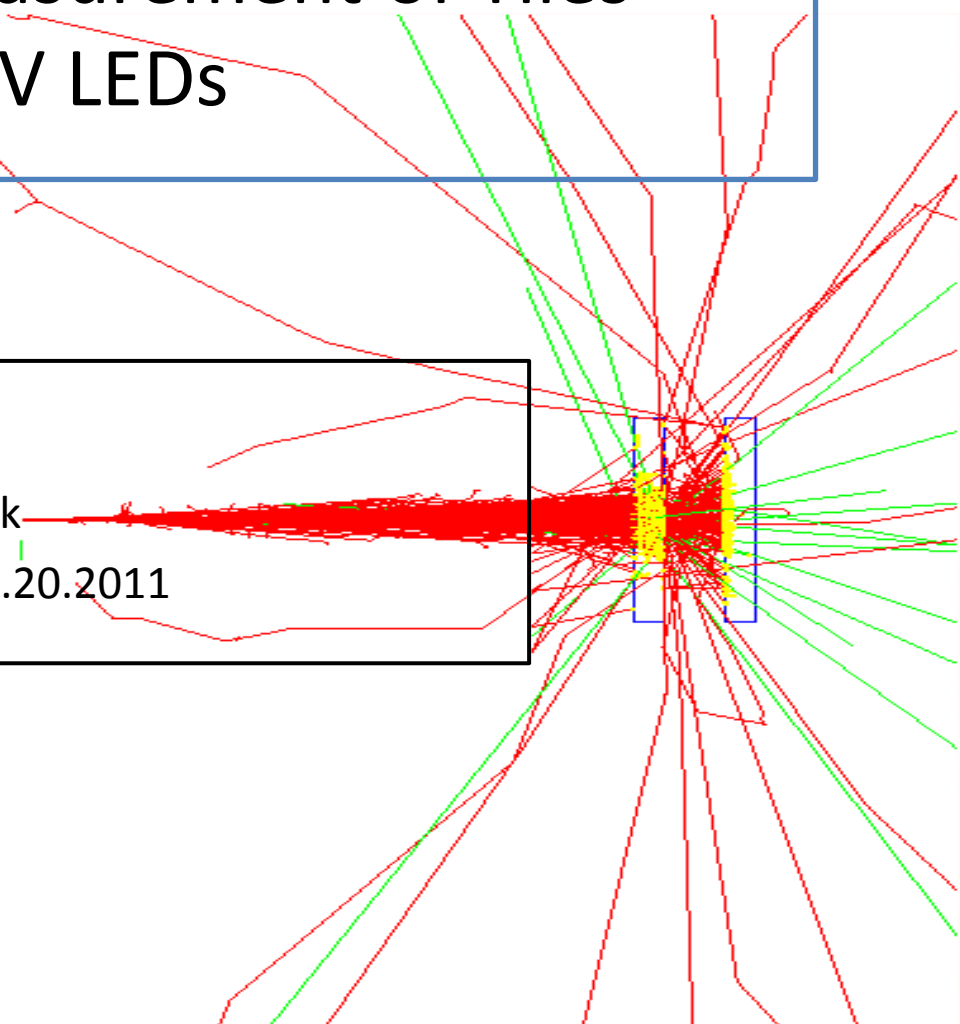


MIP Response Measurement of Tiles with UV LEDs

Patrick Eckert
Kirchhoff-Institut für Physik
CALICE Meeting, CERN, 05.20.2011

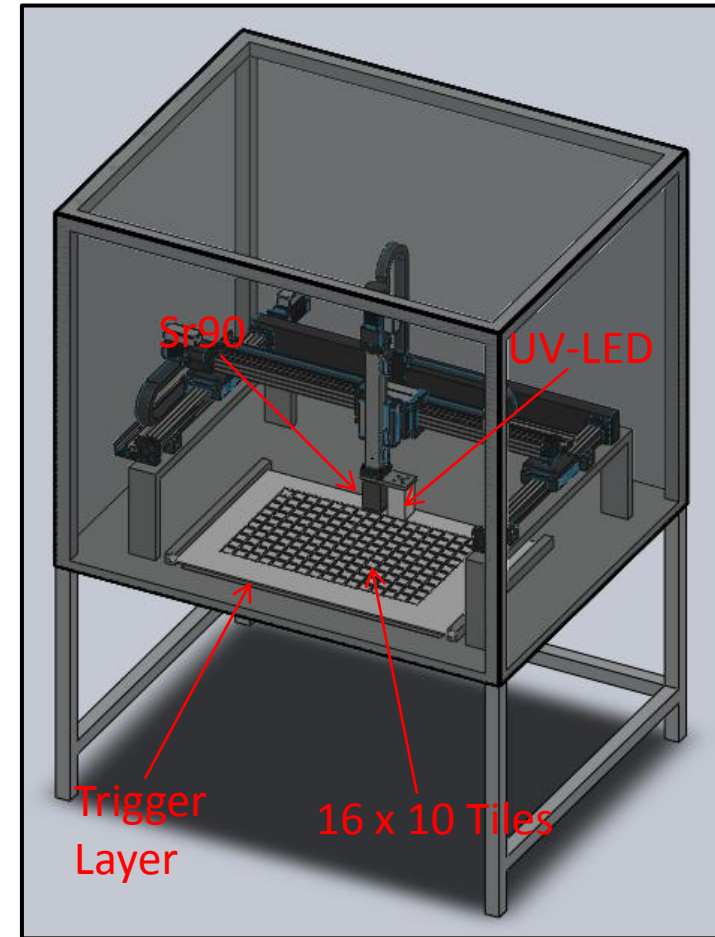
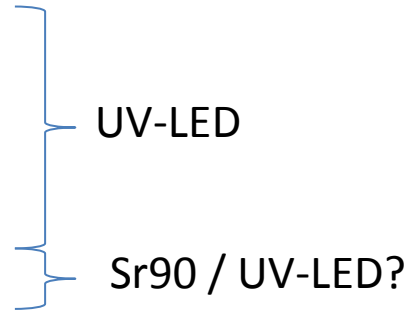


Outlook

- Introduction
- Test Setup
- Comparison Sr90 – UV Response
- Conclusion & Outlook

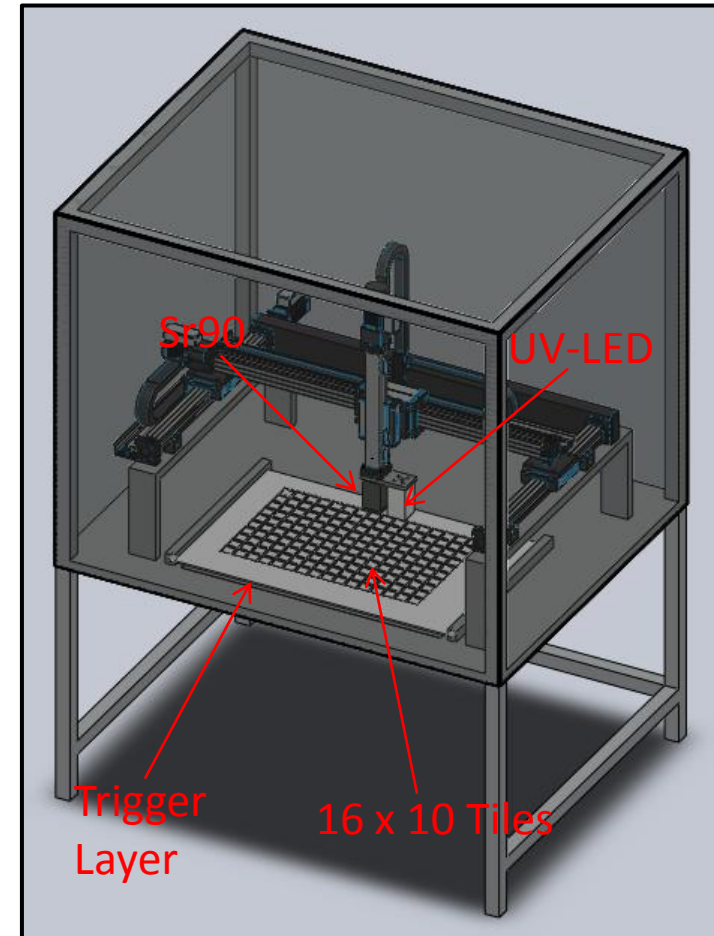
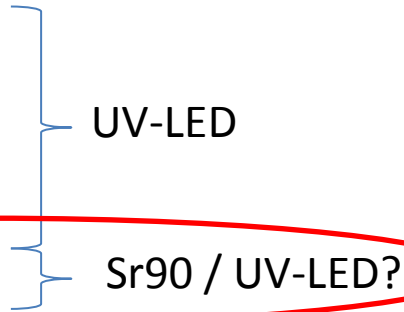
Introduction

- Motivation:
How to do quality assurance and characterization of 8 mio. scintillator tiles?
- Tile Tester Prototype:
 - Gain
 - Noise
 - Saturation Curve
 - MIP response
- Measurement time per tile $O(1s)$
⇒ Parallel testing of several tiles necessary!



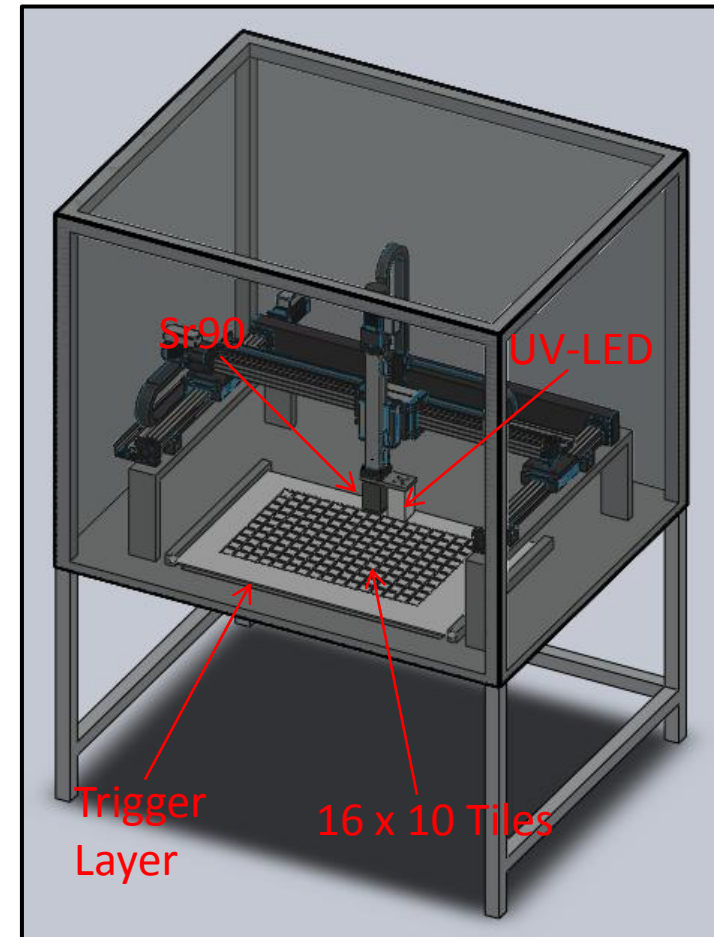
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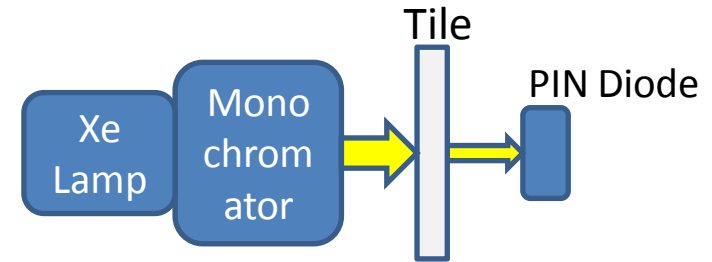


MIP Response

- Typically MIP response is measured with Sr90 source
- Problems with Sr90:
 - Slow
 - Only one tile at a time!
- **Can we use UV-LEDs to measure MIP response?**
 - Fast
 - Many LEDs in parallel possible
 - No trigger layer needed
- **Is the UV response comparable to the Sr90 response?**



Tile Response



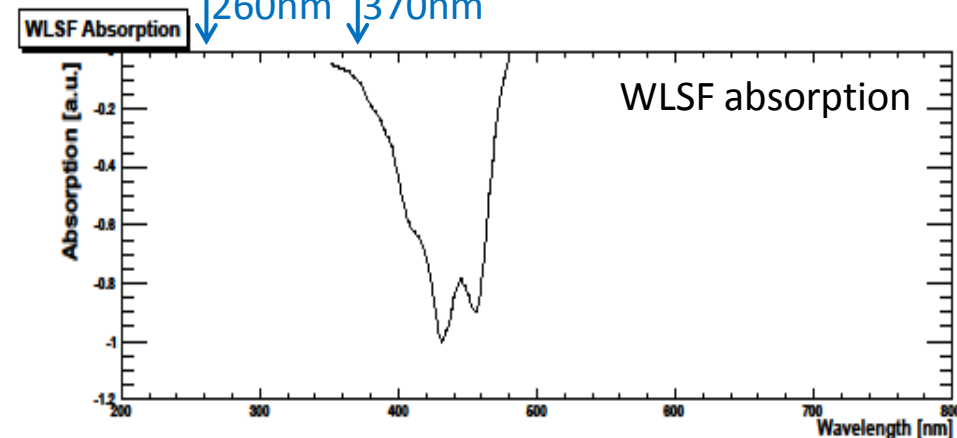
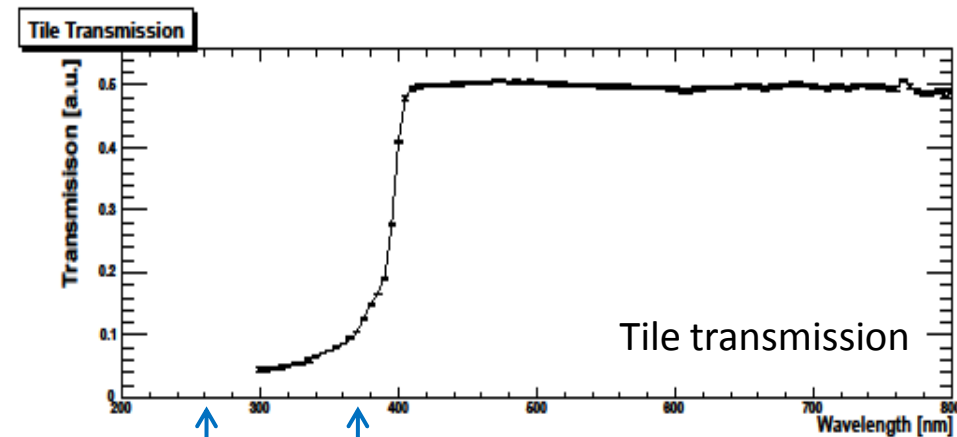
- Measurement of tile transmission spectrum

⇒ Scintillation starts at $\lambda < 400\text{nm}$

- UV light is not collected by WLSF

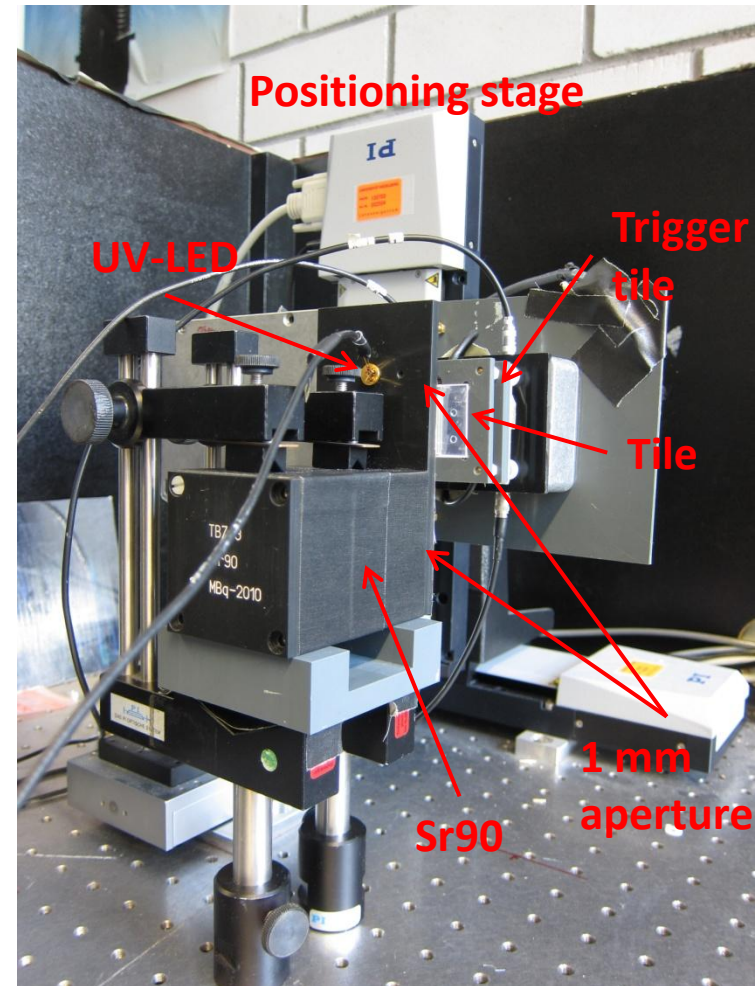
- UV response of SiPM is reduced

⇒ **Signal from direct UV light is negligible**



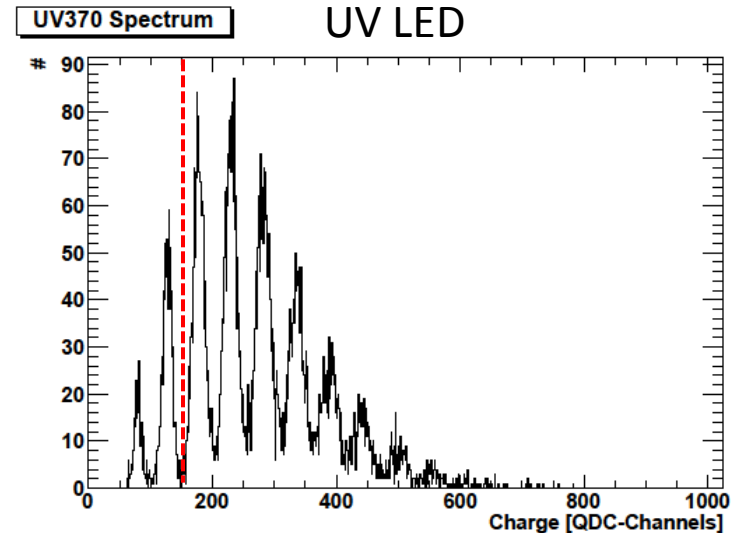
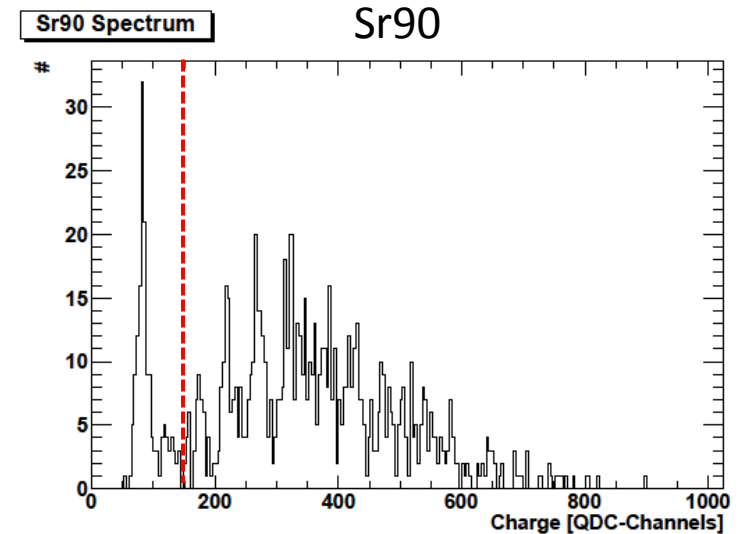
Test Setup

- Test setup for tile scans with UV LEDs (260nm & 370nm) and Sr90 source (37MBq)
 - 1mm collimation
 - Second HCAL tile for trigger (Sr90)
 - UV-LED is pulsed
 - Readout with QDC → Charge spectrum
 - Measurements w/ and w/o reflective foil
 - Preliminary setup → alignment not perfect (e.g. small angle between foil and tile), airgap between foil and tile,...
- ⇒ Possible systematic errors



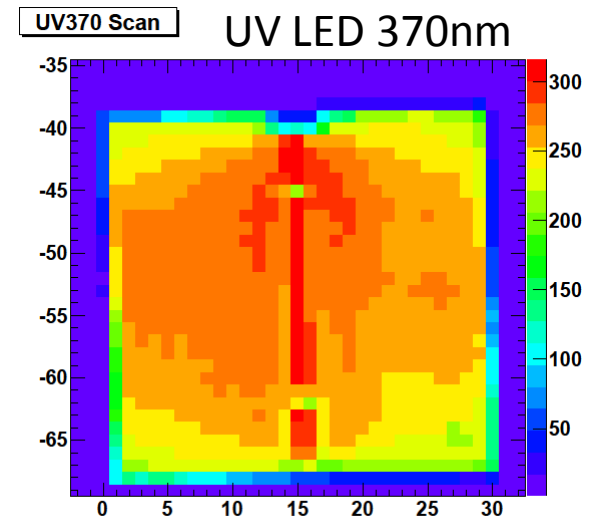
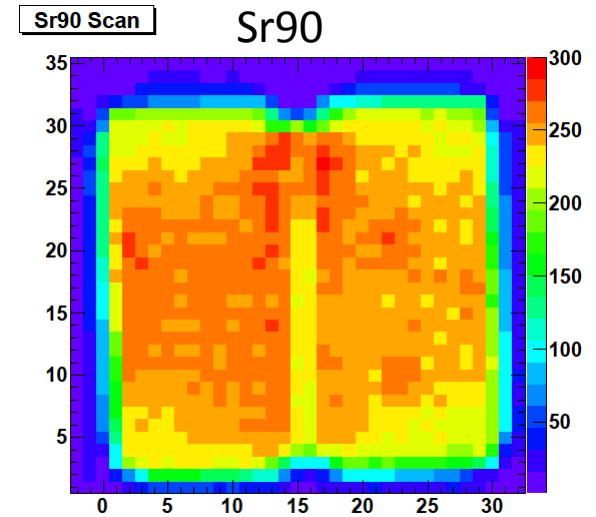
Charge Spectra

- Sr90:
 - Very slow (ca. 5Hz) due to strong collimation
 - 1000 events (ca. 3min)
 - Trigger threshold 3.5 p.e.
- LED:
 - Intensity set to approximately match Sr90 response
 - 10.000 events (ca. 3s)
- Def.: Response:
 - Mean of spectrum with 0p.e. and 1p.e. cut away



Comparison Sr90 – UV Response

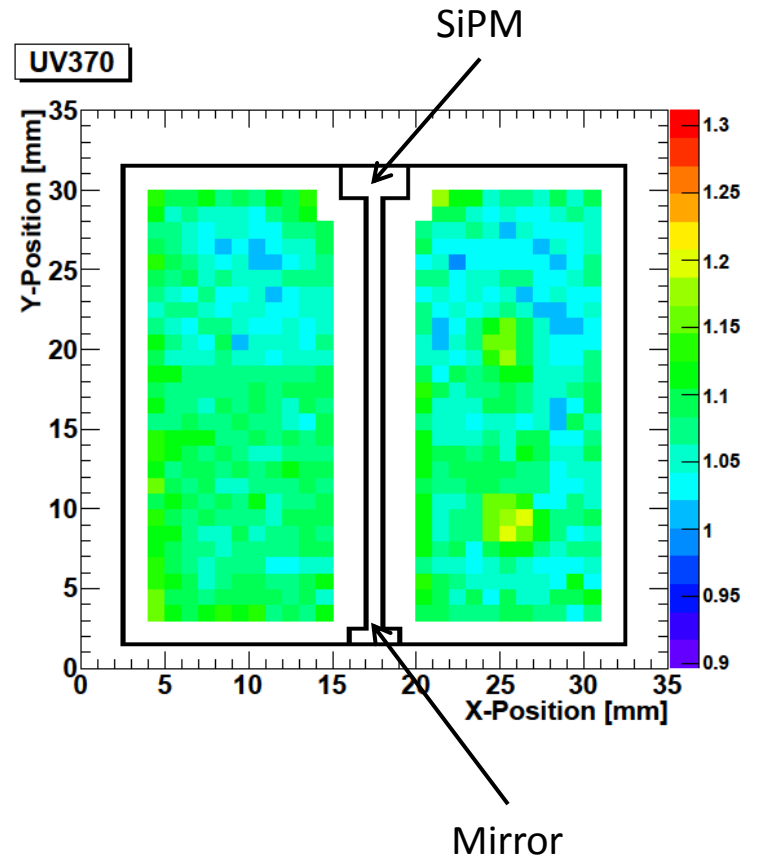
- Compare Sr90 scan with UV scan:



Comparison Sr90 – UV Response

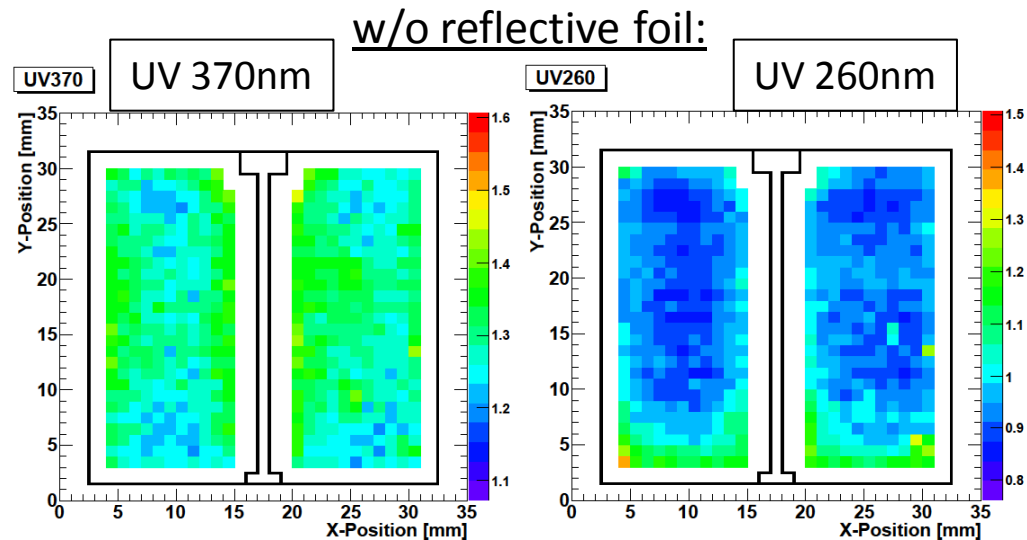
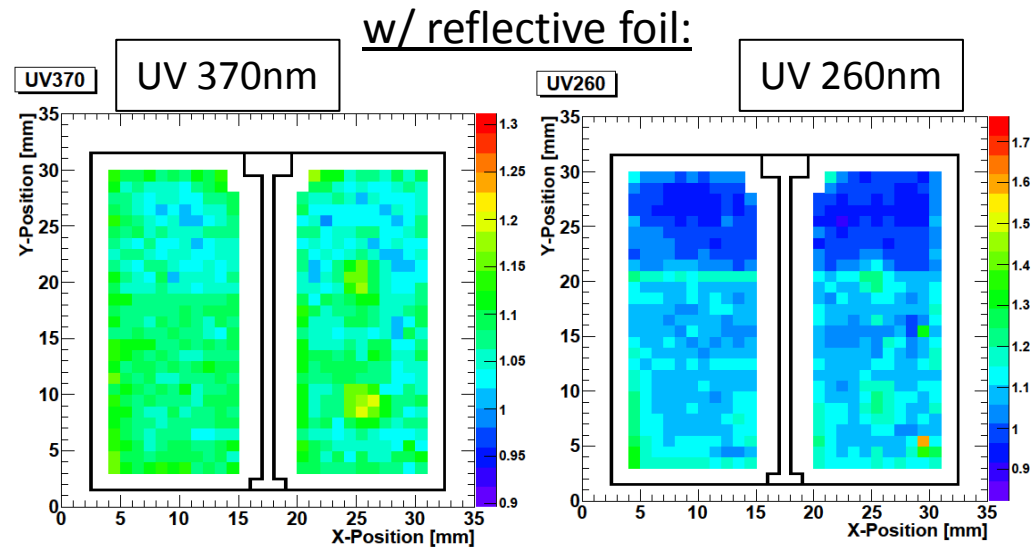
- Compare Sr90 scan with UV scan:
- Ratio between Sr90 and UV response
 - Area around borders and WLSF are not included in analysis

Ratio Sr90/UV response:



Comparison Sr90 – UV Response

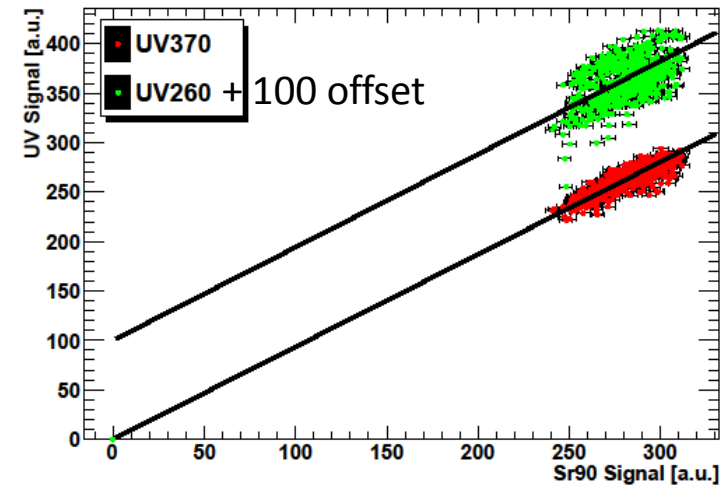
- Compare Sr90 scan with UV scan:
- Ratio between Sr90 and UV response
 - Area around borders and WLSF are not included in analysis
- Good uniformity over the tile
- Small deviations due to alignment problems



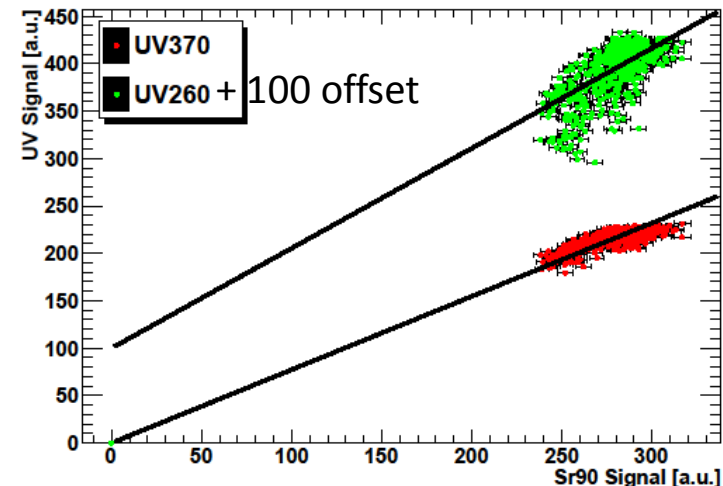
Comparison Sr90 – UV Response

- Good correlation between Sr90 and UV response
- UV 260nm seems more unstable (more sensitive to alignment & larger spread)
- Limited by statistical uncertainties from Sr90 measurement and systematical errors from alignment

w/ reflective foil:



w/o reflective foil:

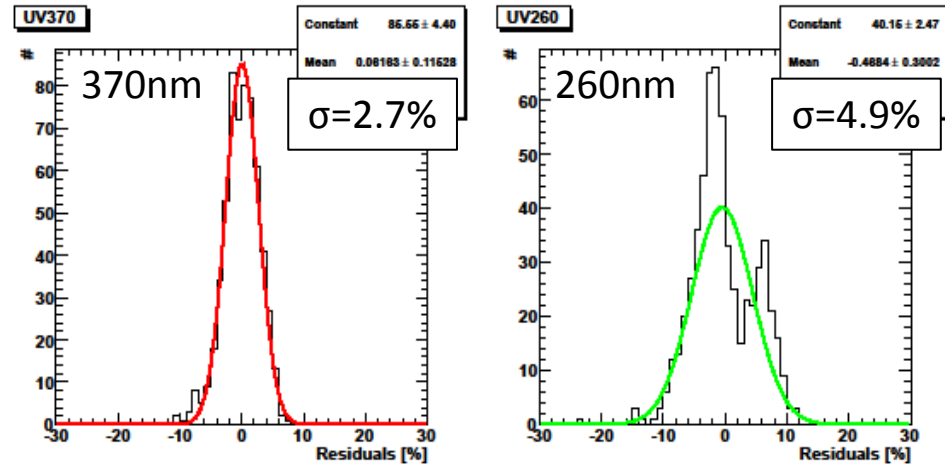


Comparison Sr90 – UV Response

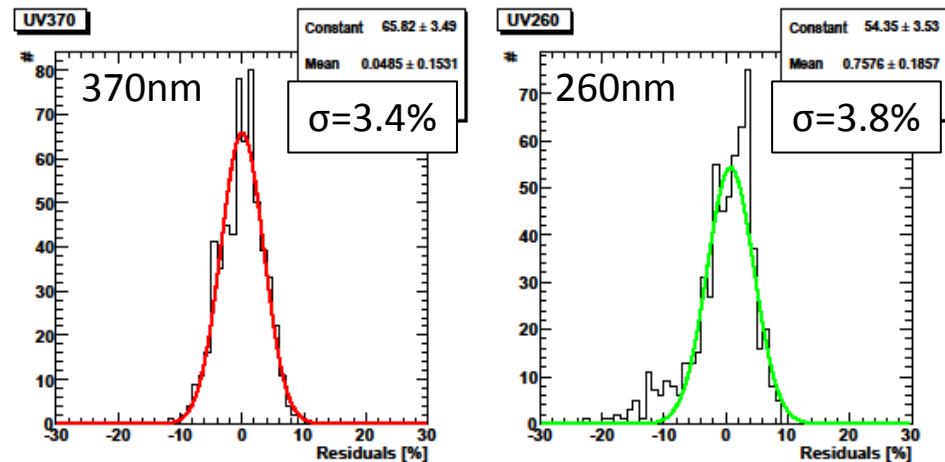
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- Best result for UV 370nm with reflective foil:
Sr90 signal is reproduced with $\sigma=2.7\%$

Residuals w/ reflective foil:



Residuals w/o reflective foil:



Conclusion & Outlook

- MIP response measurement with UV light seems possible
 - Needs to be verified by testing more tiles (with fixed UV intensity)
- ⇒ Tile tester: Use Sr90 only for a few tiles (e.g. 1 per test cycle) for reference
- ⇒ Parallel MIP response measurements with several UV LEDs at one fixed position on the tile

Backup