Pricing SiPM Options

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Outline

- The baseline SiPM array, Hamamatsu 13361-2050AE-04 SiPM, is discontinued, requiring us to choose and price-out a new baseline option
- The 13361-2050AE-04 was a 4x4 array with 2 mm x 2 mm individual SiPMs
- I've started to price out different options from several manufacturers
- Note: I've relied too much on readily available prices on Mouser, Newark, Digi-key. But scale of orders necessitates direct quote from manufacturers
- I've looked into two classes of options:
  - 1200 4x4 arrays
  - 19200 individual SiPMs
- Spreadsheet link that I'll continue to update

Array options

- All manufacturers provide a 4x4 arrays with 3 mm x 3 mm SiPMs

Manufacturer	Unit cost (order size)	Total (1200 arrays)	
Hamamatsu	$332.50 (1)	$399,000.00	Quote
ON (SensL) Series-J	$636.21 (10+)	$763,452.00	Mouser
ON (SensL) Series-C	$636.21 (10+)	$763,452.00	Mouser
Broadcom NUV	$325.91 (25+)	$391,092.00	Mouser
KETEK	$593.04 (1)	$711,648.00	Website
Avasid NUV/RGB	$264.2828 (1200)	$317,139.36	From Avasid, shipping+customs not included

Single SiPM options

- We would have to design and assemble our own SiPM boards

Manufacturer	Unit cost (order size)	Total (1200 arrays)	
Hamamatsu	coming	coming	
ON Series-J (3x3 mm)	$15.27 (3k reel)	$330,498.00	Mouser
ON Series-C (3x3 mm)	$12.60 (3k reel)	$282,438.00	Mouser
ON Series-C (1x1 mm)	$11.81 (3k reel)	$268,218.00	Mouser
Broadcom NUV (3x3 mm)	$13.72 (1k reel)	$263,734.08	Mouser
Avasid NUV/RGB (3x3 mm)	$8.42 (19,200)	**$177,759.61**	From Avasid, shipping+customs not included

Summary

- Because of large order size, I need direct quotes from manufacturers to be sure of price -- but it's probably close to Avasid + custom fees
- It seems we can save money by buying individual SiPMs and assembling our own arrays
  - But need to factor in cost of engineering and then assembling boards
  - Example: Avasid difference is 90K
  - Quick estimate: assume a well trained undergraduate can assemble 4 boards per hour (lay out components onto PCB+solder and then put into oven):
    1200 boards/4 boards per hour/8 hours per workday: 37.5 workdays
    Tufts undergrad wage: 15/hour -> 18K
  - Engineering: 20K-40K?
  - Materials: other components, PCB: 10K?
  - Savings around 20-50k …

Backups

Detectors

- Design is MINOS/mu2e-like (co-extruded polystyrene)
- Each plane (of 100) has four panels (192 channels)
- Each panel is a self-contained box containing
  - 48 slats of scintillator 3.5 cm wide with Y11 wavelength-shifting fiber
  - SiPM, Front End-ADCs (based on Texas Instruments AFE5807 chip) and associated electronics
- Panels (which are rectangular) are tilted ±3° in alternating layers
  - Gets us ~45 cm resolution in y-direction
  - An inexpensive choice – but will be subject to pileup issues at 2.4 MW (Year 6).