JOHANNES GUTENBERG UNIVERSITÄT MAINZ

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Reflective Coating in the Surround Background Tagger

12.02.2021

SHiP Decay Vessel Workshop

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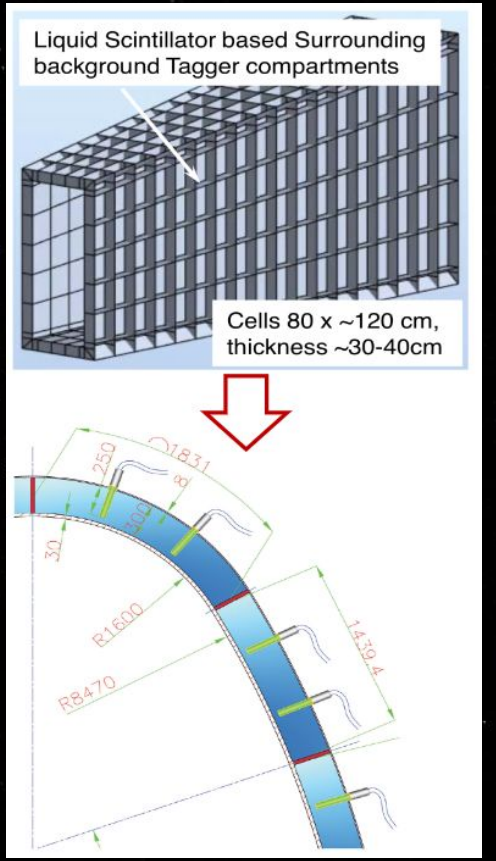
Search for Hidden Particles

Reflectivity Coating in the SBT

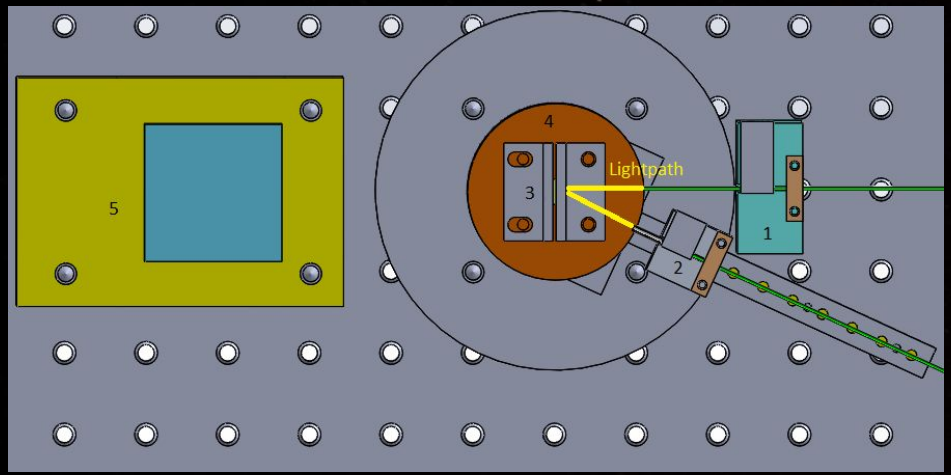
- Goal: Enhanced light collection by addition of a highly reflective coating (diffuse reflector) to the inner walls of the SBT cell

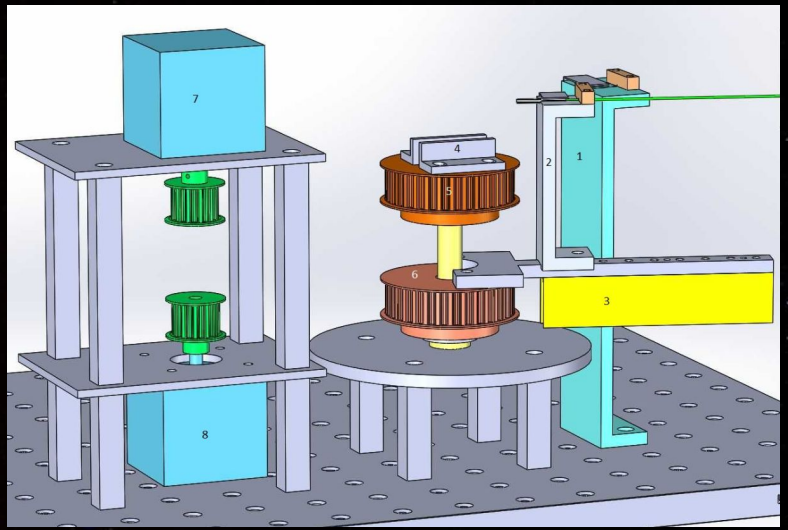
- Research includes:
  - relative reflectivity measurements
  - compatibility of the liquid scintillator and coating
  - efficient application within the cells



Schematic view of the SBT

Experimental Setup: Relative Reflectivity

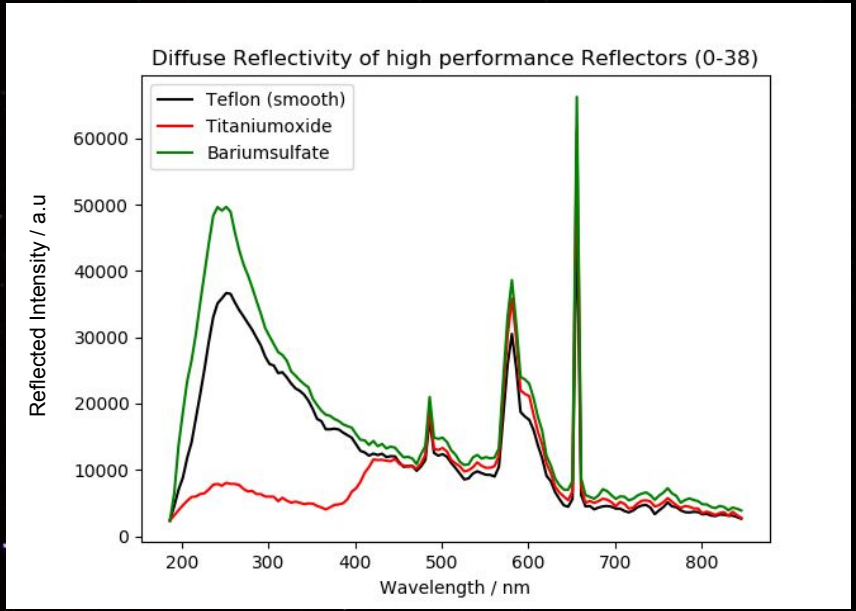




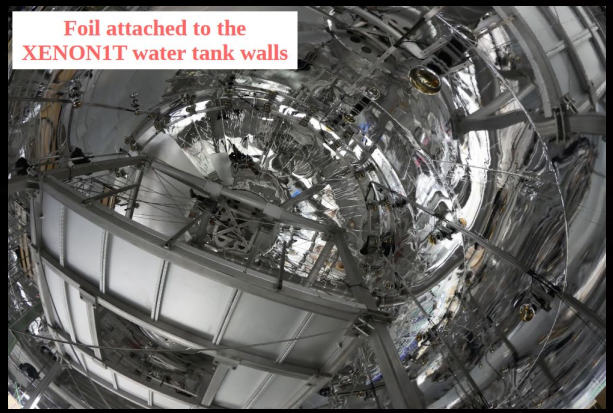
- ability to measure the reflectivity of samples with various incident and reflecting angles
- comparison to well documented and highly efficient reflector standards

First Reflectivity Measurements: Results

- quick measurement without reliable standards
- low reflectivity of Titanium oxide below 420 nm
- Barium sulfate shows high reflectivity in UV-region → focus for further research



New Reflectivity Measurements: Samples



DF2000MA foil
(Specular Standard)

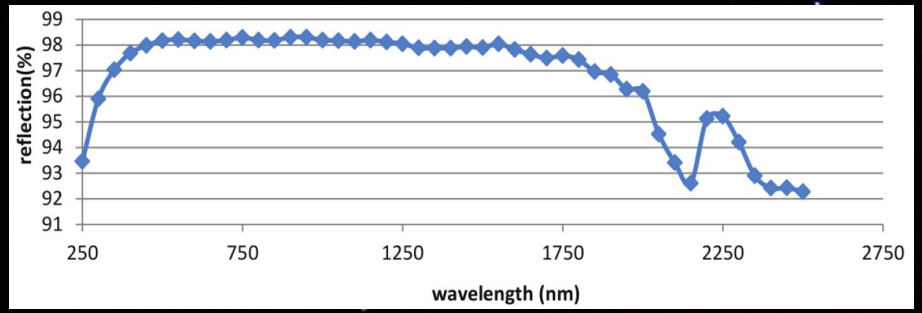
PTFE
(Diffuse Standard)

Steel (SBT Prototype)

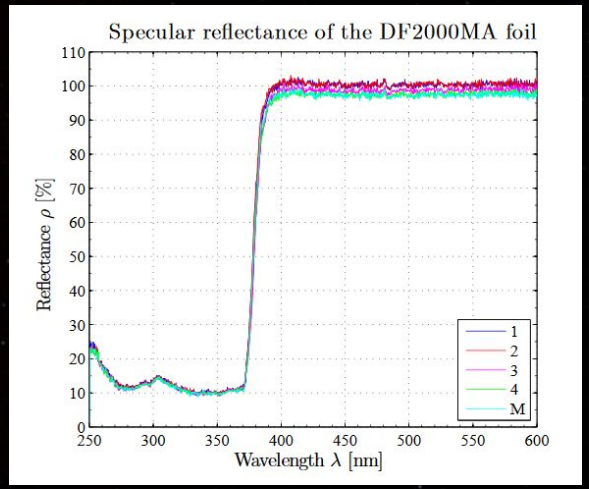
BaSO4

New Reflectivity Measurements Standards

- Comparison of diffuse reflectivity to new rough and uniform PTFE sample (Optopolymer)
- Comparison of specular reflectivity to mirror-like DF2000MA foil by 3M (XENON Muon Veto)

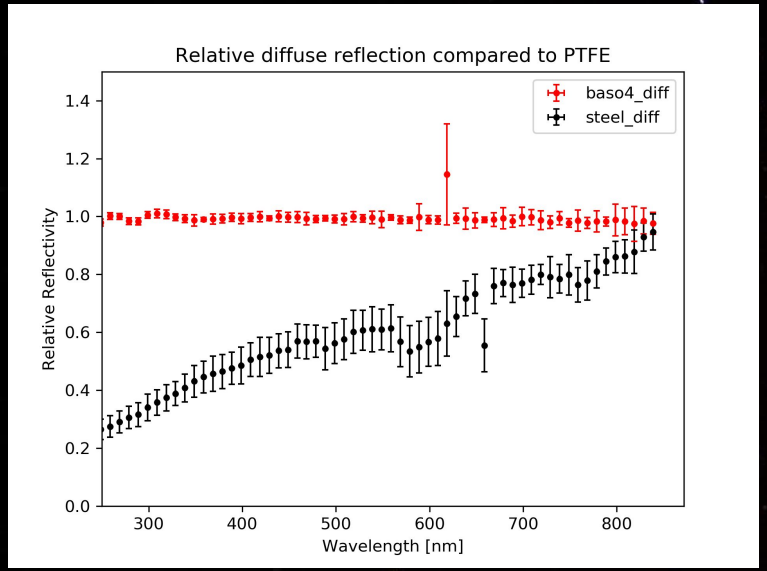


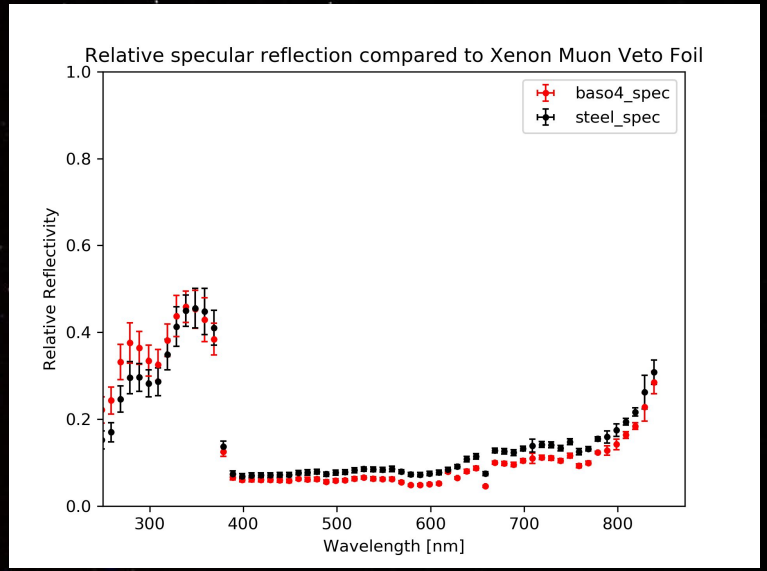
Diffuse Reflectivity of Optopolymer PTFE Sample (Manufacturer)



Specular Reflectivity of DF2000MA foil (arXiv:1706.03687)

New Reflectivity Measurements: Preliminary Results





- Barium sulfate is close to a perfect diffuse reflector; including the UV-range
- Specular reflectivity of Barium sulfate and steel is barely distinguishable at lower wavelengths

➢ New measurements indicate strong improvement of the inner detector wall reflectivity with the application of Barium sulfate

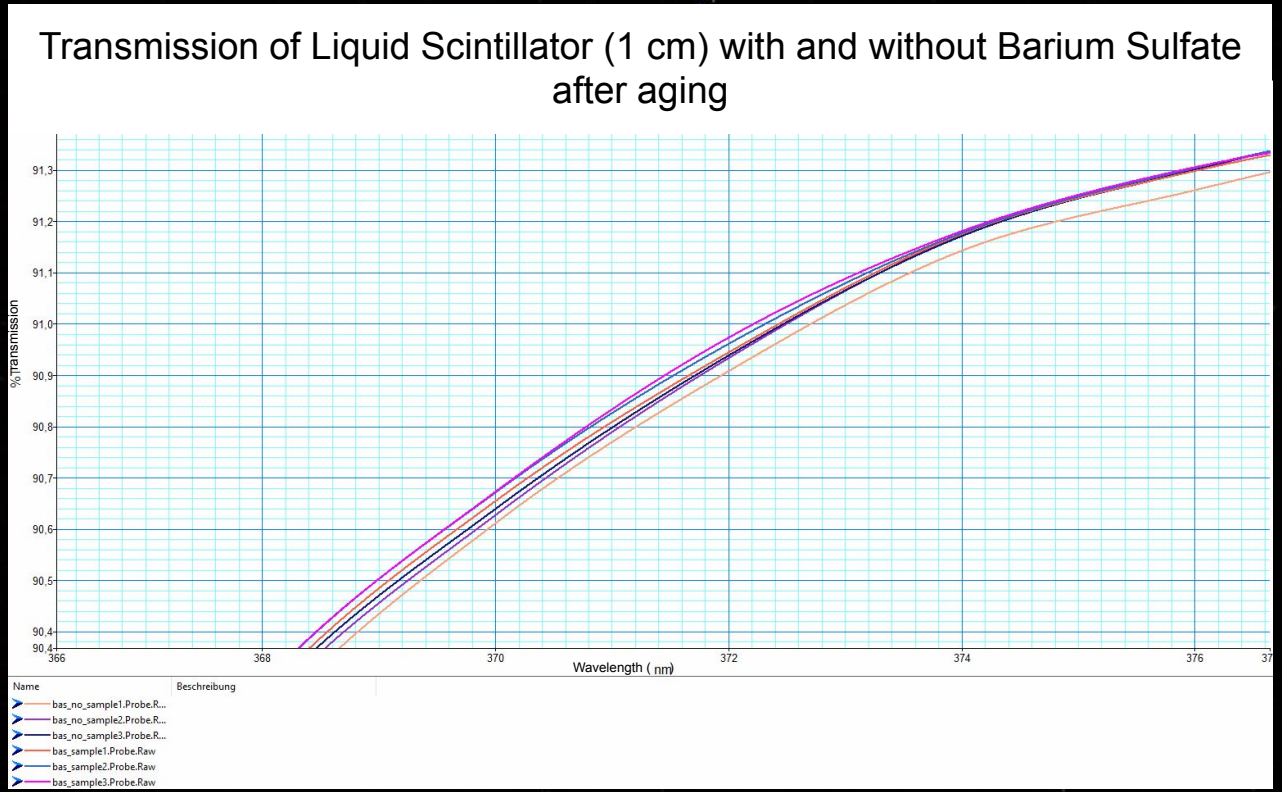
Compatibility tests

- identification of possible negative impact of the reflective coating on the transparency of the liquid scintillator over long time periods
- steel sample with Barium sulfate coating is deposited in liquid scintillator
- scintillator without sample is stored identically and acts as a reference
- transmission of the scintillators is measured and compared after incubator storage

Absorption Measurements after heat-induced aging (~3 years)

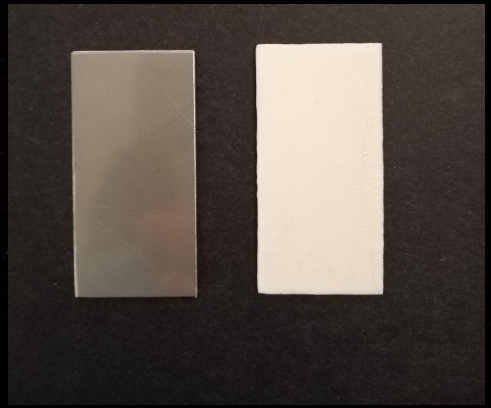
- transmission results show no negative impact of the coating on the scintillator

- no apparent crumbling of the coating from the steel



Application of the Coating

- the paint is currently sprayed onto a stainless steel with an electrical spray gun
- application of three layers with 30 min of drying in between
- current plans for the application within the SBT cells:
  - application after welding to ensure chemical stability to the coating
  - spray gun with angled nozzle
  - access through WOM entry points
  - large-scale application still under investigation



Stainless Steel Sample without and with $BaSO_4$ coating

Conclusion

- Barium sulfate shows promising properties to be used as a reflective coating on the inner walls of the SBT
- application onto steel shows high increase of diffuse reflectivity with low deficit in specular reflectivity
- Barium sulfate shows no negative impact on liquid scintillator transparency
- Research outlook:
  - impact of the liquid scintillator on the reflectivity of Barium sulfate
  - application of coating onto black steel (substitution for stainless steel)
  - efficient application within welded SBT