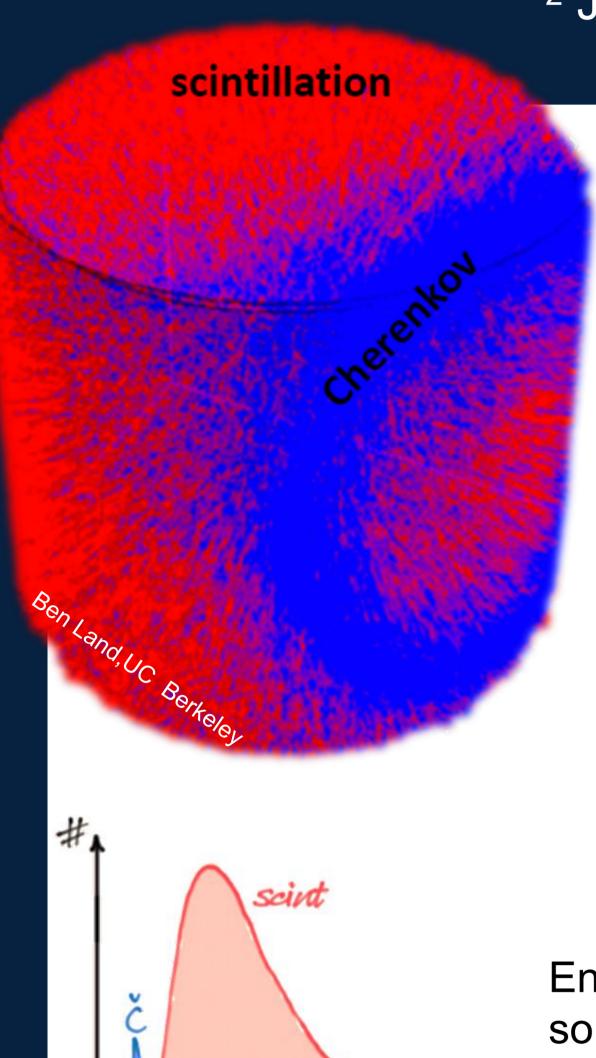


# Scintillation Time Profiles of Slow Organic and Water-Based Liquid Scintillators using a Pulsed Neutron Beam Matthias Raphael Stock<sup>1</sup>

Manuel Böhles<sup>2</sup>, David Dörflinger<sup>1</sup>, Ulrike Fahrendholz<sup>1</sup>, Lothar Oberauer<sup>1</sup> and Hans Steiger<sup>2</sup>

<sup>1</sup> Technical University of Munich, TUM School of Natural Science, Physics Department <sup>2</sup> Johannes Gutenberg University Mainz, Institute of Physics and Cluster of Excellence PRISMA+



### **Hybrid Neutrino Detector THEIA**

Separation of Cherenkov radiation from scintillation light to gain directional information of incident particles in a large volume detector (up to 100 kilotons)

Water-based liquid scintillators (WbLS) Increased ratio of Cherenkov light to otherwise dominant fraction of scintillation

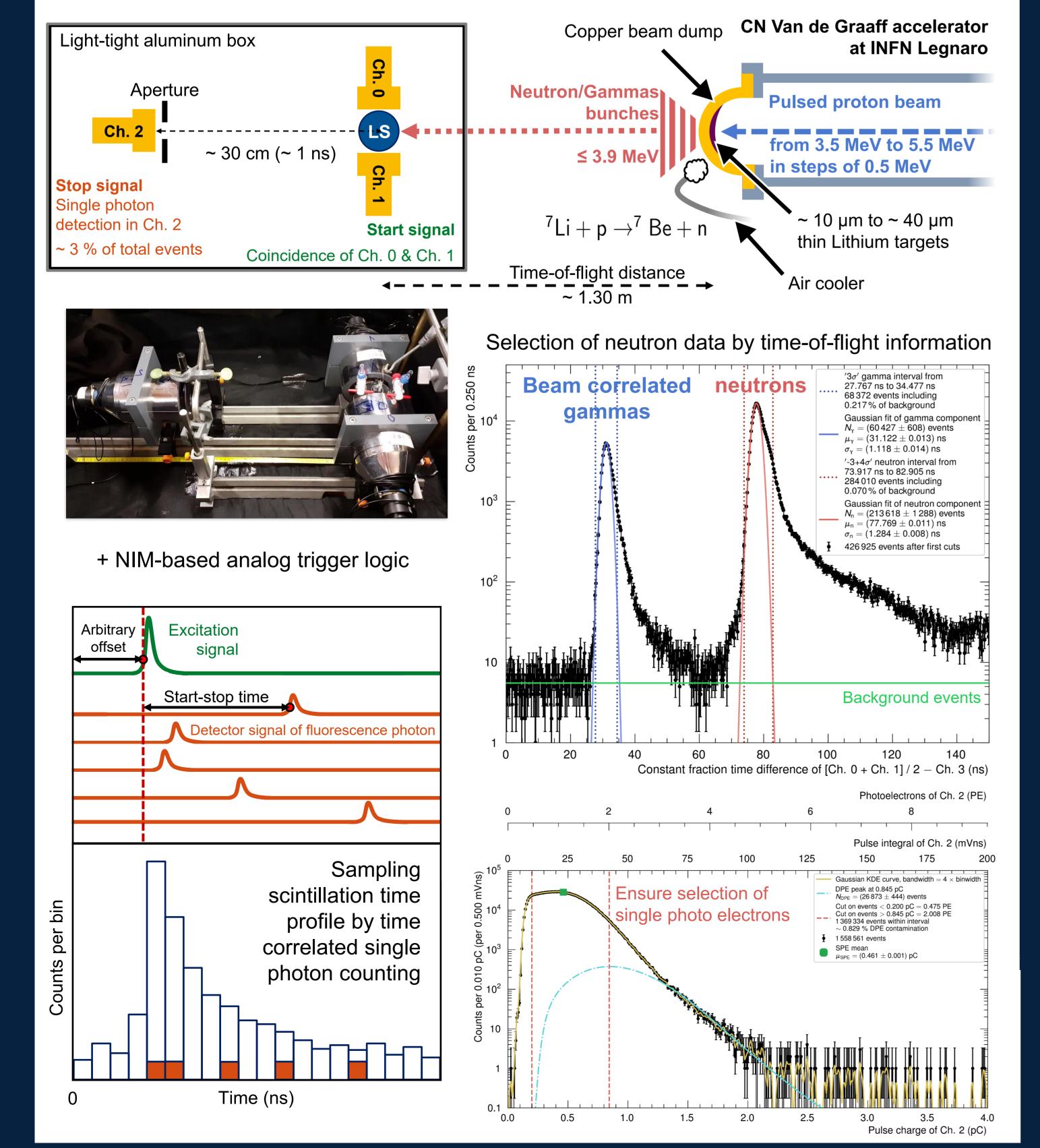
#### Slow organic scintillators

Characteristic fluorescence times intentionally retarded so that separation via timing using fast photosensors possible

Enhanced sensitivity to **broad physics program**: solar neutrinos, (diffuse) supernova neutrinos, neutrinoless double beta decay (by isotope loading of scintillator)...

# Scintillation Time Profile Experiment

Evaluate **pulse shape discrimination** (PSD) capabilities of slow organic and water-based liquid scintillators to identify neutrino events from neutron-induced background events by characterization of scintillation time profiles after excitation by gammas and neutrons



## **Experimental Results and Outlook** Water + Triton X-100 + Vitamin C **WbLS** + 1% organic LS (LAB + 100 g/L PPO) data normalized to same peak height 531 229 recoil proton events from neutron beams 1812395 recoil electron events from <sup>137</sup>Cs source ( $E_{\gamma} = 662 \,\mathrm{keV}$ ) Late pulse bump visible due to fast LS Constant fraction time difference of Ch. 2 - [Ch. 0 + Ch. 1]/ 2 (ns) data normalized to same peak height 90 % LAB + 10 % DIN + 0.5 g/L PPO 90 % LAB + 10 % DIN + 1 g/L PPO 90 % LAB + 10 % DIN + 2 g/L PPO from <sup>137</sup>Cs source ( $E_{\gamma} = 662 \,\text{keV}$ ) LAB + 0.5 g/L PPOJIUW LJ Constant fraction time difference of Ch. 2 - [Ch. 0 + Ch. 1]/ 2 (ns) Constant fraction time difference of Ch. 2 – [Ch. 0 + Ch. 1]/2 (ns) Separation of time profiles for Additional solvent DIN retards decay, recoil protons improves PSD and light yield and recoil electrons Cherenkov Scintillation Dark Hits Slow LS 0.015 Potential to perform pulse shape discrimination 0.005 ⊢ T. Kaptanoglu, UC Berkeley (PSD) **Together with Cherenkov &** scintillation separation



New window in low and high energy neutrino physics