

Wavelength Shifter Development @ MPIK-Hd & DESY-Zeuthen



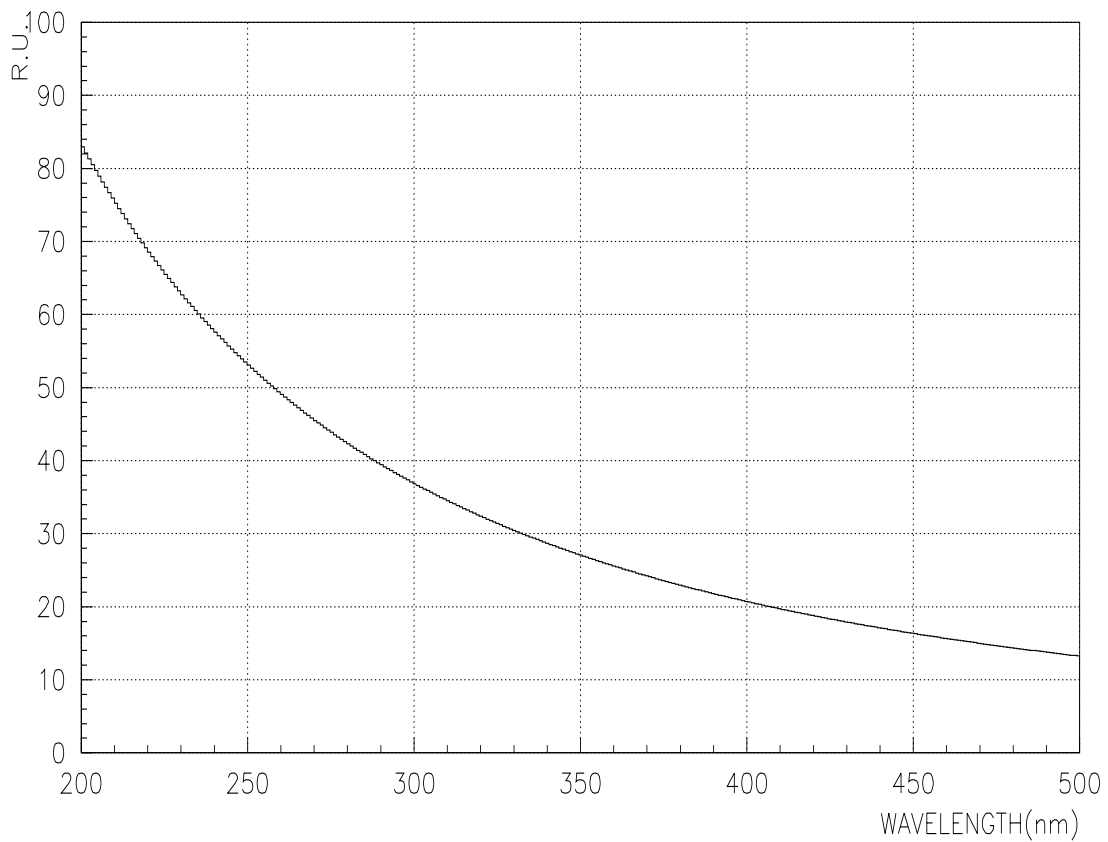
Goal: Improve OM collection of the Čerenkov light

i.e. absorb the Čerenkov light below the OM glass cut-off and re-emit it above in an efficient way.

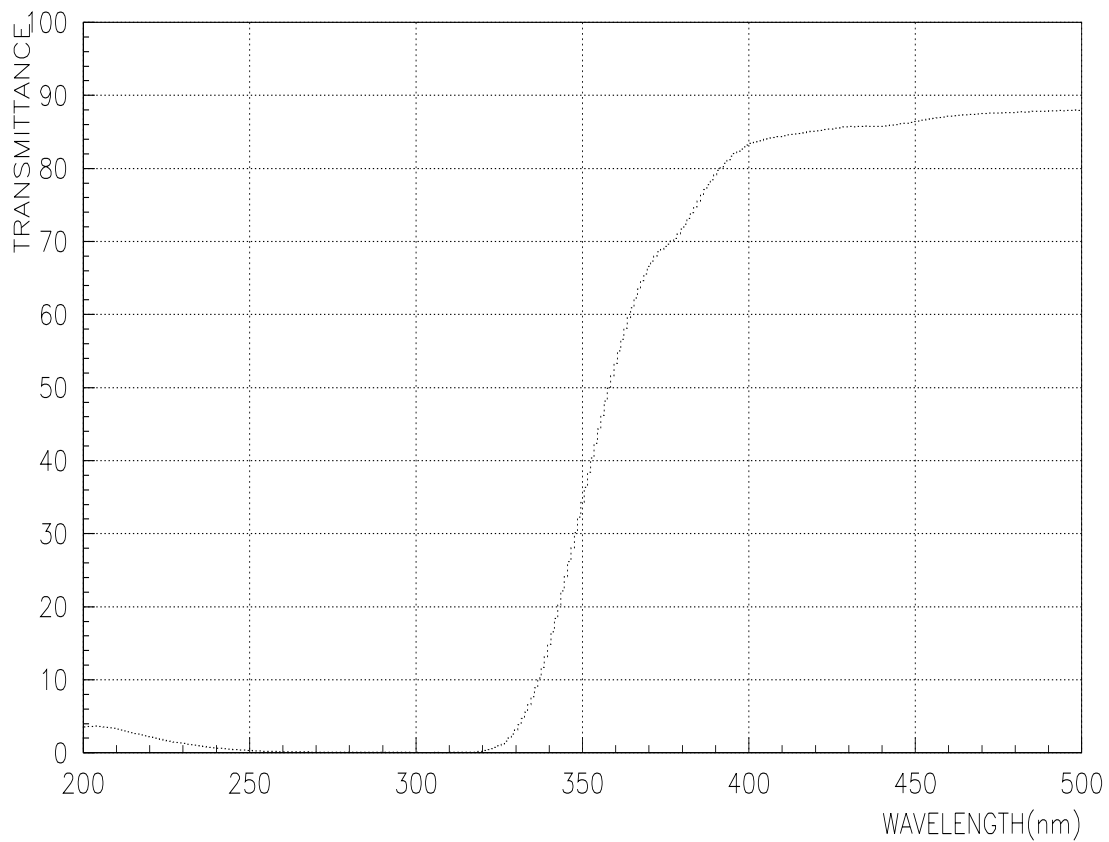
Outline:

- 1- Basic idea
- 2- Status of the development
- 3- Future programme

-1- Basic Idea: Čerenkov

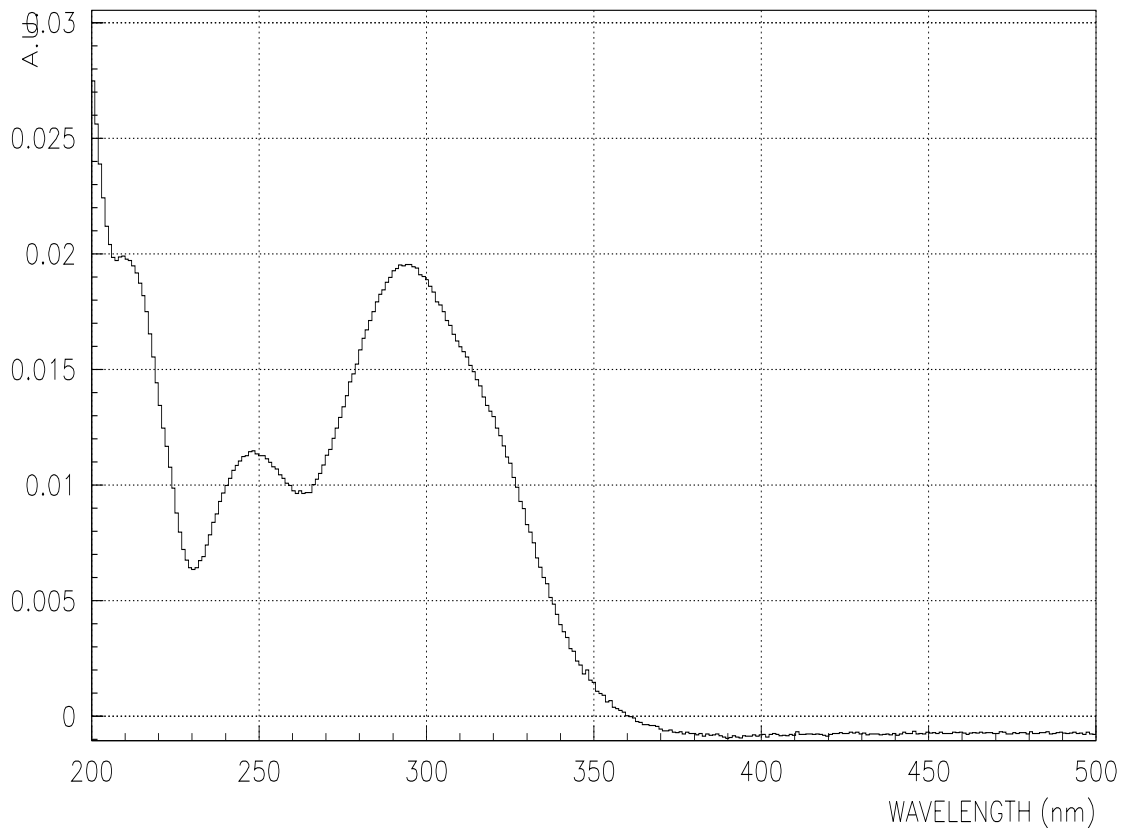


-1- Basic Idea: Čerenkov, OM glass*



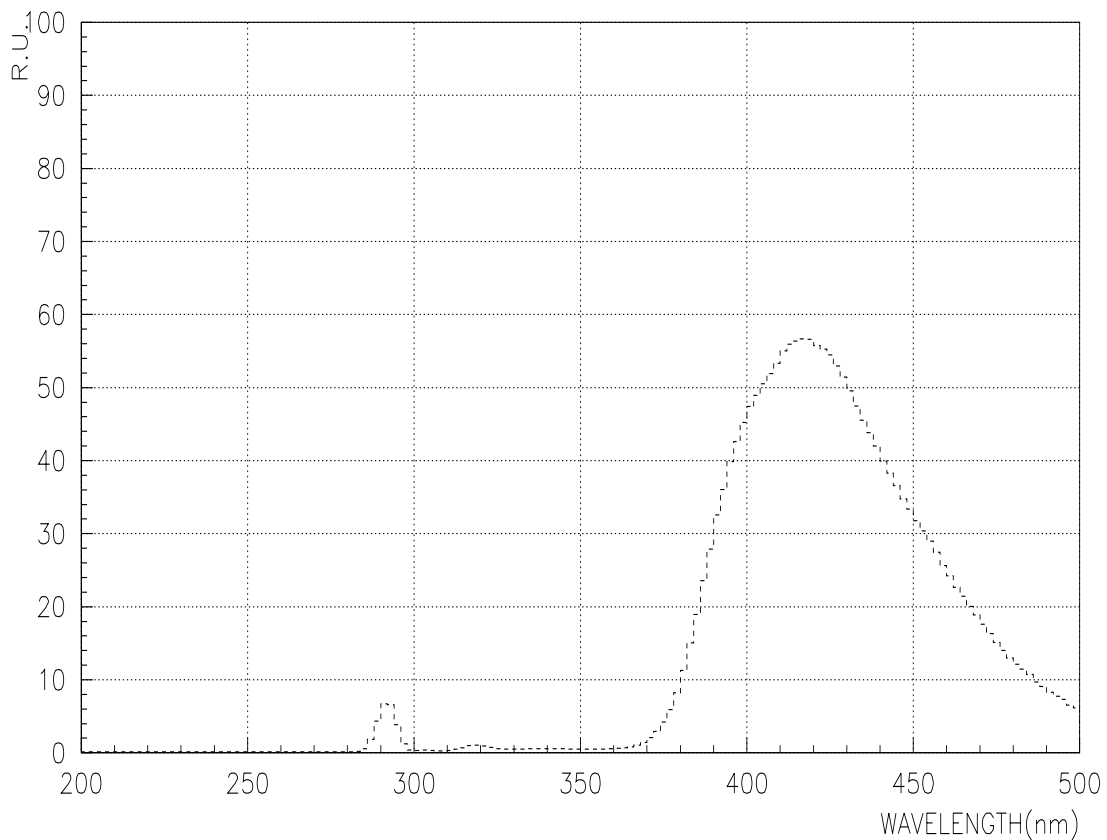
* Measurement from P. Suddhof and confirmed by E.R.

-1- Basic Idea: Čerenkov, OM glass, WLS absorption



The WLS concentration is set in order that the minimum of abs. correspond to 90% of light abs.
(PMP area density in gram per area: $88.1 \mu\text{g}/\text{cm}^2$)

-1- Basic Idea: Čerenkov, OM glass, WLS Absorption & WLS Emission (PMP)



Quantum yield: p-Tp = 0.93
PMP = 0.80

-1- Basic Idea: Make the fluor (powder) in a solid form \Rightarrow plastic thin (100 μm) film (THV) doped with one fluor (PMP or p-Tp)

Advantages:

- optical path length constant
- no adhesion problem
- one component system: high quantum yield, good timing (few nsec)

Potentialities:

Using PMP or p-Tp, 50% lost (isotropic emission) \Rightarrow \sim 40% light

[impact on IceCube performances? See for ex. A.Biron, H.Wissing AMANDA-IR/20001202]

-2- Status of the development

(in collaboration with [Fraunhofer Institute for Process Engineering and Packaging](#))

- ✓ Test of the chemical stability of the fluor at high temperature (Differential Scanning Calorimetry):

PMP and p-Tp do not degrade at extrusion temperature (~ 250 °C)

- ✓ Feasibility Test: Small scale extrusion test:

- ✓ pure polymer: problems with crystal and air bubbles formation

⇒ very low transmittance

- ✓ pure polymer with fluor (in powder) at different concentrations:

⇒ no solubility problems observed

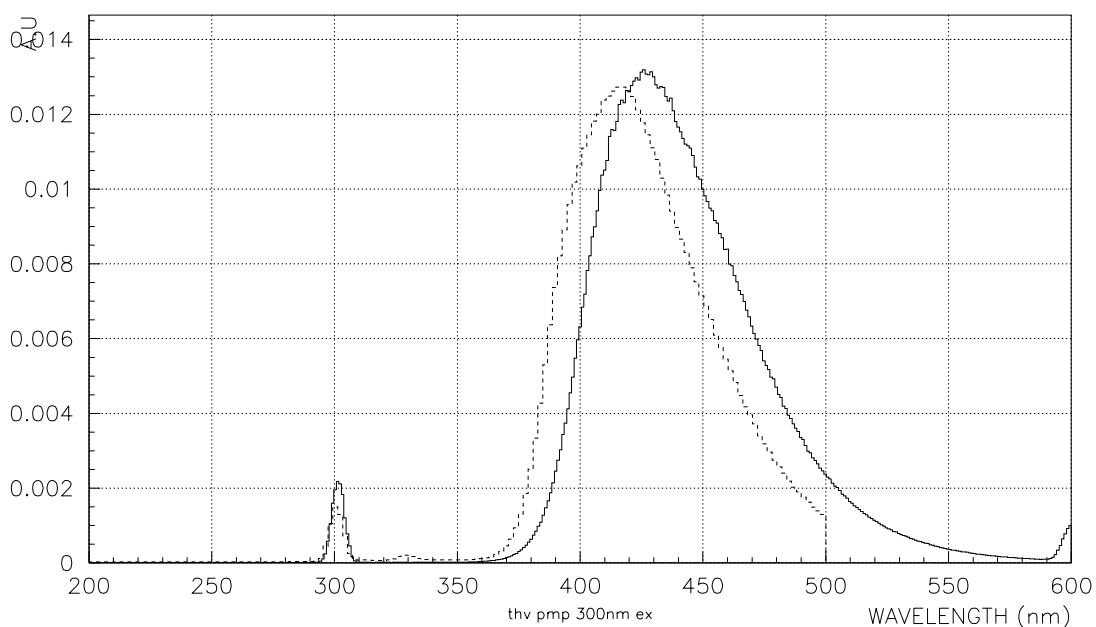
⇒ problems with crystal and air bubbles formation

⇒ very low transmittance

Working progress

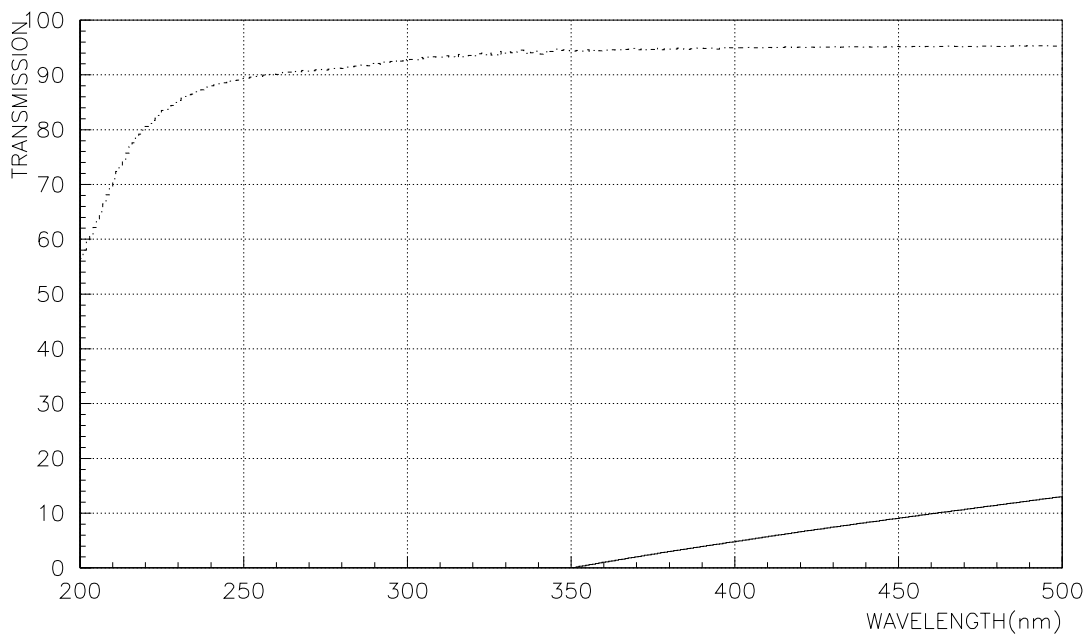
✓ Emission measurements

Front-face geometry



Emission spectrum ($\lambda_{\text{ex}} = 300\text{nm}$) of PMP in cyclohexane (solvent for optical measurements) and PMP in THV

✓ Transmittance measurement: of THV from Dyneon and THV extruded on small scale



-3- Future Programme

- Improvement of the film transmittance:

 - Cooling process faster and degassing during extrusion

 - ⇒ big scale test (cost?)

- Fluor introduction after pre-solution

- Study of backup solution:

 - Polystyrene & fluor (bi-component WLS)

 - Bicron plastic scintillator (just as a reference)

- Quantum yield determination:

 - Belgium hodoscopes

 - First dynode current measurement

- Long term stability test

 - High purity water

 - Low temperature behavior