Integrated Carbon Fiber Composite Structures for Future HEP Detectors

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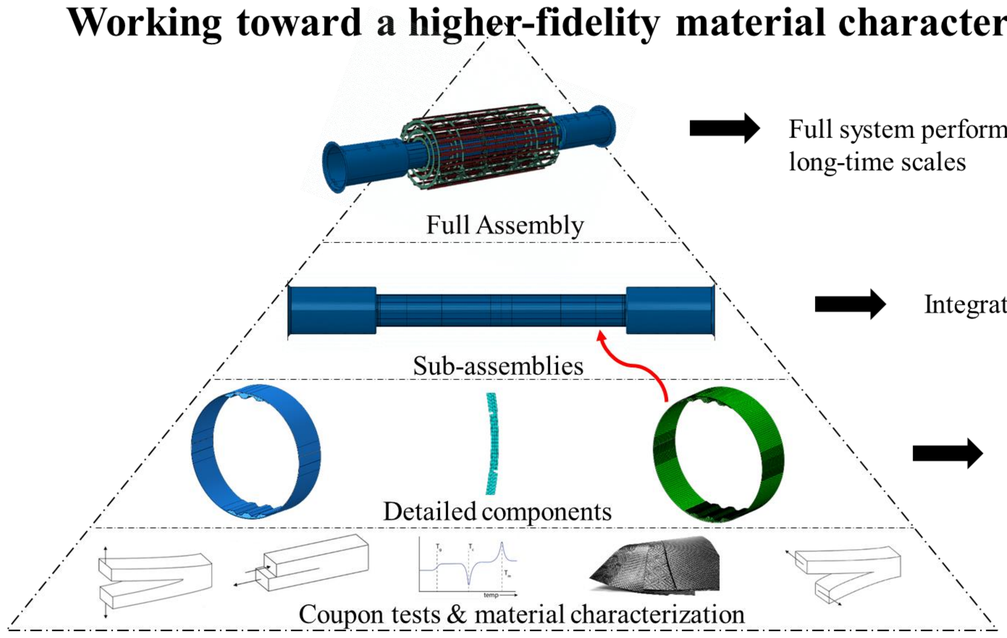
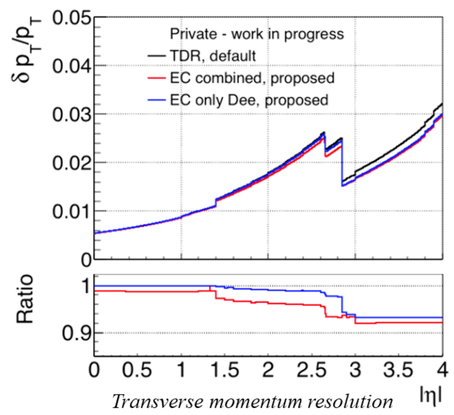
Particle detectors for future colliders rely on ever more precise charged particle tracking devices, which are supported by structures manufactured from composite materials. The higher luminosity and higher radiation environment present challenges to support structures and cooling of the detectors. An integrated engineering approach for mechanical structures, cooling and at times sensing is required from conceptualization stage of detectors. Engineering methods and research towards such future detectors is presented. Development of integrated cooling and support structure for applications in calorimetry is presented as a part of CalVision collaboration for the proposed IDEA experiment for future Higgs factories. Detectors at electron-positron machines have significantly smaller material budgets and require targeted concepts. Such sensing R&D efforts with carbon fiber composites is also summarized.

Working toward a higher-fidelity material characterization and model



Substantial R&D on all fronts to make FCC-hh detector a reality

- Support & Cooling constrains Tracker performance, e.g. thermal runaway
- Mechanics is significant fraction of the material budget
- Material testing standardization for irradiation response



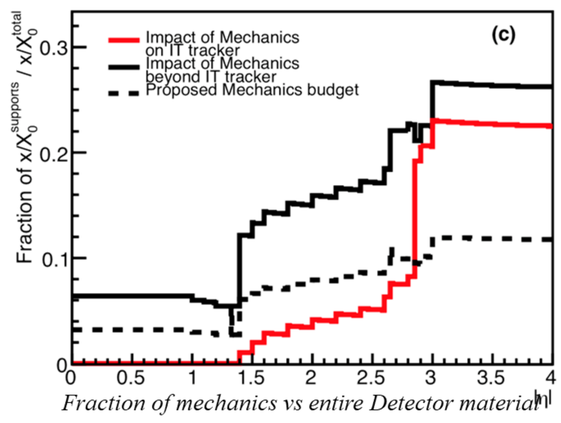


Fig.1. Material budget and qualification tests needed for FCC.

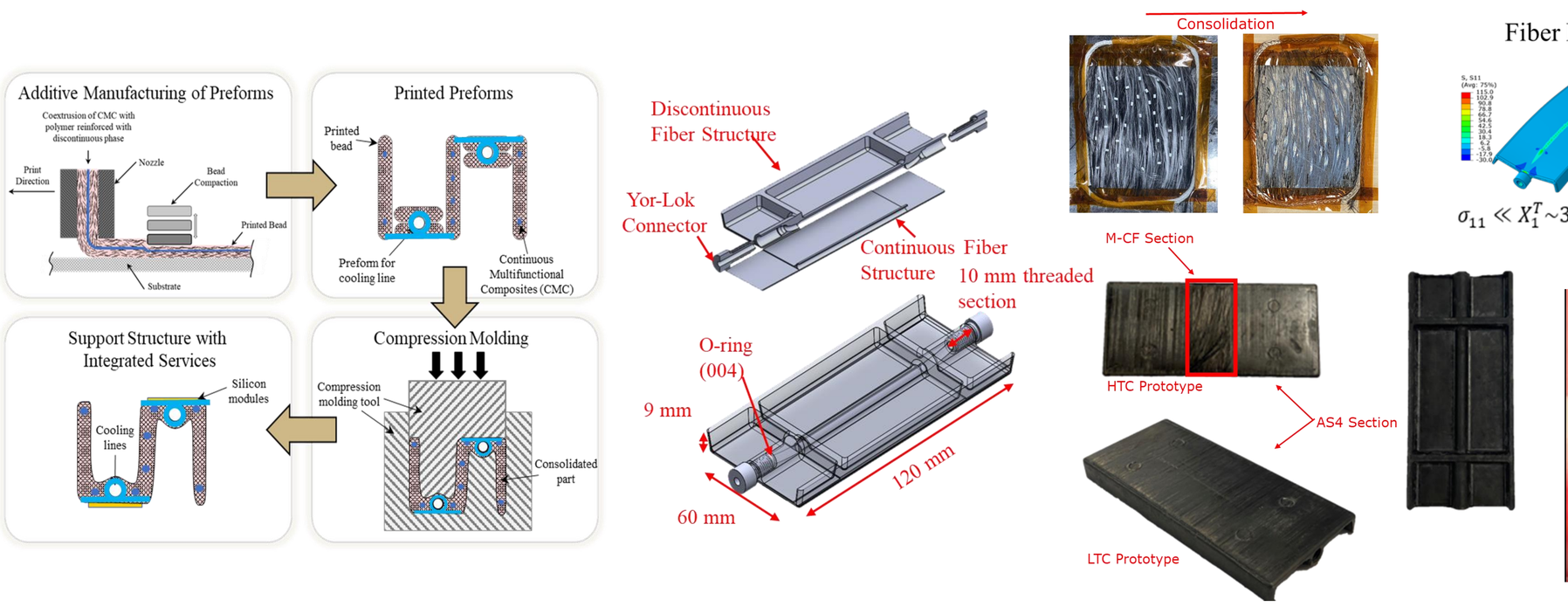


Fig.2. Multifunctional composite structures with integrated cooling. The structures are repeated units with interconnects that are highly thermally conductive, and pressure tested for 2-phase cooling.

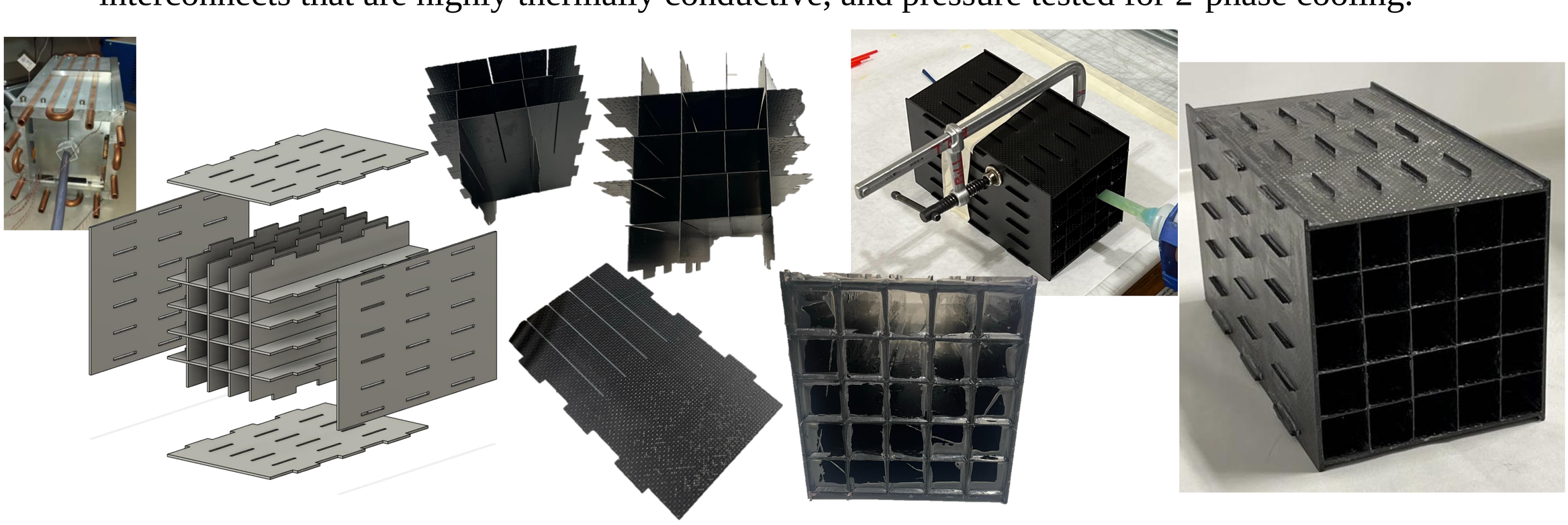


Fig.3. CalVision: carbon fiber composite support structure for calorimeter with integrated cooling