

LV PANDA collaboration meeting

01. December 2015 - Vienna



Experimental studies and simulations on the influence of a de-polished side face on the position dependent light yield of PANDA PWO crystals

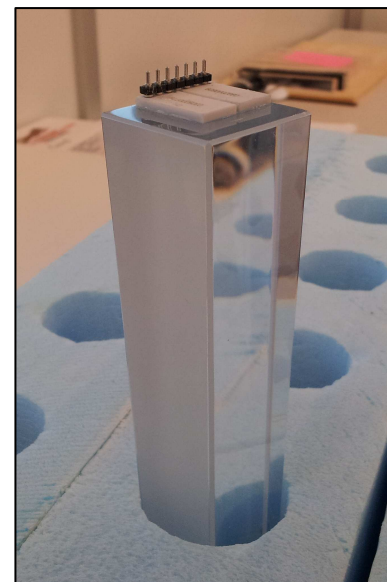
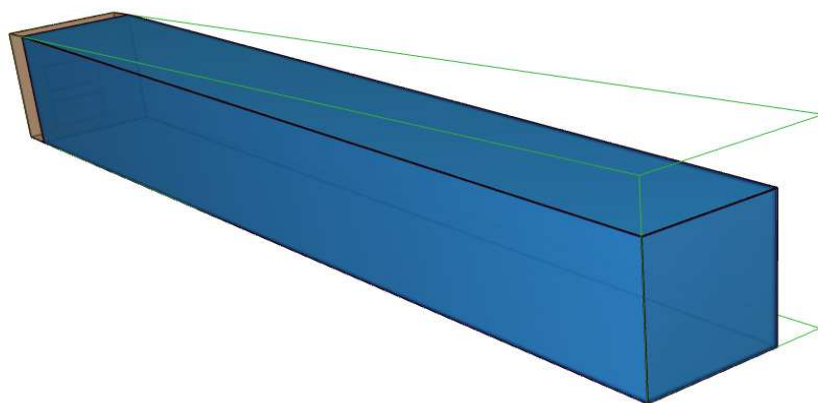
Stefan Diehl, Valery Dormenev,

Rainer W. Novotny, Hans-Georg Zaunick

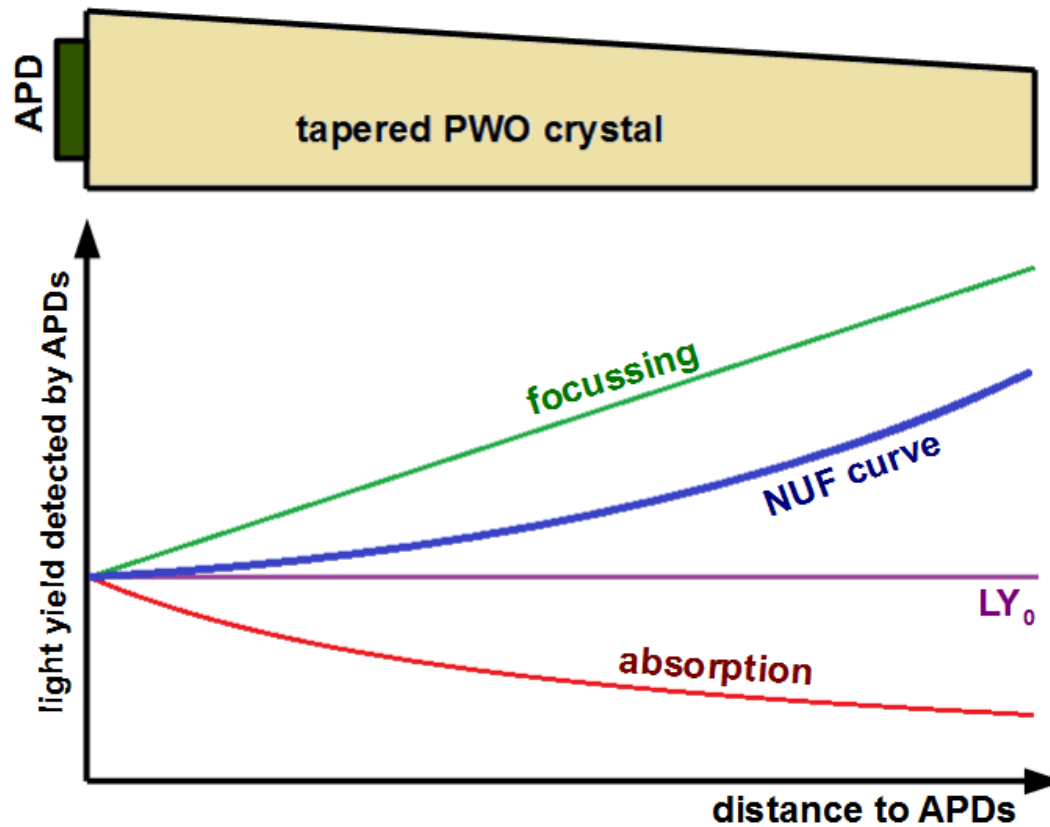
2nd Physics Institute, Justus-Liebig-University Giessen

Overview

- ➔ Experimental studies of the position dependent light yield of type 2 and type 3 crystals
- ➔ Simulation of the position dependent light yield with different surface configurations



Introduction

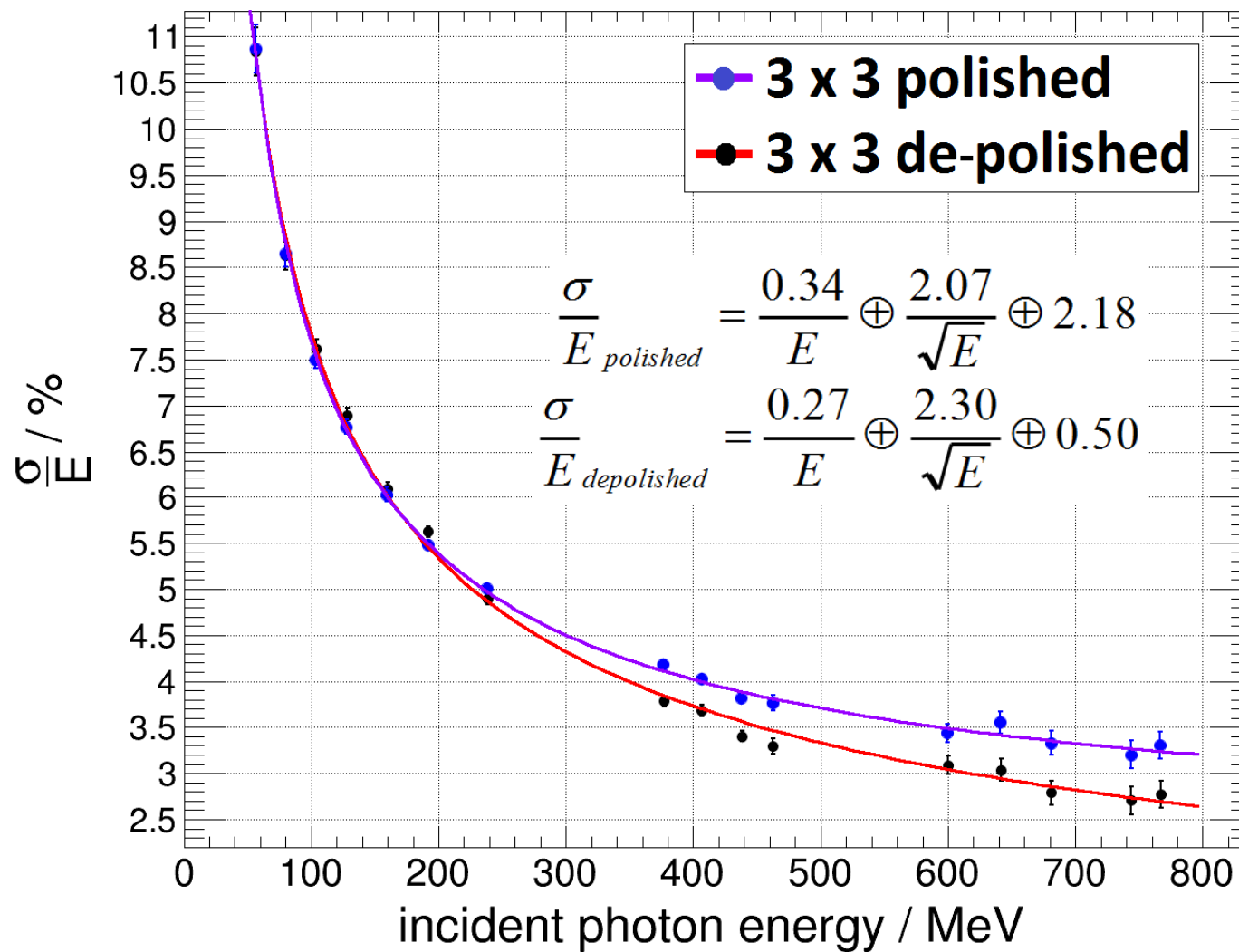


NUF curve = Interplay between focussing and absorption in the crystal



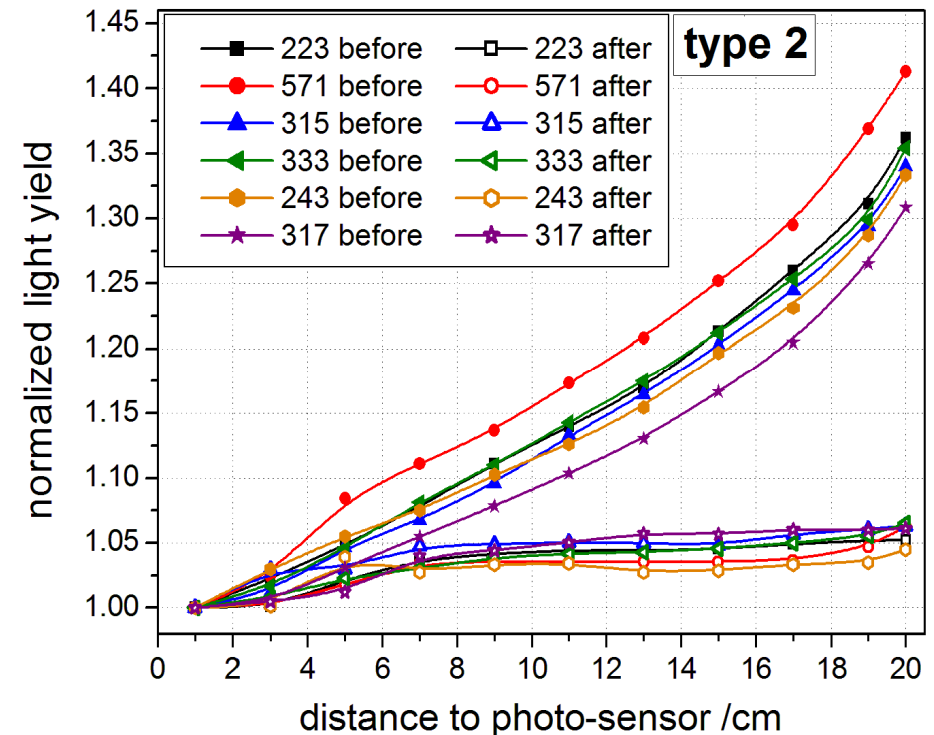
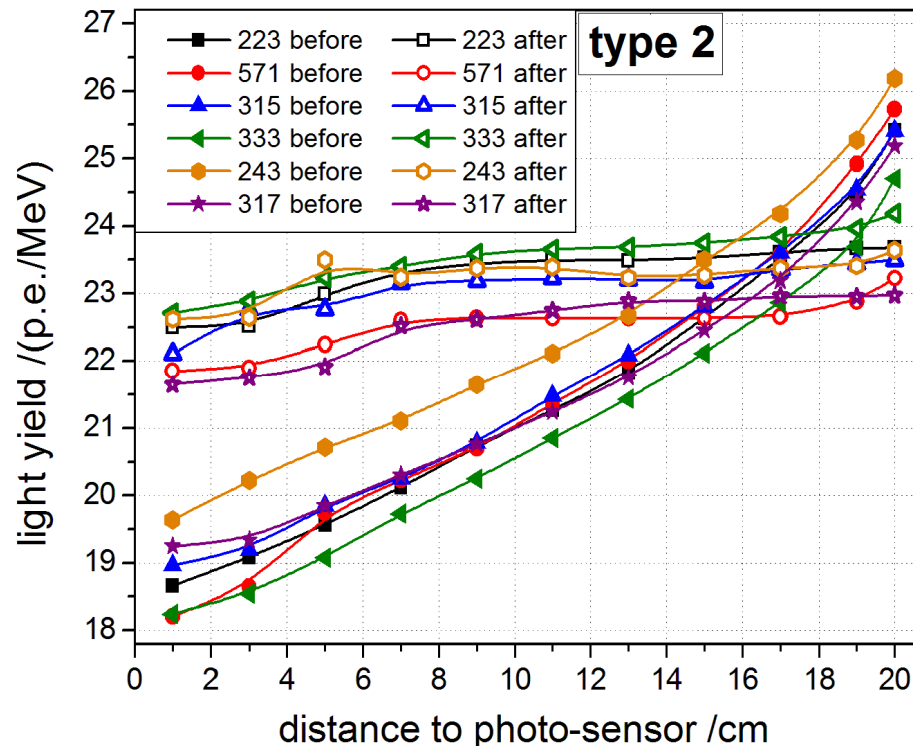
$R_a = 0.3 \mu\text{m}$

Energy Resolution of PROTO 120

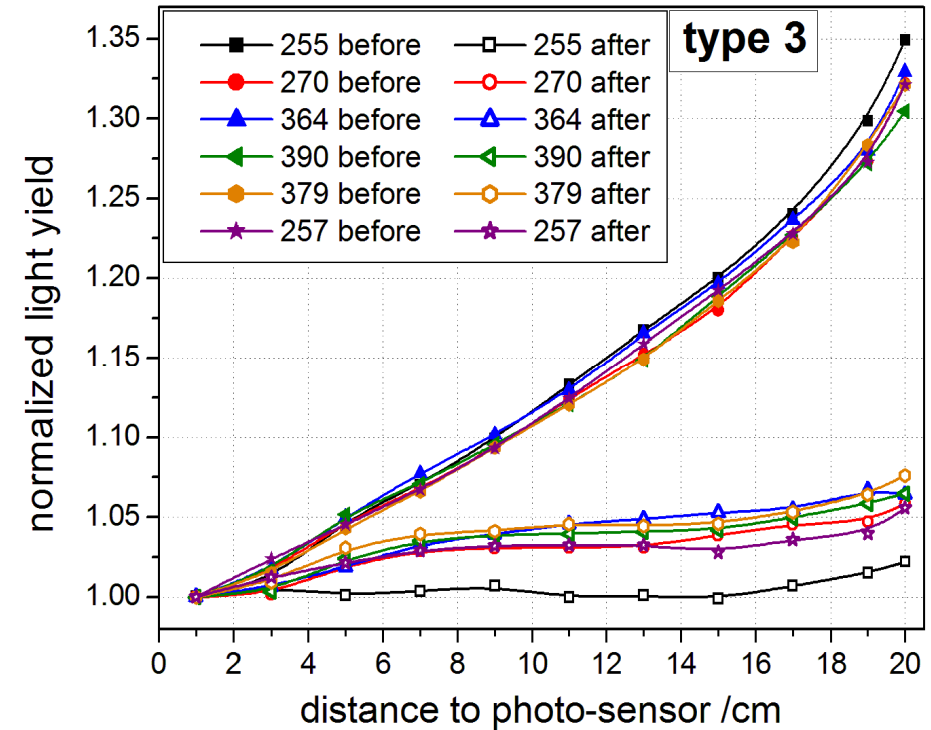
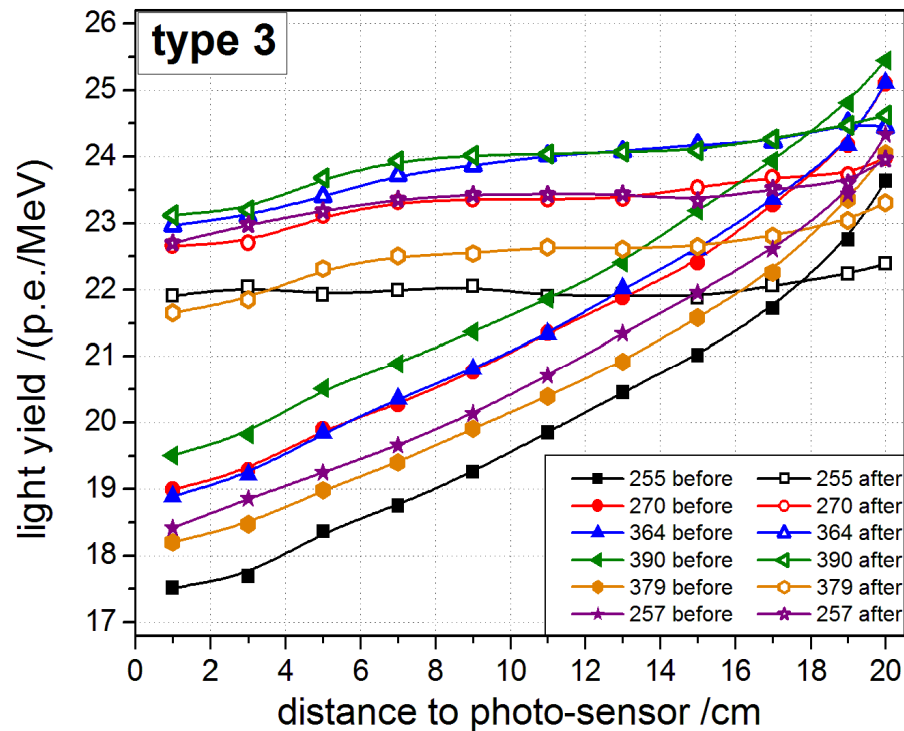


Position dependent light yield

- Crystals wrapped with 8 layers of teflon, aluminum foil and shrinking tube
- Identical PMT before and after the de-polishing procedure
- Temperature stabilized to +18 °C
- ^{137}Cs source (662 keV gammas) placed directly on the crystals side face

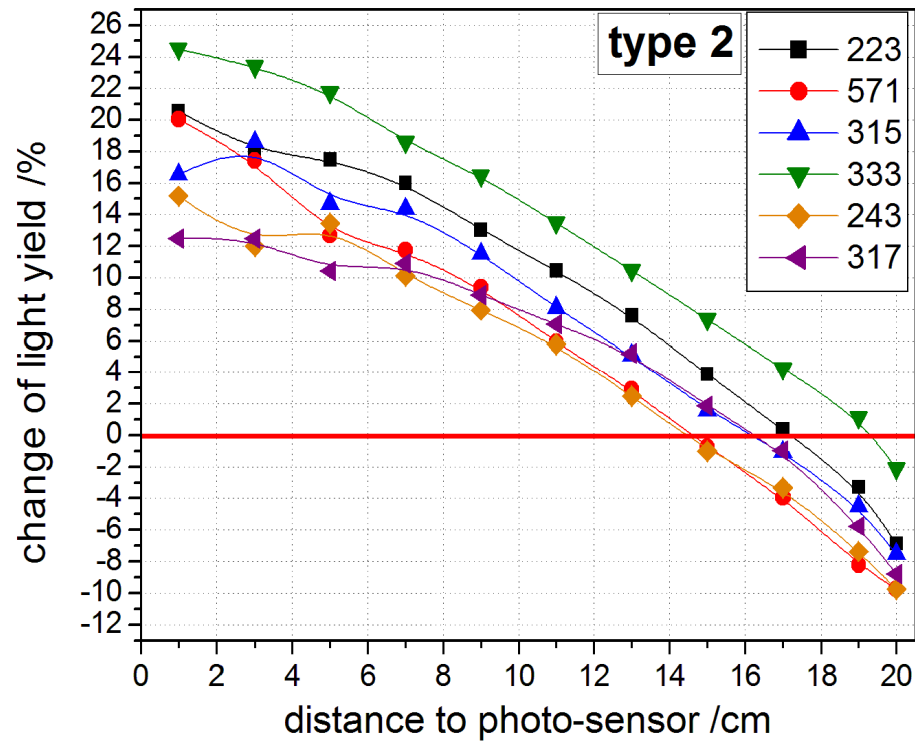


Position dependent light yield (type 3 crystals)



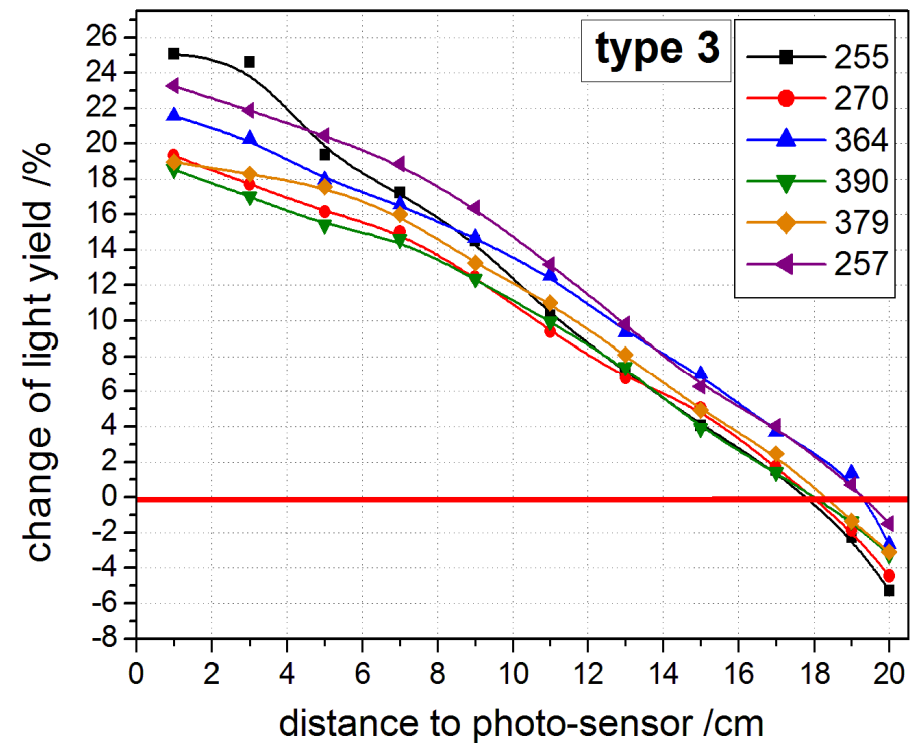
➔ Results comparable to type 2 crystals (similar non-uniformity)

Change of the position dependent light yield



light gain

light loss

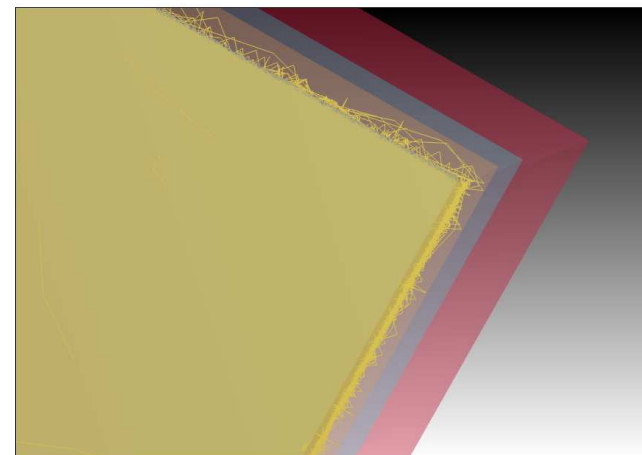
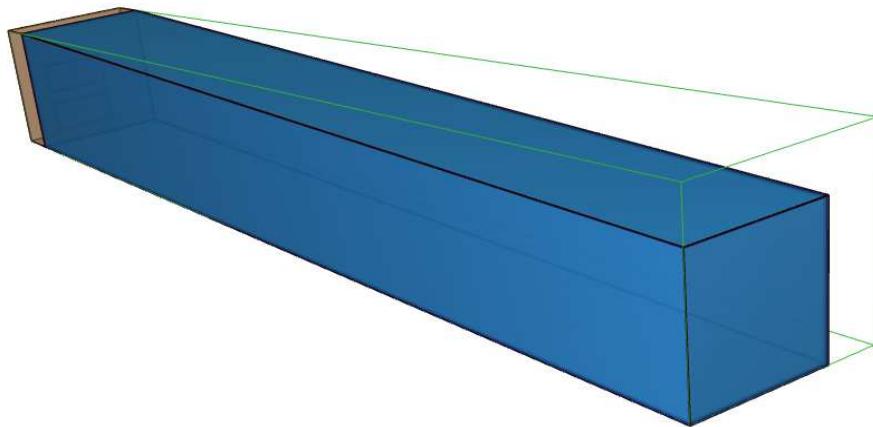


light gain

light loss

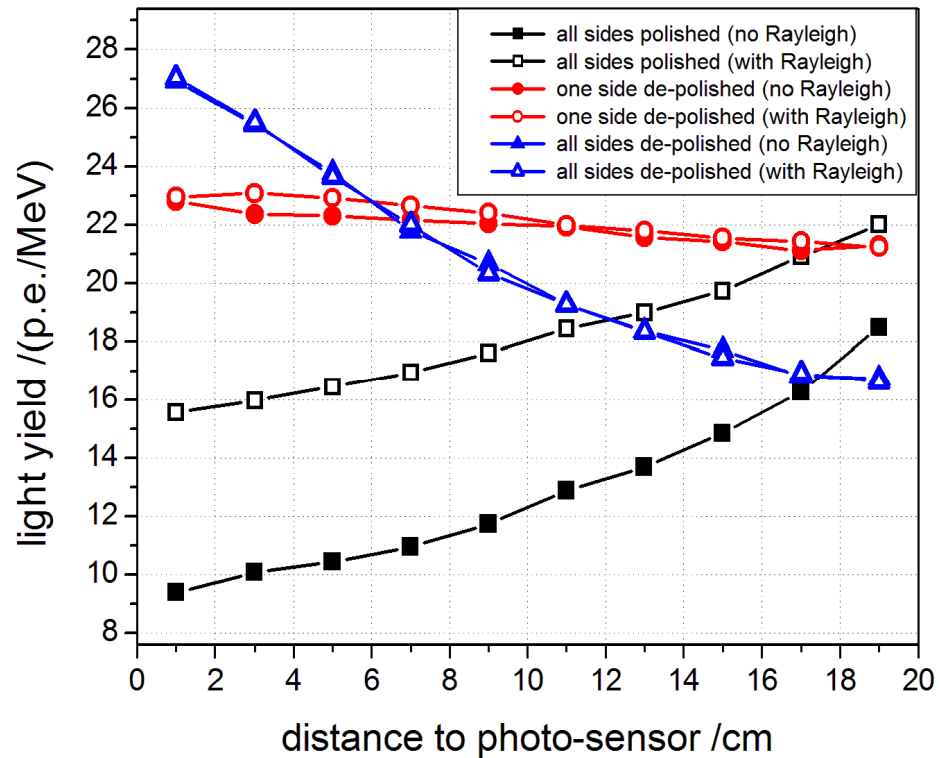
GEANT4 light collection model

- Crystals with different geometries (type 1 - 11) have been implemented in GEANT4
- Crystals are surrounded by an air gap and reflective wrapping
- Complete rear face is covered by a PMT (coupled with a layer of optical grease)
- 3 surface configurations (UNIFIED model of GEANT4)
 - a) all side faces polished
 - b) one side face de-polished and all other side faces polished
 - c) all side faces de-polished

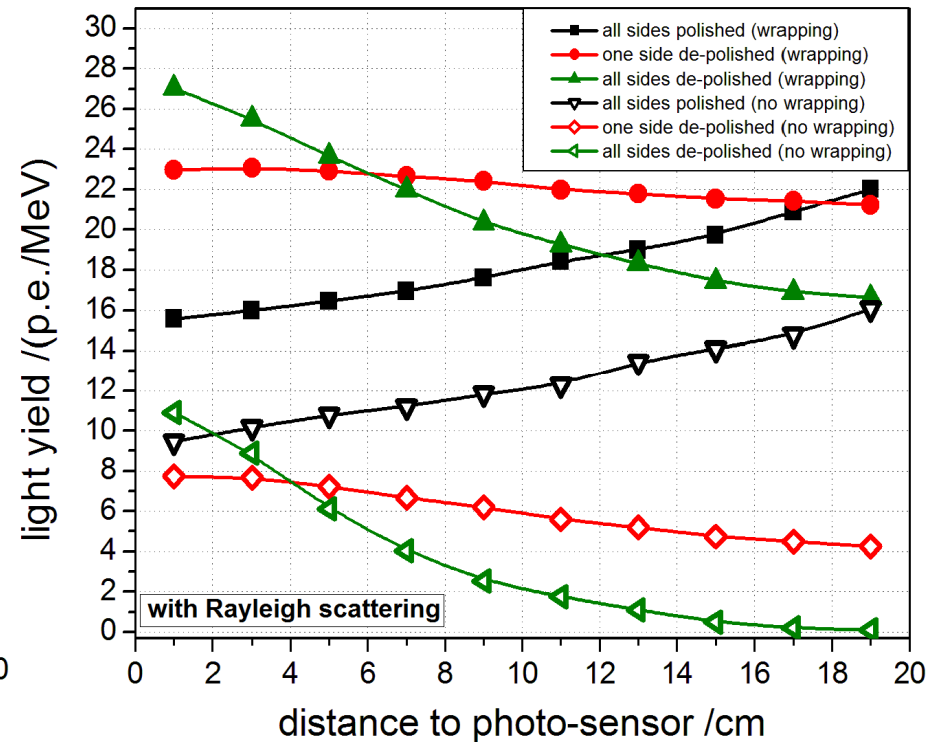


Simulated position dependent light yield of type 2 crystals (PMT readout)

crystal with and without the implementation of Rayleigh scattering

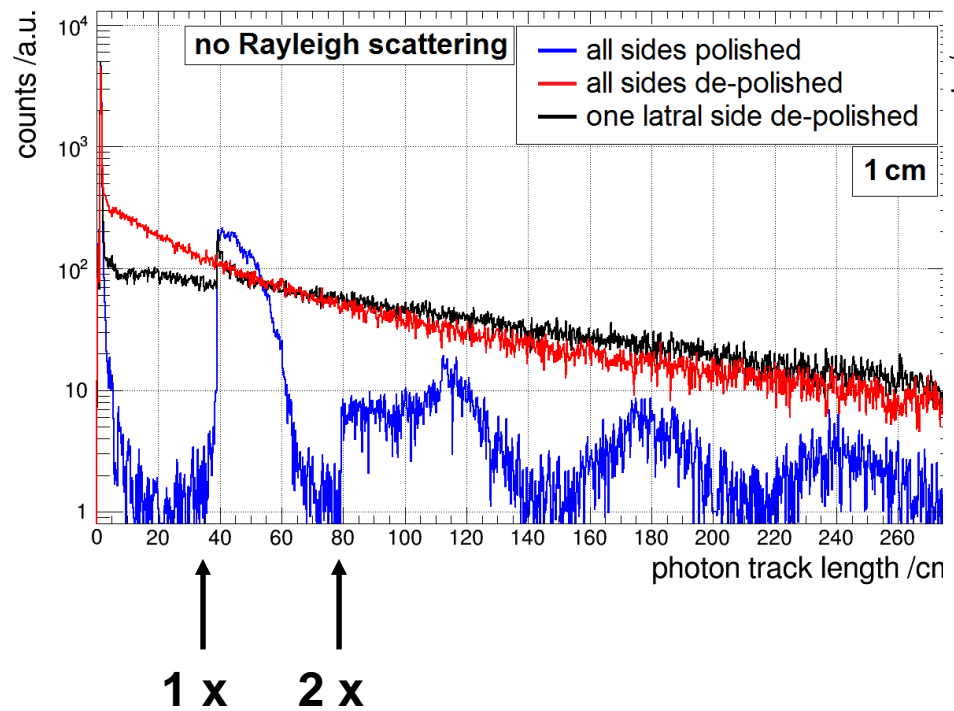


crystal with and without a reflective wrapping

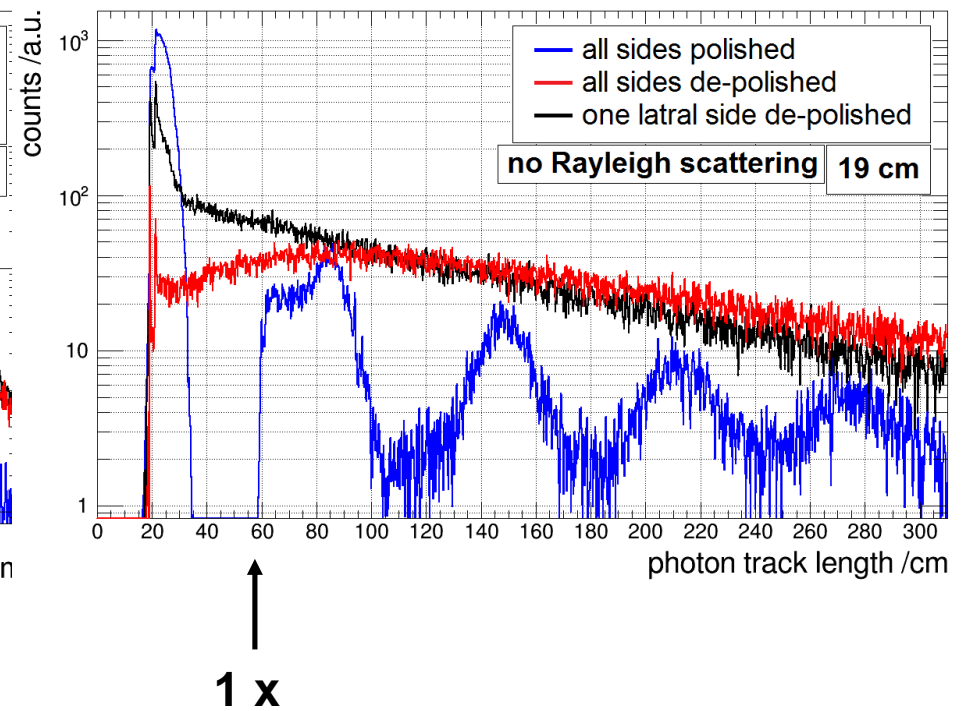


Surface dependence of the photon track length

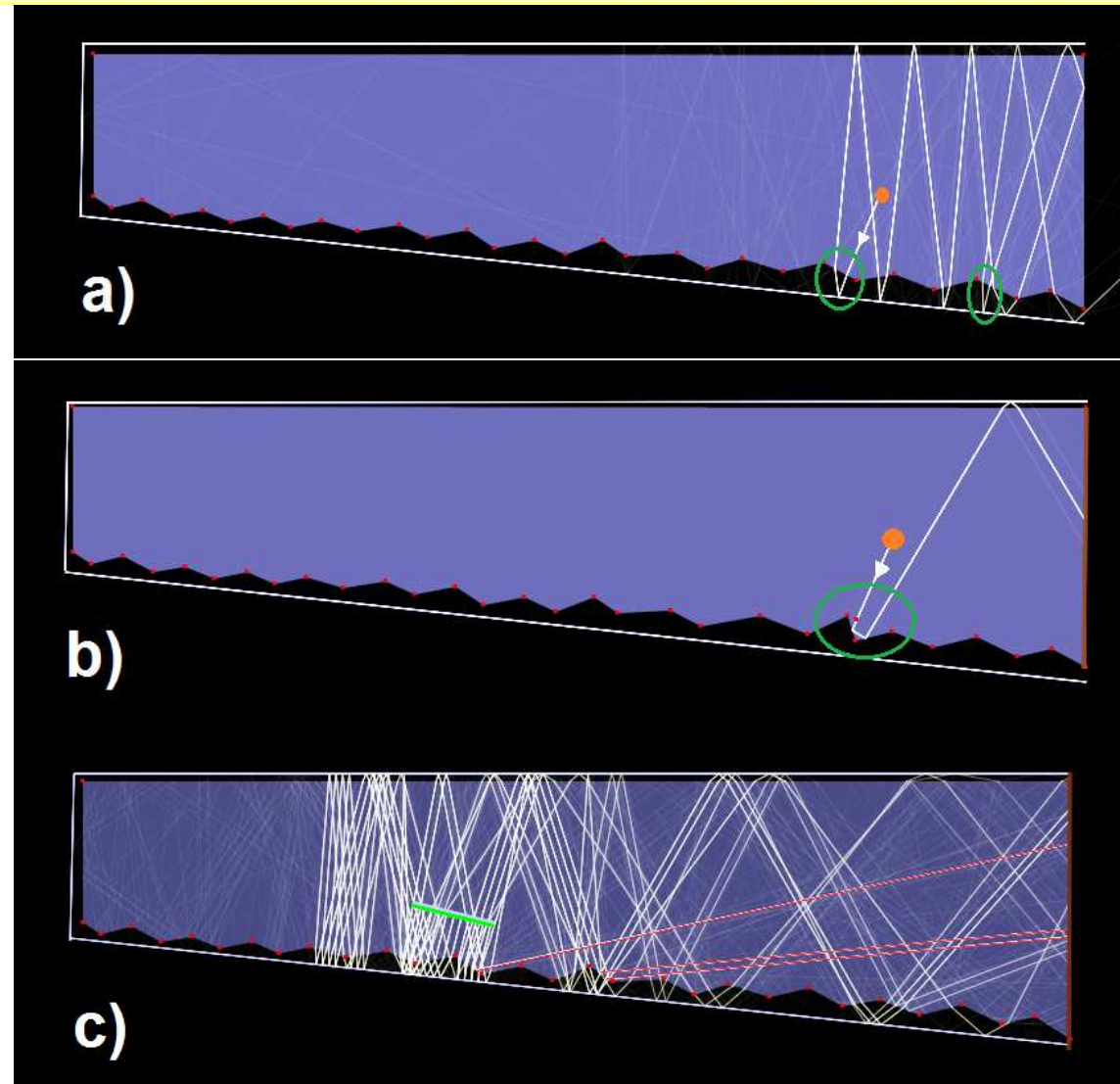
1 MeV gammas interacting
1 cm away from the PMT



1 MeV gammas interacting
in the front part of the crystal

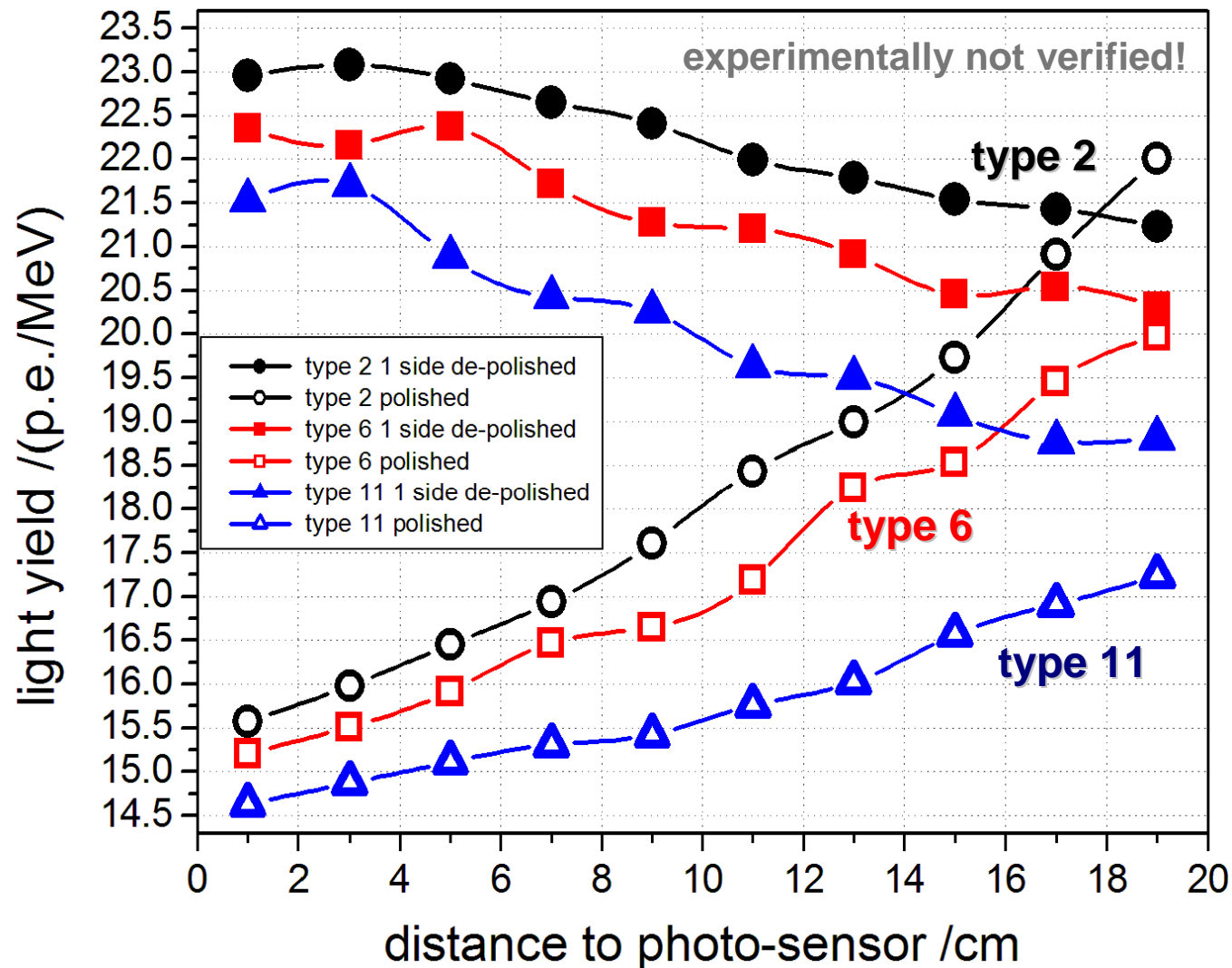


Visualization of the direction change and facet focussing effect



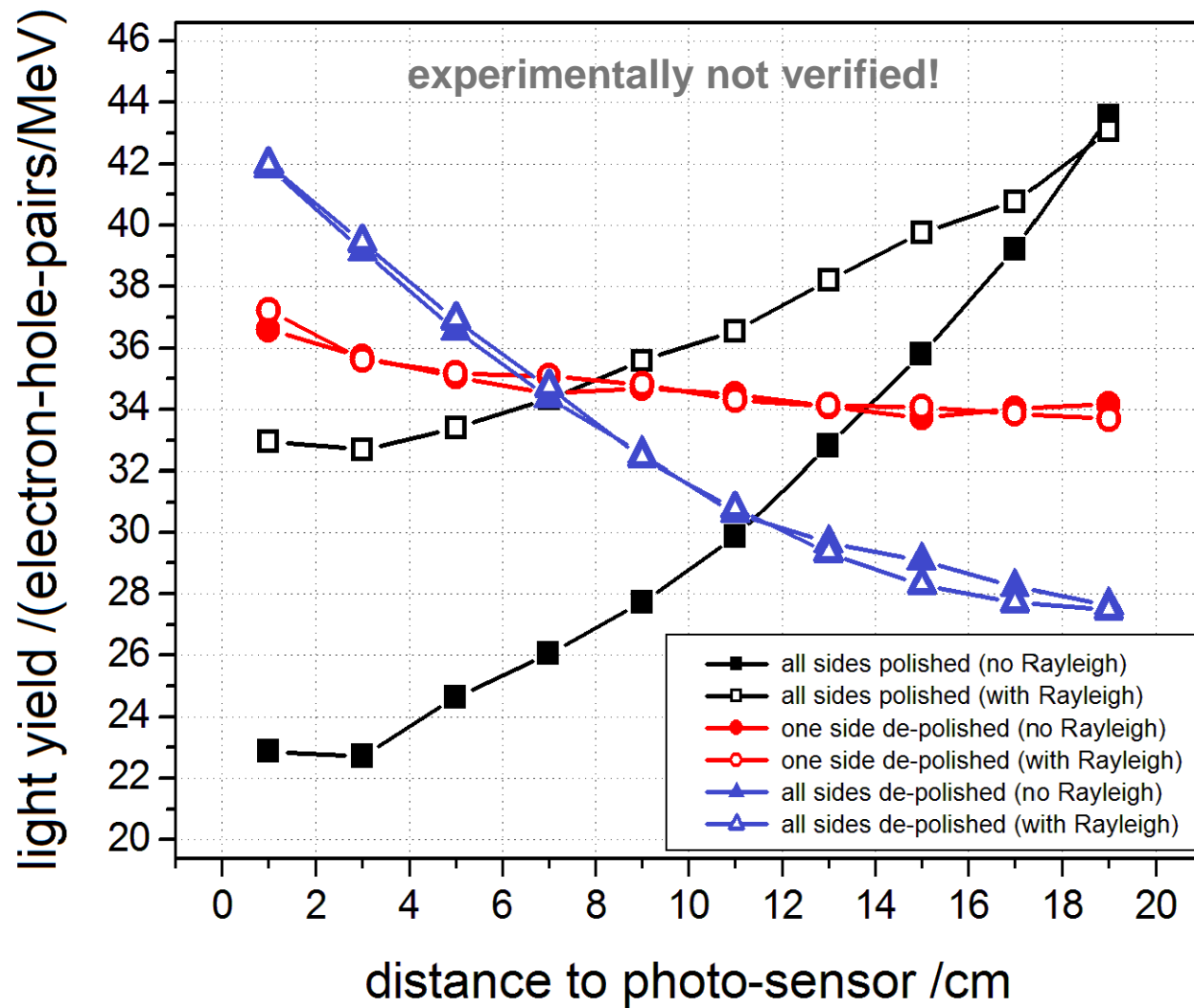
Influence of a de-polished surface on less tapered crystals

GEANT4 simulation



Position dependent light yield (APD readout)

GEANT4 simulation



Conclusion and Outlook

- ➔ De-polishing of one lateral side face increases the light yield in the rear part of the crystal
- ➔ Only relatively small light loss in the front part (depending on readout and crystal type)
- ➔ Nearly homogeneous response in the front part of the crystal
- ➔ Simulations proof experimental results
- ➔ Increase of the light yield is caused by the direction-change and the facet focussing effect

- ➔ Next PROTO 120 beamtime next week @ MAMI
 - ➔ 5x5 array of de-polished and polished crystals

Thank you for your attention!

