

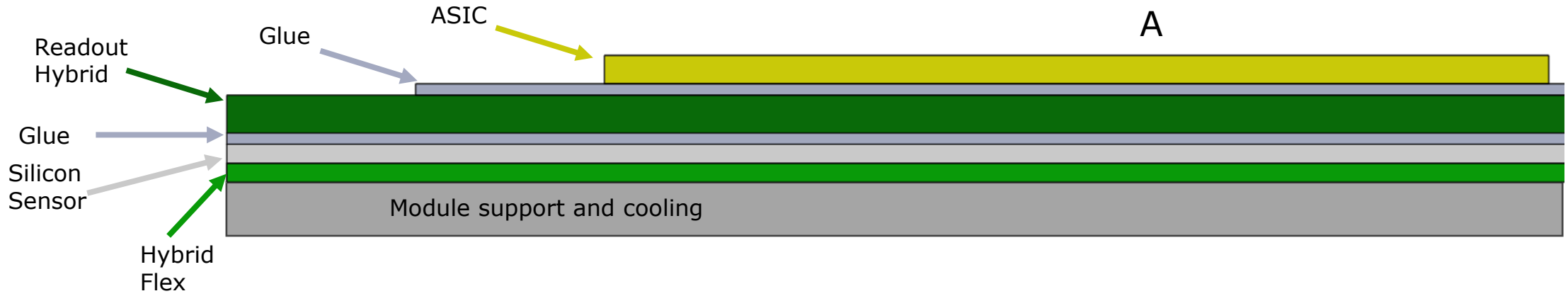
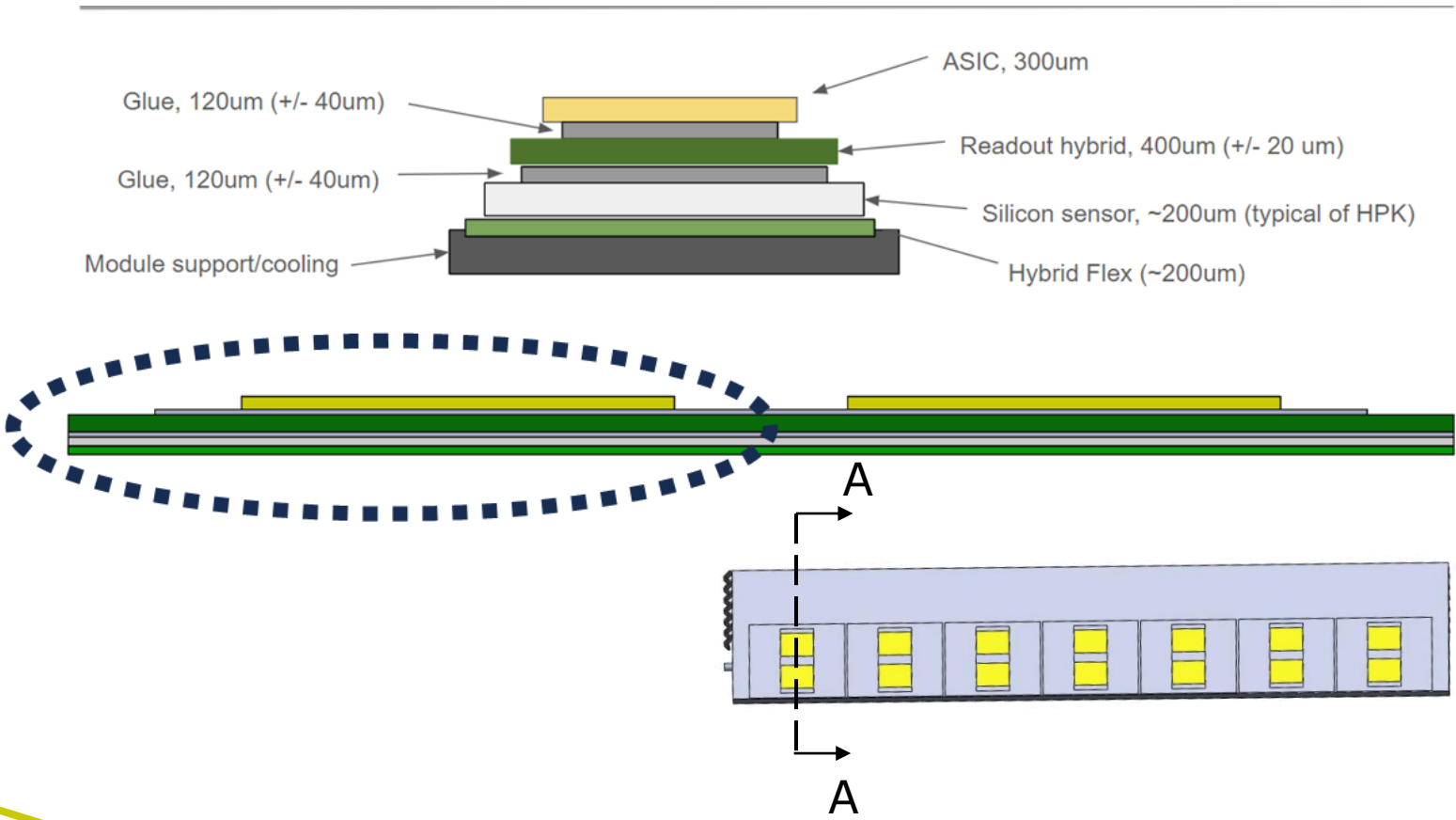
AC-LGAD ToF : halfSTAVE prototype updates and heat transfer analysis for miniSTAVE and fullSTAVE

03 April 2024

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<u>Part Name</u>	<u>Thermal Conductivity (W/mK)</u>	<u>Thickness (μm)</u>
ROC and ASIC (PCB/Kapton properties)	0.97	400 and 300
Silicon Module	148	200
Carbon Face Sheet	Kxx - 180 Kyy - 150 Kzz - 1.36	200
Carbon Foam	25	6420
Loctite Epoxy (Glue)	1.28	120
Stainless Steel Pipe	16	716



Heat transfer coefficient estimated to be (h) 1000 W/m²K decaying down to 360 W/m²K (at outlet) --

$$h = \frac{k \cdot Nu_L}{L}$$

Nusselt number (Nu_L)

$$= \frac{\left(\frac{f}{8}\right) (Re - 1000) Pr}{1 + 12.7 \left(\frac{f}{8}\right)^{0.5} ((Pr)^{\frac{2}{3}} - 1)}$$

- ⬠ Need better pressure inlet and pressure outlet understanding for refining the simulations further
- ⬠ Heat transfer coefficients in a pipe for water at room temp and pipe diameter of 5 mm used for the current estimation of h .
- ⬠ Please can Yi/NCKU help with this – cross check my numbers ?

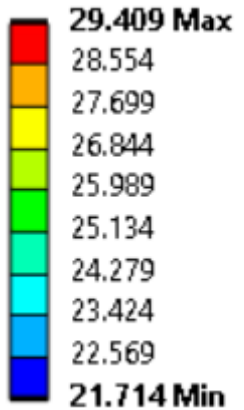
For laminar flow in a pipe at room temp we found out the Prandtl (Pr) and Reynolds (Re) numbers using (Gnielinski,1976) and first Petukhov eq. (1970) :

$$f = (0.790 \ln Re - 1.64)^{-2}$$

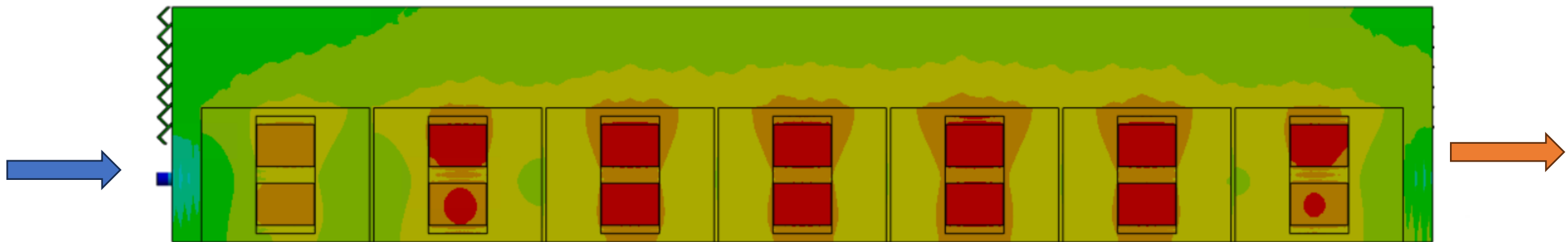
For flow conditions $Re \sim 250,000$

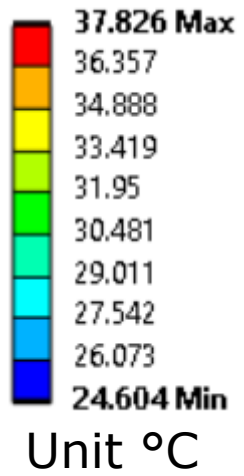
L = length (function of x); k = conductive heat transfer coefficient (W/mK)

Unit °C



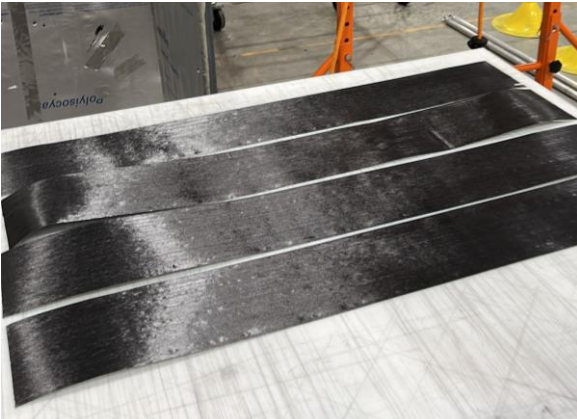
Convective heat loss from edge of the stave affects the temperature profile for the last sensor





Water cooling at +18°C





Next steps →

1. Bond the honeycomb
2. Router CNC the height of the honeycomb + carbon foam
3. Groove for cooling pipe
4. Trim structure into half
5. Bond pieces to make a ~1m halfSTAVE

Forum on Tracking Detector Mechanics 2024

Purdue University, West Lafayette, USA
29-31 May 2024

- Mechanics
- Materials
- Thermal Management
- Simulation Tools
- System Management
- Environmental Control

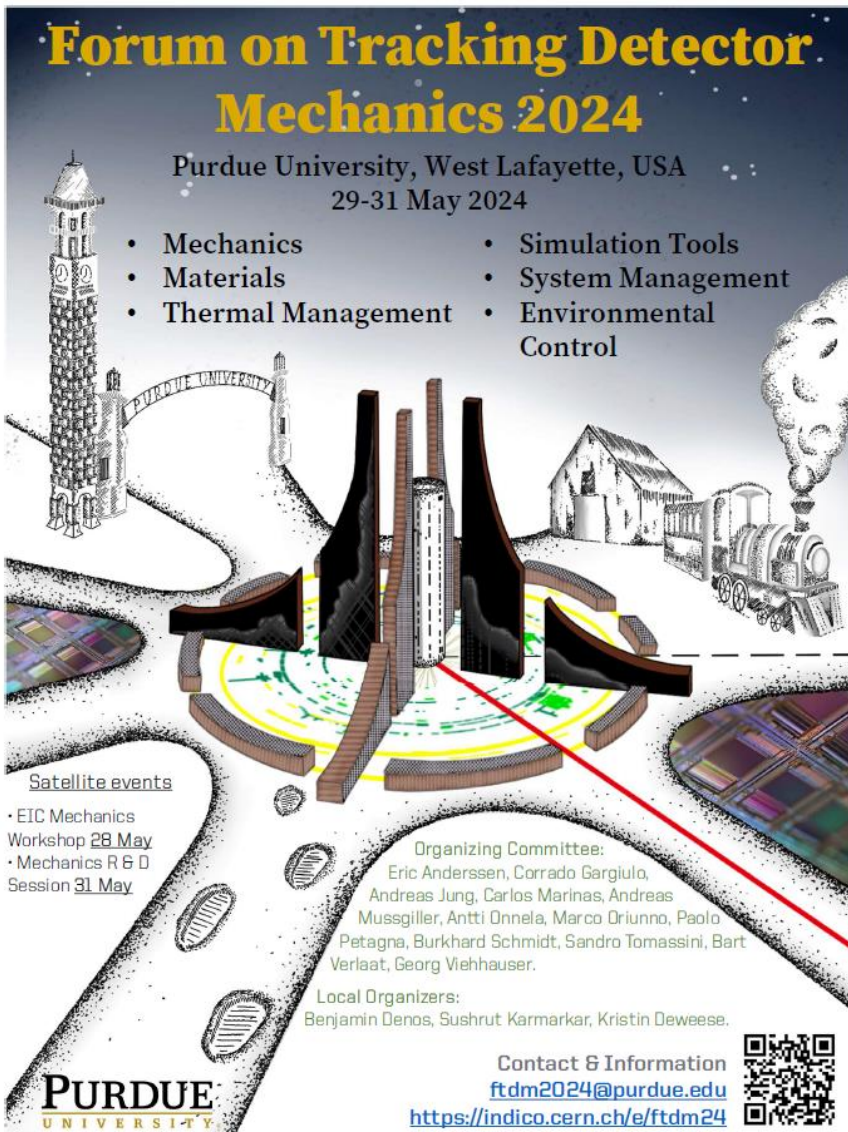

Satellite events

- EIC Mechanics Workshop 28 May
- Mechanics R & D Session 31 May

Organizing Committee:
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Andreas Jung, Carlos Marinas, Andreas
Mussgiller, Antti Onnela, Marco Oriunno, Paolo
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Local Organizers:
Benjamin Denos, Sushrut Karmarkar, Kristin Deweese.

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◊ Satellite event --

<https://indico.cern.ch/event/1371986/>

EPIC Detector Mechanics & Integration workshop

28 May 2024
Purdue University
America/Indiana/Indianapolis timezone

Enter your search term

09:00	→ 10:30	Introduction & local welcome: Working Title: TBA	
10:30	→ 11:00	Coffee break	⌚ 30m
11:00	→ 12:30	Session I: Global Mechanics & Integration	
12:30	→ 14:00	Lunch break	⌚ 1h 30m
14:00	→ 15:30	Session II: Subdetector mechanics	
15:30	→ 16:00	Coffee break	⌚ 30m
16:00	→ 17:30	Session III: Subdetectors / Open discussion	

Forum on Tracking Detector Mechanics link –

<https://indico.cern.ch/event/1336746/>