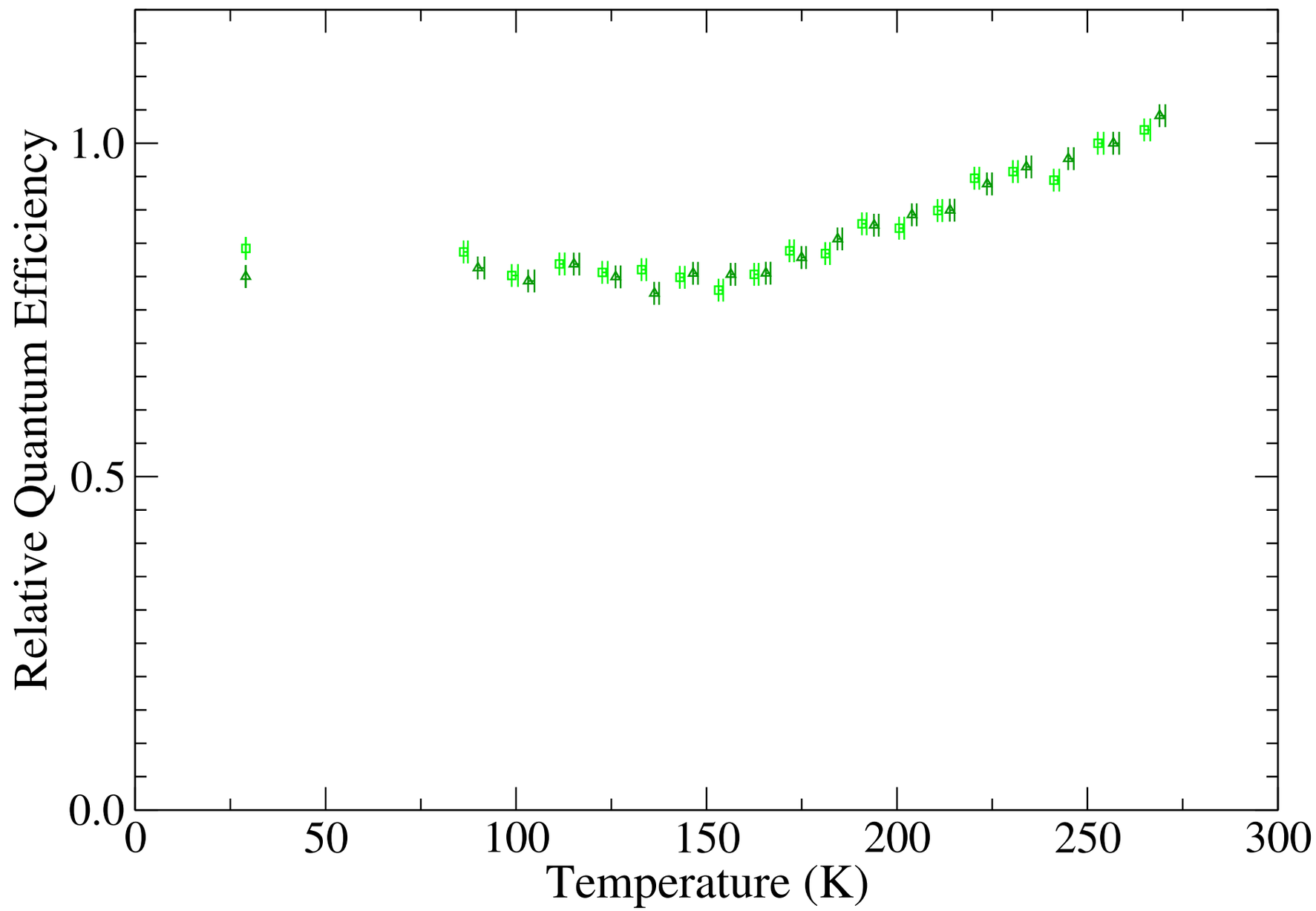
Single photo-electron peaks at various temperatures



Hamamatsu R5912
Gain Curves



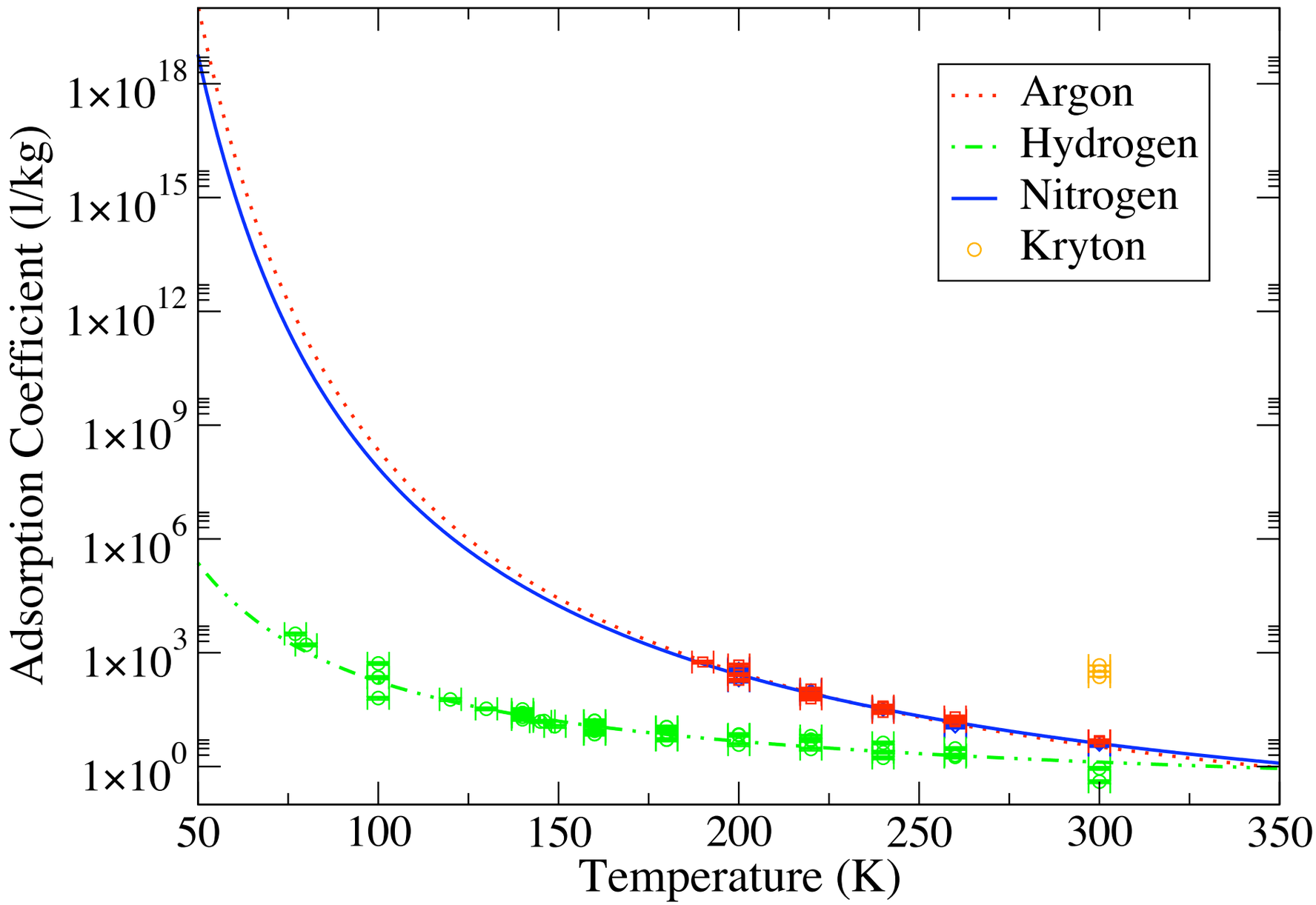
Hamamatsu R5912
Quantum Efficiency



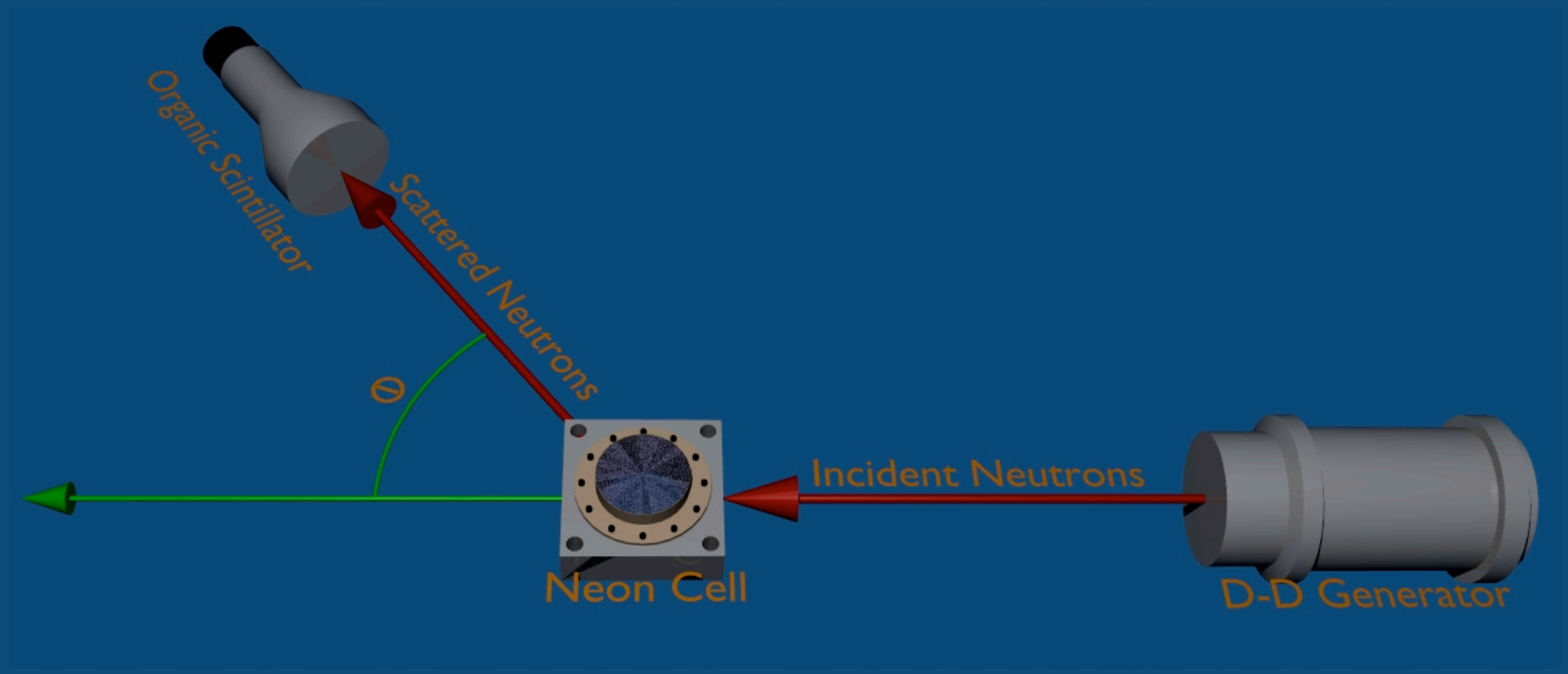
Neon Purification with Charcoal

- Flow neon through charcoal
- Spike neon with:
  - H_2, Ar, Kr, N_2
- Use RGA to time breakthrough

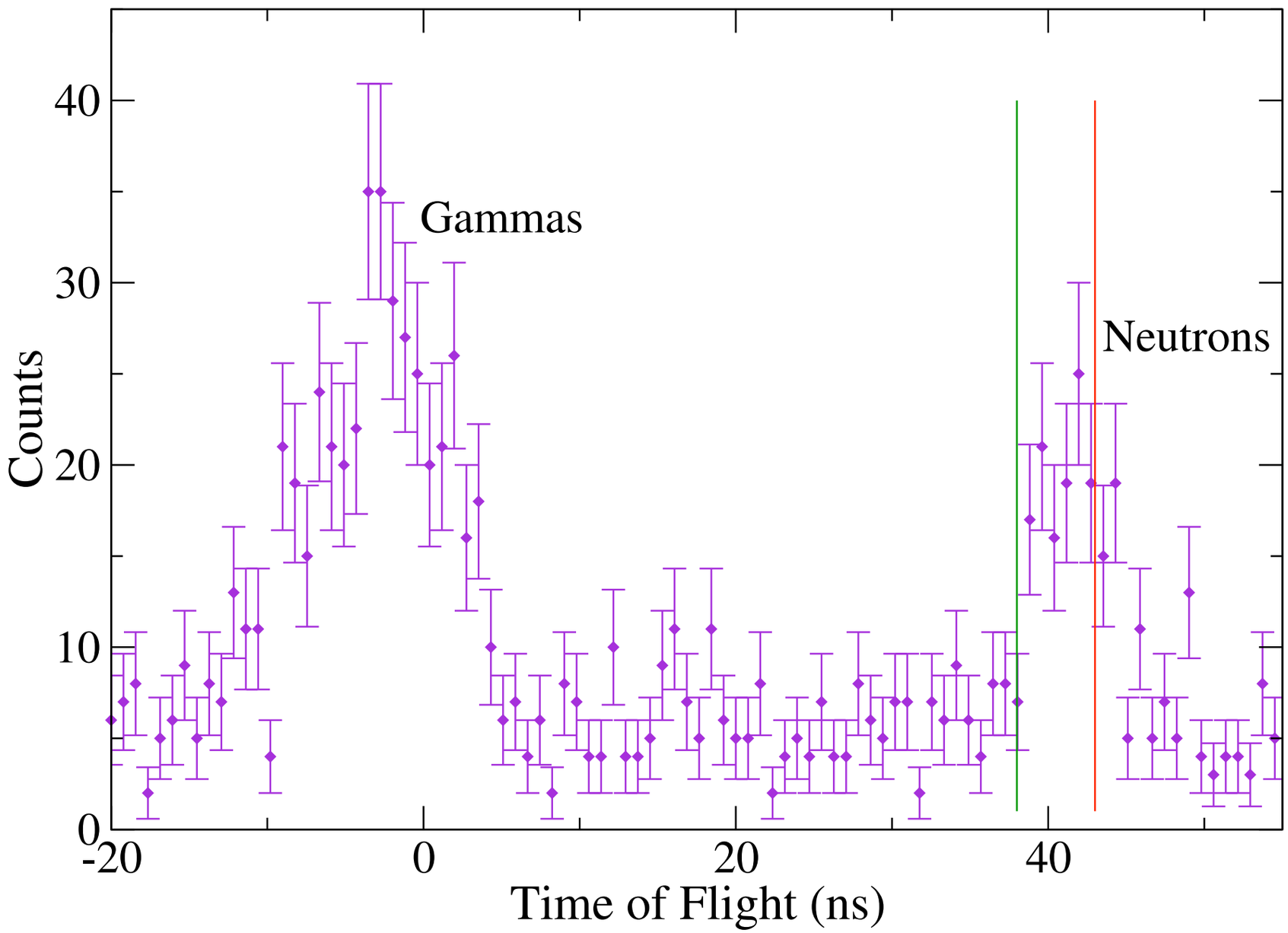
Adsorption Constants onto Charcoal



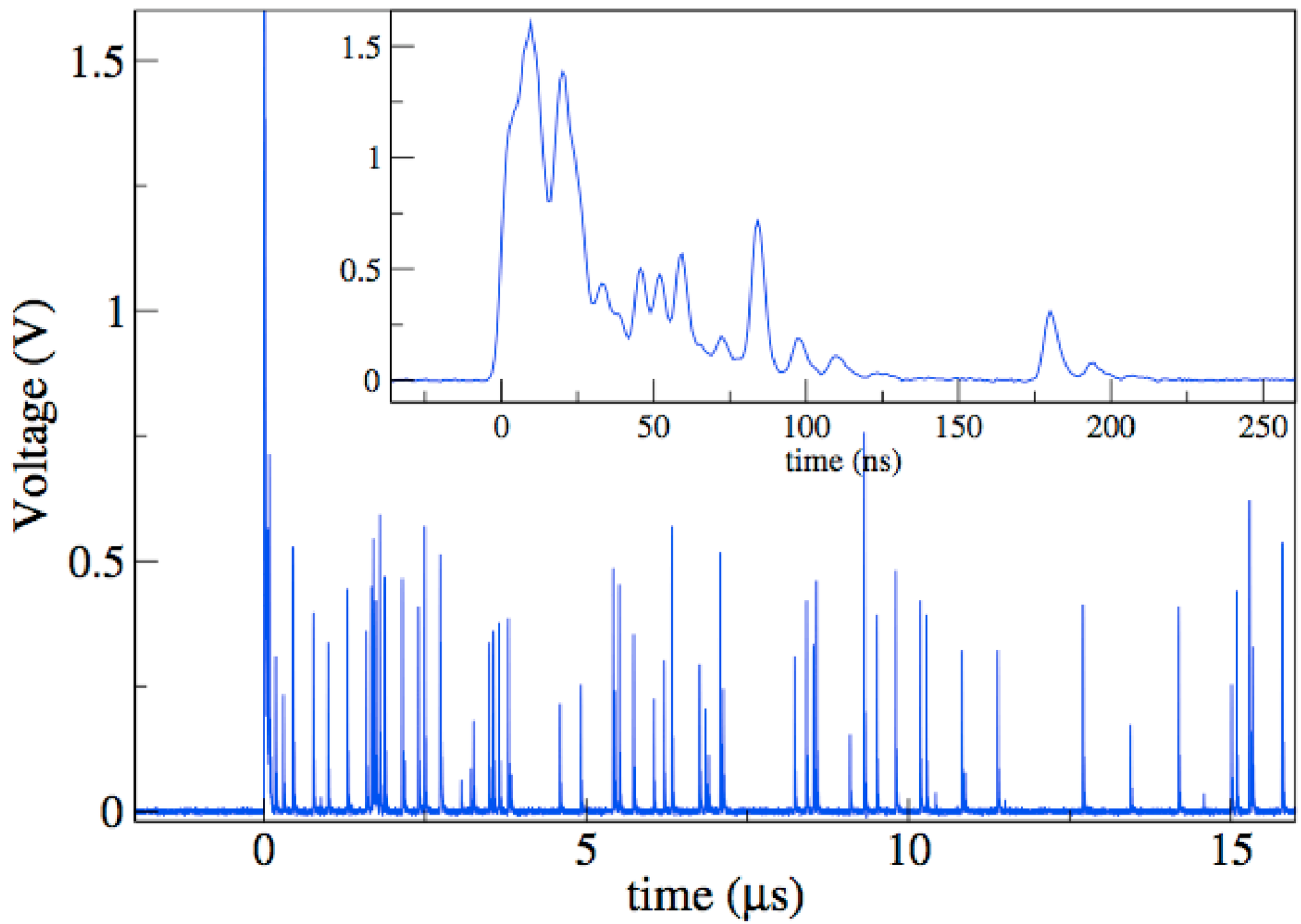
Neutron Scattering



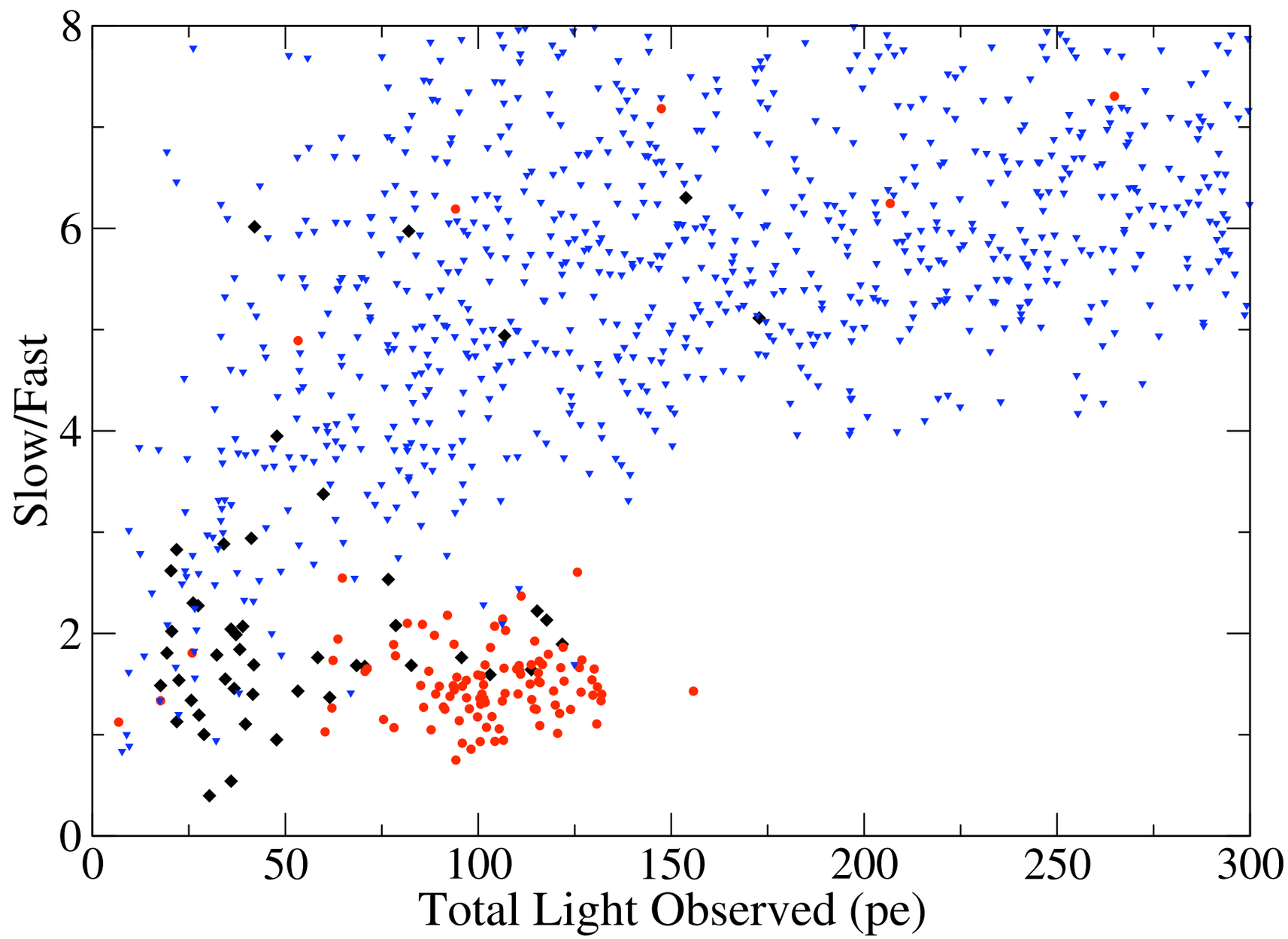
Example Time of Flight



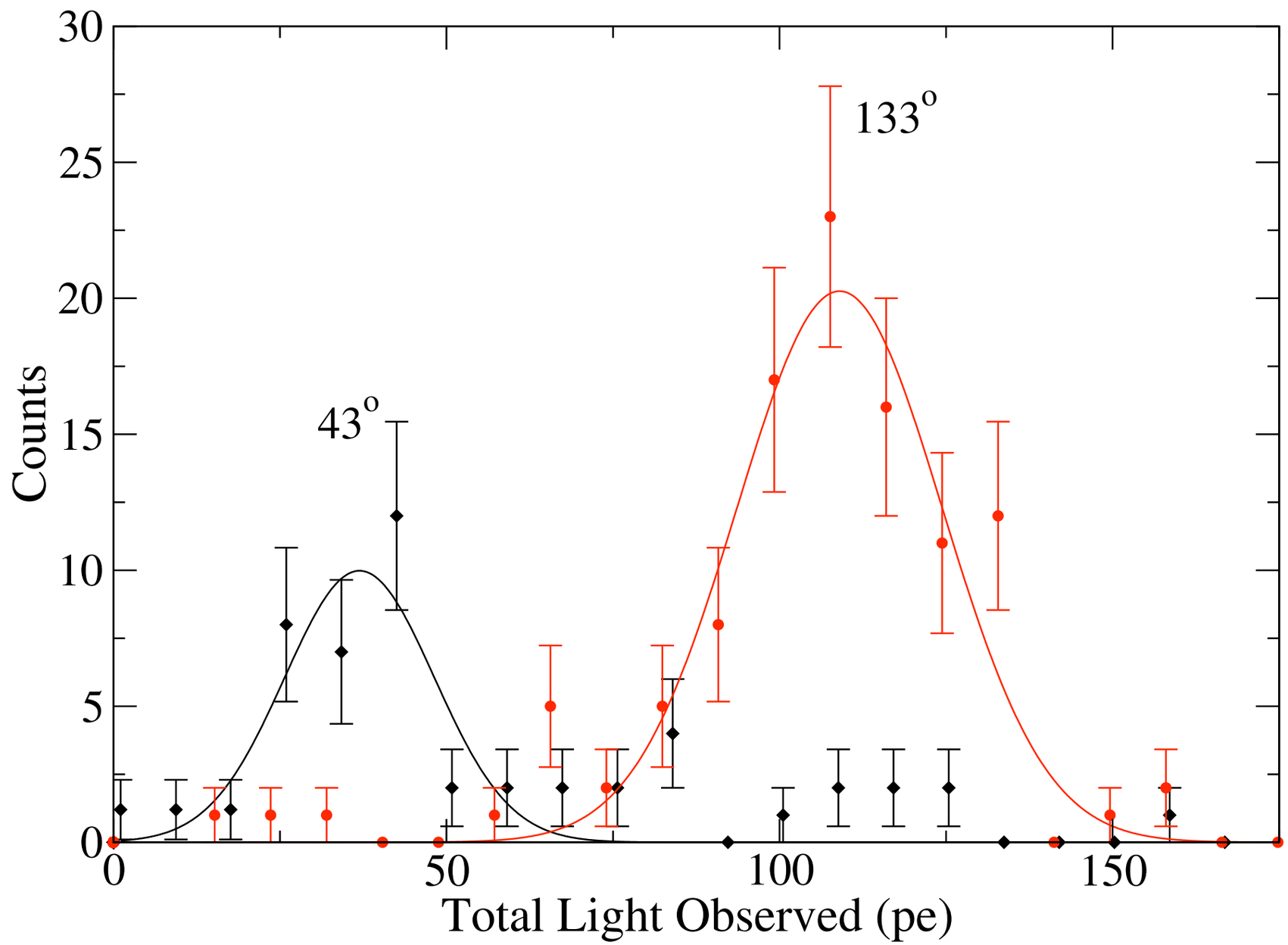
Sample Trace



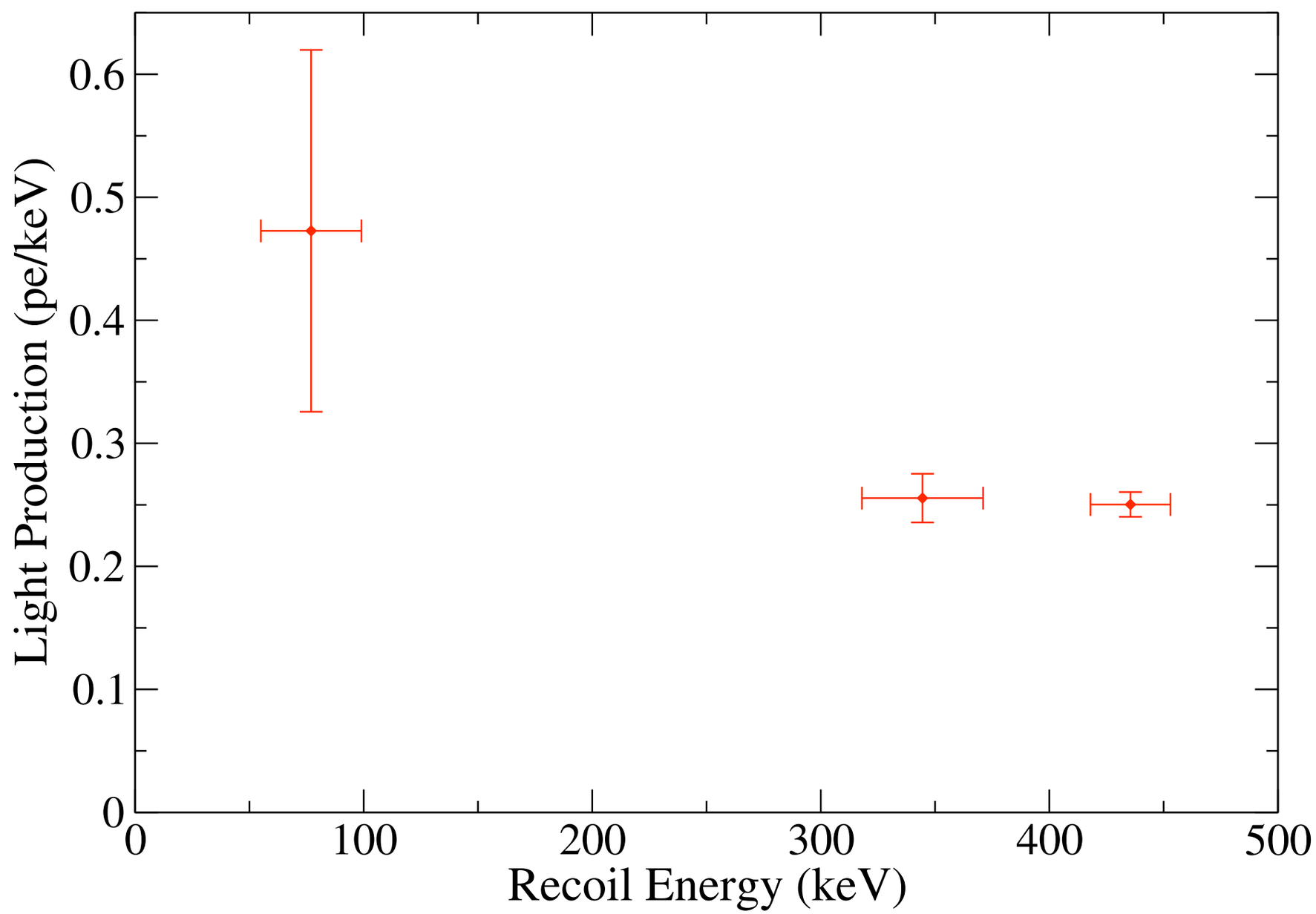
Neutron and γ Scatter Plot

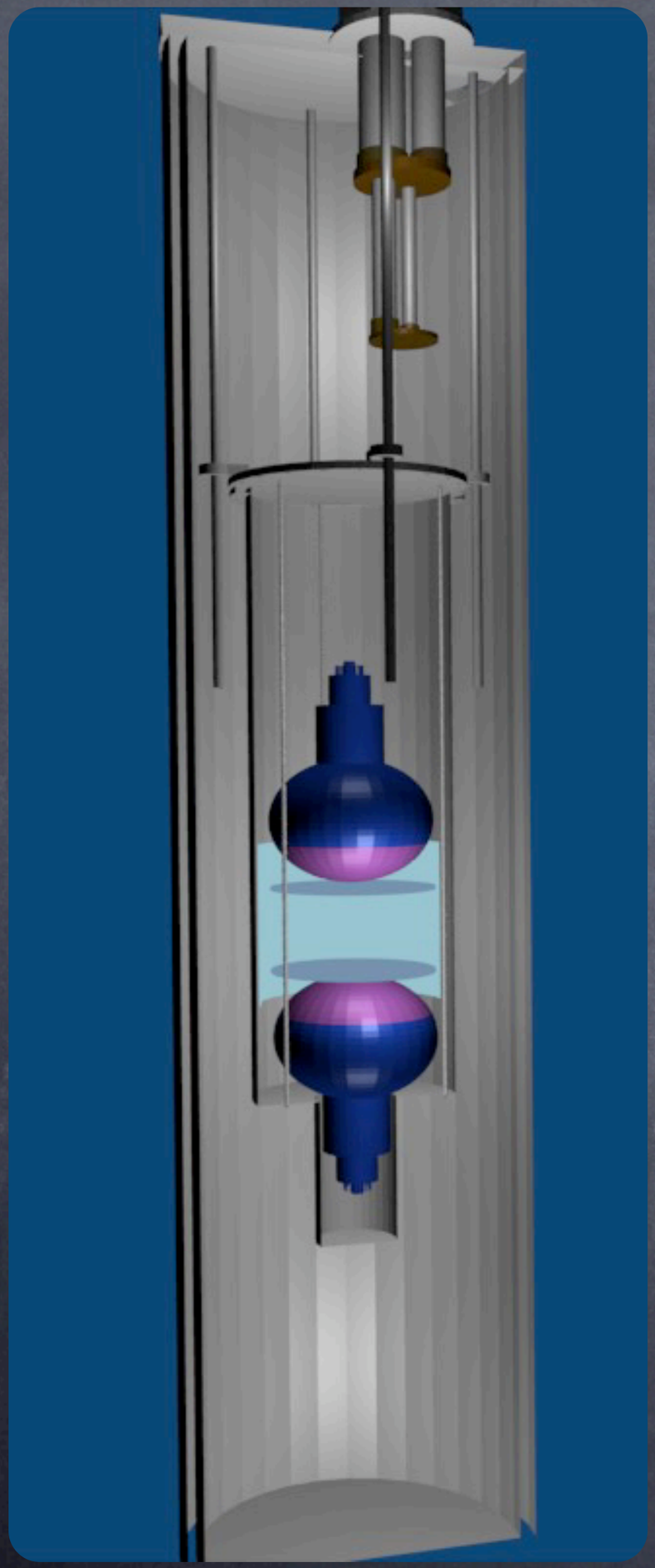


Light Production



Neutron Energy Deposition

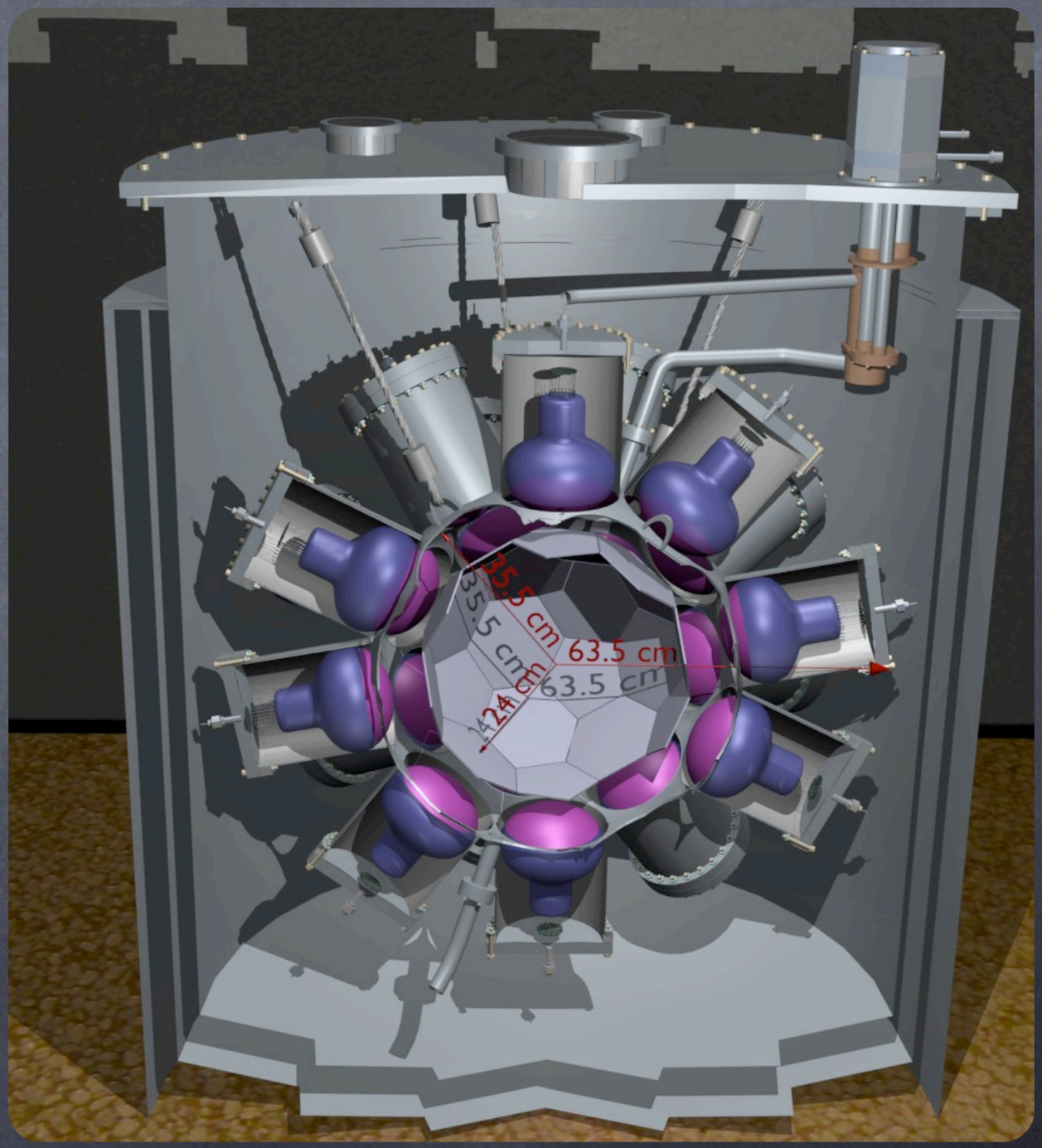




Micro-CLEAN Detector Concept

- 2 PMT's
- ~3-10 kg
- Test PMT stability
- Improved photon yield

Mini-CLEAN Detector Concept



- 32 PMT's
- ~100 kg

Summary:

- We now have PMT's that work cold.
- Have demonstrated purification using charcoal.
- Have demonstrated PSD to separate nuclear recoils from electronic recoils.
- Moving quickly towards a next generation detector.