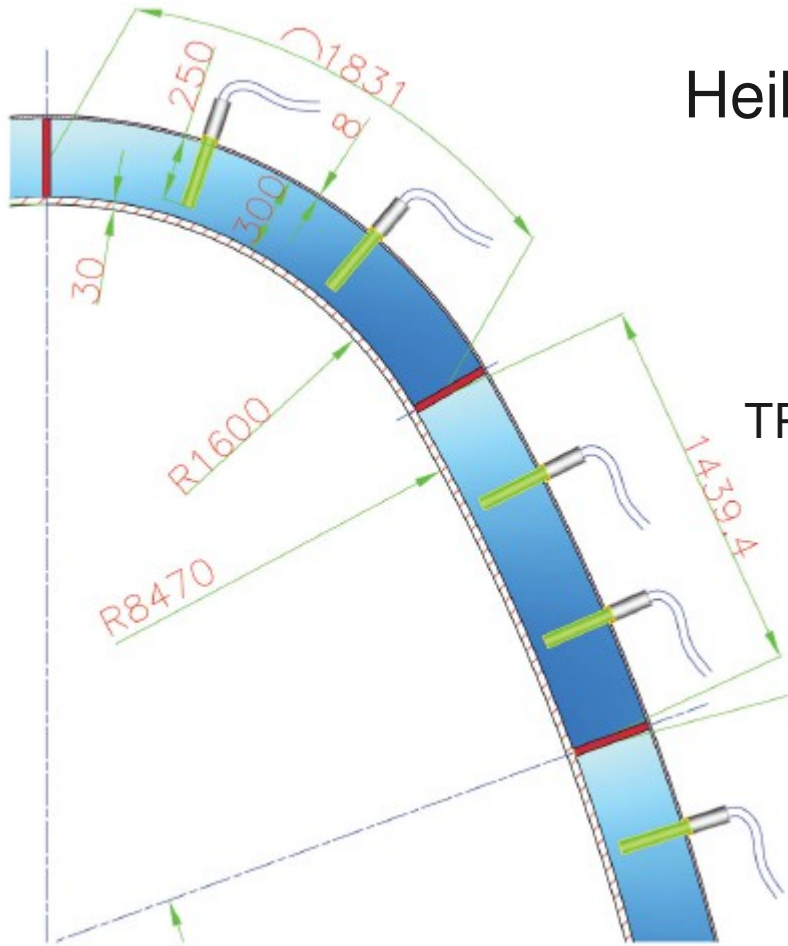


Surround Background Tagger

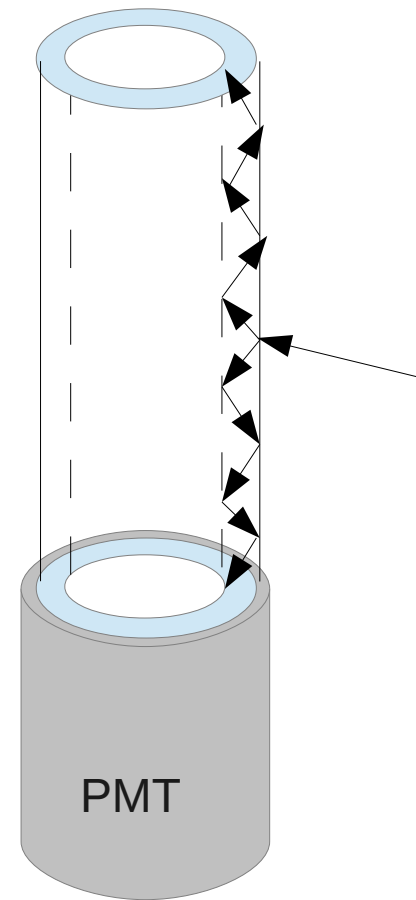
Heiko Lacker, HU Berlin

11.02.2016

TP: HU Berlin, LPNHE, MEPhI

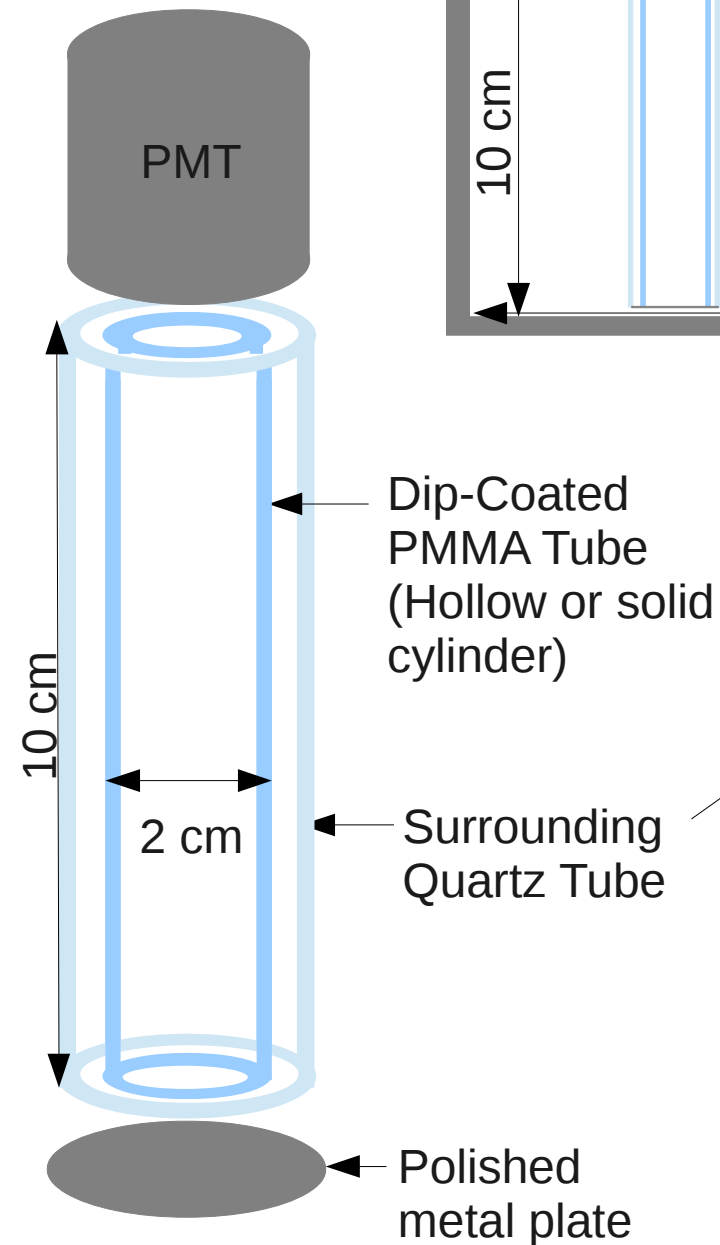
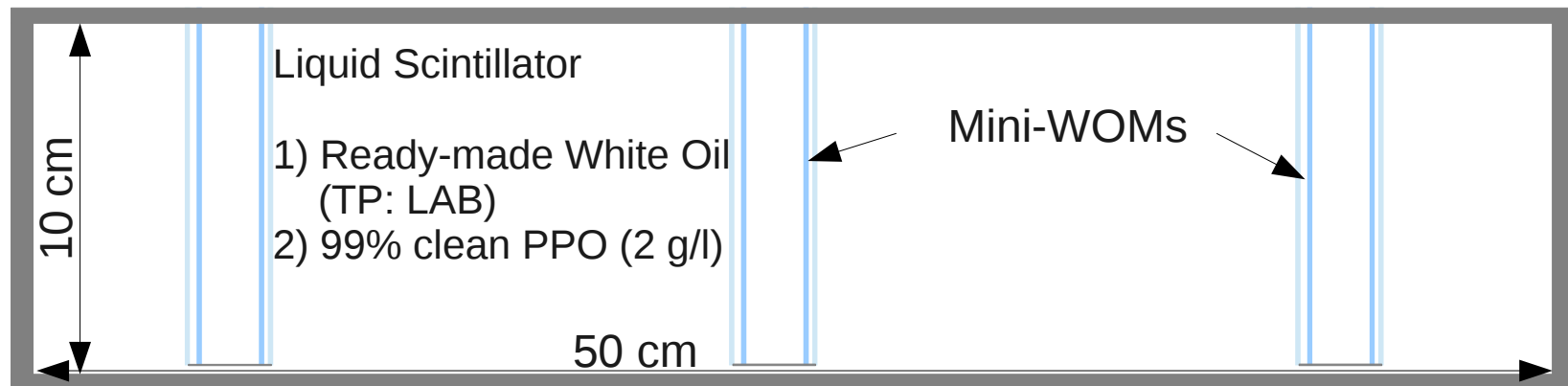


Mini-WOM
(Wavelength-shifting
Optical Module)



- 1) R&D news
- 2) Funding for generic WOM R&D
- 3) Detector Options for the SBT
- 4) R & D work to be tackled now

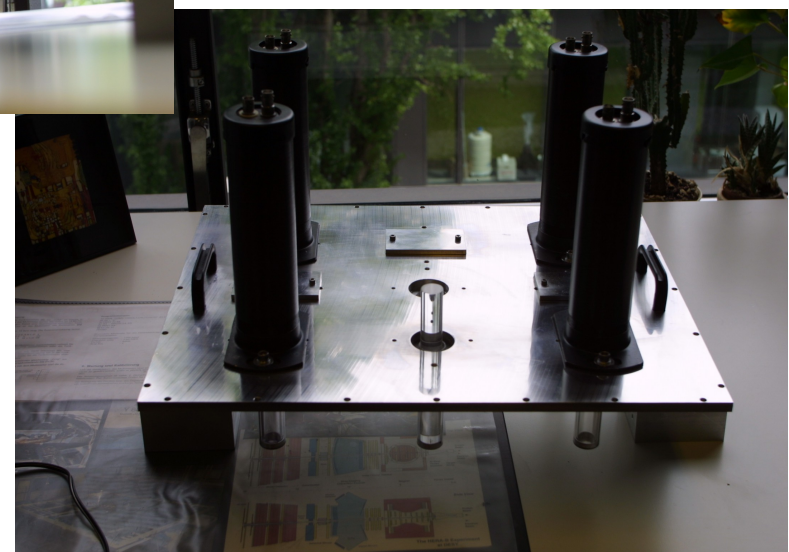
1) R&D news: Liquid Scintillator Box with Mini-WOM



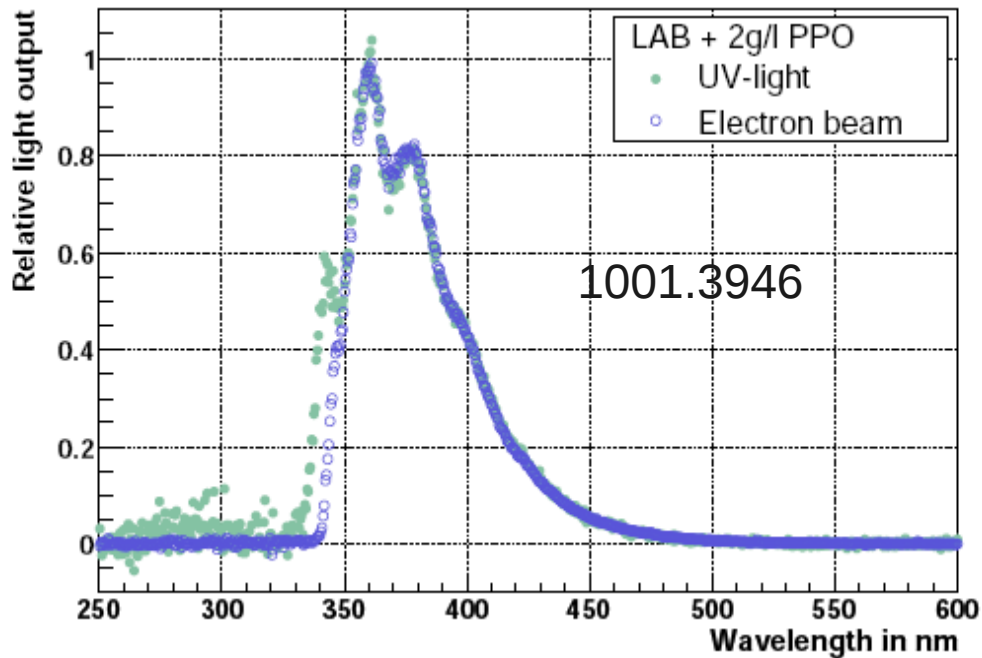
Efficiency to detect cosmics with 1 Mini-WOM (solid cyl.):

1) 94-95% (July 2015: 75%)

2) 98-99% with metal plate



1) R&D news: Absorption Length Measurement

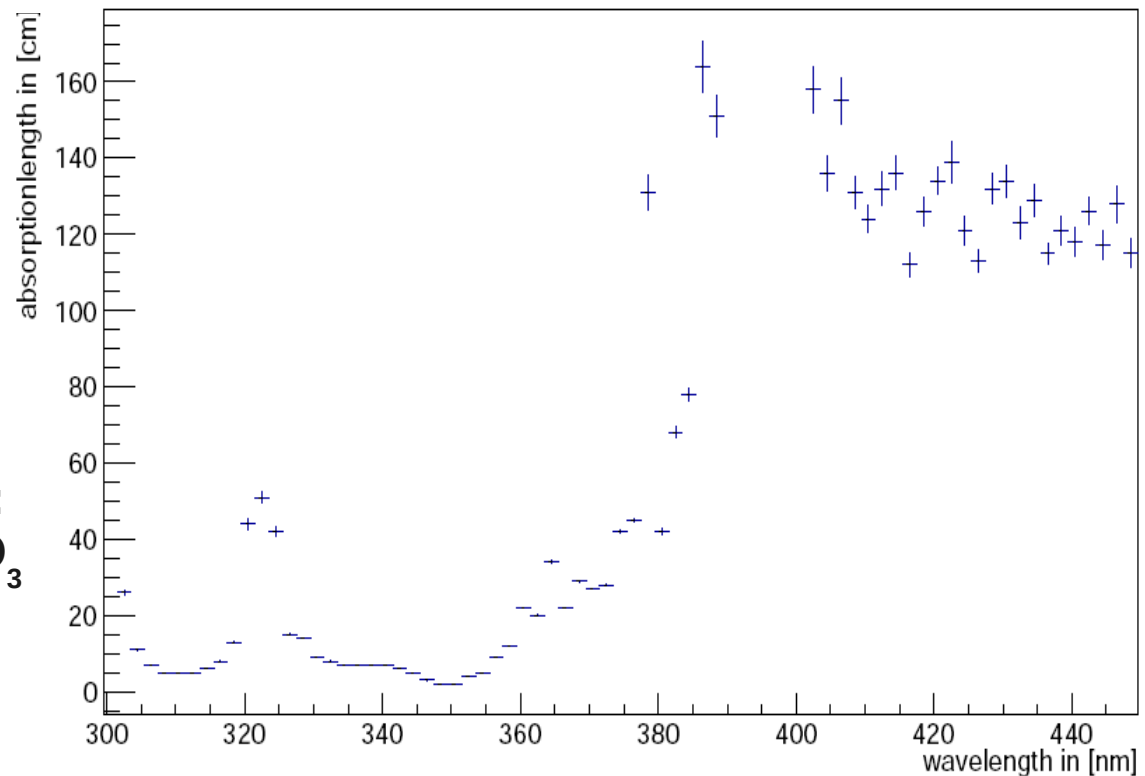


PPO emission spectrum (2g/l in LAB)
(arXiv: 1001.3946)

**Absorption length measurement
in currently used LS mixture
(White oil + 2 g/l PPO)**

**Small absorption length for $\lambda < 380$ nm
main reason for $\varepsilon < 99\%$**

**Custom-made LAB has same problem:
Solved by repeated purification in Al_2O_3**



2) Generic WOM R&D

HU Berlin received a grant from the German Research Foundation (DFG):

*** Subject: Generic R&D for WOM development (for LS)**

*** $\frac{3}{4}$ FTE for the next three years**

If you are interested in a PhD studentship/postdoc position in this area

or know possible candidates

please get in touch with me!

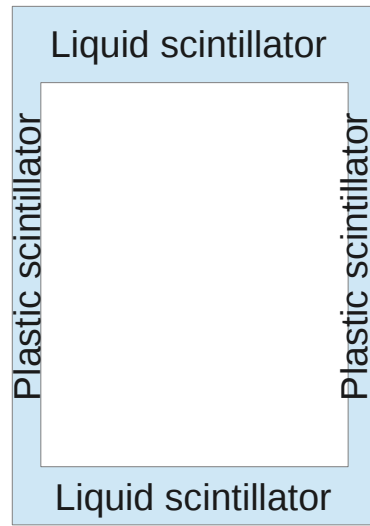
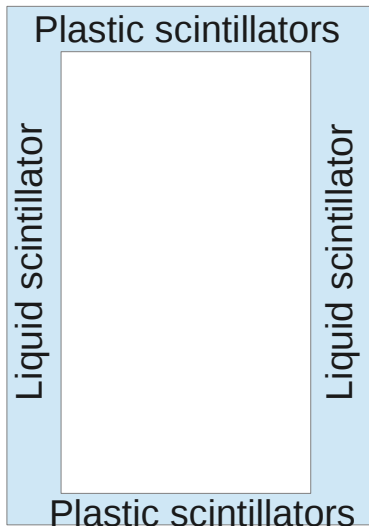
Work might be combined with

SHiP (MC simulations, see the following)

ATLAS (e.g. HNL searches)

3) Detector Options for the SBT

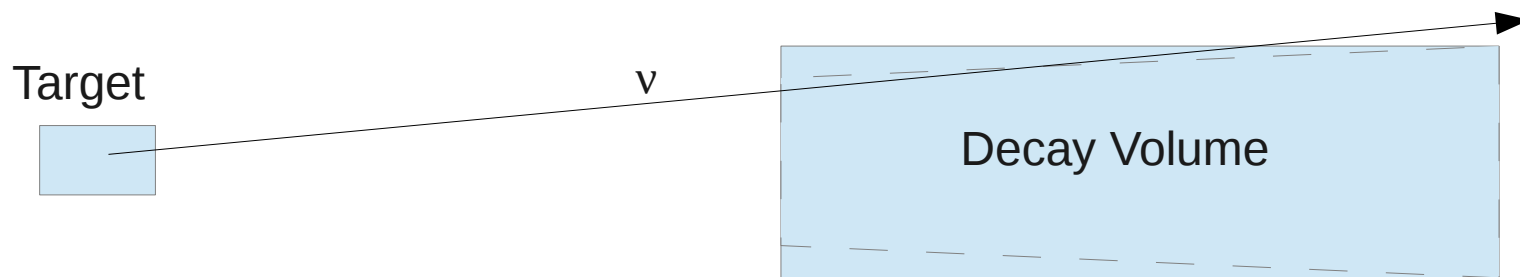
| <u>Decay Vessel</u> | <u>SBT support structure</u> | <u>Detector Technology</u> |
|--|---|--|
| Low pressure/ vacuum | TP: elliptic; metal walls (very challenging) Concrete elliptic & conical | LS: - WOMs or large-area PMTs - Tubes with WLS fibres (APD) |
| He-filled bag @ air pressure | Freedom in shape ! Much cheaper! | Plastic scintillators: + No walls needed + Support structure potentially lighter compared to LS - more expensive than LS LS: + Reduced wall thickness + Plastics as wall material - purification, N ₂ -flushing, maintenance (systems) |
| Mixed solutions e.g. for trapezoidal shape ? | | Thickness required for a given granularity to get required efficiency? |



3) Comment on conical/trapezoidal shape

Probably already mentioned by somebody else:

More ν DIS events produced in SBT walls for conical/trapezoidal shape



For He bag with “thin” plastic scintillator SBT maybe not an issue but e.g. for a conical concrete solution.

3) Detector Options for the SBT: brainstorming

LS-SBT: higher efficiency for high-energetic γ
compared to thin-wall plastic-scintillator SBT

Might be advantageous wrt

a) BG rejection of ν -reactions inside He bag ? Ex.: $K_L \rightarrow \pi\pi\pi^0 (\rightarrow \gamma\gamma)$

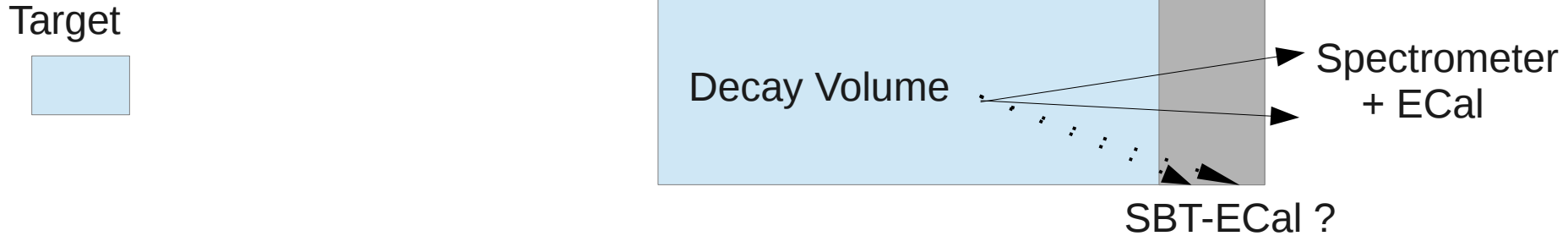
b) Signal statistics ?

Several 3- and 4-body signal final states with γ/e^\pm or π^0

Calculating invariant mass requires spatial & energy information of γ/e^\pm

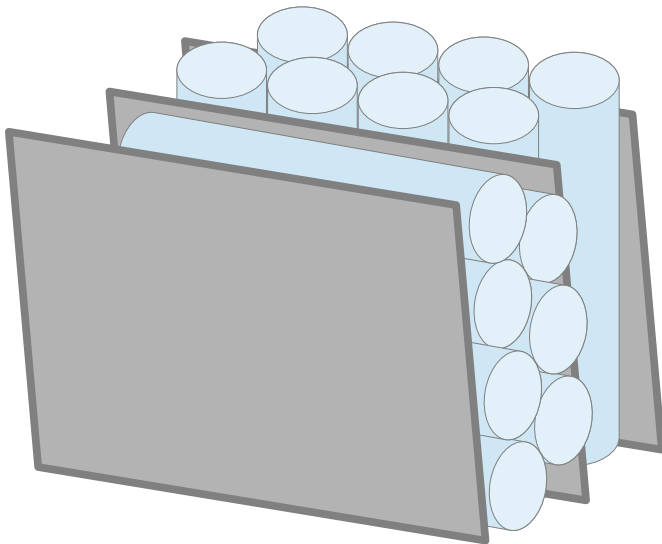
3) Detector Options for the SBT: brainstorming

For the He-bag solution: SBT endsection as a γ calorimeter ?



Issues: Granularity & Length ($X_0(\text{Scint.}) \sim O(45 \text{ cm})$)

E.g. walls of LS-filled PMMA tubes interleaved with lead plates?



Or a classical sandwich calorimeter with plastic scintillators?

4) R & D work to be tackled now

Box filled with LAB (vendor, purification) + PPO (2 g/l) viewed by

a) full-sized WOM incl. lightguide or b) large-area PMT

Efficiency, time response, light yield with cosmics & test beams

Who? 2016???

ManPower can
be funded
@ HU Berlin

MC simulations for He bag @ air pressure:

Which granularities and efficiency needed for SBT ?

Different SBT shapes & material budget (plastic ↔ LS)

End section of SBT as an ECal beneficial?

Manpower
Needed !!!

MC simulations of light output for large-area plastic scintillators
+ photon collection techniques & readout

Would profit from synergy with other systems using plastic scint.!

Manpower
Needed !!!

Low pressure/vacuum decay volume:

Much more work needed on the concrete solution

Manpower
Needed !!!

SUMMARY

SBT is in a very special situation:

The detector concept heavily depends on the decision about the decay volume (either (very) low pressure or He bag)!!!

Have to work in parallel on very different concepts (mechanics; detector material, its deployment and readout, ...)

At the same time:

SBT heavily understaffed !!! Manpower urgently needed!!!

If you (institute or individual) are interested in contributing:

Now is the time to join the effort !!!