

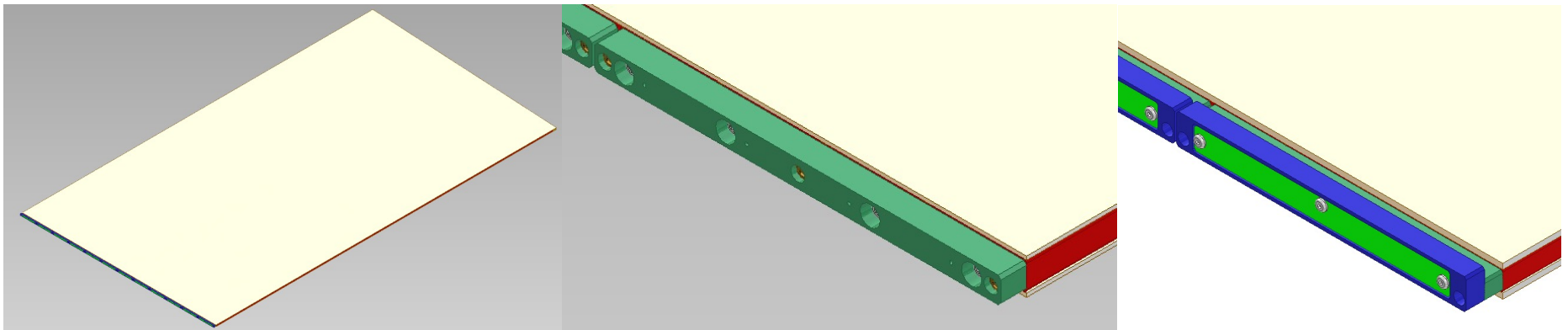
# TMS module prototyping at ANL

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[Work mostly done by Jeff White, Vic Guarino, Scott Paremba (design);  
Steve Kuhlmann, Frank Skrzecz, Tom Lecompte (prototyping)]

# Assumptions: module design described in 'TMS design report' version 14 (10/7/2022)

- 48 extruded scintillator bars (3.5cm x 1cm x 300cm) are glued side by side between two 'thin' AL plates to form a single layer 'plane'/module
- Each bar has a WLS fiber running through the entire length; 4 bars are glued together first to form a 'unit'/quad-counter
- One end of the quad-counter is fitted with a fiber guide bar (FGB)
- On top of FGB, there will be a mechanical unit (SiPM Mounting Block/SMB?) that hosts the SiPMs and the first stage of readout board (counter mother board/CMB?: supply SiPM operating conditions, a few basic functions and a connector)
- Next stage of readout (FEB?) will be outside the gap/on top of the stack



# Assumptions: module assembly steps

- Glue group of scintillator bars together (quad-counters) ✓
- Saw cut scintillator group (quad-counter) to length ✓
- Prepare end of 'group' for mounting FGB ✓
- Install fibers and FGB ✓
- Flycut to polish fiber ends
- Test the fibers (and the whole unit?) in completed 'group'/quad-counter
- Glue quad-counters and wedge plate to the bottom AL sheet
- Glue top AL sheet to quad-counters and wedge plate
- Install SMB + SiPMs + CMB ✓
- Final light tight measures
- Quality assurance tests

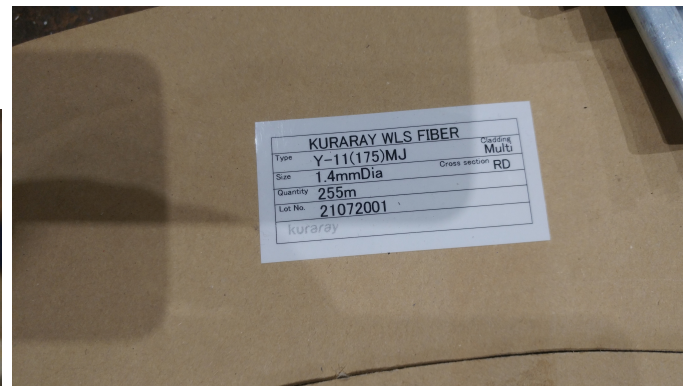
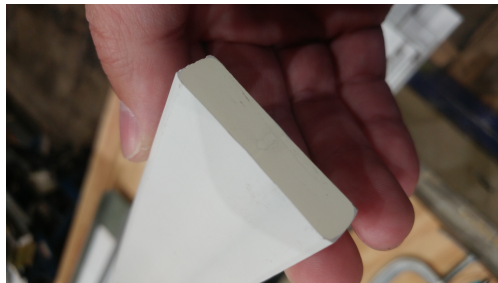
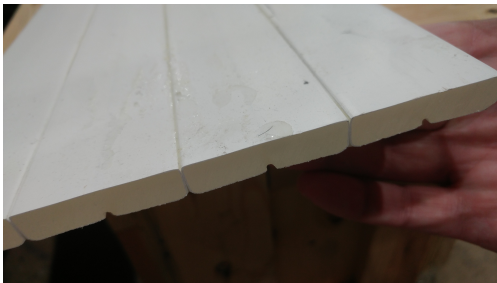
***[Heavily referenced Mu2e CRV module production experience]***

- [✓ : some level of prototyping has been done; tooling was developed along the way]



# Material available for prototyping

- ~36 new strips, 40mm x 10mm x 3m, with Mu2e-like ~2x4mm hole in middle
  - ~103 Minos strips, 41mm x 10mm x 4m, with 1.2mm grooves
  - ~58 T2K strips, 40mm x 10mm x 1.5m, with 2008 attempt at hole
  - ~255m of 1.4mm diameter Kuraray WLS fiber: Y-11(175) multi-clad (K27 dopant)
  - ~5m of scrap 1.2mm Kuraray fiber from 1999
  - [some are used in prototyping, exact numbers are not tracked]
- Some mu2e SiPM Mounting Block (SMB) assemblies. Each contains:
    - 1 SMB
    - 4 SiPMs
    - 1 Counter Mother Board (CMB)





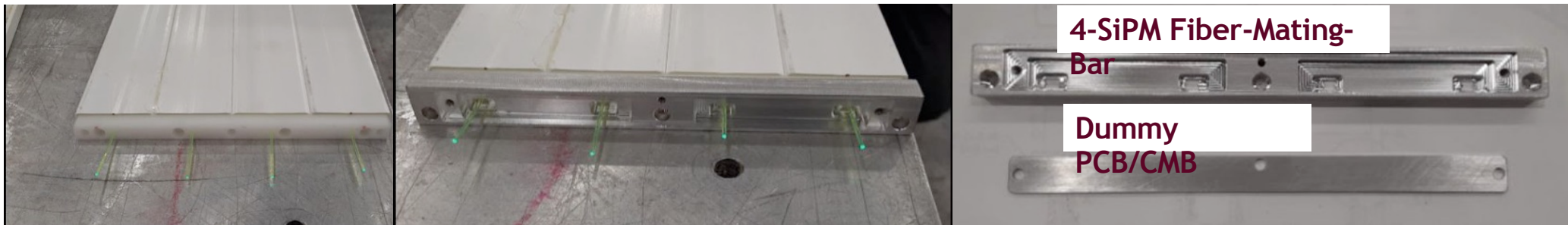
# Prototyping of quad-counter gluing

- Multiple length tried: 0.5m → 1.5m → 3m
- Developed gluing technique and fixture
- Cut quad-counter to length
- Fixture to handle/transport full length quad-counter (fiberglass U channel)



# Prototyping work on the quad-counter end

- Threading WLS fibers
- Prepare quad-counter end for FGB
- FBG prototype
- SiPM fiber-mating-bar/SiPM Mounting Block prototype
- Some work on trying to couple Mu2e SMB to quad-counter (not finished yet)



## Next steps

- Try out gluing top/bottom AL plates (3m x ? [width])
- Try out handling 3m long (partial) module [feedback to module design]
- Couple quad-counter to (Mu2e?) readout, try out light tightness methods
  - Help developing quad-counter testing method
- Try out other module design ideas, help to converge/finalize (soon)
  - Some module design aspects are couple with readout design
- Prototyping and tooling development for full module
- Ideas/suggestions?

# Questions from Vic/Jeff on mechanical design

- Short stack analysis
  - What kind of plates are available? Need to know their sizes
  - Any need to look at the field again, before a detailed mechanical analysis?
- What other design work is needed?
- At what schedule?