Investigation on an

MCP-PMT based

Disc DIRC

alternative to the "3D design"

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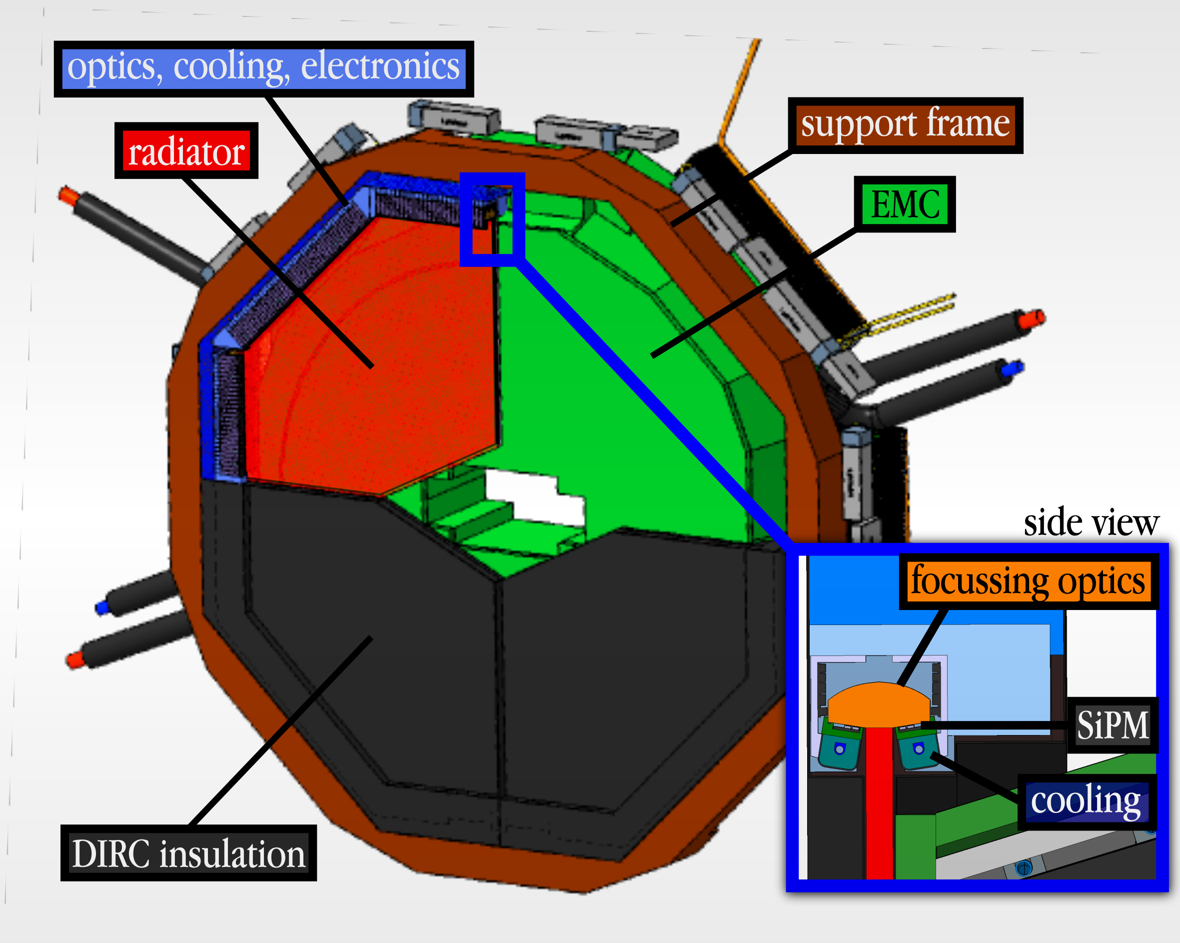
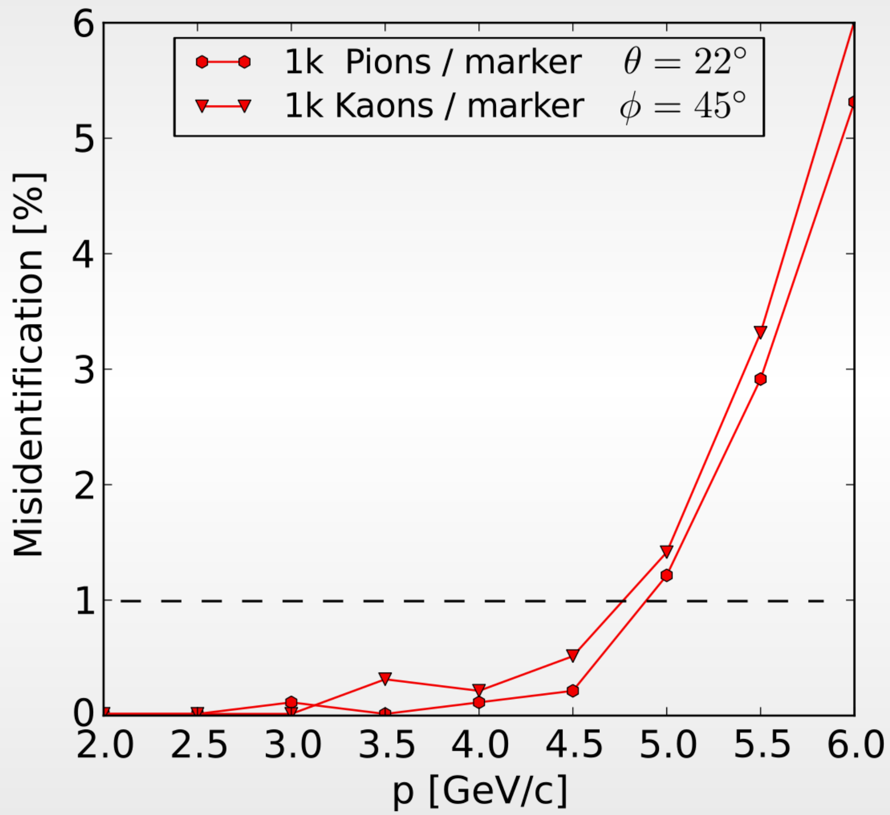
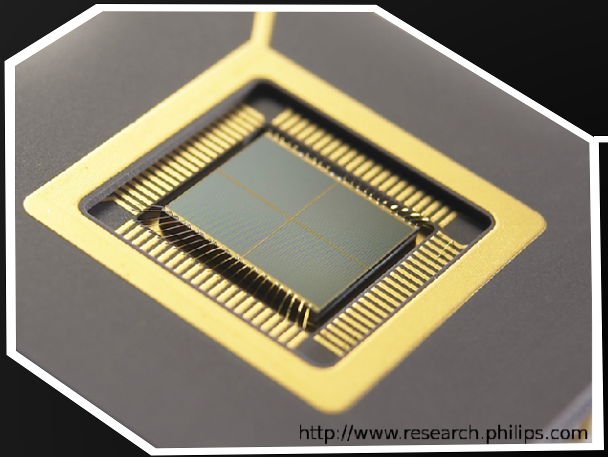
PANDA Collaboration Meeting 12/2012

dSiPM based "3D Disc DIRC"





Open critical issues:

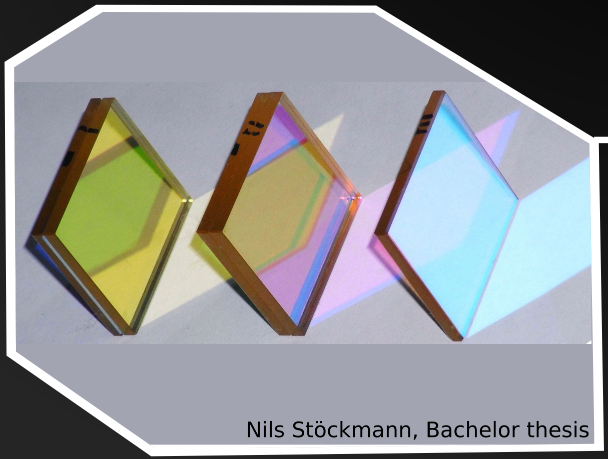


Philips dSiPM

radiation hardness

sensor modification

cooling [-20, 0] °C



Dielectric filters

feasibility of design

(filters with wide AOI acceptance required)

Sensor alternatives ?

Wanted:

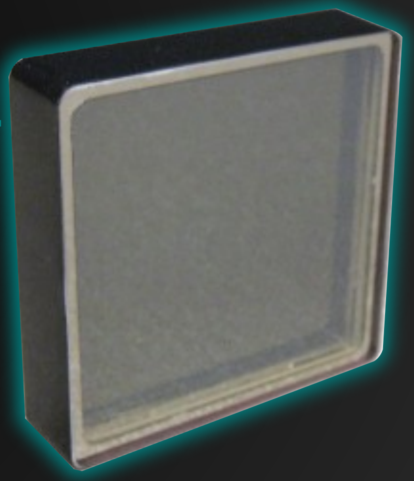
single photon
radiation tolerant
B-Field (0.7 - 1.5 T)
fast timing (~100 ps)
sub-mm resolution
high rate (~ MHz)
high geo. efficiency

Possible:

PMT with ...
- MCP dynode
- finemesh dynode

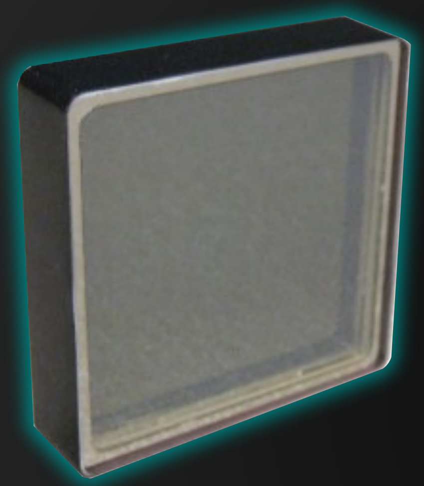
HPD

Available:



Photonis Planacon

MCP-PMTs are not perfect



Photonis Planacon

Limited lifetime

Work in progress, > 5 C/cm² is in reach

6 C/cm² translates to:

only **~12 photons / track**

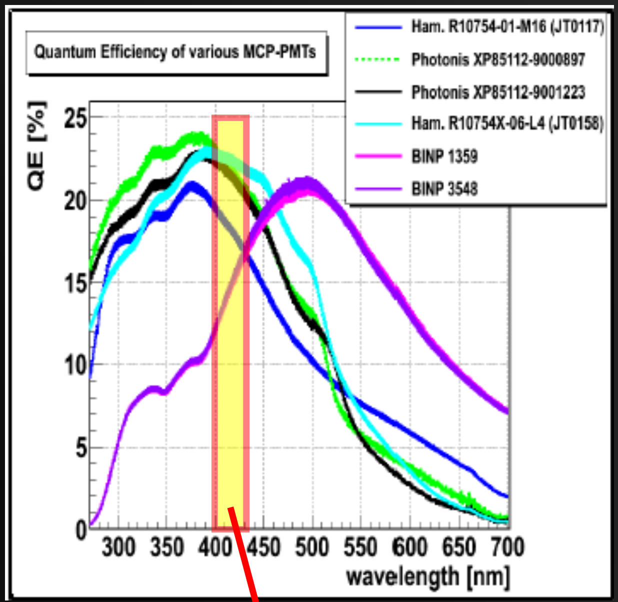
and **6 MHz** sustained rate

Gain 10^6, 20 MHz IR, 5 yrs continuous operation

Less photons more precision

Design idea:

Use narrow bandpass filter (400 - 430 nm)
reduced rate and dispersion error
at the same time

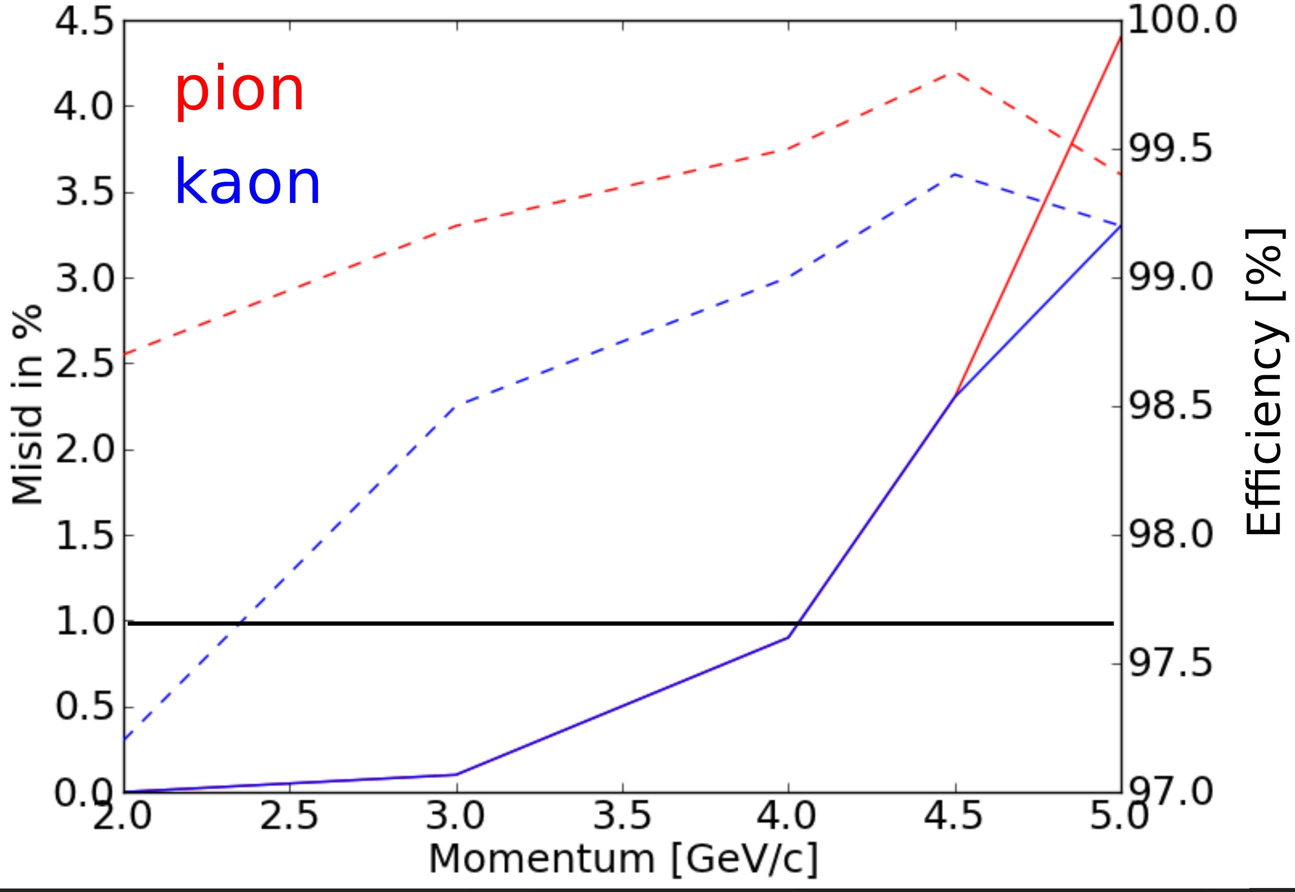


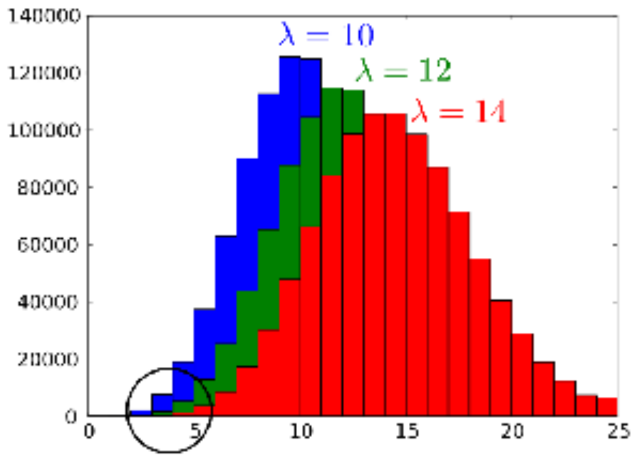
A. Britting, Talk, PANDA Collab. Meeting 06/2012

Apply filter to PMT window
narrow AOI range, less demanding filter design

Simplistic proof of concept

Applied changes to 3d Disc DIRC simulation



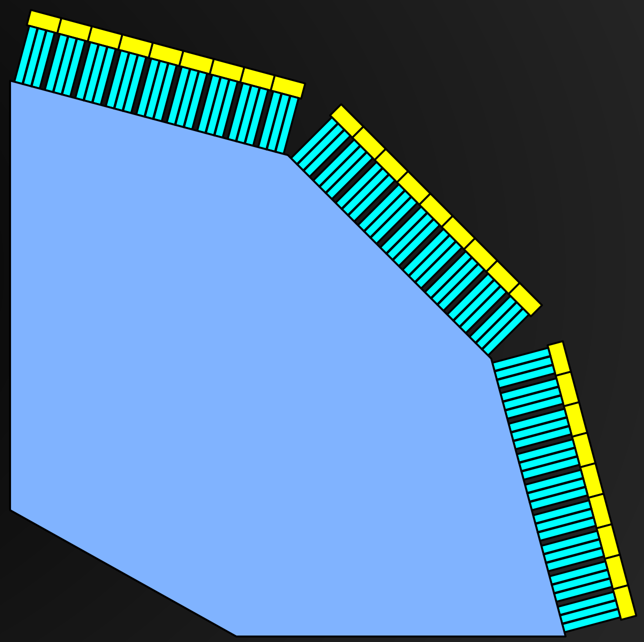


Critical region

A first detector design

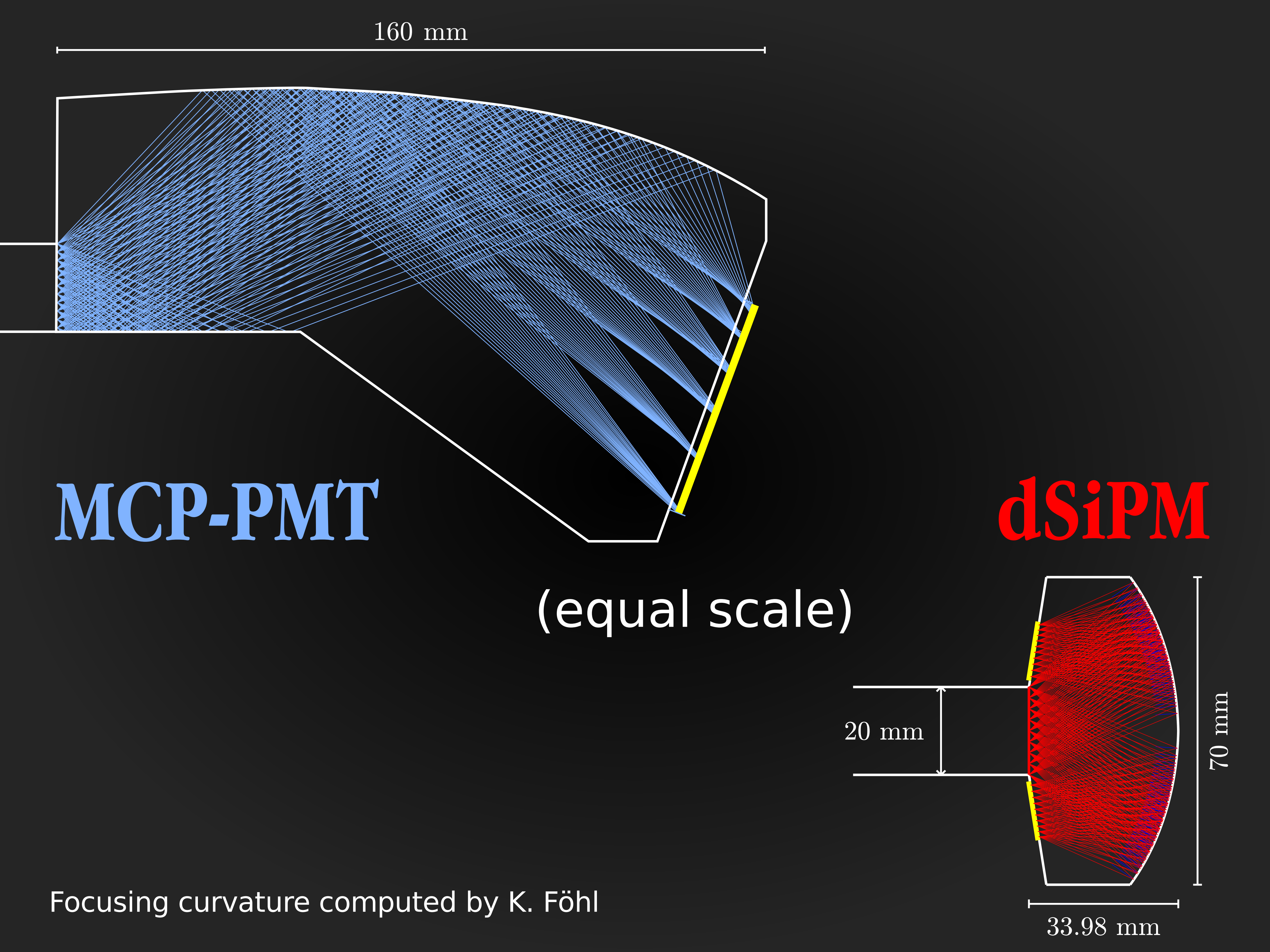
Keep 3D-DIRC advantages

- 4 independent detectors
- radiator produced in one piece
  (radiator size cannot be increased)

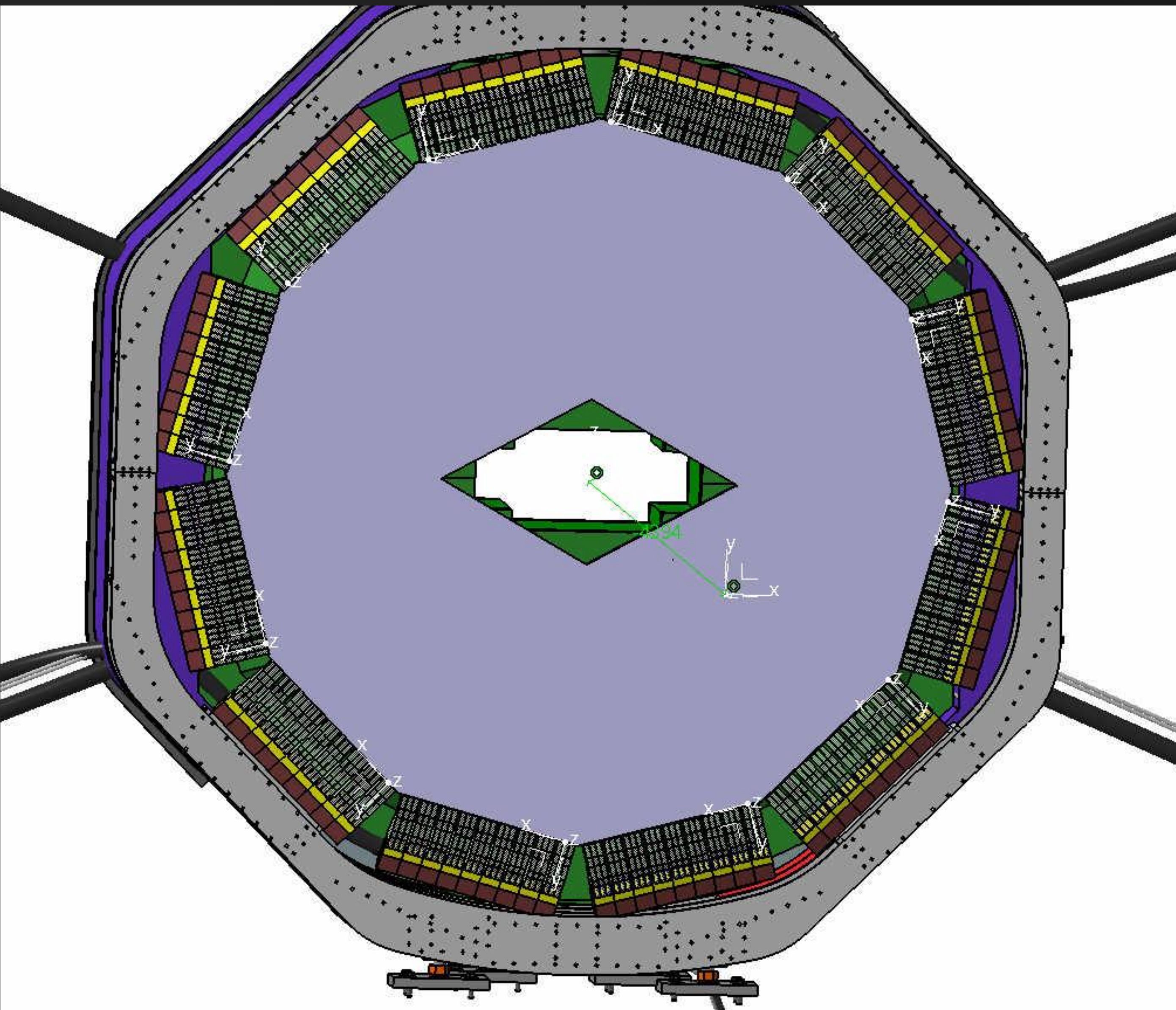


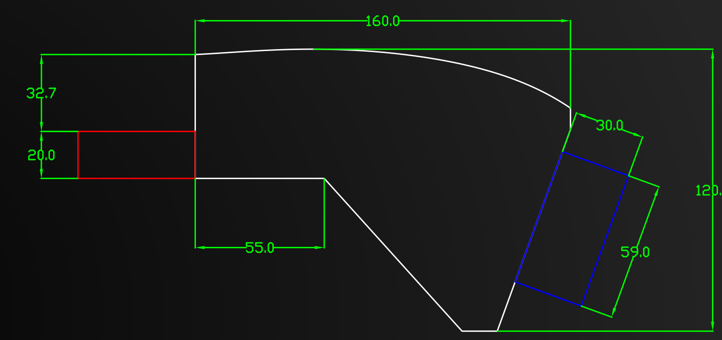
Focusing optics

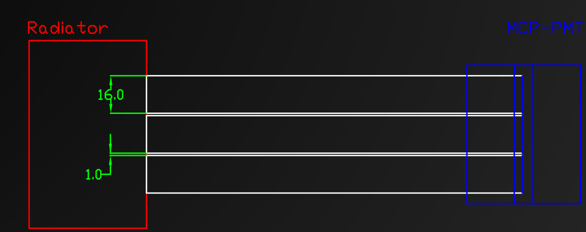
- must fit in the DIRC space together with FEE
- MCP-PMTs have to be aligend to B-field
- had to pick optics with bad resolution (~0.5 mm)

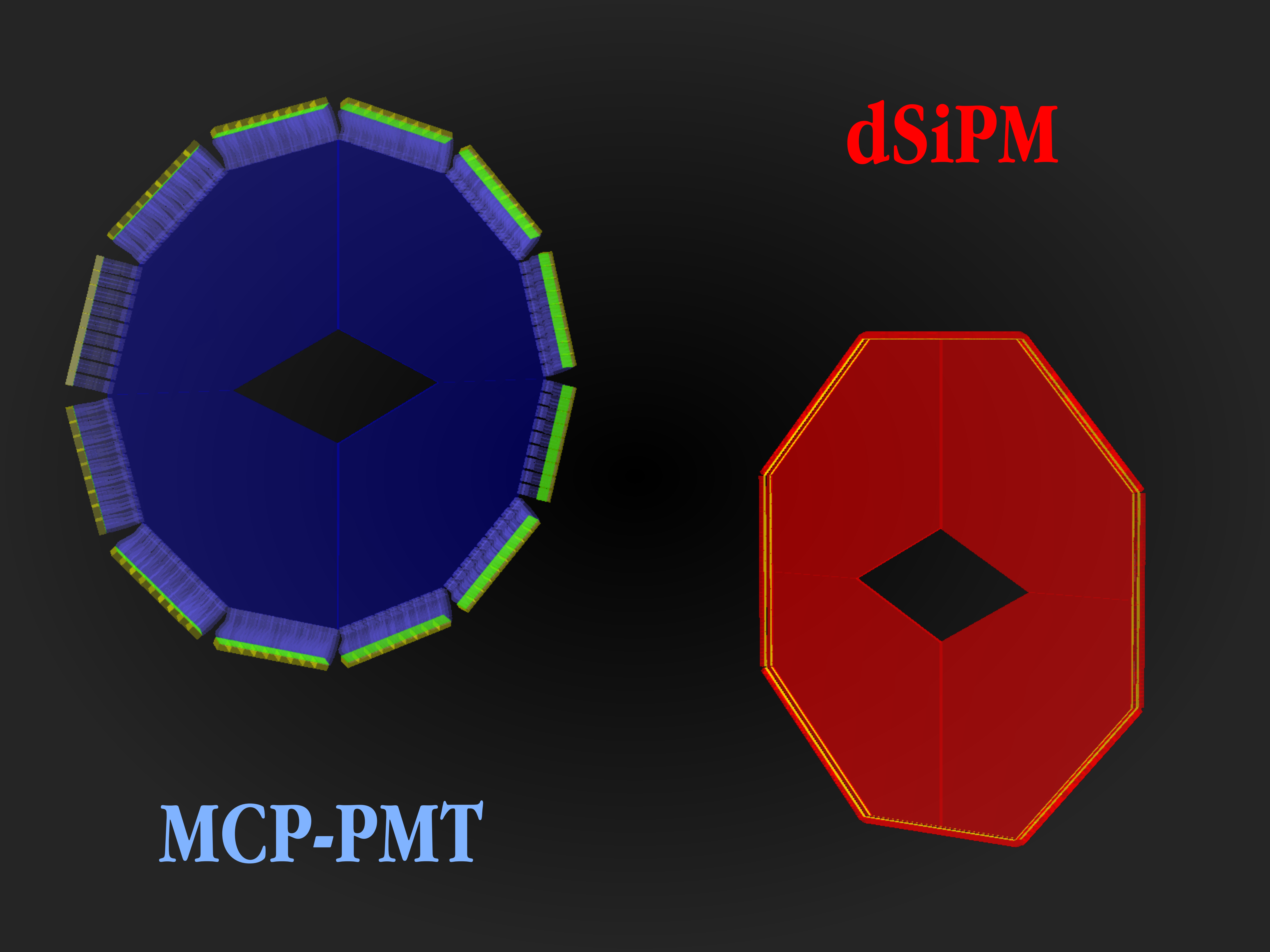

160 mm
MCP-PMT
dSiPM
(equal scale)
20 mm
70 mm
33.98 mm
Focusing curvature computed by K. Föhl

Some CAD drawings …



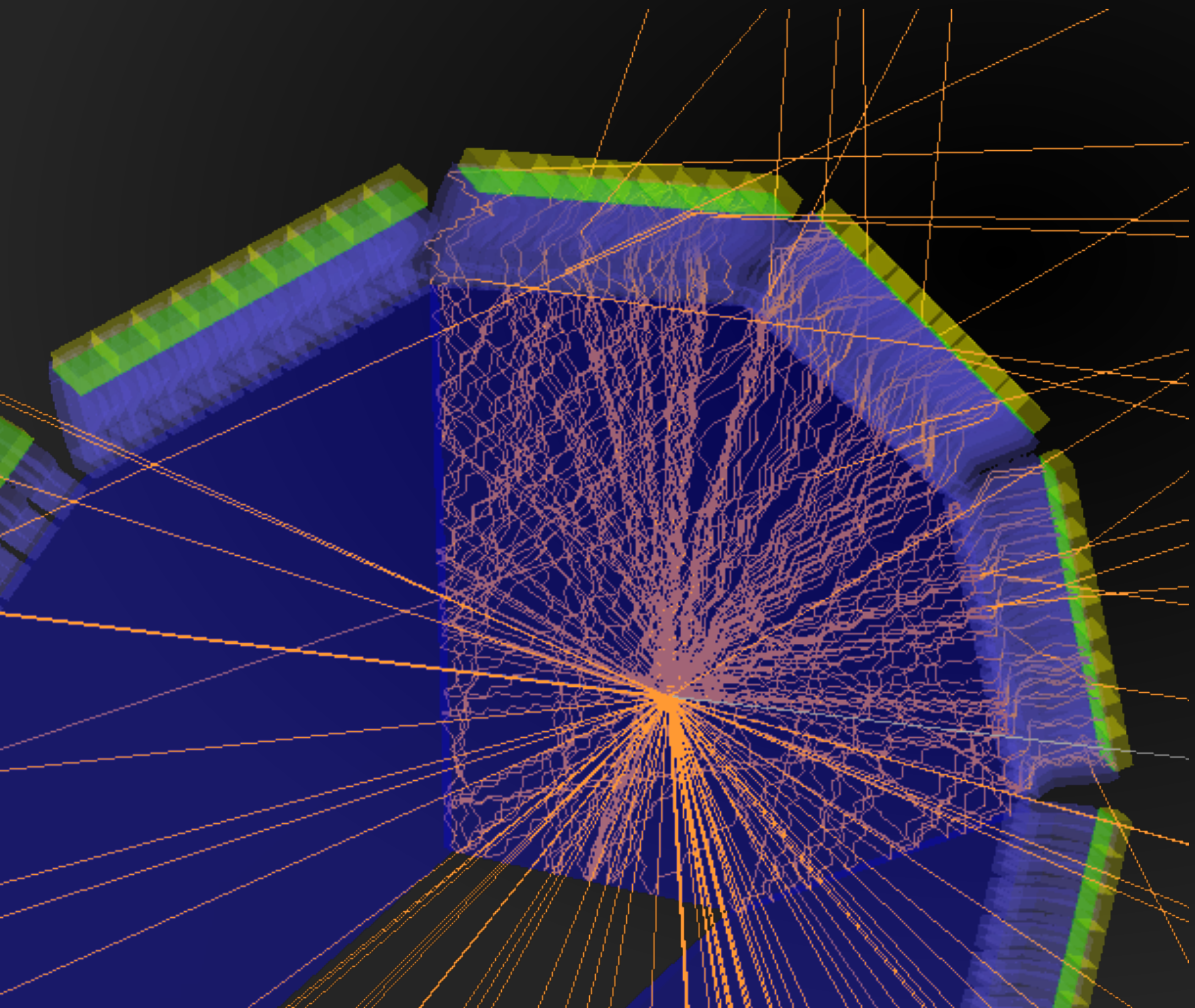


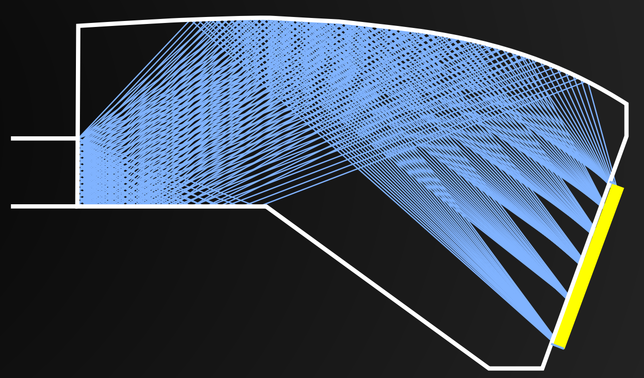



dSiPM
MCP-PMT

Focusing surface approximation

form error $< 2\,\mu m$

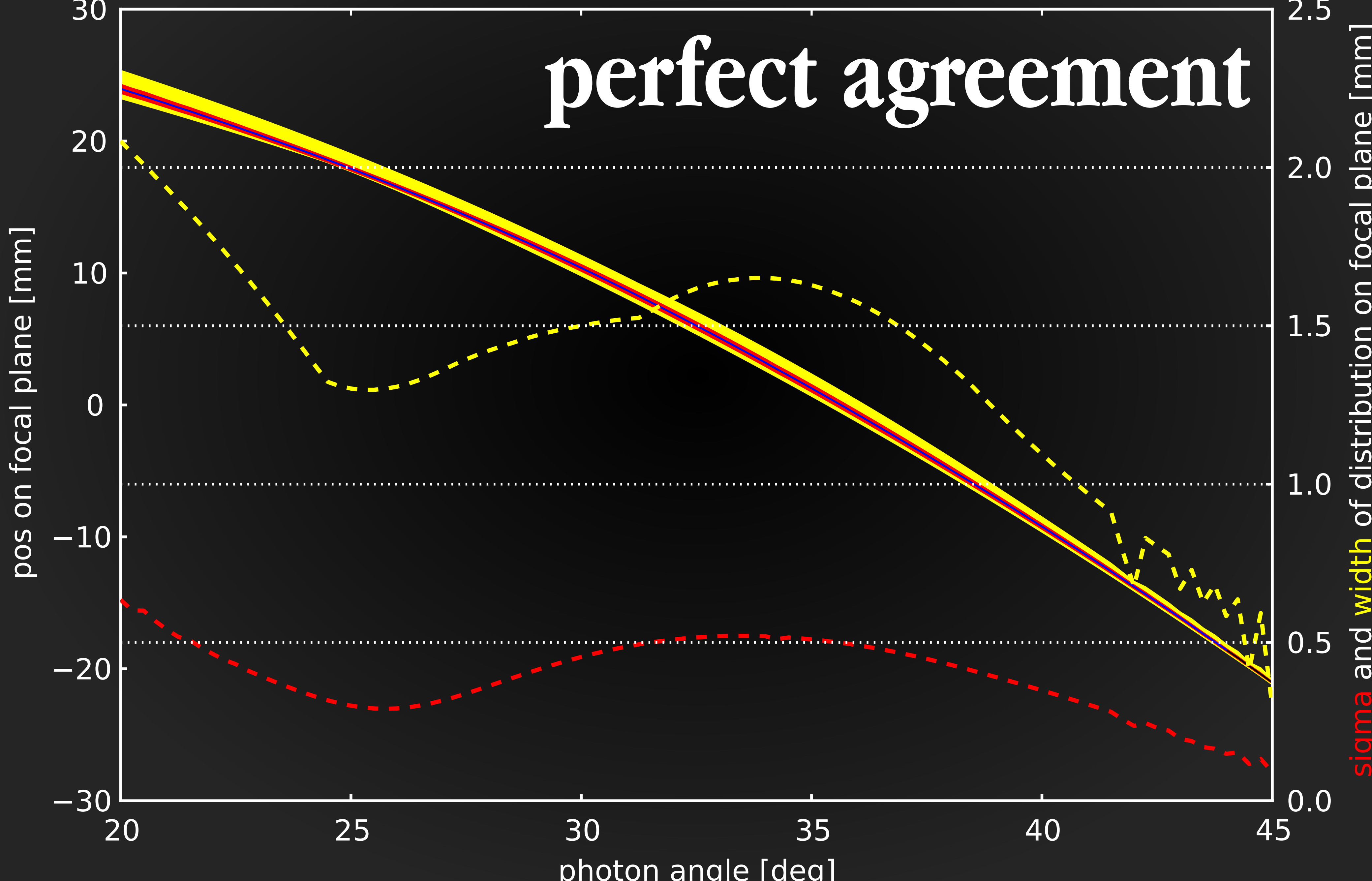




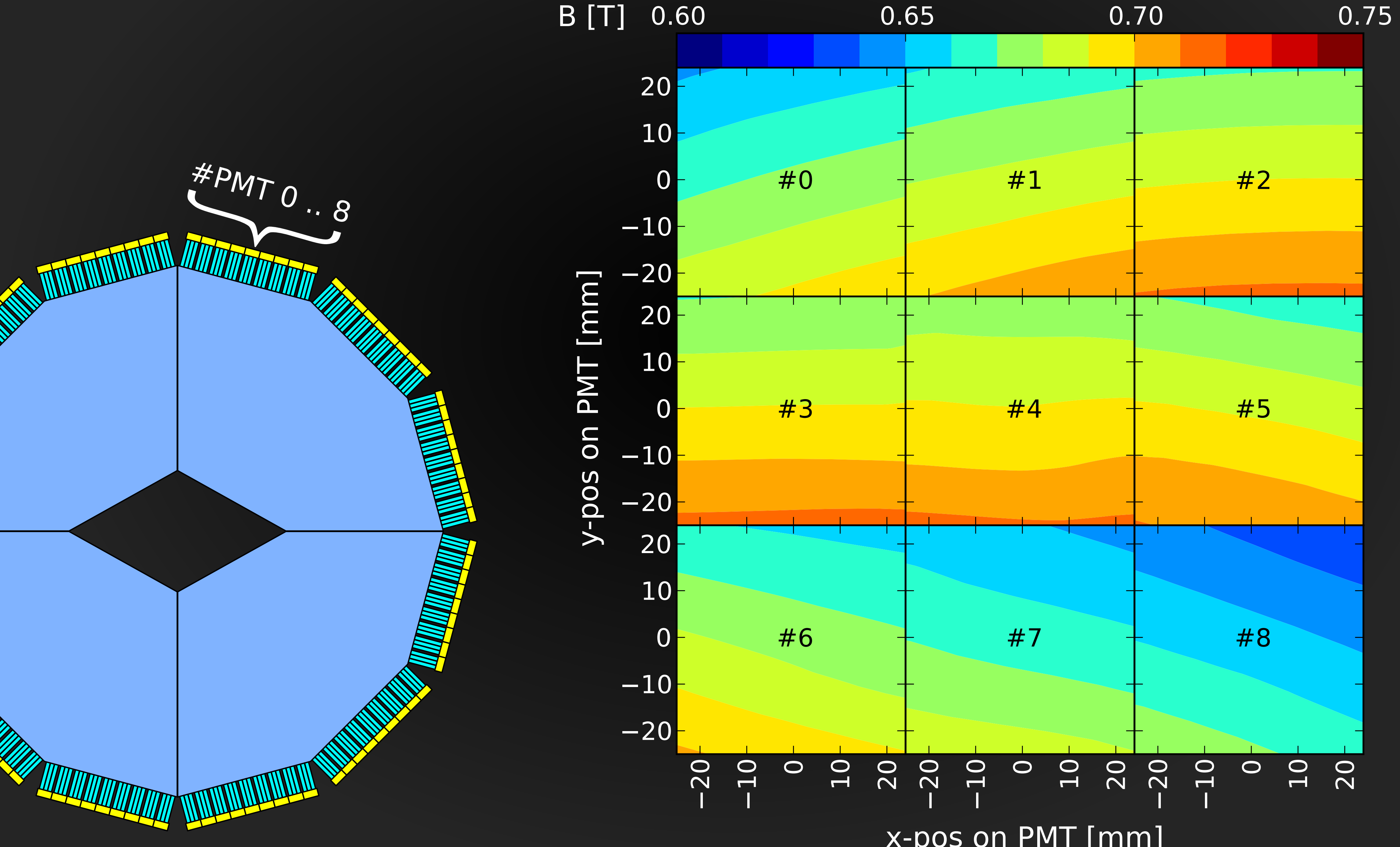
PandaRoot

✓

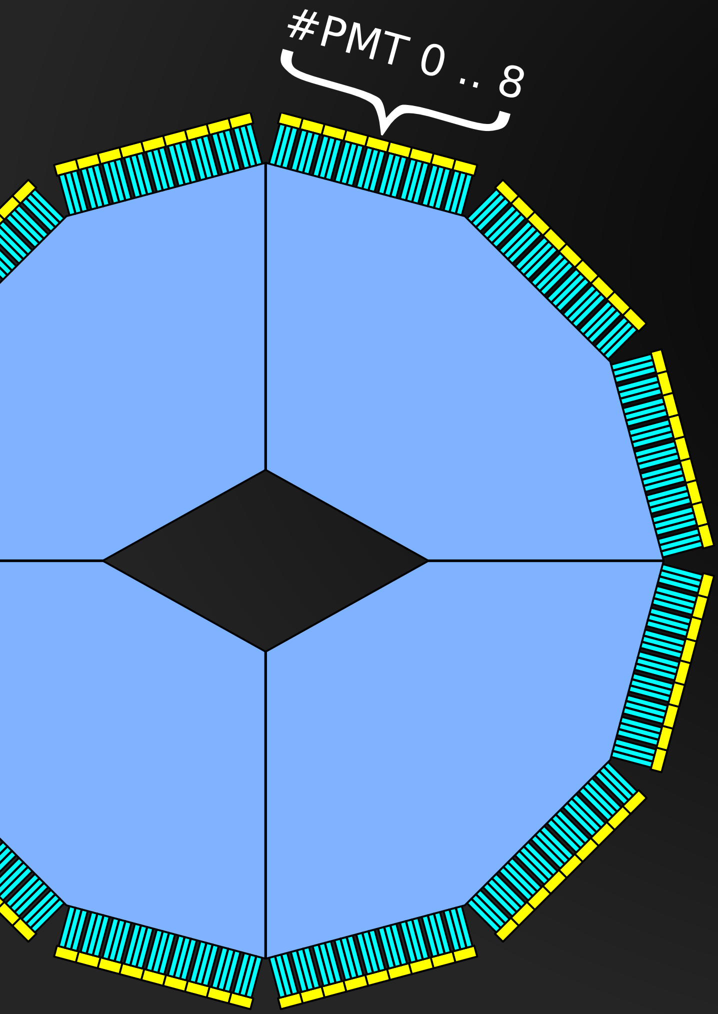
Imaging quality in PandaRoot ✓

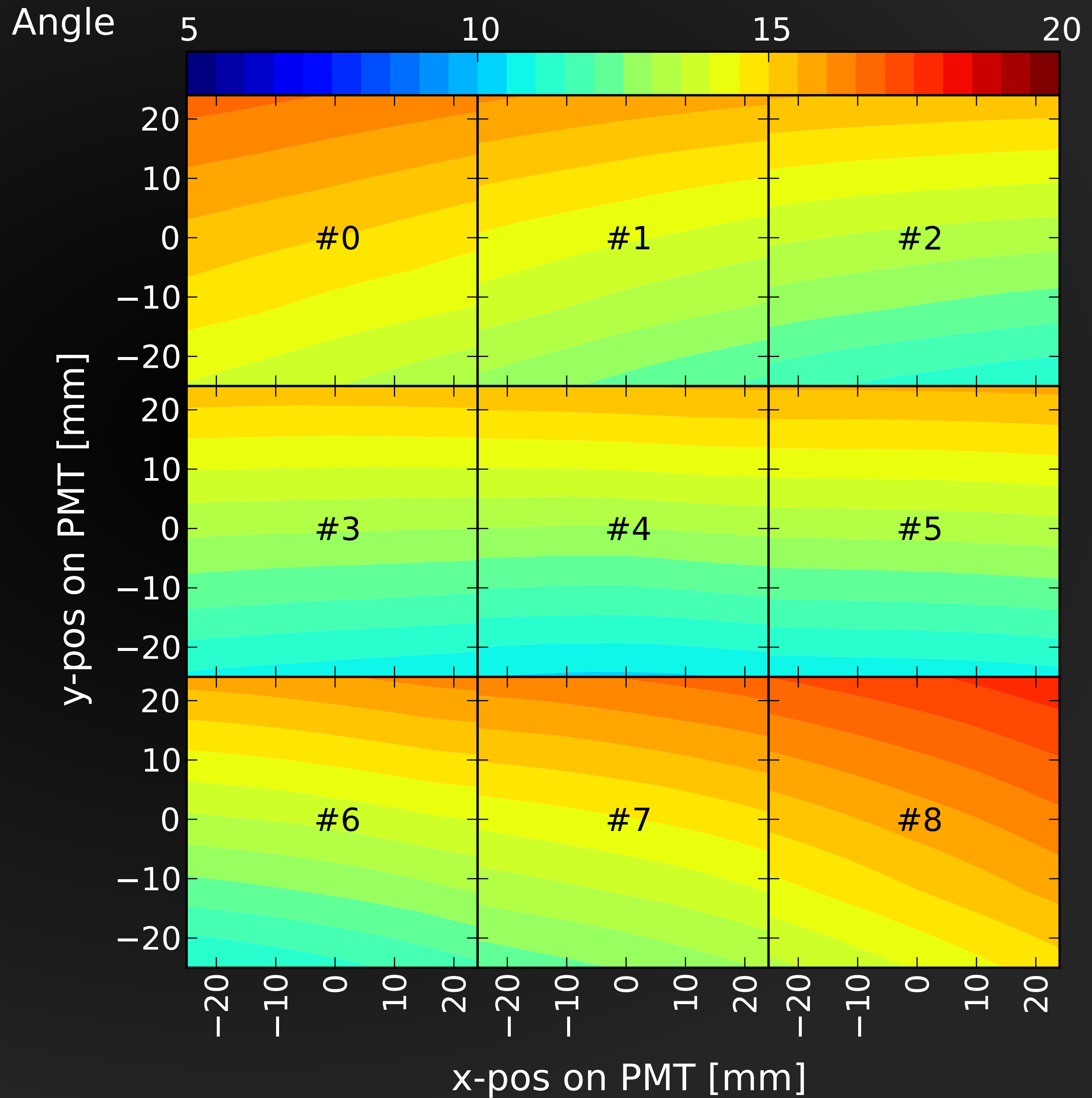


Magnetic field on MCP-PMT area



Field angle to MCP-PMT axis





Delay line anode concept

Ge - resistive pads

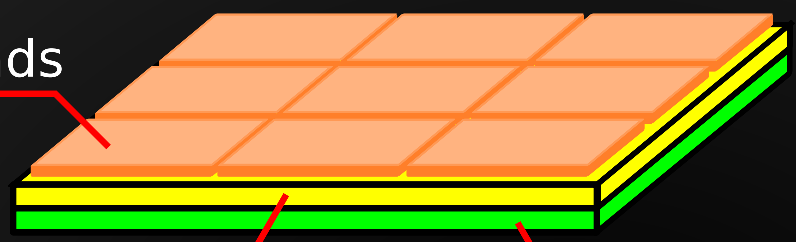
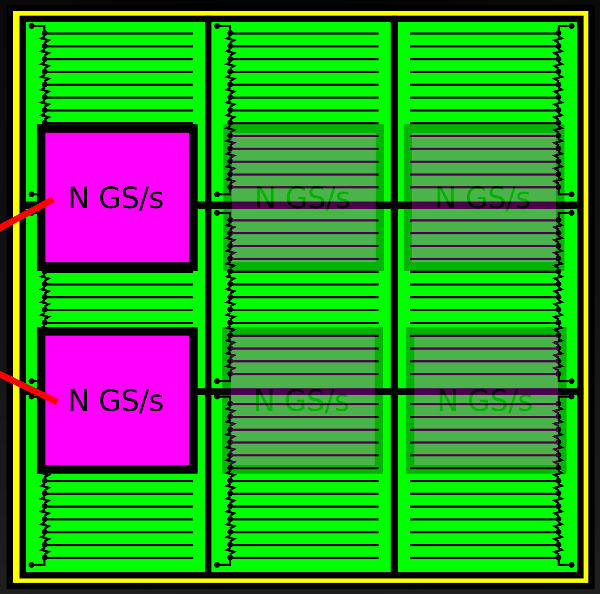


Image charge on Ge Layer permits centroiding in presence of B-Field

ceramic backplane

delay line structure (on PCB?)

667 kHz / DL



3x3 DelayLine Array

continuous waveform sampling if possible

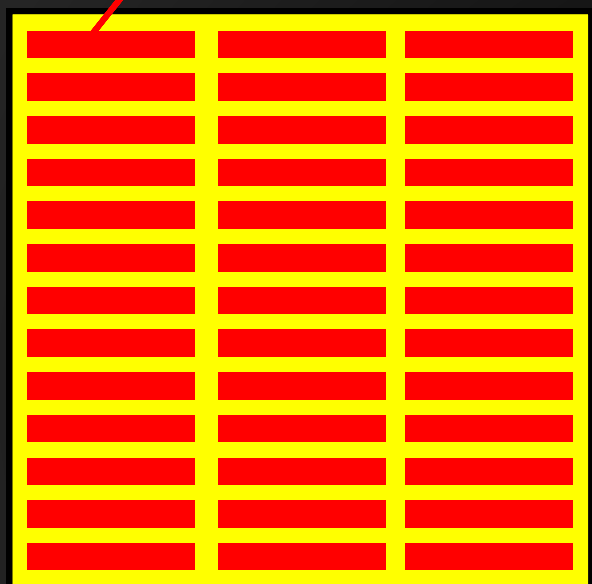
Segmentation to match the signal rate (<1% occupancy / DL)

O. Merle, 10/2012

Alternative anode concepts

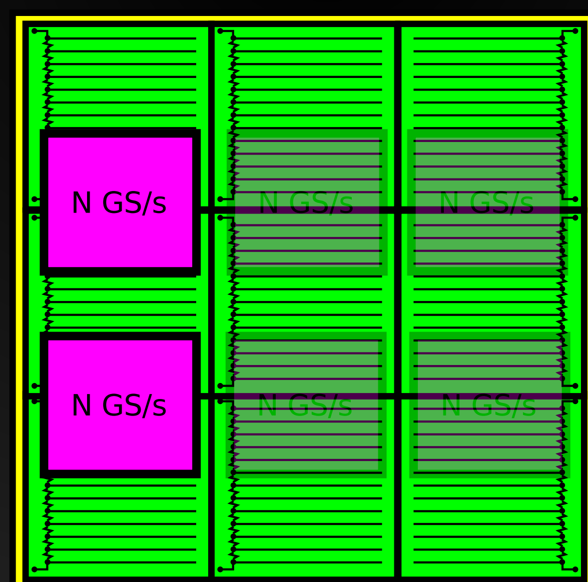
3x60 + TDC@FPGA

metal pads



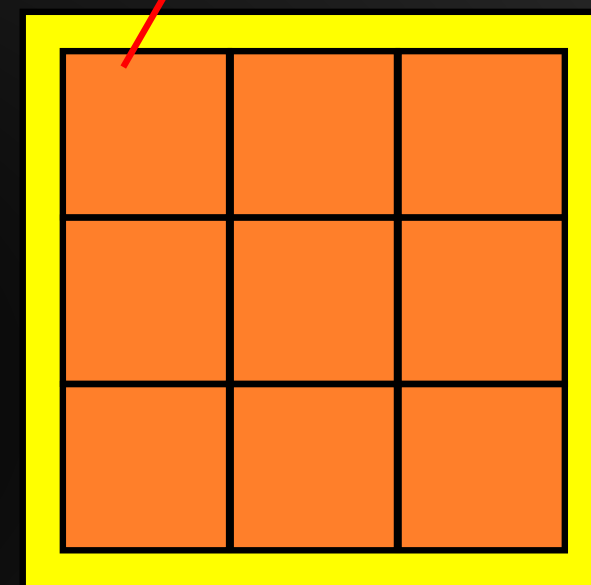
Low spatial resolution
High rate
Good time res

High spatial resolution
Low rate
Good time res



3x3 DelayLine Array

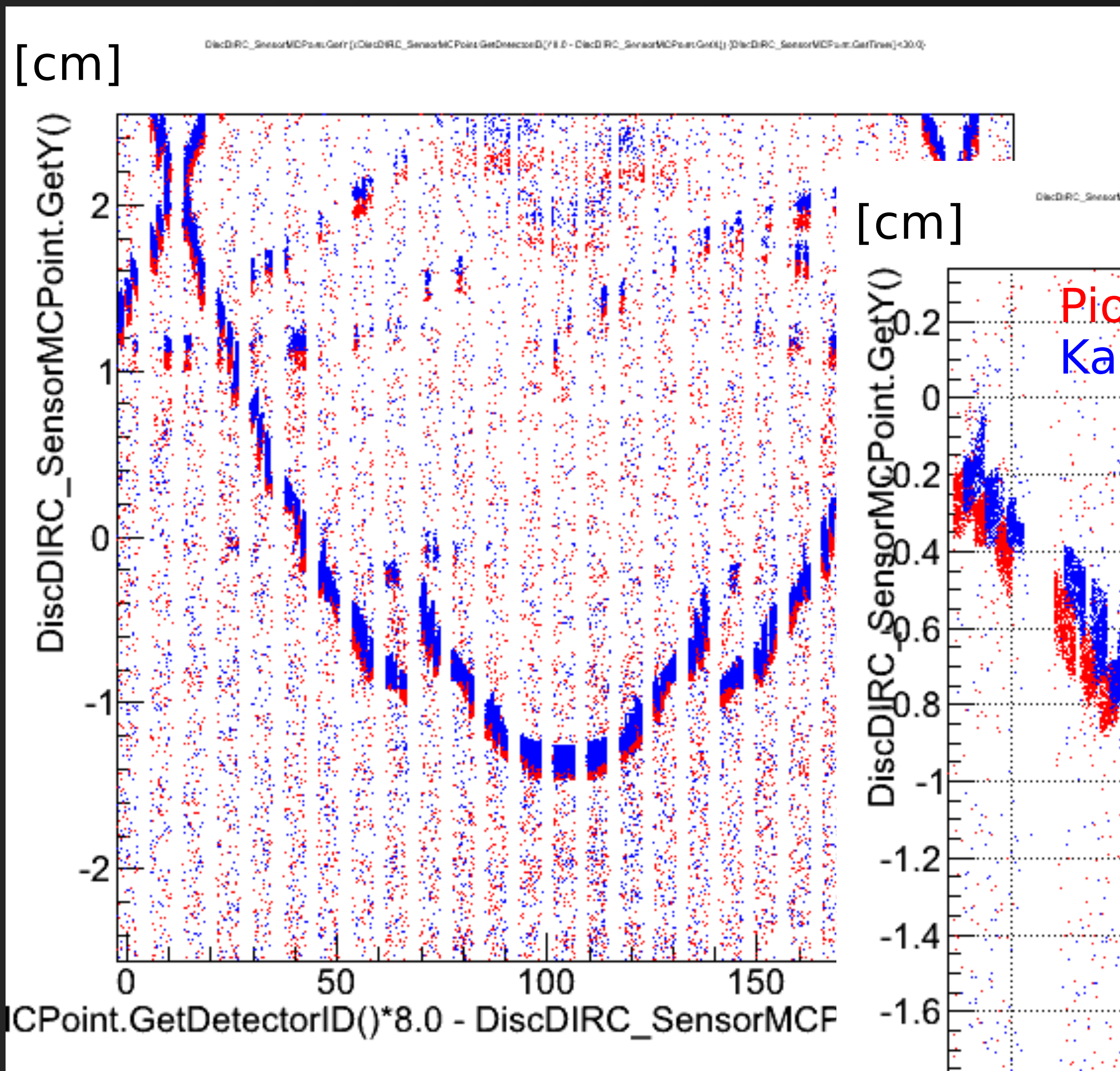
Timepix (50x50 µm², 1.6 ns)

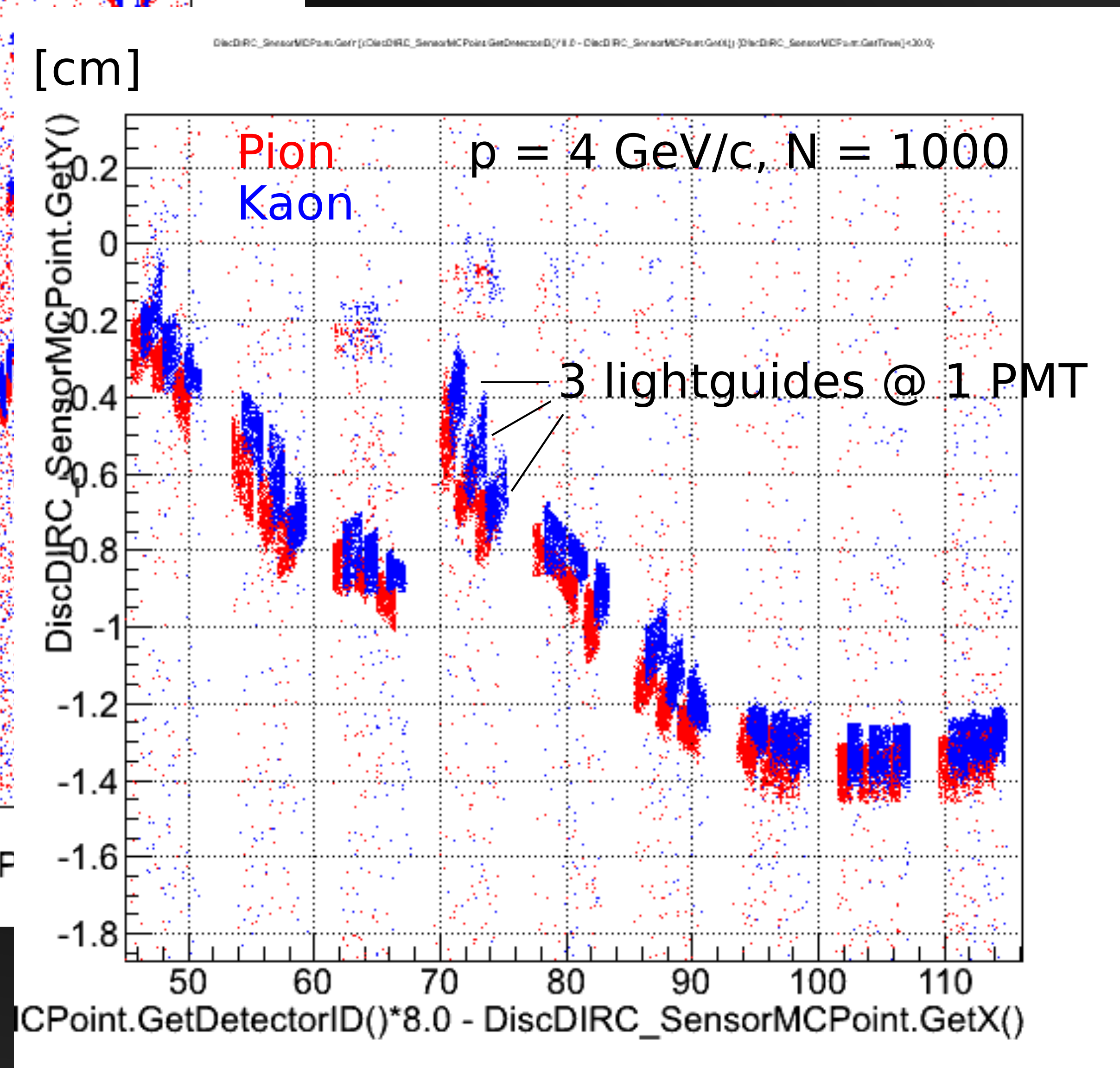


Very high spatial resolution
Very high rate
Bad time res

O. Merle, 10/2012

Pion/Kaon 4 GeV/c sneak peek





That's all folks !