CEDAR Project – Overview, Status

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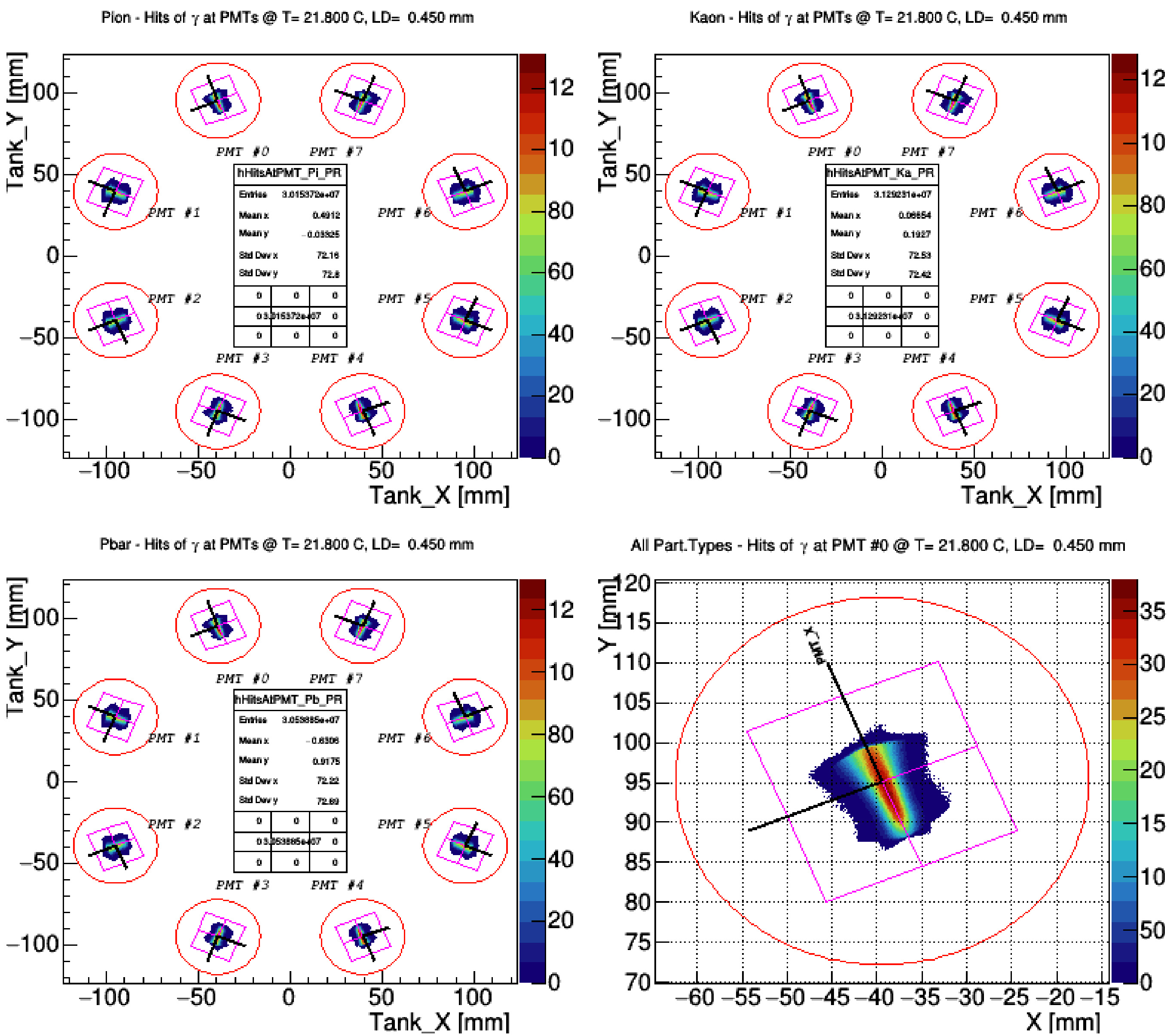
CEDAR meeting, 2017-05-31, Vidyo

Project Introduction

- Purpose of the project:
  - Modify CEDARS to withstand higher rate ($\approx 10^8$ particles/s)
- Project scope:
  - Photomultipliers
  - Thermal system
  - Monitoring of PMT gain stability
  - Readout (funding to be clarified)
- Who is involved:
  - Warsaw University of Technology (WUT)
  - INFN Torino
  - Academia Sinica Taipei
  - CERN (owner od detectors)

PMT Status

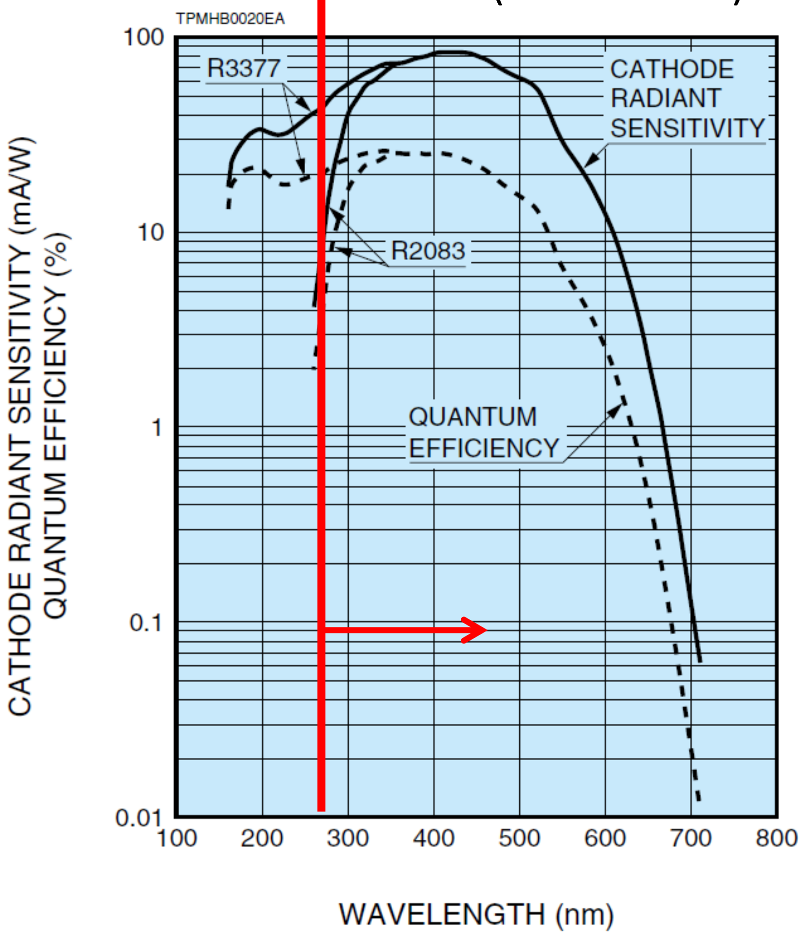


- Monte-Carlo done by Flavio
- Light spot is small, centered at the PMT
- Can use smaller PMT
  - Less dark hits
  - Better timing
  - Can use HQE photocathode
- Problem:
  - HQE PMT is multichannel one

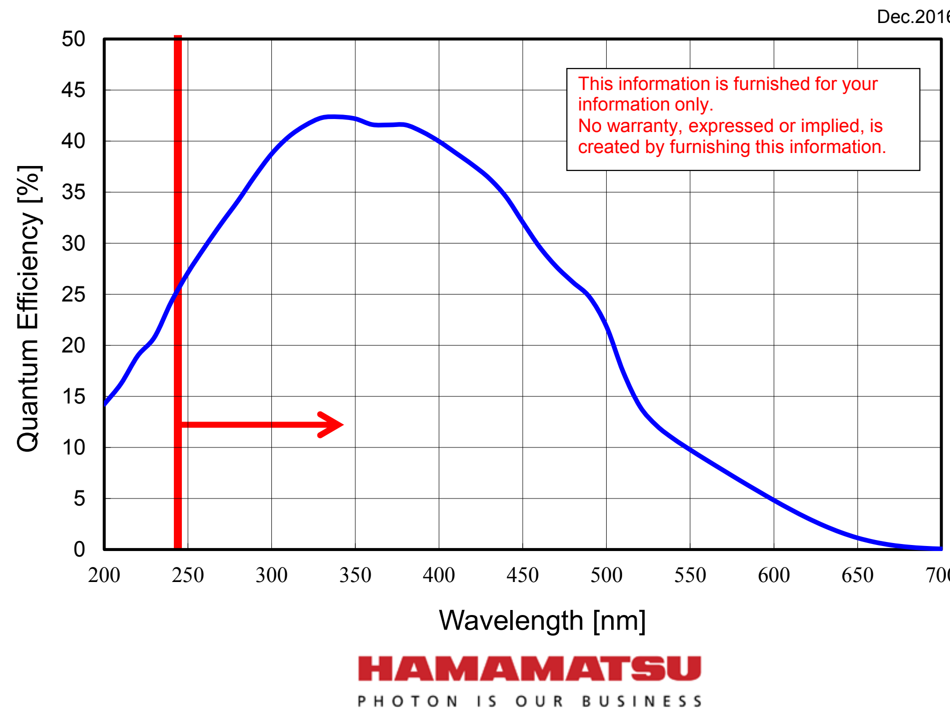
Plots from Flavio's talk

Bialkali vs Ultra-bialkali

R3377 (fast 2" PMT)



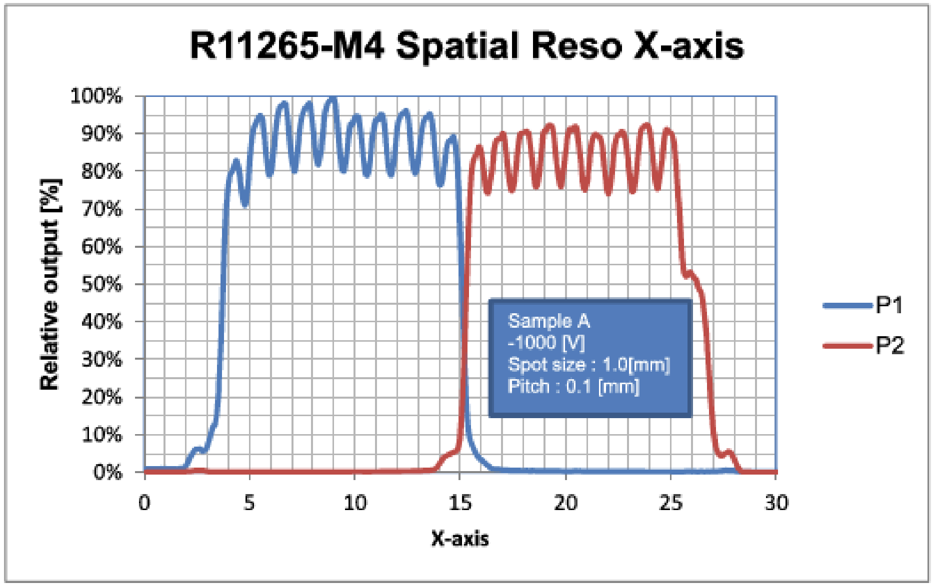
R11265-203 Quantum Efficiency

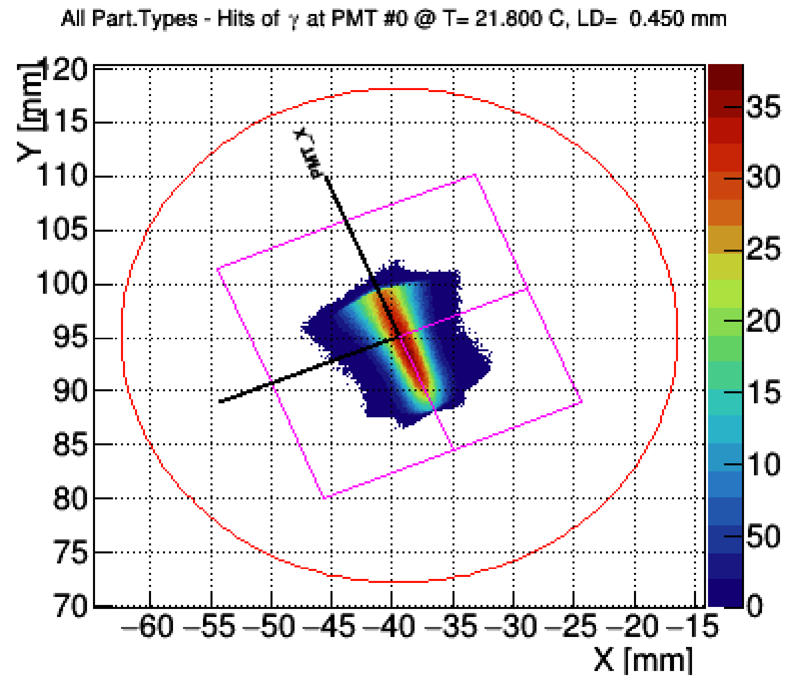


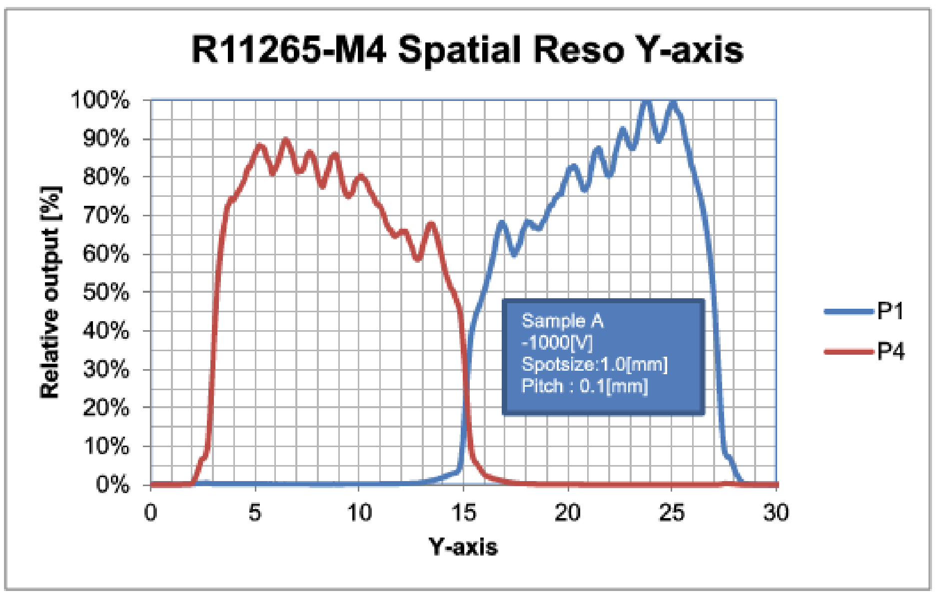
- CEDAR optics cut anything shorter than 240 nm
- UBA ~5% better at 250 nm, much better at visible spectrum

Thanks to Flavio for getting information from Hamamatsu

Problem with R11265-203





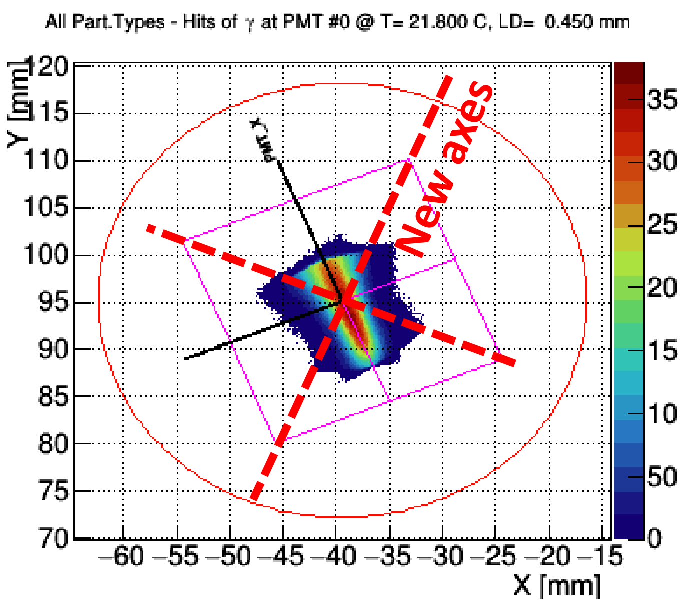


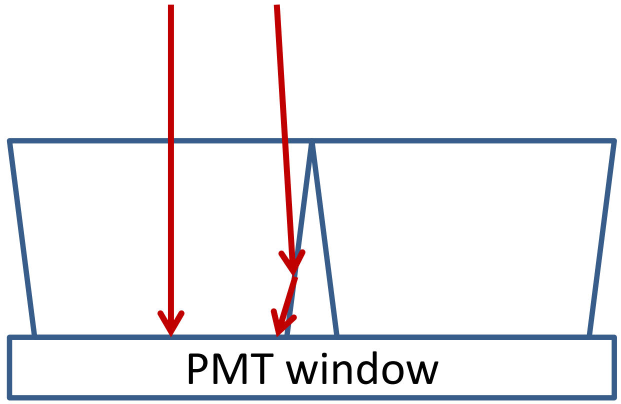
- Given shape of our light spot, we risk loosing significant portion of photons at channel boundaries

Information obtained by Flavio from Hamamatsu

Solutions?

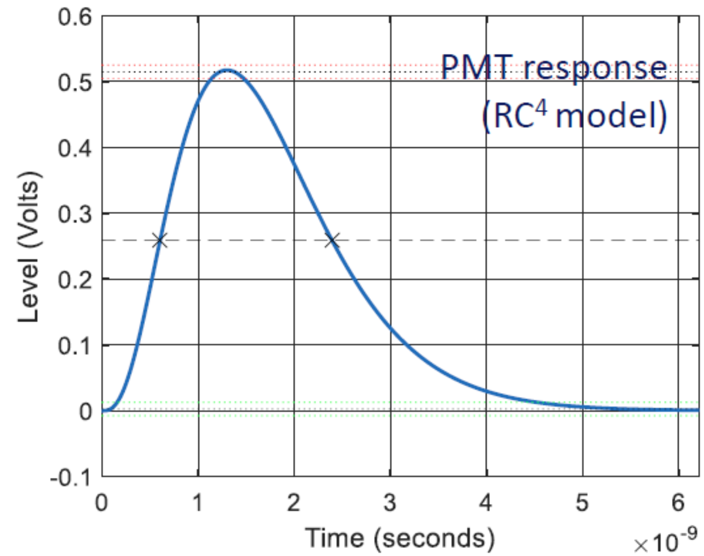
- Stick with R3377
  - Pro: no dip in collection efficiency at the center, simple solution
  - Con: bialkali photocathode, more expensive, more dark rate
- Options for R11265
  - Shift the PMT in one axis
  - Rotate by 45 degree – better, but still significant loss of photons
  - Ask Hamamatsu for possibility of single-anode potion – maybe problem is the collection at anode
  - Put PMT at different distance – check needed if light spot is broader
  - Employ light-guides to remove light from channel boundaries
    - Also check diffusers or possibility of applying etching to PMT window to get 'frosted surface'
  - Check whether the loss is the same when PMT is magnetically shielded

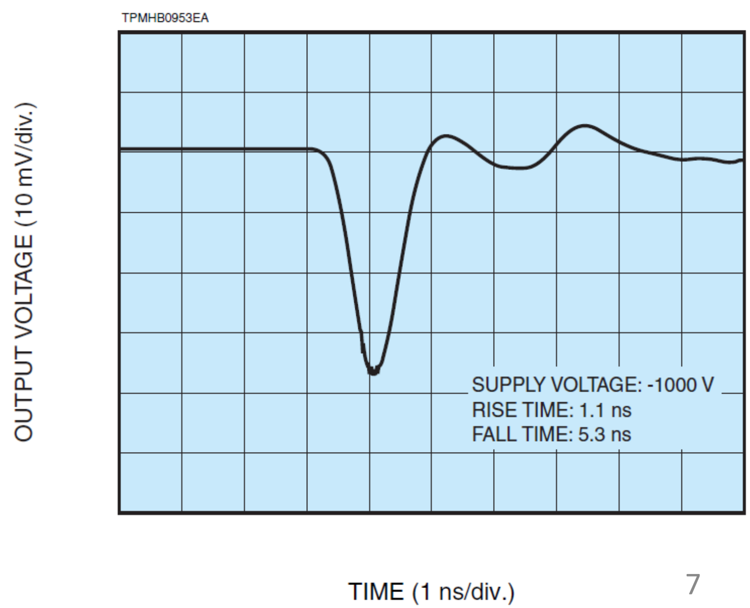




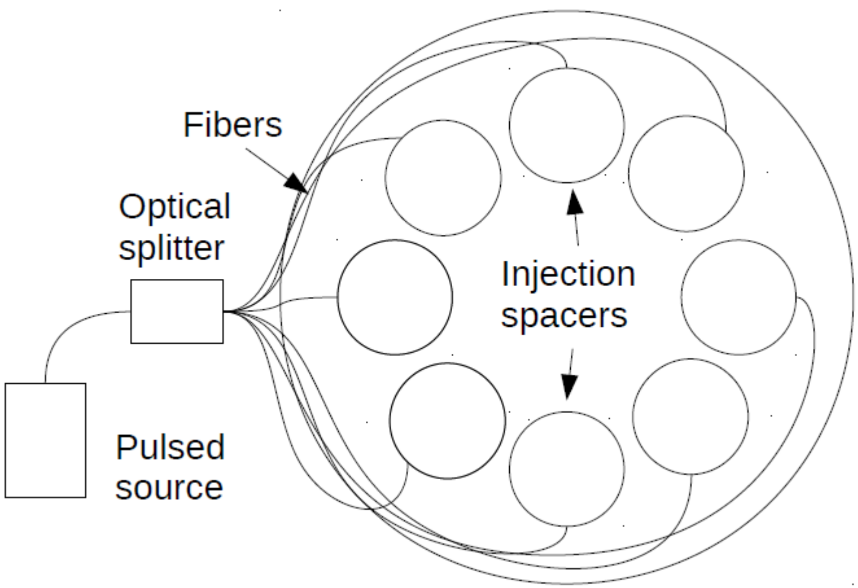
Readout

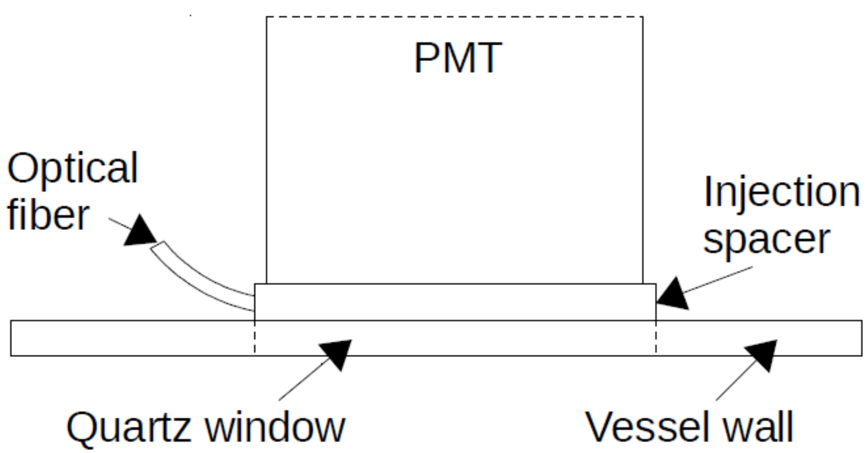
- Readout
  - We may be able to go with discriminator + TDC rather than sampling system (both PMT options
- For R3377, pulse rise time is 0.7 ns
  - Assuming RC^4 model of PMT response, this gives FWHM = 1.7 ns
- R11265 has rise time of 1.1 ns, FWHM ≈ 2.7 ns





PMT Gain Monitoring

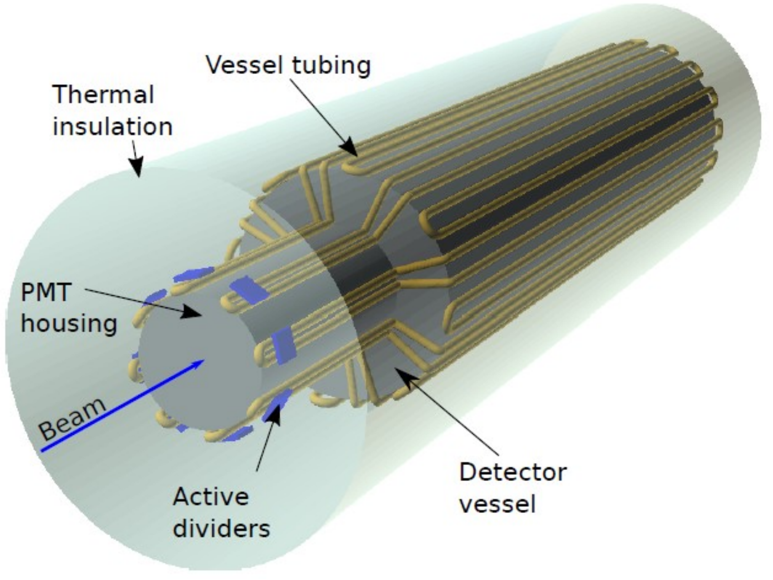


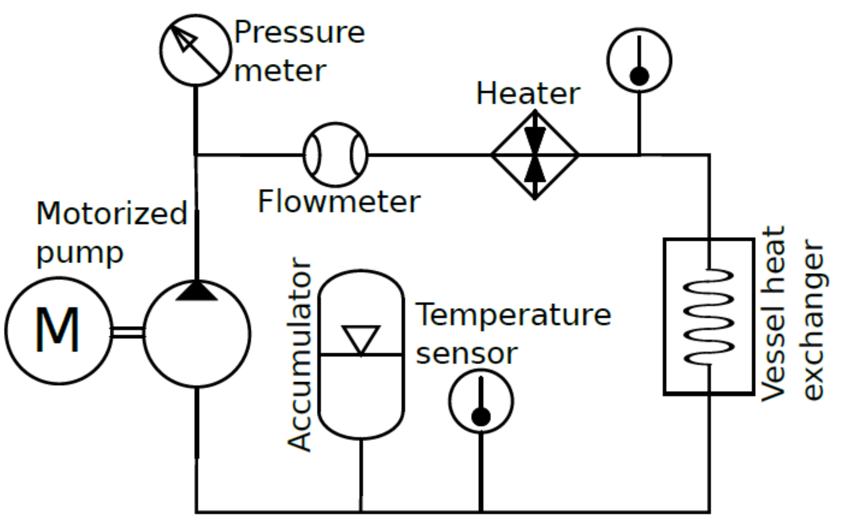


- Measure PMT gain using light pulses of constant intensity, in off-spill time
- Components:
  - Pulsed light source – calibrated 470nm LED flasher, same as used in ECAL0
  - Multimode fiber splitter
  - Injection spacers for light delivery to PMTs.

Contact: Robert Kurjata, WUT

Thermal system





- Equalize temperature using water & copper pipes
  - Proposed in original concept, but too expensive then
  - Now affordable & reliable
- To be investigated by CERN:
  - Run CEDAR at higher than ambient temperature

Contact: Robert Kurjata, WUT