Design of the Hyper-Kamiokande Outer Detector

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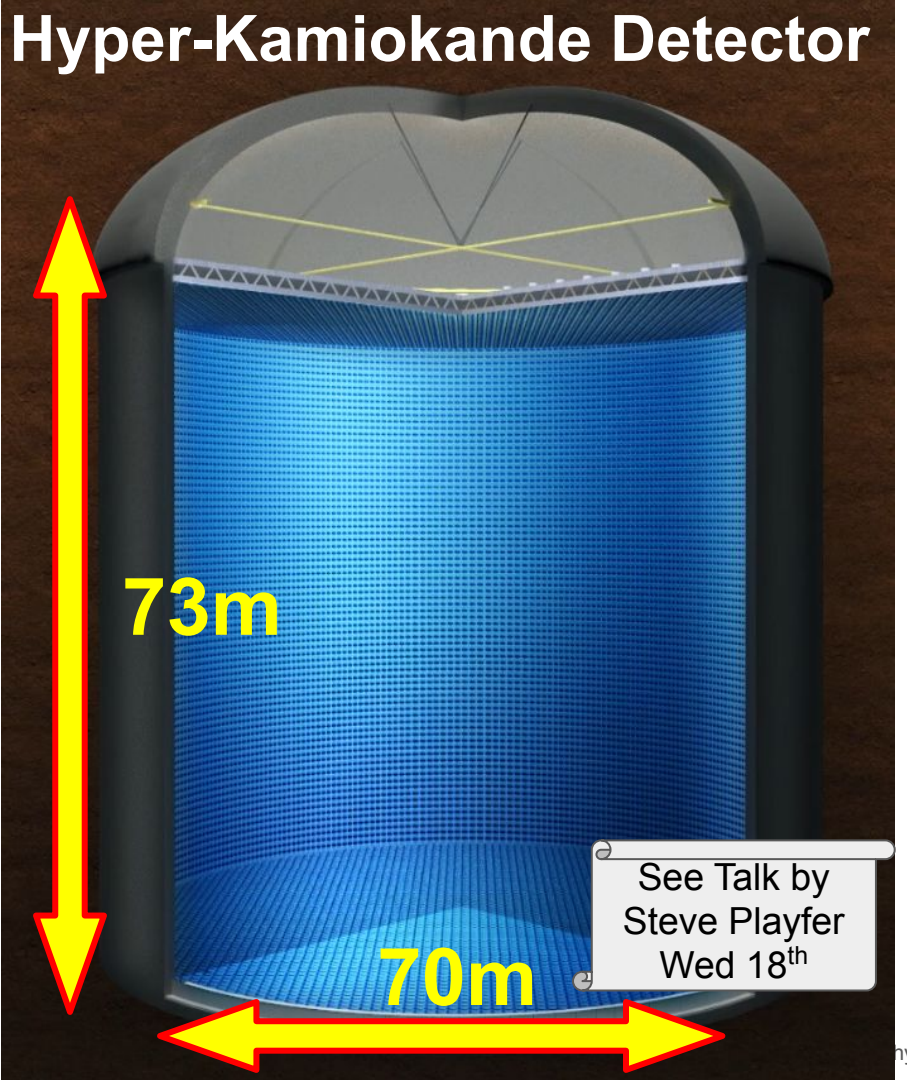
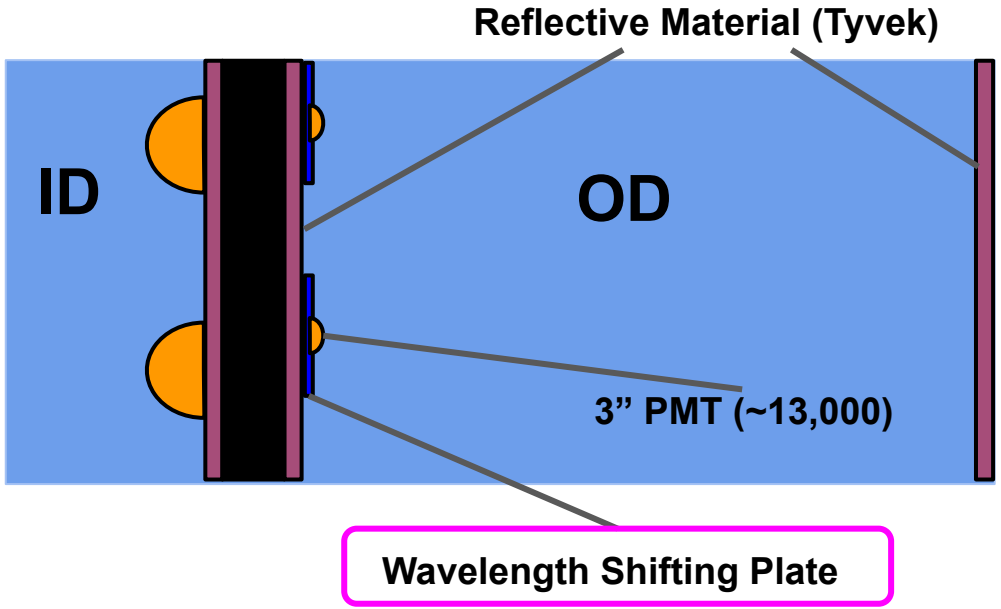
Hyper-Kamiokande Detector



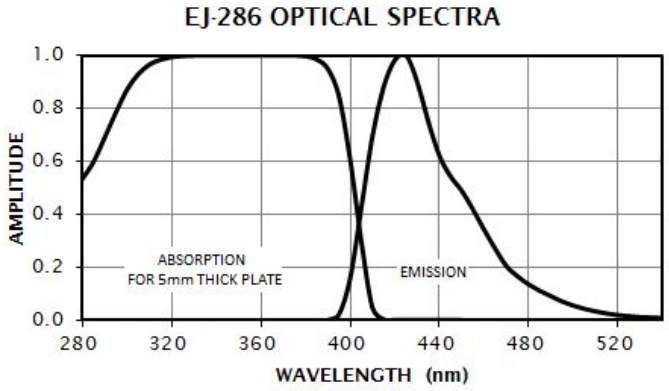
- Large underground water Cherenkov detector
- Will have an outer detector to veto incoming charged particles



Aim: To maximise light collection

Wavelength Shifting Plates

ELJEN Plate (HK OD candidate)

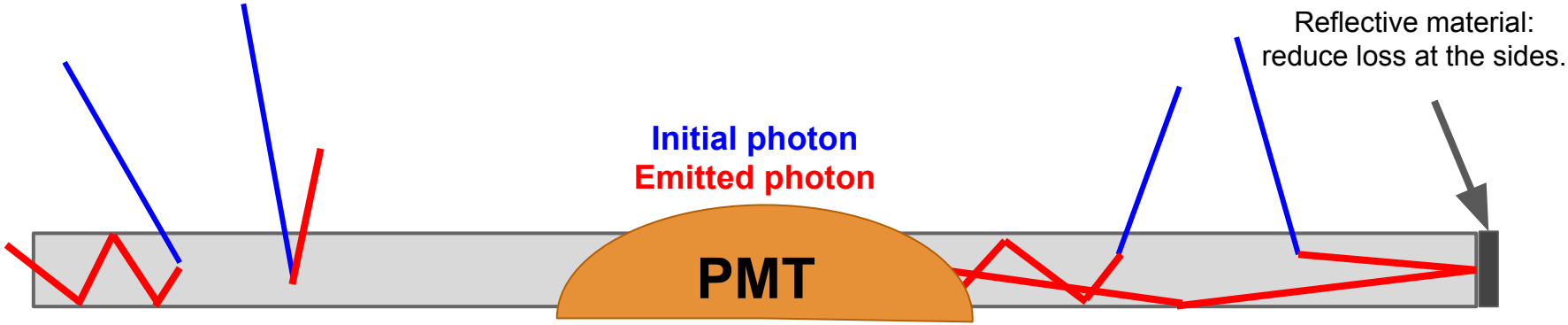


Light from shorter wavelengths (varies by plate type) get absorbed by the plate.

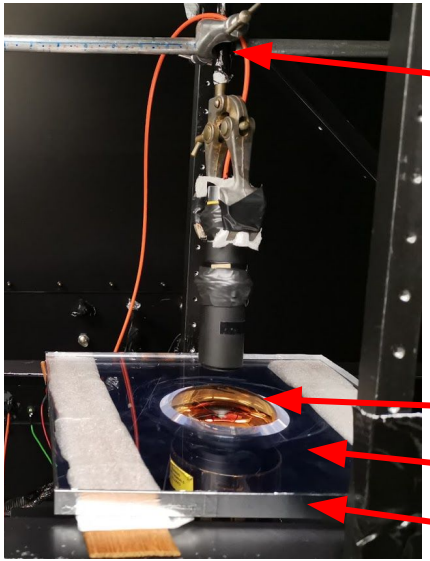
The dopant in the plate re-emits the light at a longer wavelength, isotropically.

The emitted light gets totally internally reflected (some loss through top and sides).

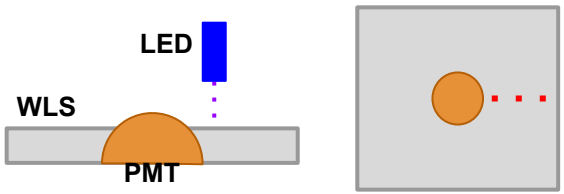
Some of the reflected light reaches the PMT



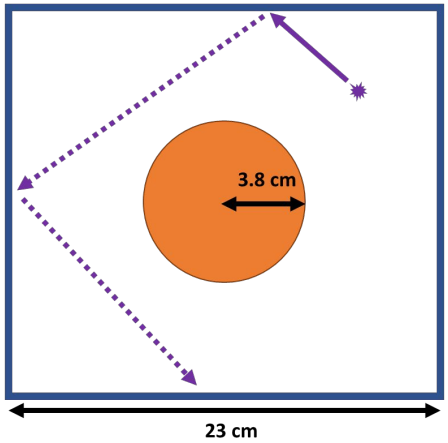
Setup and Simulation



Scan at several radial distances away from the PMT center



- Setup
  - Pulse 370 nm LED
  - Measure rate at each point
- Simulation
  - 2D basic simulation to track percentage of photons requiring n reflections to reach the PMT



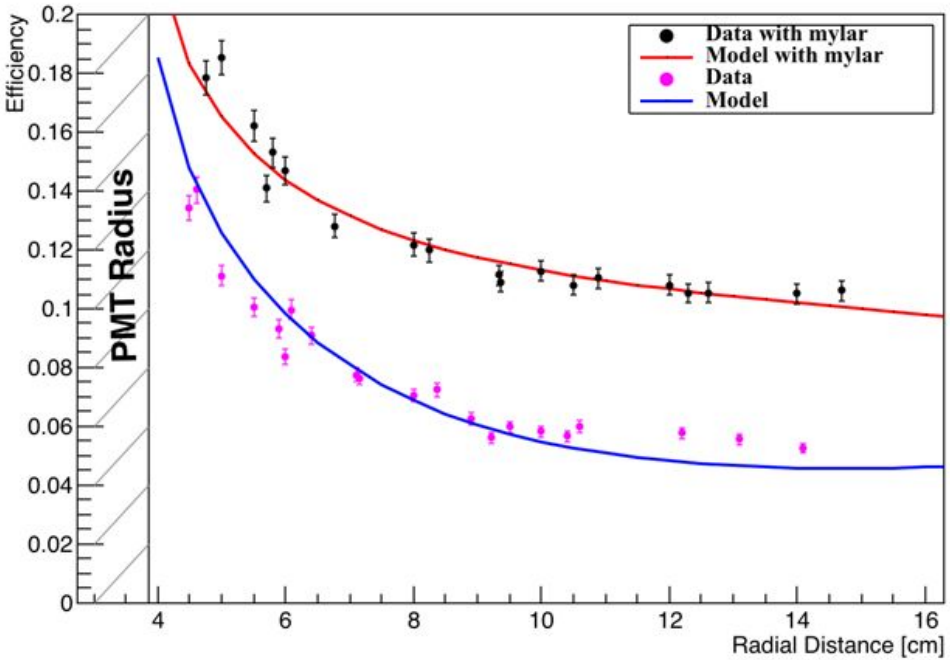
Model

$$Eff \times (M_0 + \sum_{i=1} Ref^i M_i)$$

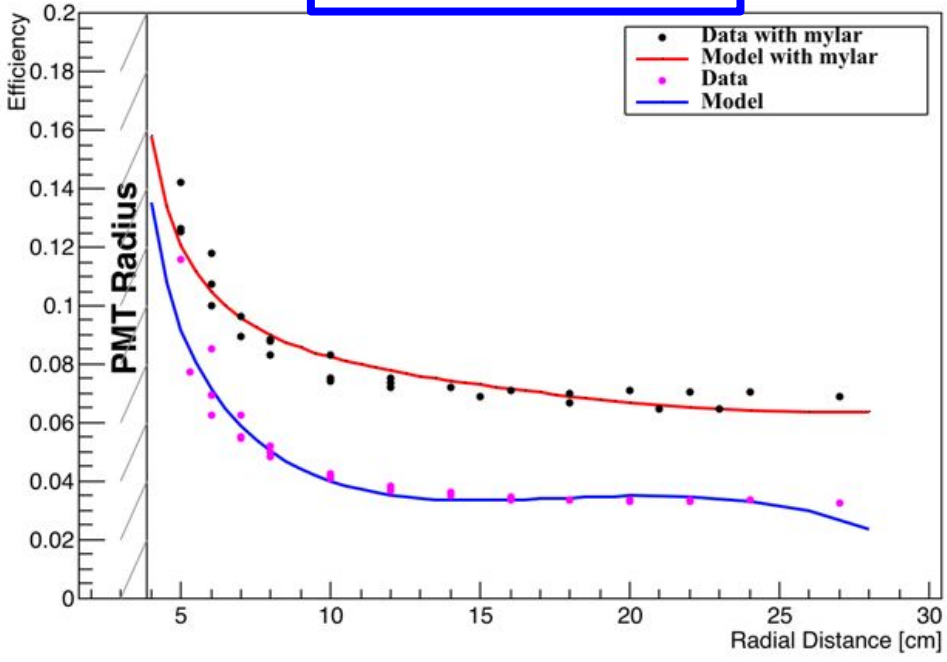
Eff = Plate efficiency
Ref = Plate edge reflectivity
M_i = Simulated captured photons that bounced i times

Efficiency Vs Radial Distance

EJ286 Plate 23x23x1.3cm

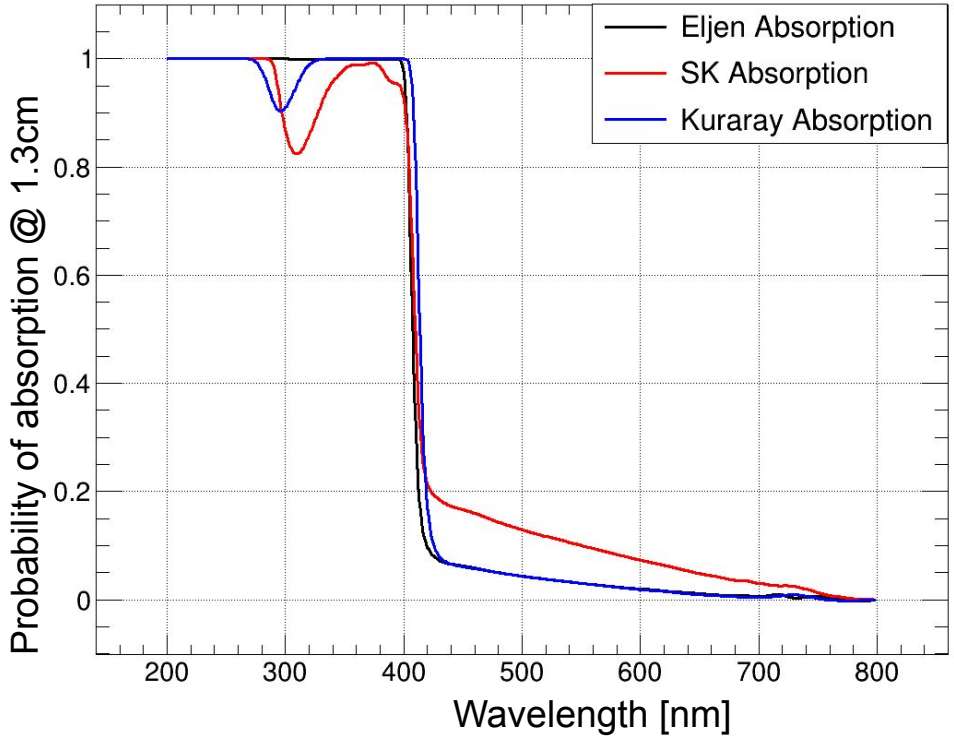


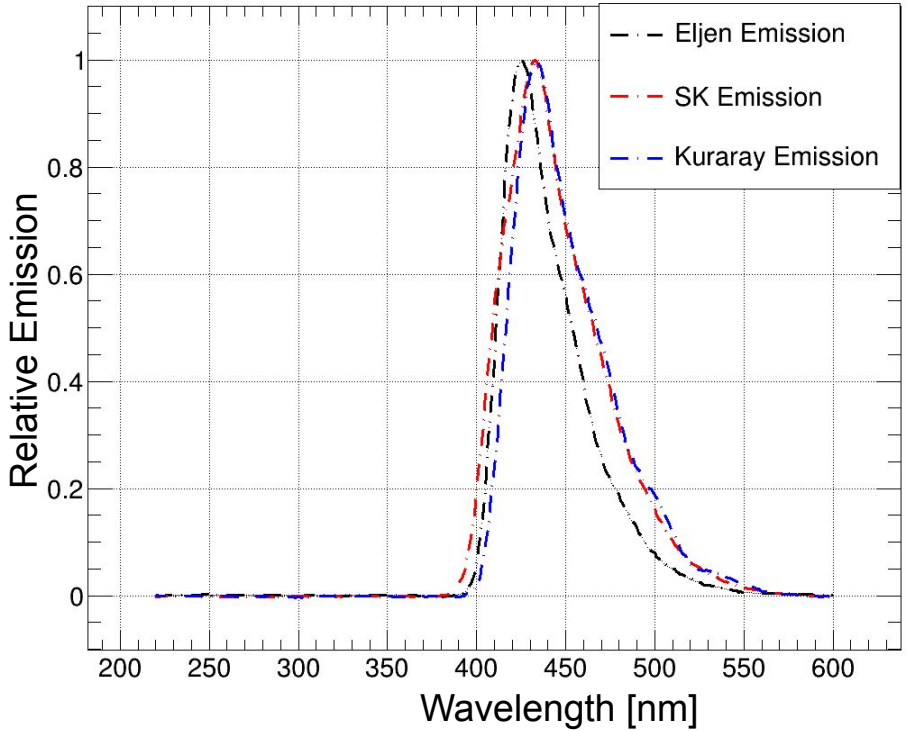
EJ286 Plate 30x50x1.3cm



- Efficiency = (Measurement at a point) / (Measurement of PMT center)
- Fit our model to large plate data and used it to predict the performance of the smaller plate.
- Model performs reasonably well

Measuring the Spectra (using a spectrometer)

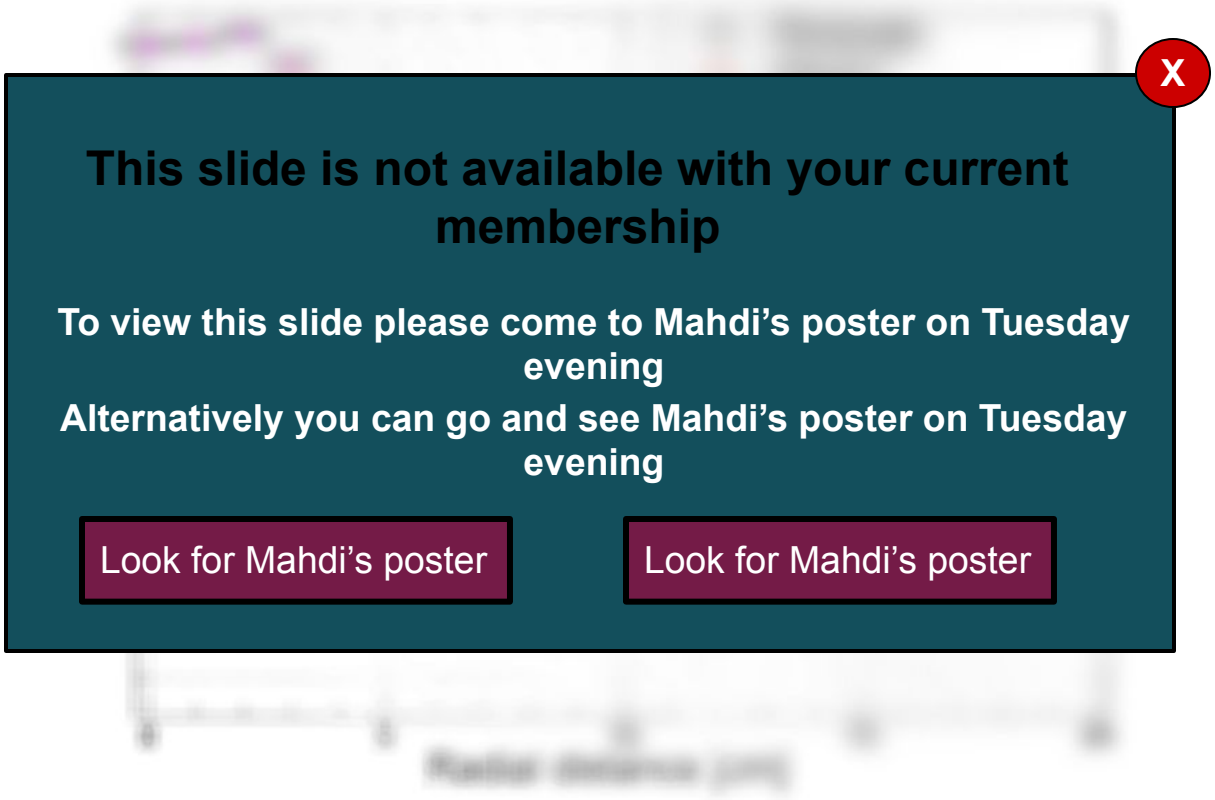




Absorption and emission spectra measured for each candidate plate

We combine these with the efficiency measurements and simulations to find out which plate would perform best

Super Interesting Fantastic Thing That You Must See



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