TOWARDS PHOTOSENSOR REQUIREMENTS AND SPECIFICATIONS

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Requirements (Derived)

- It should be possible to actively gang upto 48 SiPMs per readout channel so as to allow for adequate photon system efficiency for detection and triggering of low energy neutrinos.
- The SiPM characteristics along with the associated FEE should allow for single photoelectron identification for detection of low energy neutrinos interacting close to the CPAs and for reliable calibration and threshold setting.
- For a given threshold, the SiPM DCR should not dominate the background rate
- The threshold needed for the above requirement should be less than the one needed to satisfy the overall efficiency requirement of the PD system

Requirements (Derived)

- The SiPMs and the associated FEE must provide a timing resolution no worse than 10 nsec
- The SiPM should be able to meet the above requirements and function within specifications for atleast 10 years in a LAr environment. It should be assumed that the sensor will see atleast 20 room temperature to LAr temperature cycles during this time.

Quantity

- ~200 x 1500 = 300000 devices
- The quantity required places constraints on the vendors that can be used
- On the flip side the quantity required gives us some customization ability within budgetary constraints
- The two vendors that can handle this scale of production and would be willing to carry out customization R&D: FBK & Hamamatsu

Form Factor

- Will be driven largely by the mechanical design
- Without going for custom dies, 6mm x 6mm devices sound reasonable and consistent with the current mechanical design
- Ask for PCB mounted uniquely number devices from vendor?

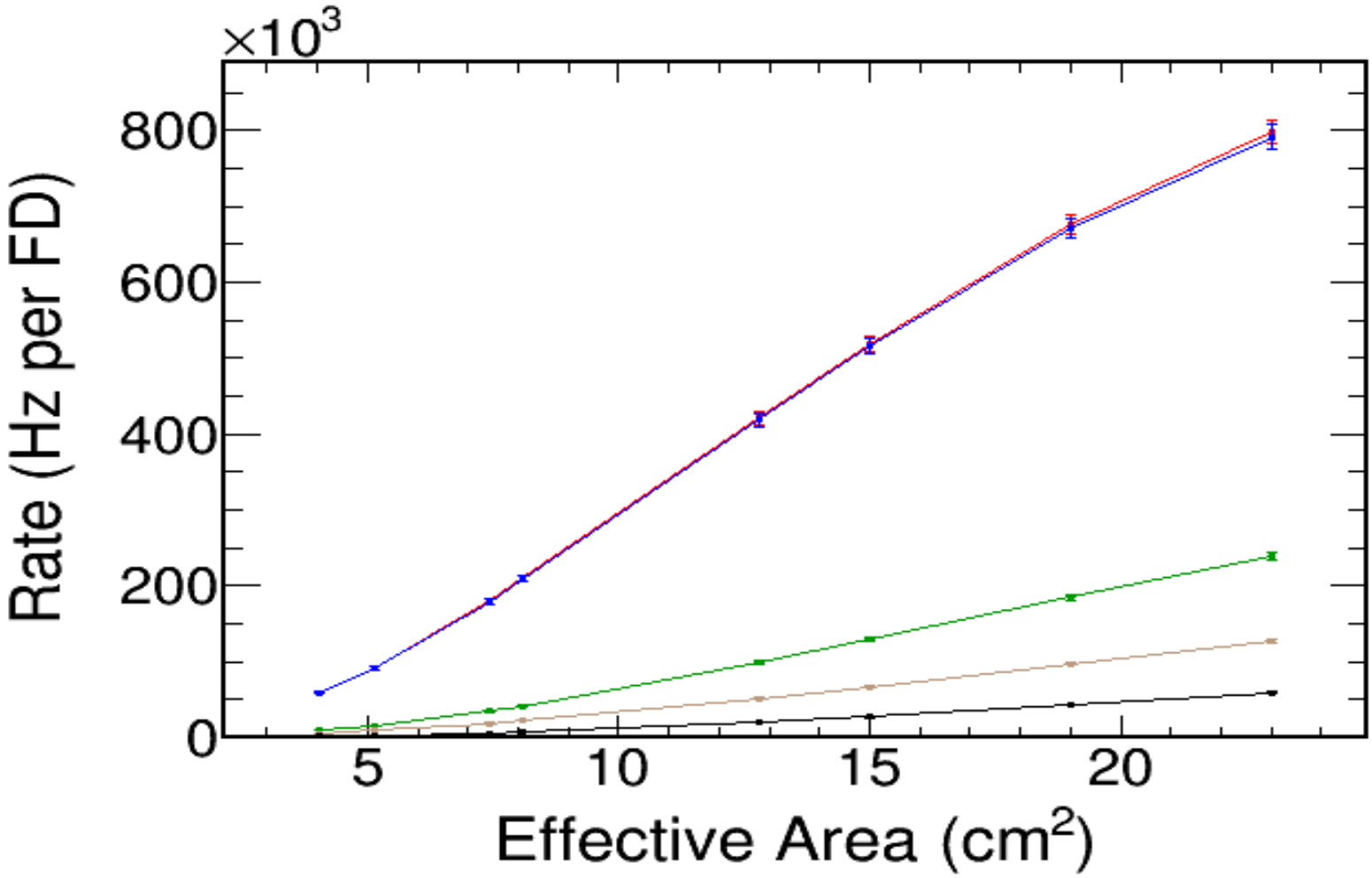
Dynamic Range

- Does not seem to be a stringent constraint
- Very small correction with 25-30% occupancy
- Assuming 20 PE/MeV and 2000 MeV going into one readout channel, even 100 micron pixel devices would be fine
- 75 micron pixel size may be optimal
- This may be a bigger issue for the electronics

Bias & Bias Dispersion

- < 50 V (cold)
- Ganging places constraints on operating voltage range of the devices
- Within ± 0.1 V per batch
- Batch ~ 4-5k devices
- Within ± 1 V for the full production

Argon 39 Background Rate



DCR

- Assuming ~1MHz for a 10kT detector, the background rate is roughly 200 Hz
- It would be good to keep SiPM DCR < 100 Hz
- DCR < 0.06 Hz/mm^2

Capacitance (Terminal)

- Not > 0.03 nF/mm^2
- Can we get this lower?

PDE

- > 35% at nominal operating voltage
- At what wavelength?
- PDE vs wavelength as a function of temperature?

X-talk and after-pulsing

- Devices with trench technology
- < 5% at operating voltage
- Need to determine the appropriate time-scale for afterpulsing specification

Summary

- Need to expand and sharpen these requirements and specification to both interact with the vendors and address our review committees