

Scintillator Summary, Issues, & Plans

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- Summarize
 - > Costing of the revised M64 design
 - > Costing of various readout options
 - > Cost of liquid version (with an APD readout)
 - > Containerized version (with an APD readout)
 - Issues to address
 - Initiatives & goals for July (or before)

Cost of M64 top-only readout

		unit	per	quant	total (\$M)
2.1.1	EDIA	\$ 1,000,000.00		1.00	\$ 1.00
2.1.2	particle board	\$ 0.14	lbs	90,478,080.00	\$ 12.77
2.1.3	framing	\$ 2.99	8ft board	244,800.00	\$ 0.73
2.1.4	bookends	\$ 42,000.00	bookend	36.00	\$ 1.51
2.2.1.1	EDIA	\$ 700,000.00		1.00	\$ 0.70
2.2.1.2	strips	\$ 3.69	m	8,486,400.00	\$ 31.31
2.2.2	wls fiber	\$ 0.40	m	18,387,200.00	\$ 7.41
2.2.3.1	clear fiber	\$ 0.14	m	1,414,400.00	\$ 0.20
2.2.3.2	parts	\$ 9.00	m	22,100.00	\$ 0.20
2.2.3.3	labor	\$ 44.00	m	22,100.00	\$ 0.97
2.2.4.1	skin	\$ 216.00	mod	22,100.00	\$ 4.77
2.2.4.2	manifold	\$ 200.00	mod	22,100.00	\$ 4.42
2.2.4.3	connector	\$ 5.00	mod	22,100.00	\$ 0.11
2.2.4.4	comsumables	\$ 200.00	mod	22,100.00	\$ 4.42
2.2.5	factory set up	\$ 500,000.00	factory	4.00	\$ 2.00
2.2.6	factory labor	\$ 400.00	module	22,100.00	\$ 8.84
2.2.7	module shipping	\$ 75.00	module	22,100.00	\$ 1.66
2.3.1	PMTs	\$ 11.00	PMT	707,200.00	\$ 7.78
2.3.2	Readout boxes	\$ 250.00	pmt	11,050.00	\$ 2.76
2.3.3	Frontend chips	\$ 5.30	ch	707,200.00	\$ 3.75
2.3.4	HV	\$ 100.00	pmt	11,050.00	\$ 1.11
2.3.5	Fab/base	\$ 225.00	pmt	11,050.00	\$ 2.49
2.3.6	DAQ	\$ 2,000,000.00		1.00	\$ 2.00
2.3.7	Control & monitoring	\$ 500,000.00		1.00	\$ 0.50
2.4.1	set up SWF	\$ 500,000.00		1.00	\$ 0.50
2.4.2	plane SWF	\$ 1,080,000.00	yr	3.00	\$ 3.24
2.4.3	support & supervision SWF	\$ 360,000.00	yr	3.00	\$ 1.08
2.4.4	receiving/staging SWF	\$ 180,000.00	yr	3.00	\$ 0.54
2.4.5	installation oversight	\$ 50,000.00	yr	3.00	\$ 0.15
2.5	building	\$ 20,000,000.00		1.50	\$ 30.00
2.6	outfitting	\$ 2,000,000.00		1.00	\$ 2.00
total					\$ 140.91

Same thing rolled up

- First, can reproduce Brajesh's cost to <<5%
- Few details different
 - > Abused PMT pricing quote - too much quantity discount
 - > Lower outfitting/structure cost
 - > Added installation labor estimate
 - > Few other small details
- Add a tops down contingency estimate
- Add in estimate of G&A only partially included below some of my is surely double counting - maybe 50%

top-only scint - brajesh for everything but the installation/building, pmt cost, fi

		\$M	G&A	cont %	Cont
2.1	absorber & structure	\$ 16.01	\$ 0.60	33%	\$ 5.28
2.2.1	scintillator	\$ 32.01	\$ 0.70	26%	\$ 8.18
2.2.2	WLS fiber	\$ 7.41	\$ 0.60	25%	\$ 1.85
2.2.3/.4/.5	modules parts	\$ 15.09	\$ 6.04	24%	\$ 3.68
2.2.6/.7/.8	modules labor/shipping	\$ 12.50	\$ 5.00	46%	\$ 5.70
2.3.1	photodetector	\$ 7.78	\$ 0.60	25%	\$ 1.94
2.3.2	FEE/base/housing/HV	\$ 10.10	\$ 4.04	34%	\$ 3.48
2.3.x	other elec	\$ 2.50	\$ 1.00	75%	\$ 1.88
2.4	installation	\$ 5.51	\$ 1.49	66%	\$ 3.64
2.5	building	\$ 30.00	\$ 8.10	25%	\$ 7.50
2.6	outfitting	\$ 2.00	\$ 0.54	150%	\$ 3.00
2.0	total	\$ 140.91	\$ 28.70	33%	\$ 46.12

Put in Rusack/Yarema Electronics Design/Packaging

- Reduce electronics cost from PPD design saves \$5M
- Reduced photodetector cost for APD save \$5M
- Costs now driven by
 - > Bulk scintillator
 - > Module construction
 - > Building
- Cost per channel is almost trivial

		\$M
2.1	absorber & structure	\$ 16.01
2.2.1	scintillator	\$ 32.01
2.2.2	WLS fiber	\$ 7.41
2.2.3/.4/.5	modules parts	\$ 15.09
2.2.6/.7/.8	modules labor/shipping	\$ 12.50
2.3.1	photodetector	\$ 2.76
2.3.2	FEE/base/housing/HV	\$ 5.36
2.3.x	other elec	\$ 2.50
2.4	installation	\$ 5.51
2.5	building	\$ 30.00
2.6	outfitting	\$ 2.00
2.0	total	\$131.15

Comments on APD value in cost reduction

- Cost is lower but also relaxes the light yield requirements
 - > 8x the QE of a M64
 - > Up to 33% lower light allowed in preamp design
 - > No impact of EM resolution by Poisson statistics - the light yield rules are different and need to be quantified
 - > Can:
 - Reduce the bulk scintillator volume and/or
 - Make longer modules and hence narrower building
 - > Readout costs not important so shorter modules only impact parts, labor costs, and fiducial
 - Shorter modules can reduce bulk scintillator since more light
 - Containers are conceivable
- Exact method to best realize cost savings not fully analyzed
 - > Can see a number of ways to save \$10M+
 - > Only question becomes which is optimal

Liquid Scintillator - Plug n Play Use APD for Direct Comparison

- Saves in module skins
- Saves in bulk scintillator cost
- Saves some in modules components
- About \$35M less than equivalent solid scintillator

		\$M
2.1	absorber & structure	\$ 16.01
2.2.1	scintillator	\$ 11.98
2.2.2	WLS fiber	\$ 7.41
2.2.3/.4/.5	modules parts	\$ 11.84
2.2.6/.7/.8	modules labor/shipping	\$ 3.44
2.3.1	photodetector	\$ 1.77
2.3.2	FEE/base/housing/HV	\$ 3.63
2.3.x	other elec	\$ 2.50
2.4	installation	\$ 5.51
2.5	building	\$ 30.00
2.6	outfitting	\$ 2.00
2.0	total	\$ 96.09

Containerized (use LS for increments)

- Small increment in cost but decreased building costs
- Largely same price because module building cost is small and per channel costs are very low
- Plastic would be similar but higher module component and fabrication costs
 - > Not completely unreasonable
 - > Surprised me!

		\$M
2.1	absorber & structure	\$ 13.77
2.2.1	scintillator	\$ 11.98
2.2.2	WLS fiber	\$ 7.41
2.2.3/.4/.5	modules parts	\$ 19.71
2.2.6/.7/.8	modules labor/shipping	\$ 3.44
2.3.1	photodetector	\$ 8.84
2.3.2	FEE/base/housing/HV	\$ 11.26
2.3.x	other elec	\$ 3.74
2.4	installation	\$ 1.77
2.5	building	\$ 20.00
2.6	outfitting	\$ 2.00
2.0	total	\$ 103.90

Scintillator Issues & Plans

- Continue Physics Optimization
 - > Leslie shows $X_0/3$ - 30% impact for 1D readout
 - Undoubtedly makes the RPC and scintillator solutions different
 - > Means there is more room for optimization in sampling and strip width (probably...)
 - > Sampling clearly the cost driver
 - > Is 45Deg OK?
 - > How to best optimize sampling in high QE detectors
 - > FNAL group continues study, UMN group continues their new studies (Mualem, Petyt, Litchfield)
 - > Early study by NU showed some similar reach with similar sampling to this design (New Initiatives - May,02)

More things

- Results from the APD test stand in S/N, light yields
- Tune light output for high QE device
 - > Reduce bulk scintillator costs?
 - > Model with UMN light yield MC (validated on MINOS)
- Pursue options for reducing module component and fabrication costs due to 10x more units
- Refine and continue to evaluate install costs
- Include new information on building scaling and fiducial effects in optimization at constant reach