## P2

## Detector Development

- Fused silica radiation hardness tests -

## Kathrin Imai

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### P2 Overview





#### P2 Detector radiation exposure







#### Possible radiation damage





(M. Hoek)

Lichtenberg figures in insulating material

Radiation induced damage of optical transmission in Cherenkov radiator









Beam spot: - rastered over 1 cm x 1 cm areas - visible on fluorescent screen



Monitor picture in MaMi control room: Beam spot on fluorescent screen in front of quartz samples





Sample dimensions



P2 doses

10

5

1

1/2



No visible damage or transmission losses...



- Calculated: Cherenkov production spectrum for electrons with  $\beta$ =1 for
  - Spectrosil 2000
  - Material with constant n=1.46
- Simulated: Cherenkov light spectrum at location of PMT cathode for quartz bar with undamaged transmission spectrum





#### Transmission measurements of samples in spectrophotometer







Transmission measurements of samples in spectrophotometer

#### Absorption bands as predicted by existing defect models

10

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Transmission loss of samples in spectrophotometer



Transmission loss relative to original transmission spectrum:

$$L(\lambda) = \frac{T_{\textit{before}} - T_{\textit{after}}}{T_{\textit{before}}}$$

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Transmission measurements of samples in spectrophotometer (Zoom of previous plot)



~5% signal Cherenkov light loss per 1 cm between 200nm and 240nm



~5% signal Cherenkov light loss per 1 cm between 200nm and 400nm



Quartz active area: 45 cm  $\rightarrow$  average distance traveled by photon > 22.5cm  $0.95^{^{22.5}} \approx 0.3$ 

70% signal loss



#### Cherenkov spectrum at PMT cathode from Simulation





Position scan: Comparison radiation damaged quartzes vs new quartzes

### Attempt to "heal" the quartz samples:

#### 26h in an ancient artificial sun







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#### CONCLUSION

- Severe radiation damage expected
- Signal decrease and change in Q<sup>2</sup>-weighting due to transmission loss in UV region
- Need to find practical solution in order to not lose signal over experiment time



A4 calorimeter during Cherenkov medium "healing" phase

• "Healing" with UV light seems promissing



# THANK YOU VERY MUCH

If I refered to anything, it can be found here:

M. Antonini , P. Camagni , P. N. Gibson & A. Manara (1982) Comparison of heavy-ion, proton and electron irradiation effects in vitreous silica, Radiation Effects, 65:1-4, 41-48,

C. M. Nelson, J. H. Crawford (1959) Optical Absorption in Irradiated Quartz and Fused Silica, Pergamon Press 1960. vol. 13. pp. 296-305

Hoek, M. (2008). Radiation hardness study on fused silica. Nuclear Instruments and Methods in Physics Research Section A Accelerators Spectrometers Detectors and Associated Equipment. 10.1016/j.nima.2008.07.098.

