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Reflectivity Coating of a WOM-LS Prototype Detector

Bundesministerium für Bildung und Forschung

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High-D-Consortium-Meeting
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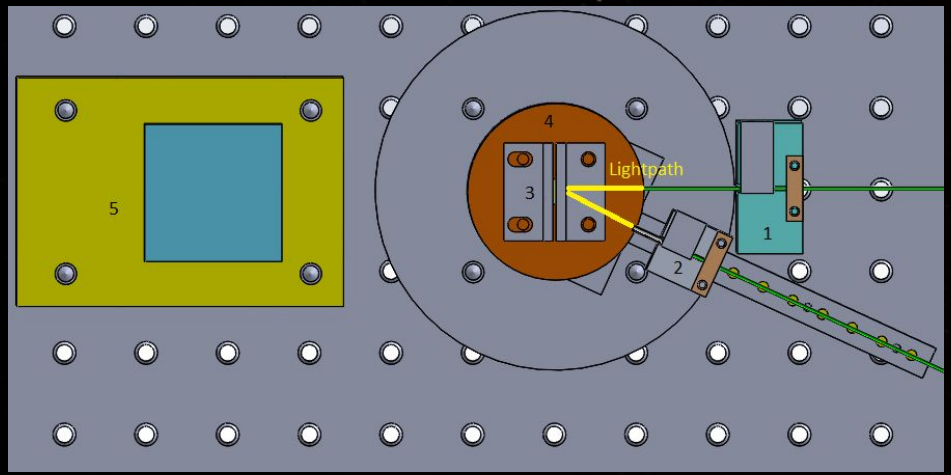
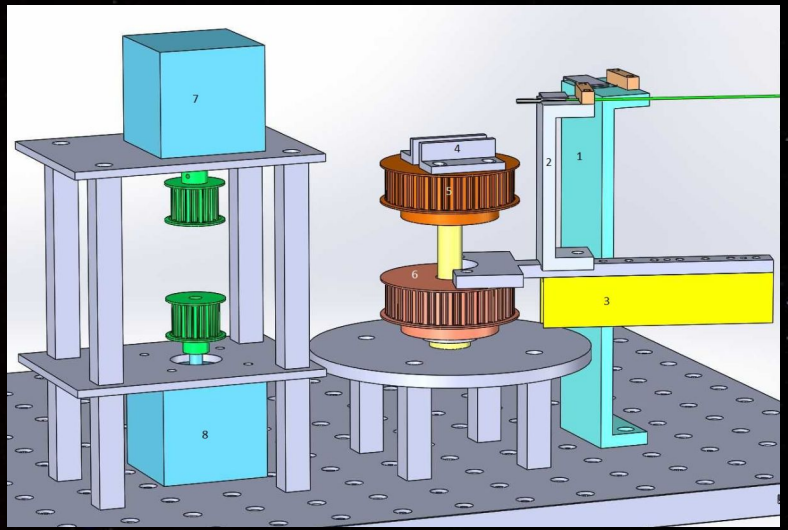
Overview: Reflectivity Coating in LS Detectors

- Enhanced light collection
  - purification of LS
  - light shifting to transparent region of LS
  - **increased reflectivity**
- Photon Transport Simulation: increase of light yield by factor 4-5
- Currently the most promising candidate is the “Bariumsulfate (BaSO4) Coating OPRC” from Optopolymer
- Research includes:
  - relative reflectivity measurements
  - compatibility of the liquid scintillator and coating
  - efficient application within detectors

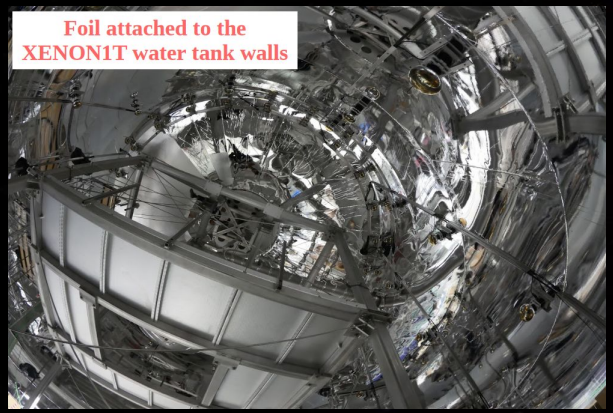
Experimental Setup: Relative Reflectivity





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

Reflectivity Measurements: Samples



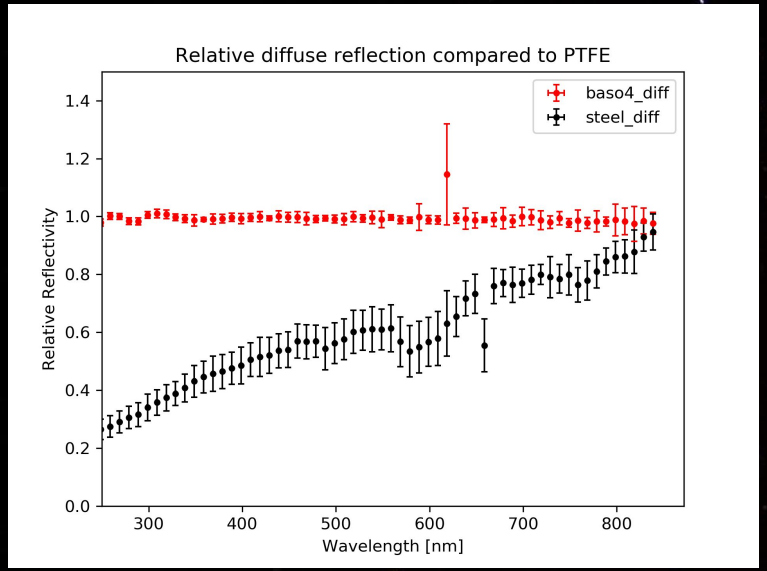
DF2000MA foil
(Specular Standard)

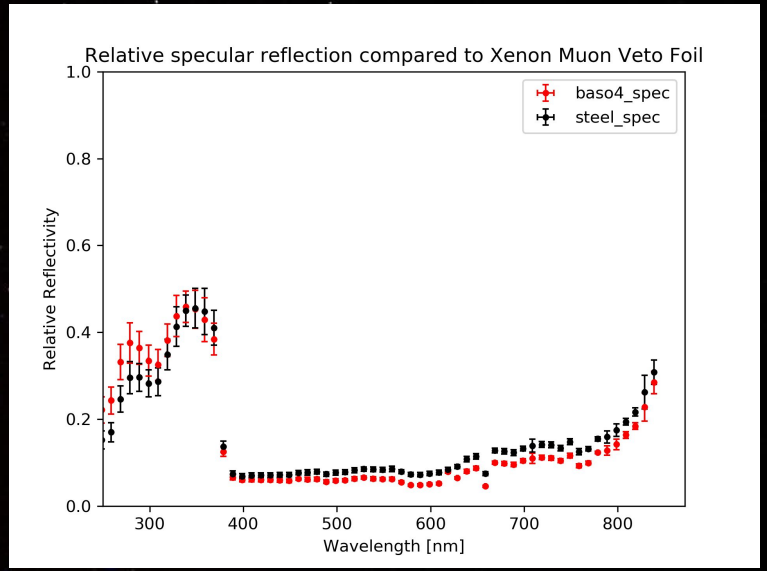
PTFE
(Diffuse Standard)

(unpolished) stainless steel

$BaSO_4$

Reflectivity Comparison: BaSO4 / Stainless Steel





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

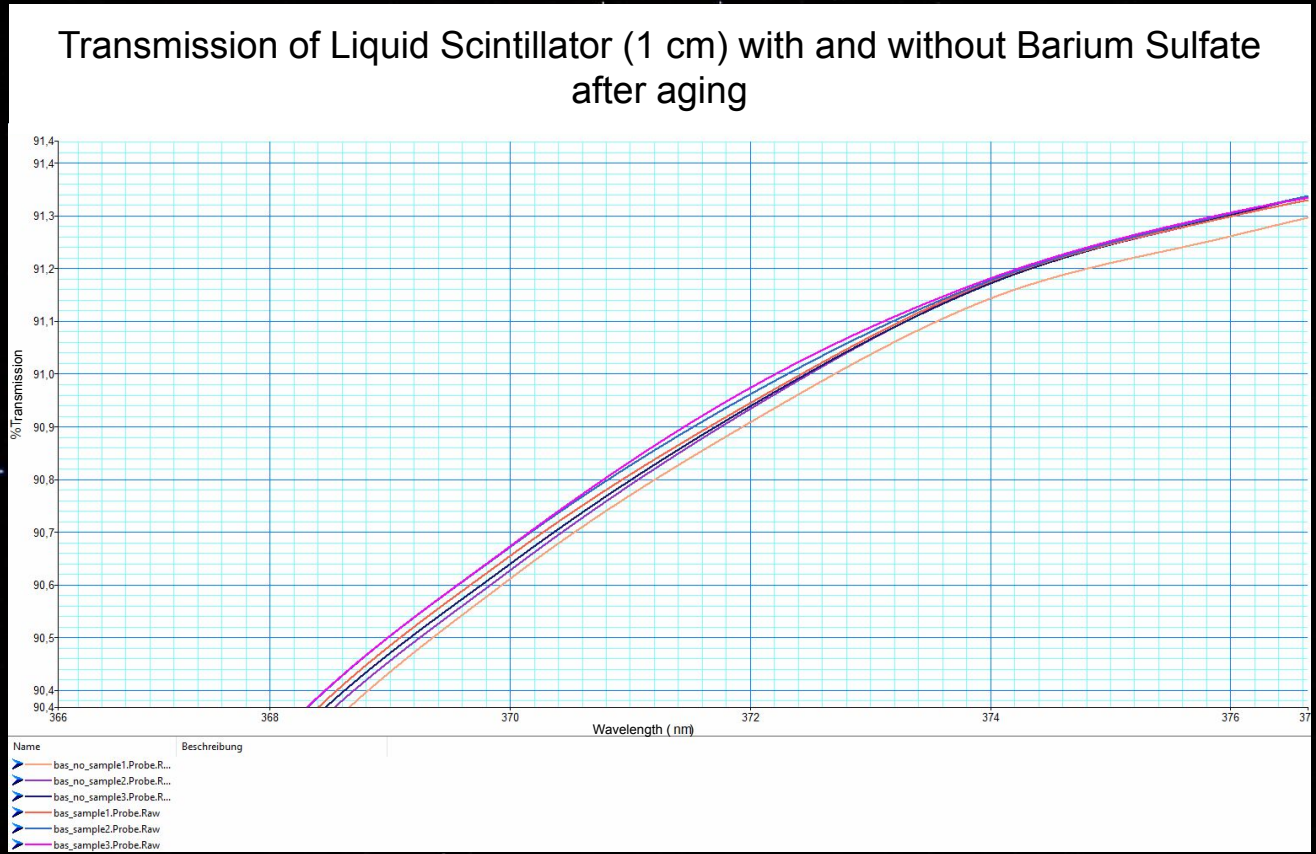
➢ Measurements indicate strong improvement of the inner detector wall reflectivity with the application of Bariumsulfate

Compatibility Tests through Thermal Aging

- identification of possible negative impact of the reflective coating on the transparency of the liquid scintillator over long time periods
- incubation at 80°C accelerates chemical reactions by a factor of ~64
- 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

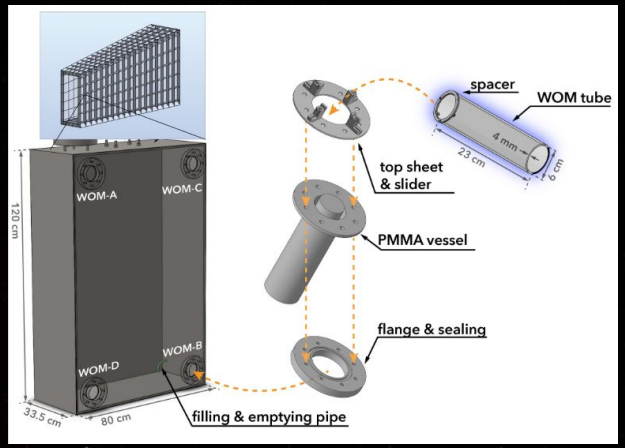
Absorption Measurements after heat-induced aging (~3 years)

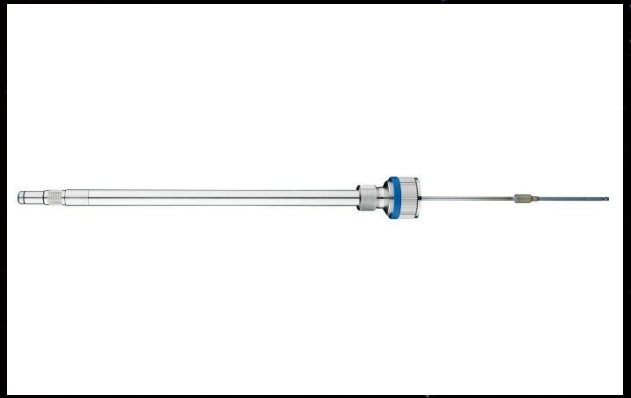
- transmission results show no negative impact of the coating on the scintillator
- crumbling of the coating was observed when applying mechanical stress
- new test for coating stability planned with optimized application



Application of the Coating

- the coating is currently sprayed onto a stainless steel with an electrical spray gun (suboptimal application)
- current plans for the application within WOM-LS detectors:
  - application after welding to ensure stability of the coating
  - access through WOM entry points
  - radial nozzle for SATAjet spray gun to coat the inner walls
  - tests will show if stability increases





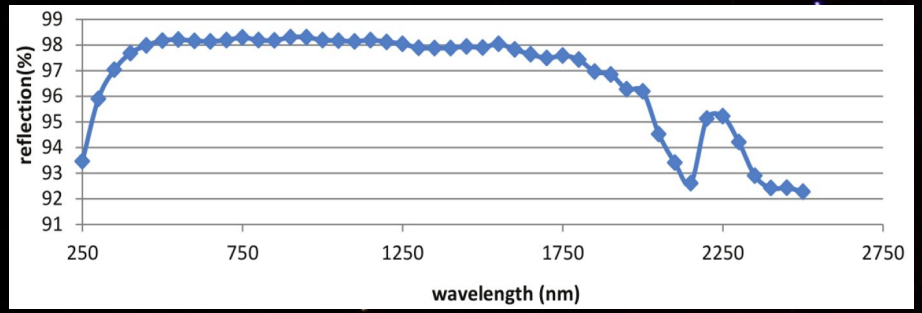
Conclusion

- Bariumsulfate shows promising properties to be used as a reflective coating on the inner walls of WOM-LS detectors
- application onto steel shows high increase of diffuse reflectivity
- Bariumsulfate shows no negative impact on liquid scintillator transparency
- Research outlook:
  - impact of the liquid scintillator on the reflectivity and stability of Bariumsulfate to be investigated (ongoing)
  - radial spray system for efficient (and more stable) application (in preparation)

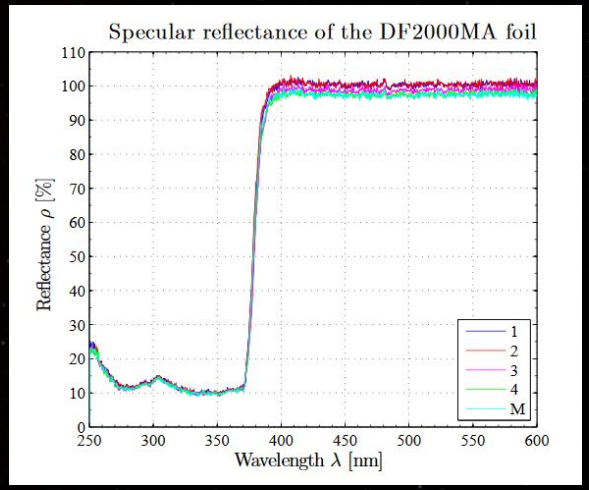
Thank you for your Attention

Reflectivity Measurements Standards

- Comparison of diffuse reflectivity to 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)