Timing calibration
Light path

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Simulation setup

vertical direction

horizontal direction

right-angle prism

light input (perpendicular to prism surface)
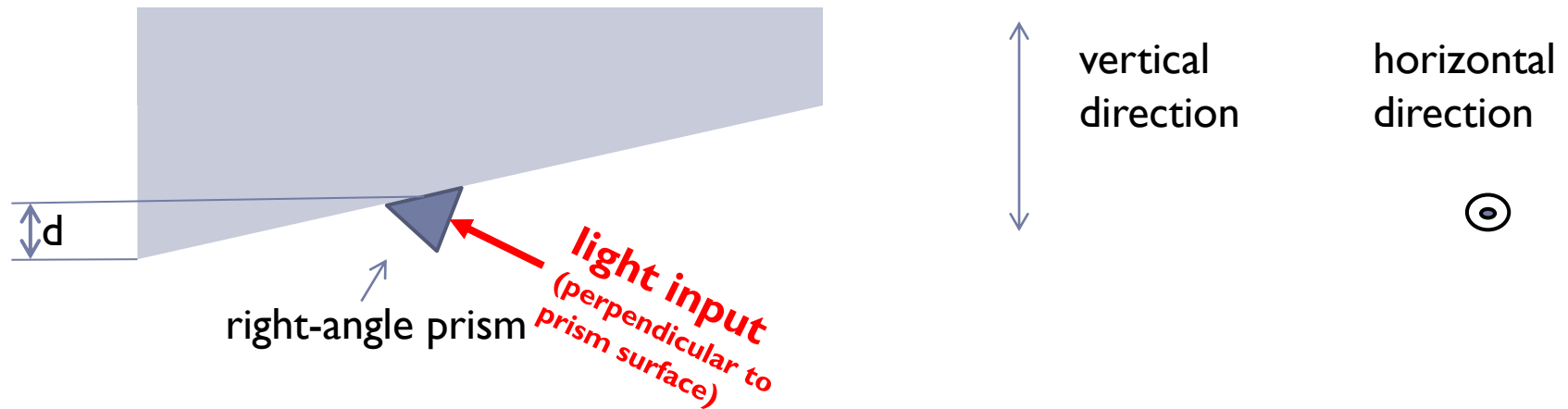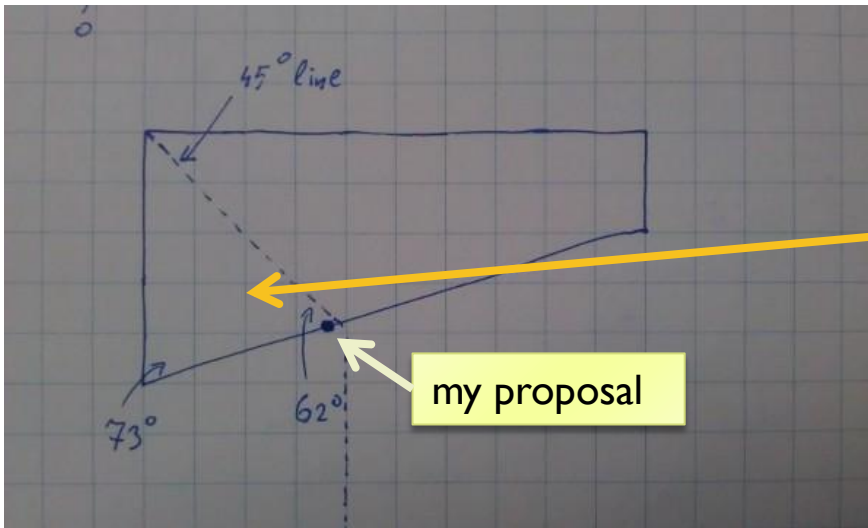
- light source properties:
  - uniform light intensity distribution from 0 to ρ
  - ρ chosen in accordance with the fiber NA=0.48 (biggest I found)

- simulated under different:
  - d ... prism position
  - n ... prism refractive index
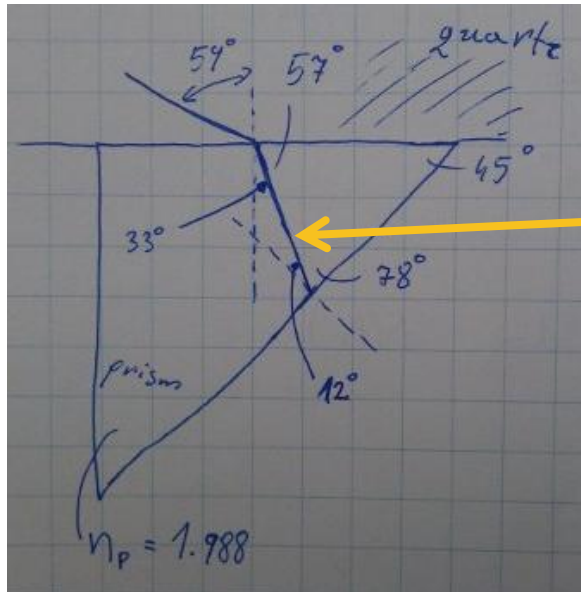
Entry point into the quartz

beam:
- 59° towards the plane normal
- 31° divergence

my proposal

- closer to PMT ➔ larger beam divergence
- further from PMT ➔ leak for photons during physics running

- open questions:
  - is the photon loss acceptable if coupling is 1cm*1cm area
  - is the position ‚free' – other thing there?

Optical coupling into quartz

beam:
- 12° towards the plane normal
- 13° divergence

- example prism is 6mm x 6mm prism from Thorlabs with n=1.988 (smaller n available)
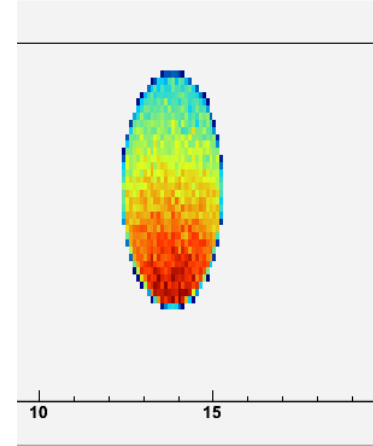
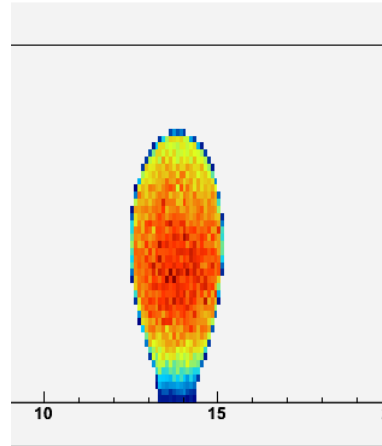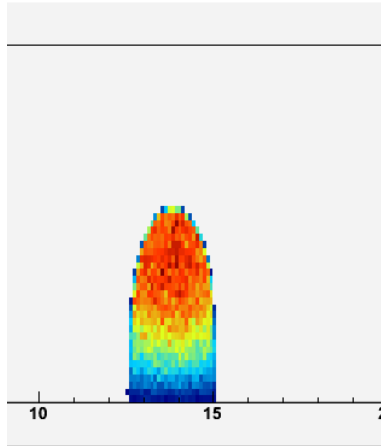- how to couple the fiber to the prism?

Beam divergence

- in horizontal direction the beam is perpendicular to prism/quartz border so NA of the fiber is the only parameter
- in vertical direction the beam in not perpendicular to the surface, thus numerical aperture of the beam changes
- picture shown for NA=0.48 in coupling prism
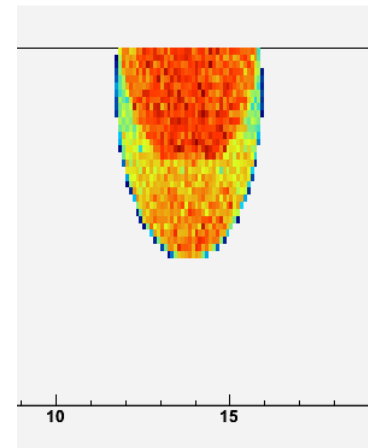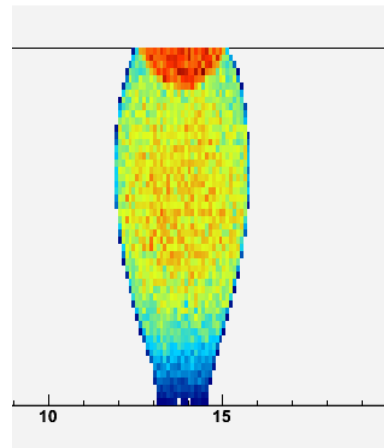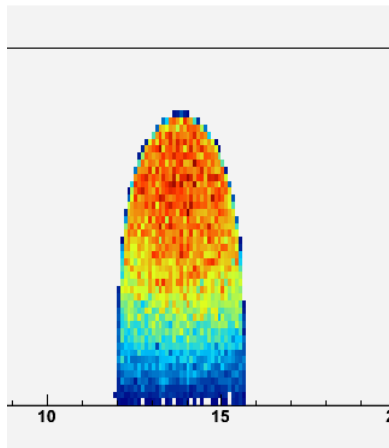- below: divergence of the beam in quartz as a function of prism ref. index
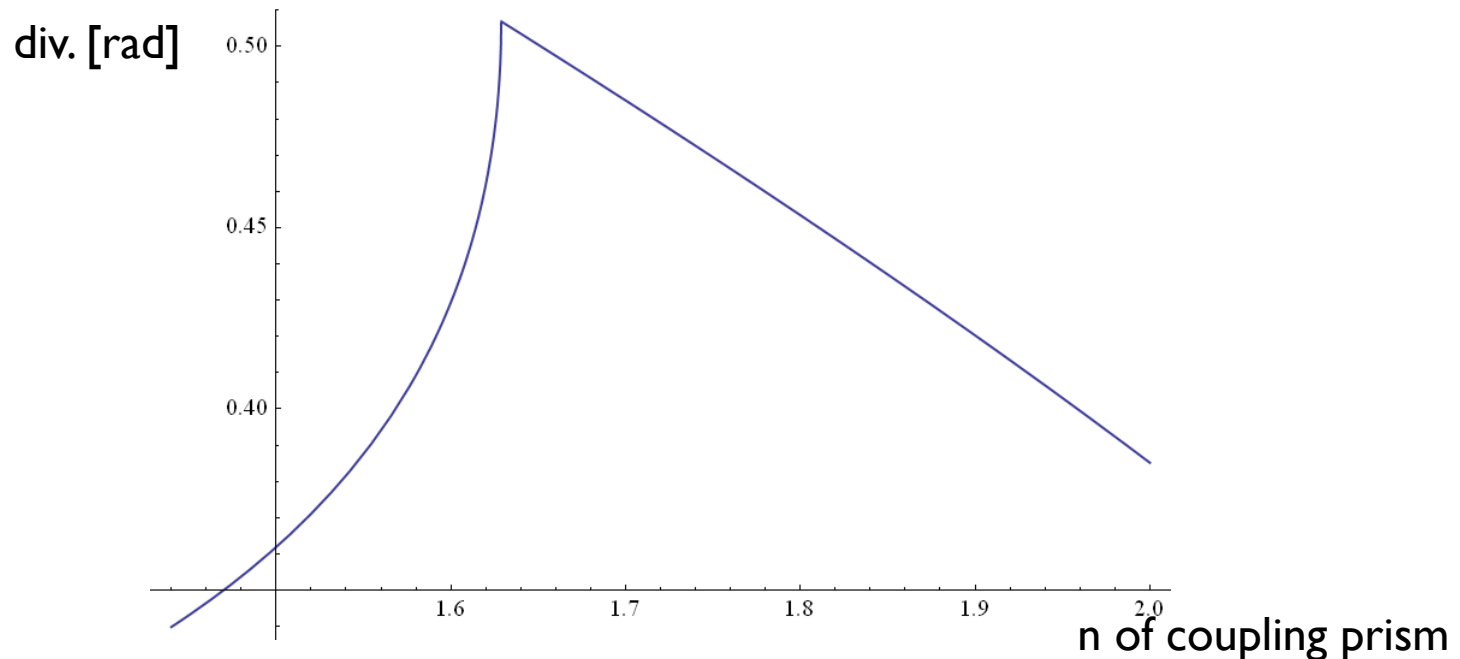
Simulation outcome

d=10 mm

d=15 mm

n=1.98   n=1.65   n=1.44

Conclusions - horizontal direction

- in horizontal direction the beam is perpendicular to prism/quartz border so NA of the fiber is the only parameter

- the width of the pattern not sufficient to cover everything with 8 fibers

- solutions:
  - more fibers
  - fibers with larger NA
  - increase d (move prism more toward the quartz bar)

Conclusions - vertical direction

- in vertical direction the beam in not perpendicular to the surface, thus numerical aperture of the beam changes

- entire ‚height' can hardly be covered
  - by choosing optimal ref. index of prism or its position
  - the intensity distribution is highly nonuniform: min/max ~ 1/100

- solutions:
  - fibers with larger NA (does not solve the nonuniformity)
  - different coupling element
    - what can one wish for? what can be done?

- in principle there is one more degree of freedom: rotating the coupling prism around its axis, but that only leads to even higher nonuniformity and more obscure light pattern shapes (could be exploited if we could get a prism that is not a ‚right angle' one, but with a desired top angle)