
Clear Fiber Readout Option

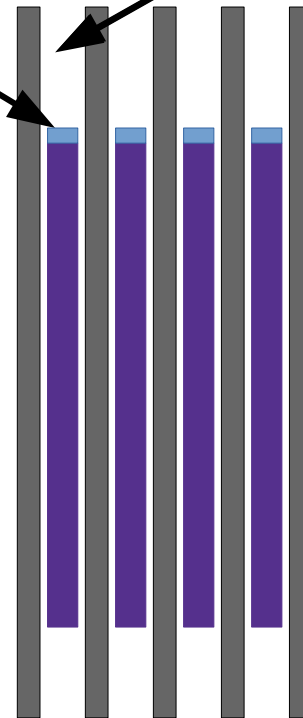
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DUNE TMS Meeting
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The “problem”

SiPM, amplifier, digitiser, all mounted on the modules here

This gap is too thin and too long to reach the electronics, should something fail



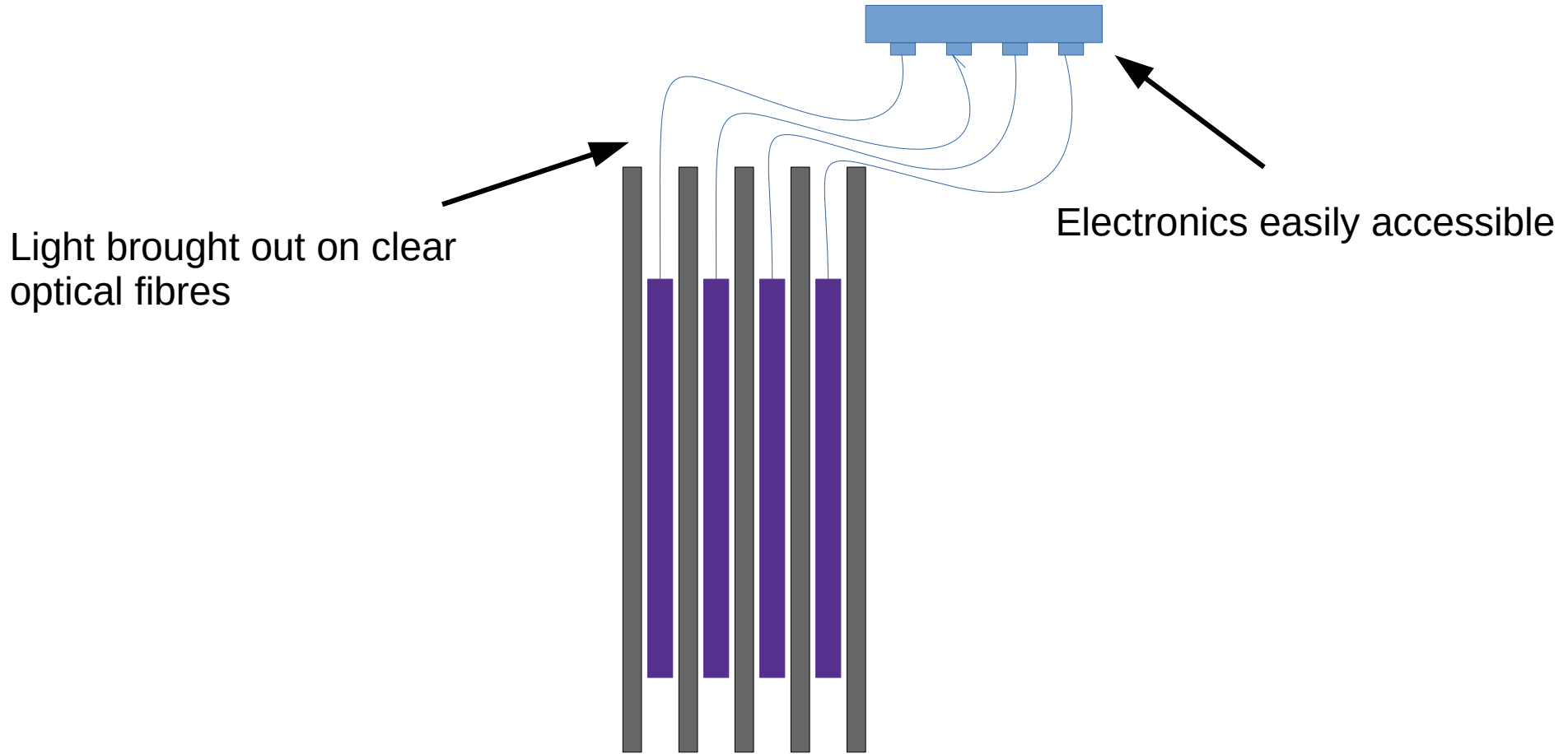
Scintillator

Steel

Etc... I won't be drawing all of the layers – you get the point



The “solution”



Light brought out on clear optical fibres

Electronics easily accessible



MINERvA Experience

Paraphrasing Steve Manly

- Custom-made clear fibre cables
- Custom-made connectors
- 8 fibres to a cable
- 8 cables (64 fibres) to one multi-channel PMT
- 30,000 channels in total
- Total time taken to produce – 154 weeks (including R&D time)



Scaling MINERvA costs

- MINERvA costs, scaled to channel count:
 - \$1.1M - \$1.4M for construction (2007 \$)
 - Inflation adjusted is **\$1.6M - \$2M**
- **R&D cost was \$0.7M (extra)**
 - We may assume this is reduced, but we still need to prototype...
 - Like, we definitely need to prototype



Some unknowns

- Not everything inflates at the same rate
 - Working on a comparison of actual fibre costs (assuming the same Kuraray fibres)
 - Also, could we get by with lower-quality fibres? (most of the loss is in the connection, not the fibre)
- Single-channel SiPMs vs multi-channel PMTs
 - Probably don't need to jumble adjacent channels (assume we'll get minimal cross-talk)
 - Flexibility in bundling
 - Could lead to some cost reduction, but I can't see it being game-changing



Commercial options?

- Tom LeCompte got a quote for \$2M
 - This doesn't seem that far off from doing it ourselves...
 - From a military contractor
- What are our real fiber specs?
 - If we can't see Bragg peaks event-by-event, then our requirements might be reduced?



Plain old telecoms?

- Can we use regular telecom fiber?
 - Probably not, it's (usually) too thin
 - i.e. 0.1mm not 1mm...
- Can a telecom company turn kuraray fiber into nice cables for us?
- Probably still need custom connectors at the SiPM end
- Example: 24-count, 5m cable for \$150, quad connector costs \$3
 - \$200k ish
 - Not clear what fraction of this cost is the fibre itself



Colour-coded options available too



Bottom Line

- “Doing what MINERvA did” is surprisingly expensive
 - Although, actual fibre cost comparison is needed
- Not obvious that commercial options would work, but they might
 - Need to understand requirements better
 - Unlikely to come in at under 300k, highly likely more



Other notes from MINERvA

- Best if connectors only attach one way
 - Otherwise you get flipped channels
- Fewer connectors is (probably) better
- You definitely want to prototype

