The SuperNEMO Light Injection and Monitoring System

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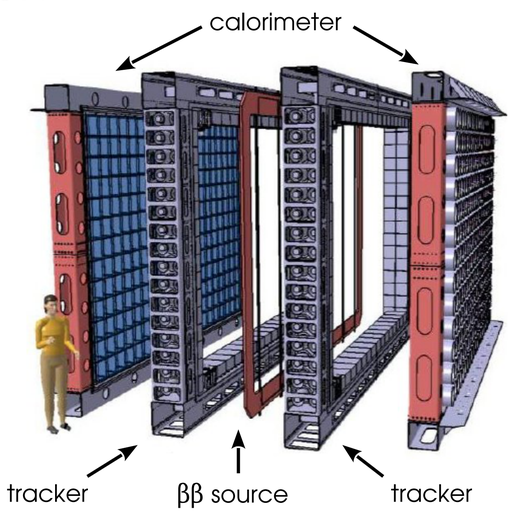
On behalf of the SuperNEMO collaboration

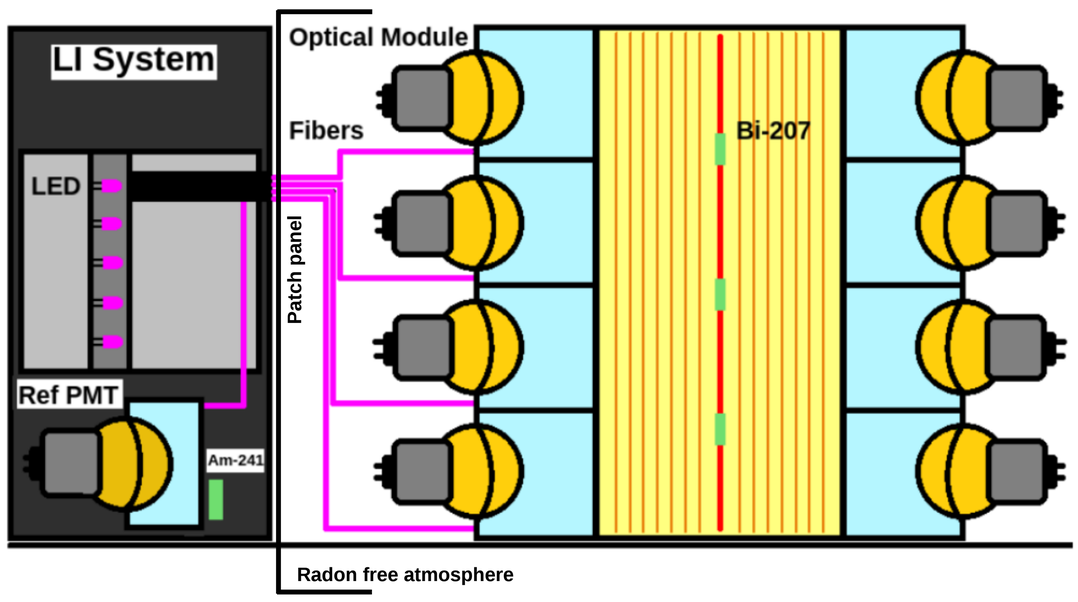
SuperNEMO

- SuperNEMO combines tracking and calorimetric measurements to search for $\beta\beta0\nu$.
- The calorimeter consists of 712 optical modules made of scintillator blocks directly coupled to PMTs.
- A constant monitoring of the calorimeter response is required to guarantee the calorimeter stability.



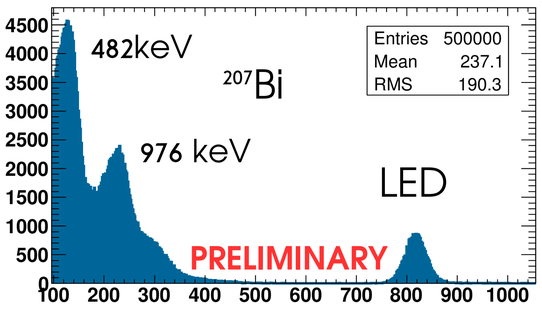
The Light Injection System

- The main goal of the Light Injection (LI) system is to monitor the response of each calorimeter module to a precision of 1 %.
- 20 LEDs illuminate 1500 optical fibers routed to optical module.
- Fibers enter into the radon-tight tent surrounding the detector through a dedicated patch panel.

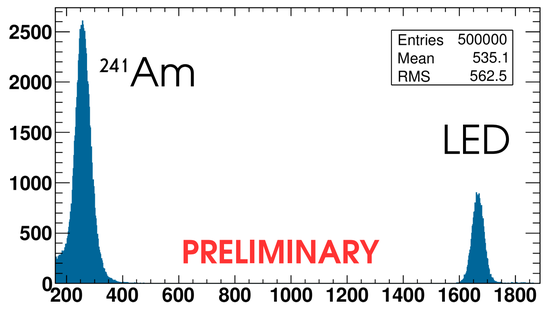


- To avoid time differences and to simplify the system, the lengths of all fibers are the same (~20m).
- A reference optical module is used to monitor the light level for an Am-241 source.
- Bi-207 sources are regularly introduced into the detector to provide an absolute energy calibration using the conversion electrons at 482 keV and 976 keV.

Calorimeter OM spectrum



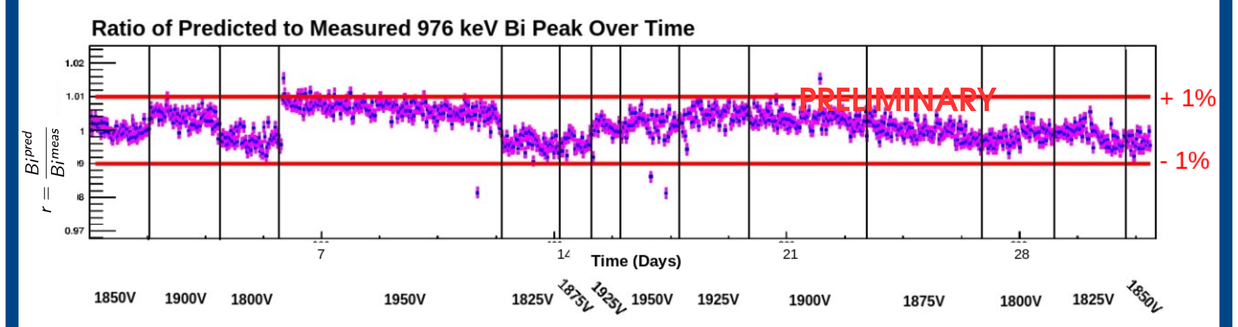
Reference OM spectrum



Monitoring Withing 1 %

- To verify the ability of the LI system to monitor the response within 1 %, we predict where the 976 keV Bi-207 peak would be shifted using LED and Am-241 peaks.

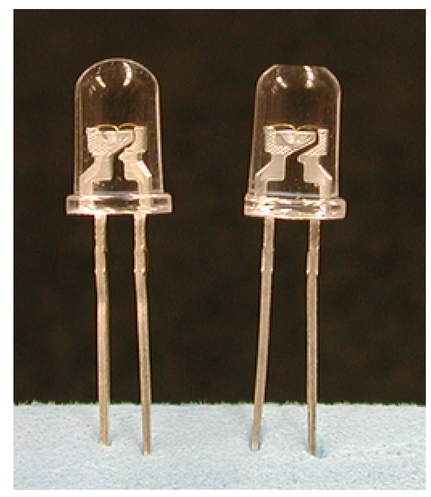
$$Bi^{pred} = Bi(t=0) \times \frac{LED_{calo}(t=0)}{LED_{calo}(t)} \times \frac{LED_{mon}(t)}{LED_{mon}(t=0)} \times \frac{Am(t=0)}{Am(t)}$$



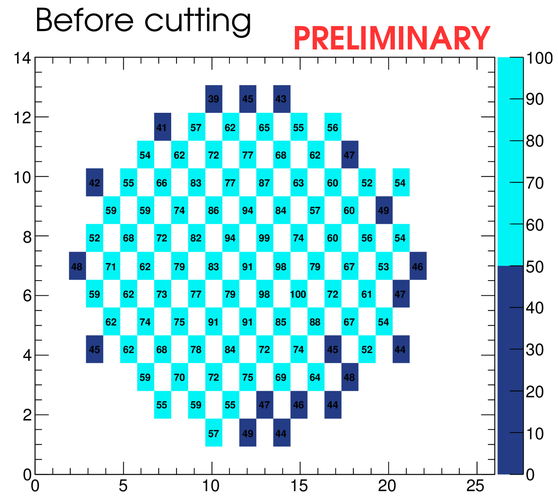
(The discontinuities in the data correspond to changes in HV on the 8-inch PMT)

Uniformity of Light Distribution

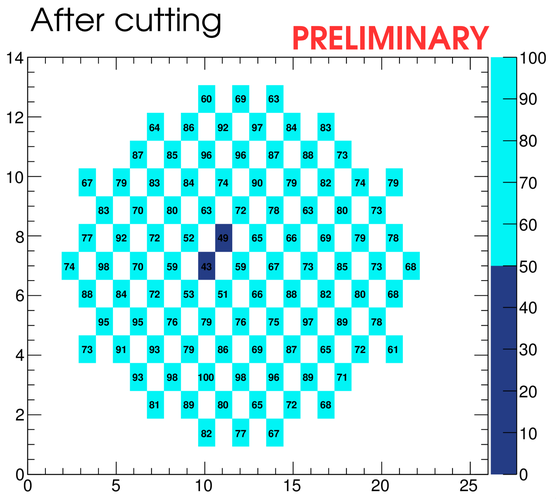
- For linearity tests and for proper monitoring precision, the PMT light level is desired to be uniform.
- The uniformity of the light is improved by slightly cutting the tip of the LED.



Before cutting



After cutting



Light Attenuation

- The attenuation length of the fibers has been measured to be : 9.7m ± 0.1 for the UV LED (385nm).
- A fiber of 15m loses 79 % of the initial light.