Direct observation of liquid argon scintillation light

Studies of a magnesium fluoride (MgF_2) PMT for neutrinoless double-beta decay experiments

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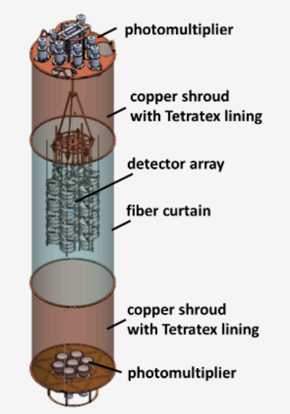
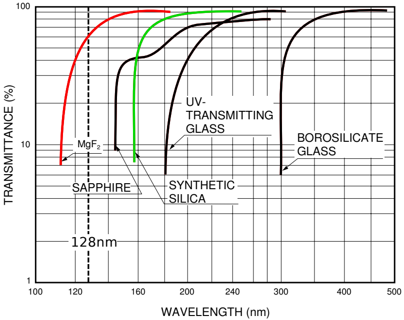
Liquid argon (LAr) active shielding

- Argon scintillation light emitted at 128nm
- Current R11065 PMTs opaque at this wavelength → wavelength shifters required, shift to ~400nm



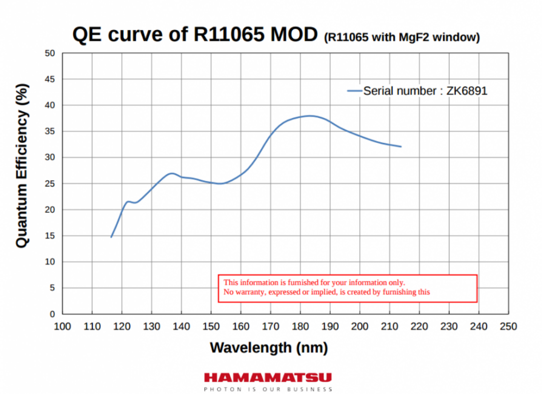
The GERDA LAr veto system

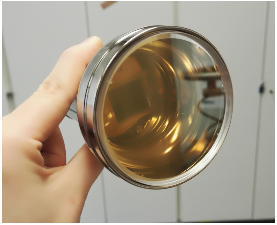


Transmittance of various Hamamatsu PMT window materials [Hamamatsu PMT handbook]

MgF_2 PMT

– MgF_2 is transparent at 128nm
– MgF_2 PMT could form part of liquid argon setup without use of wavelength shifters → reduction in material





The Hamamatsu R11065 with a MgF_2 window

The Liquid Argon Setup (LArS)

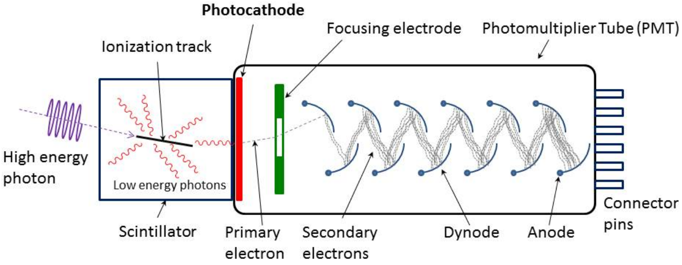
– LArS: chamber for testing PMTs and SiPM arrays during operation in liquid argon or nitrogen, at UZH

PMT fixing for LArS

Schematic of LArS setup

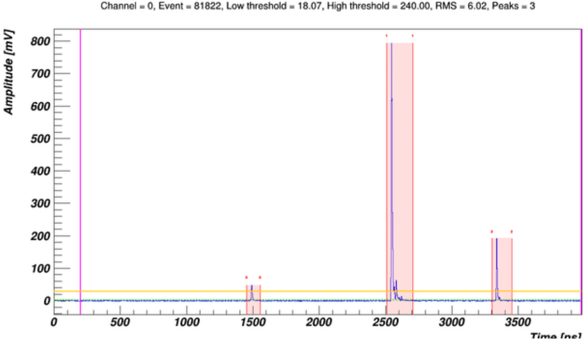
PMT operation

- Impinging photon causes emission of photoelectrons
- Signal is amplified as electrons are accelerated by electric field $\rightarrow$ gain $10^6 - 10^7$
- Signal electrons are collected at anode



Observation of scintillation light

– Scintillation light stimulated by α-emitting ^{241}Am source in LArS
– Average waveform shows fast and slow component decays



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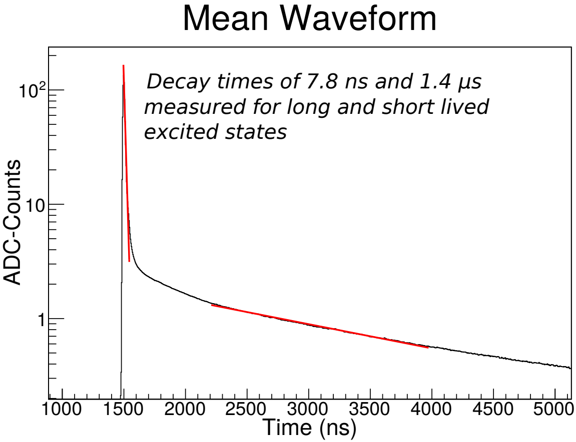
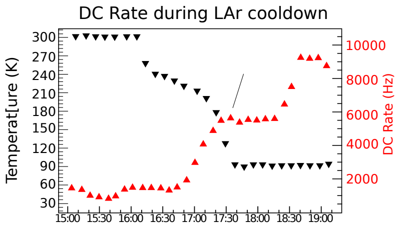
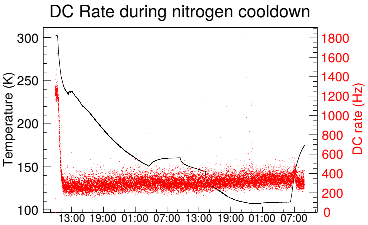


Dark count rate measurements

- Dark count rate: rate of events above 0.3 photoelectrons in the absence of external signal
- Increase in DC rate in LAr, but not seen in nitrogen (low light yield for scintillation) $\rightarrow$ observation of cosmic ray events in LAr





Conclusion and future outlook

- MgF_2 PMT observes LAr scintillation light without the use of wavelength shifting materials
- LAr scintillation light was observed stimulated by a ^{241}Am source
- Dark count rate increases in LAr but not in nitrogen $\rightarrow$ observation of cosmic ray events
- Long term stability tests will be performed in nitrogen and liquid argon