Thin and Stack PREx Detectors - status

Piotr Decowski
Smith College

Collaboration Meeting, December 7, 2007

Detectors, short review:

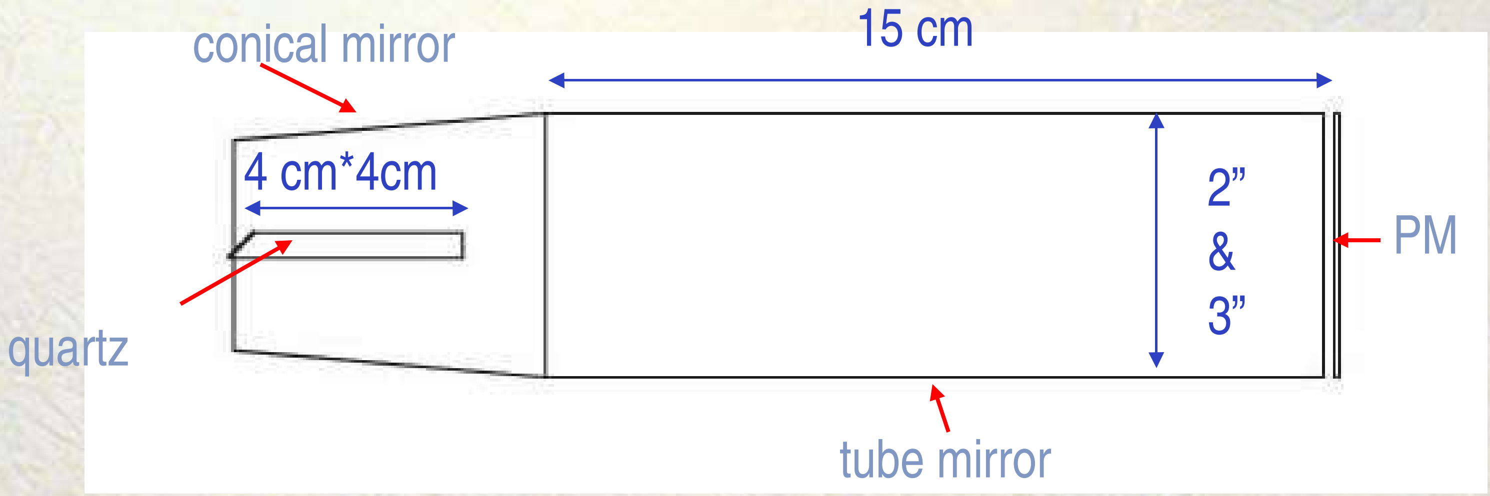
- Single thin quartz block
- Tungsten/quartz stack

January tests:

- PREx detectors
- Lumi studies - KK's slides

Thin Quartz Detector

Concept:



Optimization:

-- cone length (mirror angle)

-- quartz thickness

-- quartz position in the cone

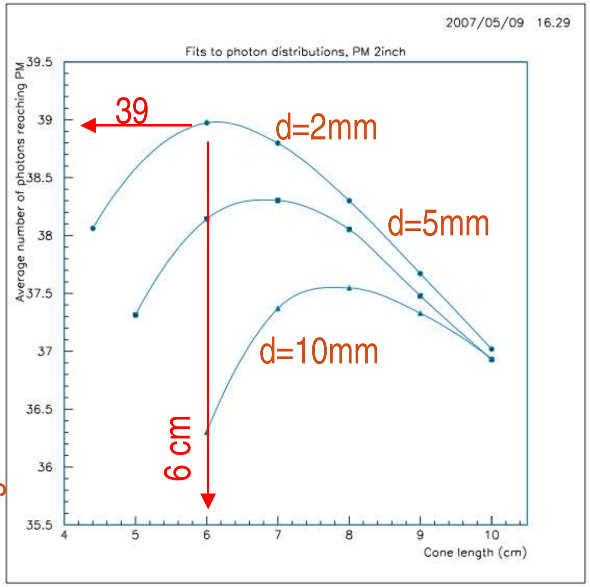
-- PM diameter (2” and 3”)

Electron energy 850 MeV

Cone length (5 mm quartz)

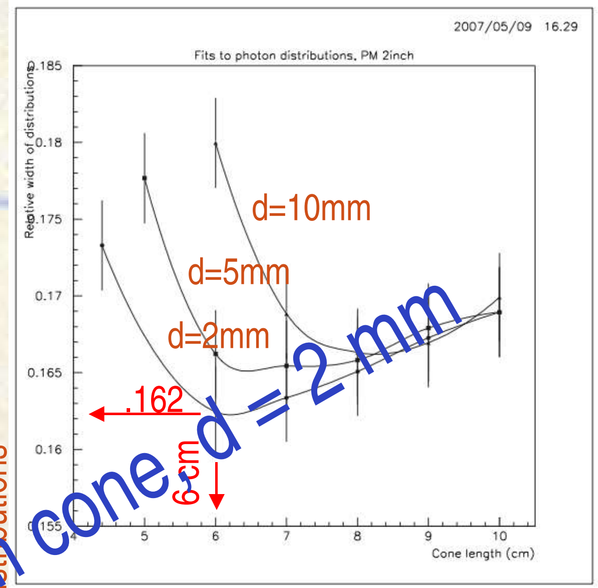
2 inch PM

Number of photons reaching PM



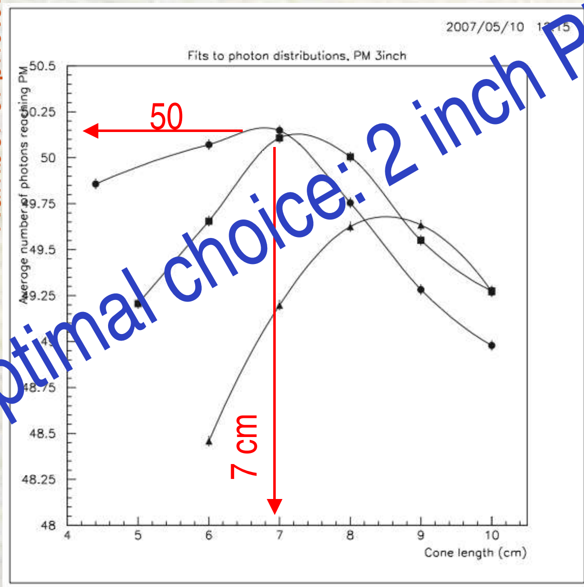
Cone length (cm)

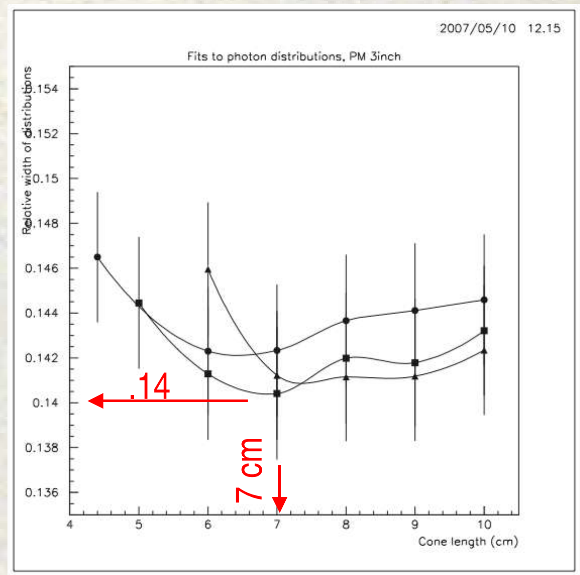
Relative width of distributions



Cone length (cm)

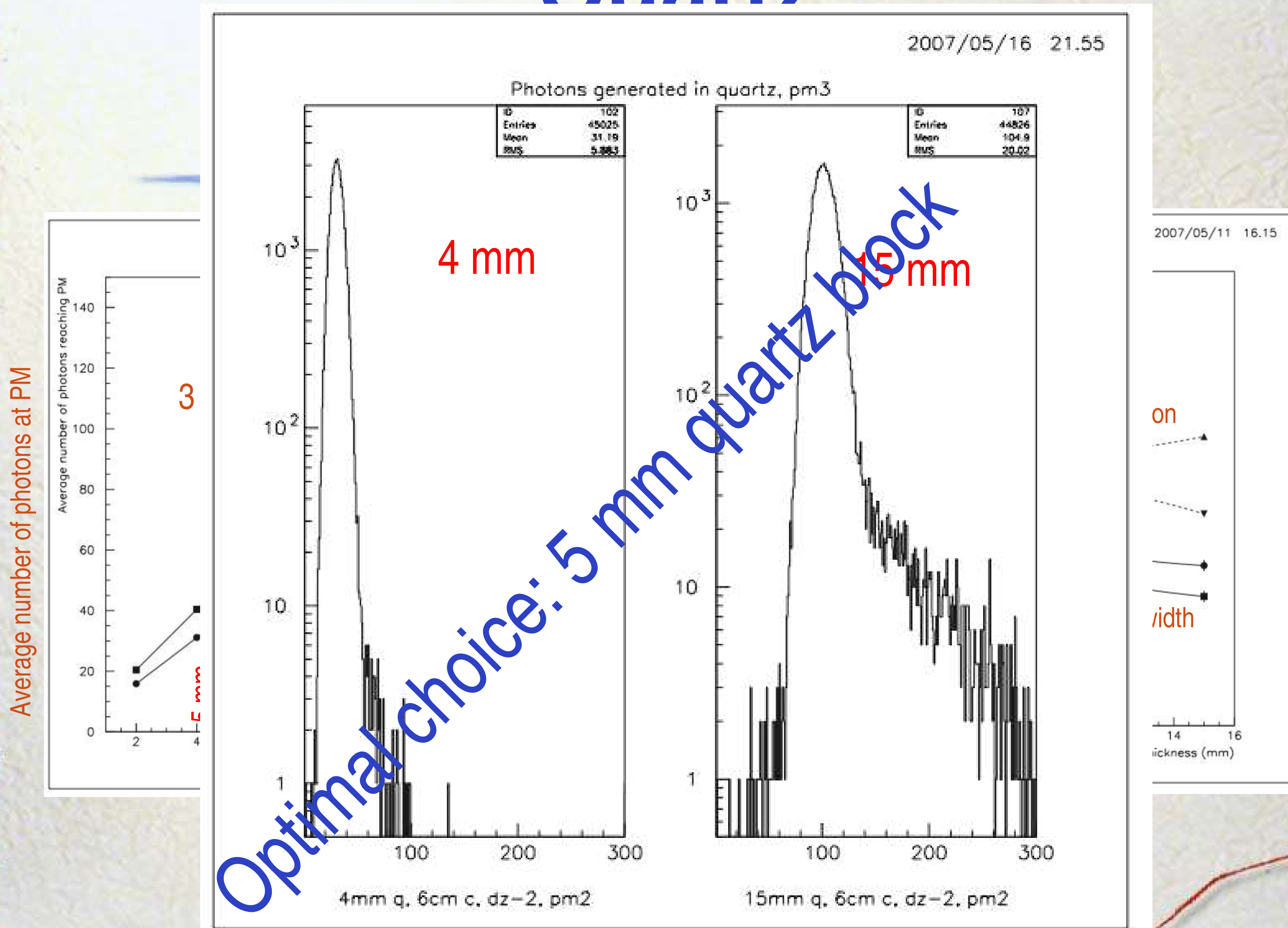
3 inch PM





Optimal choice: 2 inch PM, 6 cm cone, d = 2 mm

Quartz



2007/05/16 21.55
Photons generated in quartz, pm3
ID 102
Entries 45025
Mean 31.19
RMS 5.863
ID 107
Entries 44826
Mean 104.9
RMS 20.02
4 mm
15 mm
4mm q. 6cm c. dz-2, pm2
15mm q. 6cm c. dz-2, pm2
Average number of photons at PM
Average number of photons reaching PM
3
2007/05/11 16.15
Optimal choice: 5 mm quartz block

Optimal detector parameters:

Trapezoidal quartz block 0.5cm thick, 4cm*4cm upper surface

Cone mirror 6 cm long, with quartz block positioned at the smaller opening of the cone

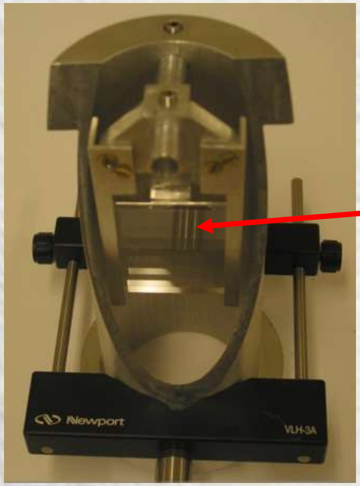
2 inch diameter PM

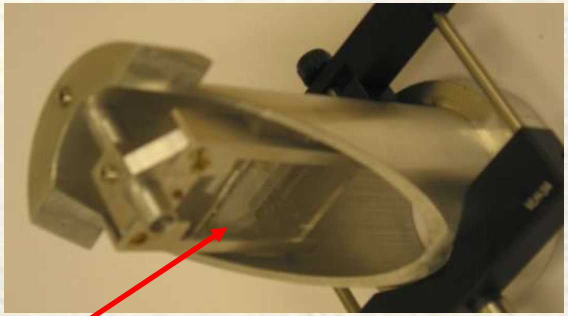
The design is robust - the resolution does not depend strongly on design parameters as well as condition of quartz surface (as a matter of fact, more rough surface improves resolution by ~1%)

Simulated performance: N_{Ph} ~ 40, δN_{Ph} ~ 17%

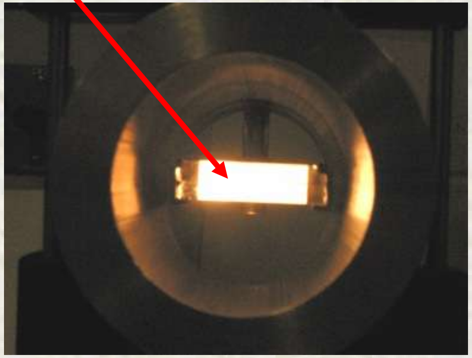
Thin detector

head and quartz holder

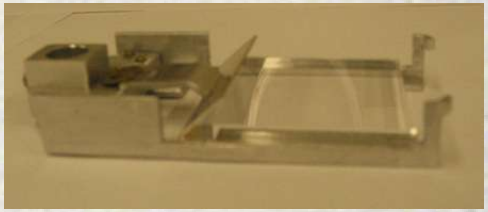




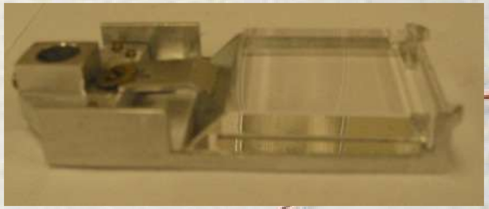
Quartz



0.5 cm quartz block

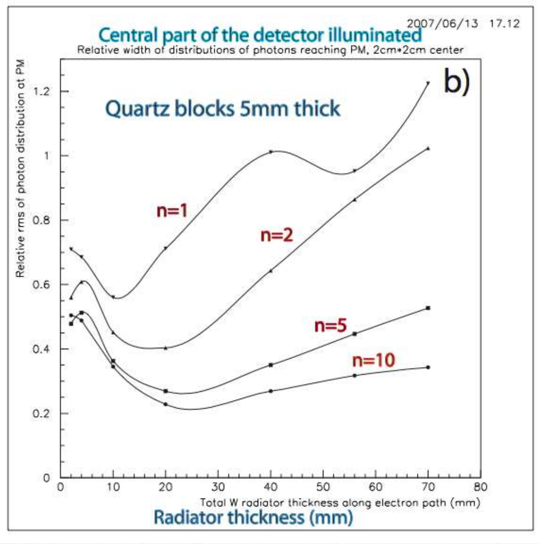


1 cm quartz block



Stack detector simulations

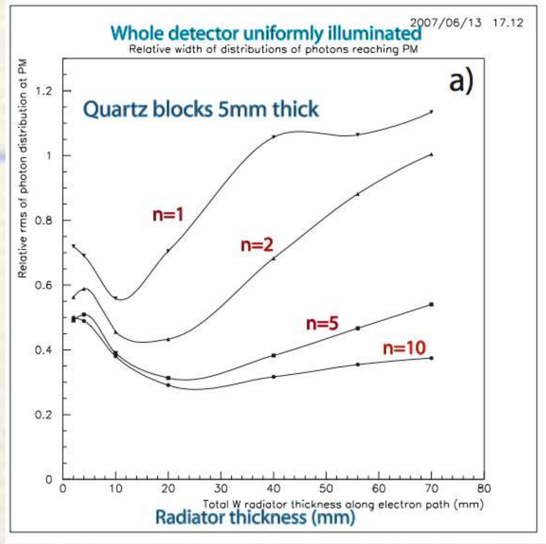
Relative width

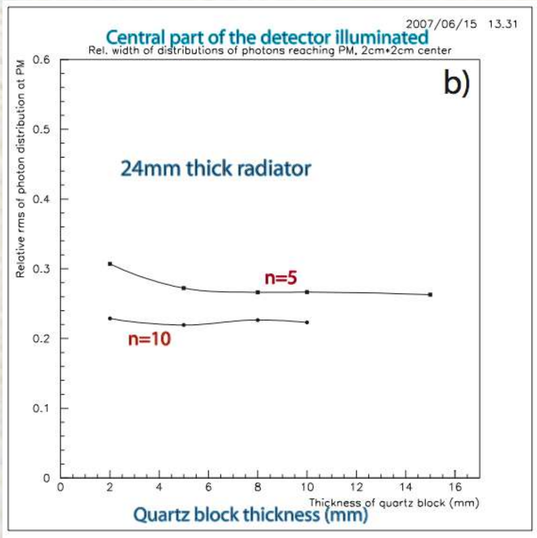


Radiator

thickness

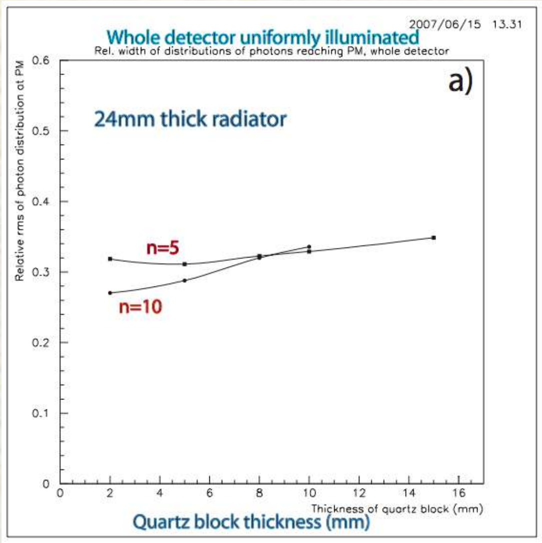
Relative width





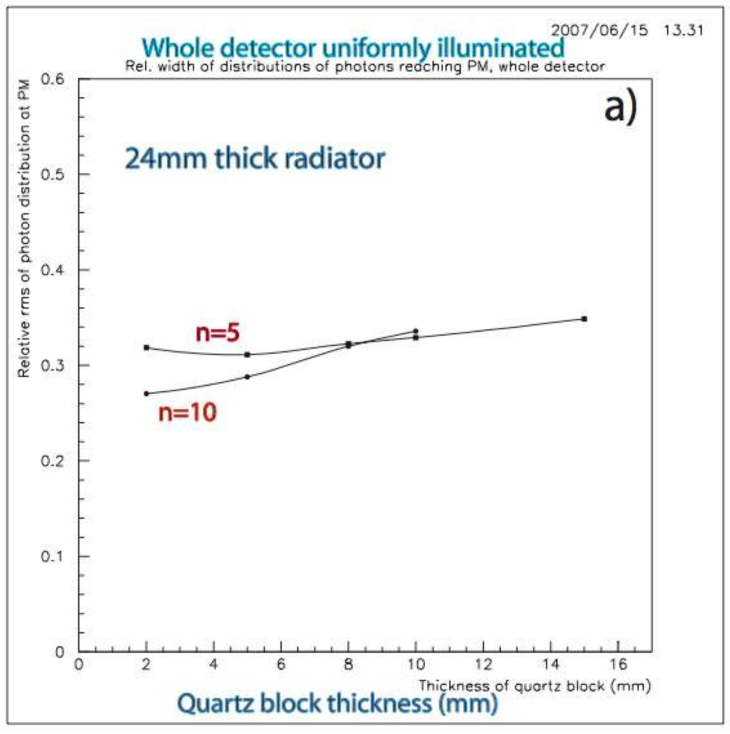
Quartz

thickness

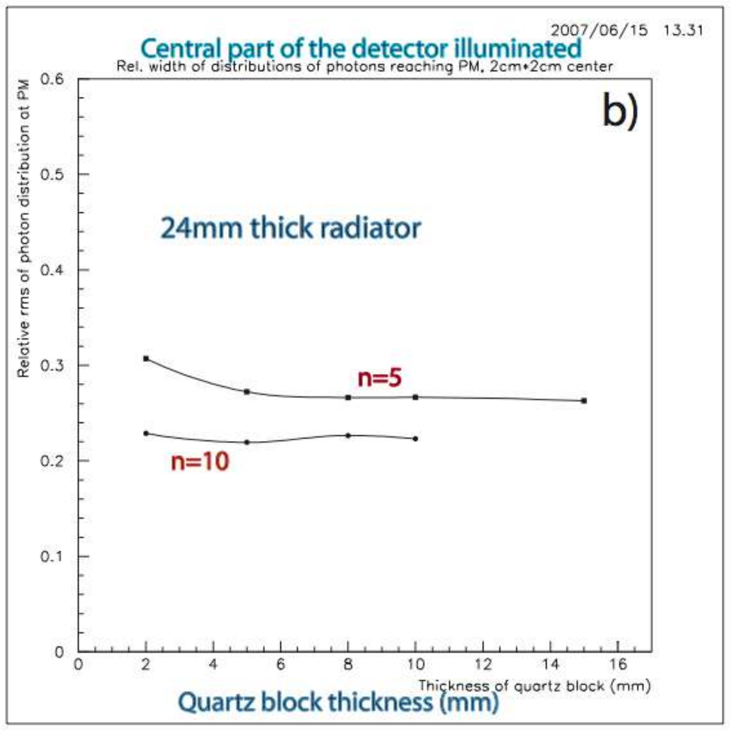


Stack detector simulations cont.

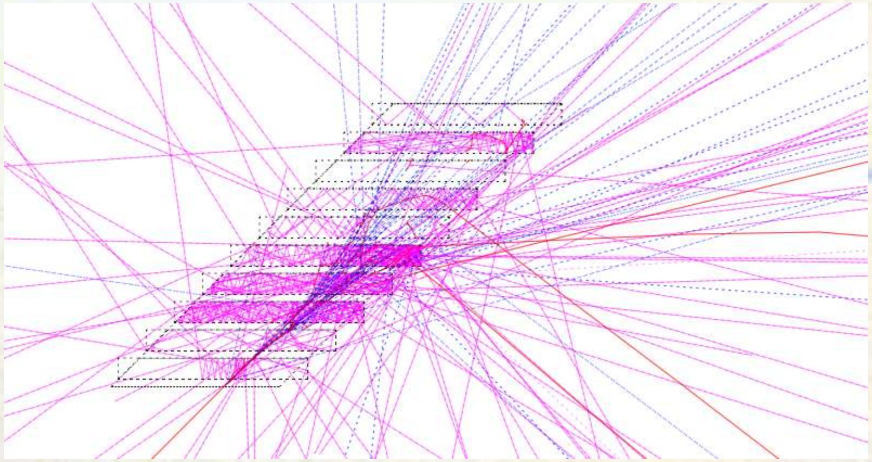
Relative width



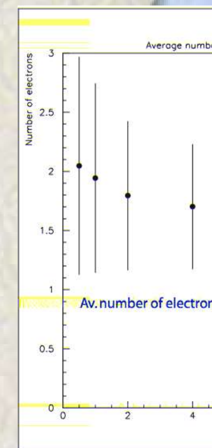
Relative width



Stray electrons

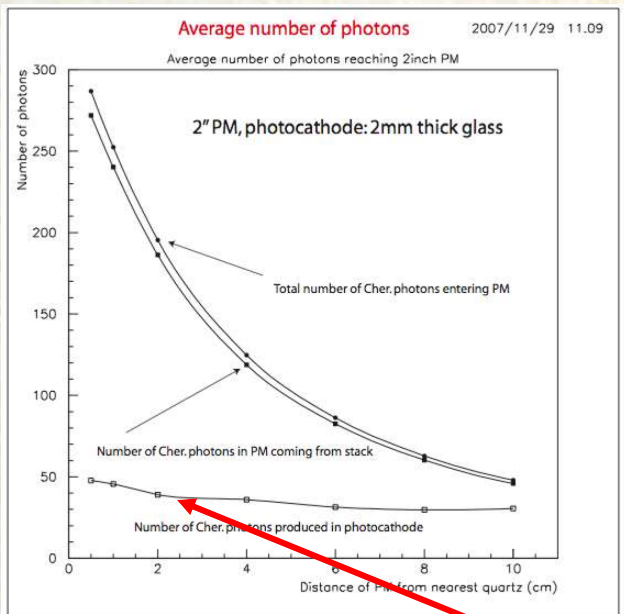


Number of electrons

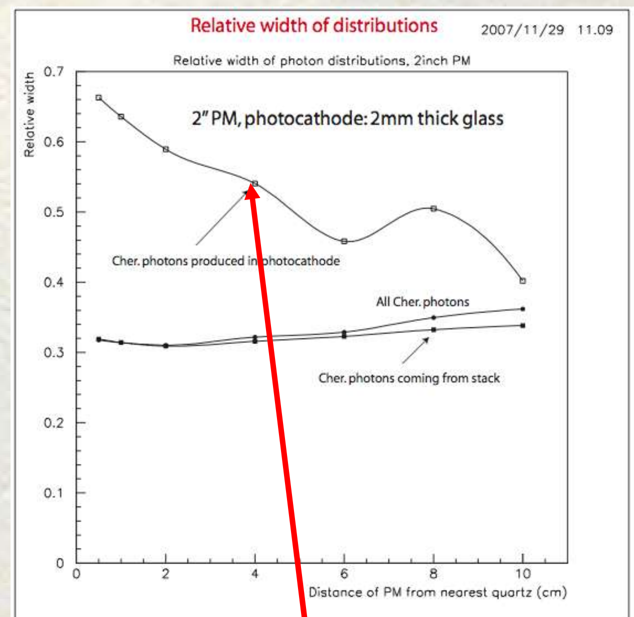


PM distance from the nearest quartz

Number of photons



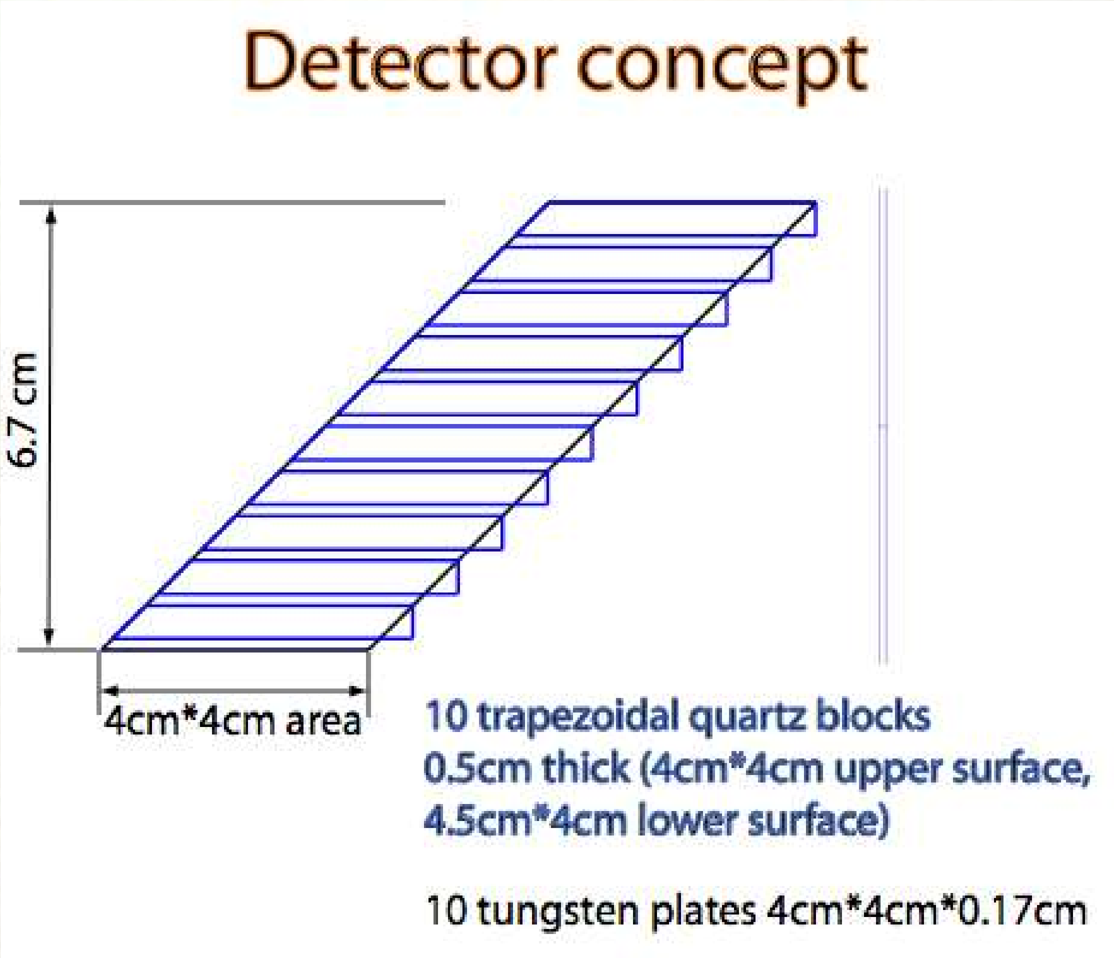
Relative width



PM distance from the nearest quartz

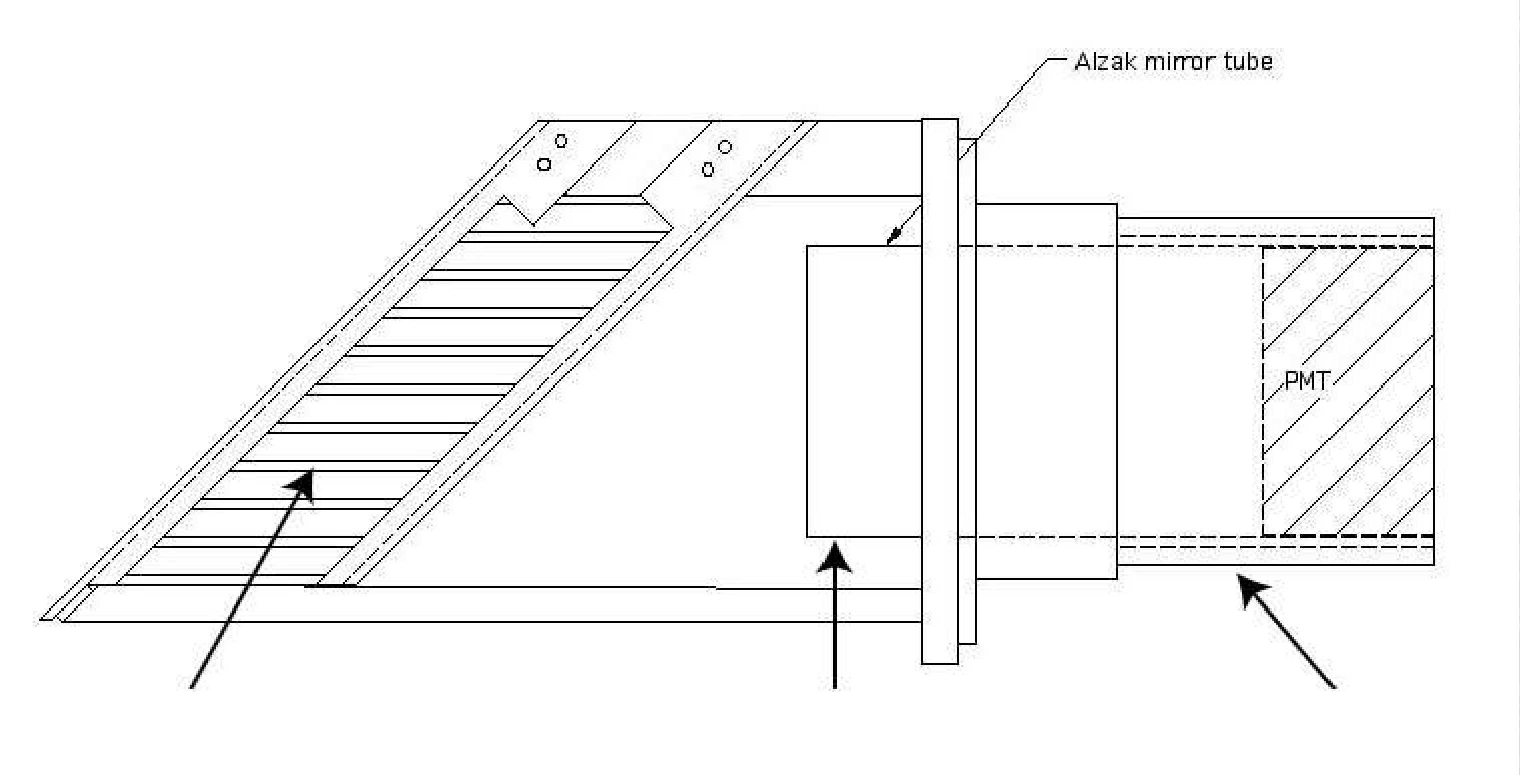
Cherenkov photons produced in PM glass

Concept



Detector concept
6.7 cm
4cm*4cm area
10 trapezoidal quartz blocks
0.5cm thick (4cm*4cm upper surface,
4.5cm*4cm lower surface)
10 tungsten plates 4cm*4cm*0.17cm

Stack detector - design

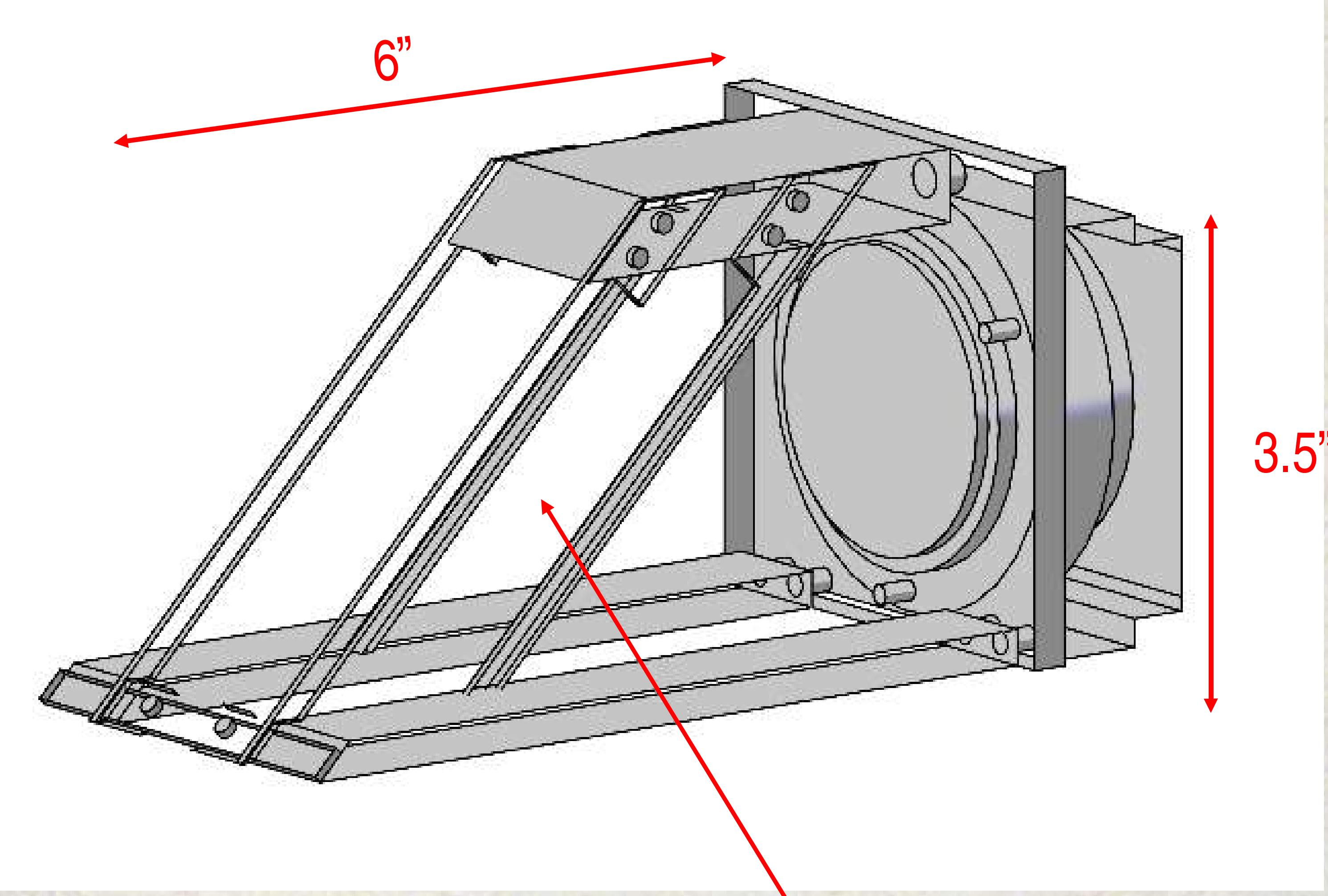


Tungsten/Quartz Stack

Alzak tube at -HV

Insulating PCV tube

Detector frame



Status

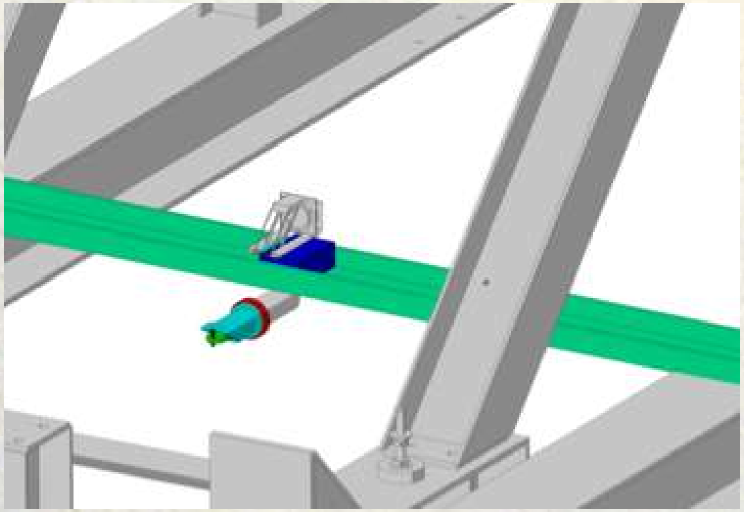
- Quartz blocks and PMs for both detectors are in place
- Tungsten radiator plates should be delivered in the first half of December
- Machining almost finished
- Tests with cosmic rays will be done in December and January

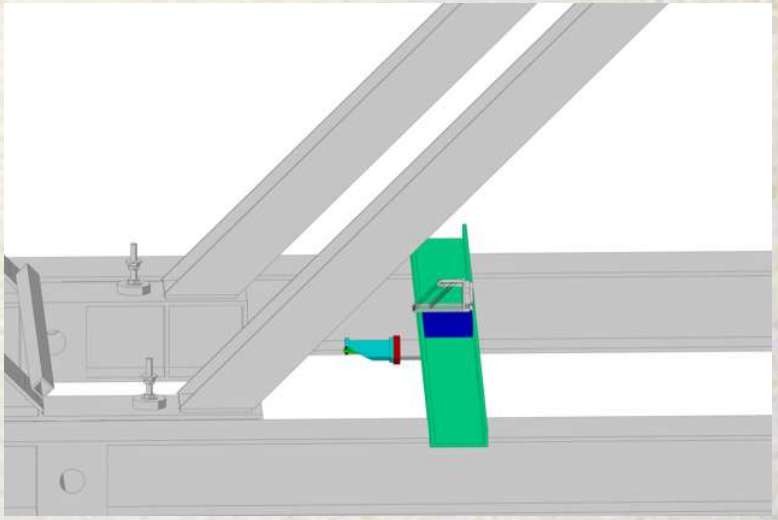
January tests

Goals:

- From measured detector output and known PM gain determine number of Cherenkov photons reaching PM - compare with simulations
- Detector spectra and resolution in counting and integrating modes
- PM background (stray electrons, neutrons, etc.)

HRS focal plane





Experimental conditions

E_b = 908MeV, ~10 μA, 100mg/cm^2 Ta target

Wire chamber, S0 trigger (removable)

Counting mode:

HRS@20^o, expected rate ~100Hz

Integrating mode:

HRS@12.5^o, expected rate ~50kHz ??

Activities

• we have to be able to observe PM signals in the counting house (at some moment we have to go back to standard configuration - access needed)
• we have to exchange quartz block in thin detector (tests will be done with 0.5cm and 1cm thick blocks)
• we have to blind PMs

At the beginning of run counting (low intensity) mode (HRS@20^o)

At the end of run integrating (high intensity) mode (HRS@12.5^o)

January Lumi Width Studies

Krishna Kumar

University of Massachusetts, Amherst

December 7, 2007

HAPPEXIII/PREX Collaboration Meeting

Must Do

- Optimize light input and current output
  - Set appropriate ND filters to limit photocathode current ~ 10 nA
  - Look at some PMT responses upstairs
  - Set appropriate HV settings to limit anode current ~ 50 uA
- Ensure PMT response is dominated by high energy scatters from target
  - Blinded tube tests (shielding needed?)
  - Dithering coefficients vs PMT number
- Study noise properties
  - Minimize pedestal noise
  - Widths vs rep. rate, oversampling rate
  - Widths vs beam current (10 uA, 50 uA)
  - Widths for different targets (C, Pb)

Like to Do

Activities on previous page should take of order 2-3 shifts

Take a break (do something else)

- Minimize statistical widths
  - Analyze data already collected
  - Find conditions for smallest possible width
  - Is oversampling same as faster flipping?
- Long asymmetry run on Pb target: (4 hours: ~ 0.1 - 0.2 ppm)
  - Is longitudinal asymmetry zero?
  - Is transverse asymmetry non-zero?
- Maximize for Transverse Asymmetry

1-2 shifts