



## NASA SBIR 2016 Phase I Solicitation

### Z4.01 Joining for Large-Scale Polymer Matrix Composite (PMC) Structures

Lead Center: MSFC

Participating Center(s): GSFC, LaRC

The subtopic area for Large-Scale Polymer Matrix Composite (PMC) Structures and Materials concentrates on developing lightweight structures, using advanced materials technologies and new manufacturing processes. The objective of the subtopic is to advance technology readiness levels of PMC materials and manufacturing for launch vehicles and in-space applications resulting in structures having affordable, reliable, and predictable performance. A key to better understanding predictable performance and faster qualification of components includes integrating the analytical tools between the materials and manufacturing process.

This subtopic will focus efforts on innovative low cost, light weight, high reliability composite joint concepts/techniques to enable the fabrication of complex geometry and/or large composite structures (5 to 9 meter diameter by 10 meters long). The specific area of interest is focused on:

- Novel concepts for joining (mechanical or bonded) large and/or complex segmented PMC structures together are of interest. Useful concepts can consider metallic-to-composite and composite-to-composite material interfaces. Examples of joints of interest include, but are not limited to, longitudinal and circumferential joint configurations for launch vehicle structures. In addition, cylinder to cylinder, and cylinder to frustum/conical ("Y" shaped) designs are of interest.
- Innovative joint designs with integrated sensing for the purposes of assisting with qualification of the joint design and interrogation of the joint during use to assess its performance and capability are also of interest.
- For bonded structure, novel, reproducible, and scalable surface treatments, bonding methods and techniques for very large structure, and novel adhesives are of interest as well as techniques to verify bond quality and predict/validate strength. Useful concepts can consider metallic-to-composite and composite-to-composite bond interfaces.
- New concepts for lightweight separation joints, both longitudinal and circumferential designs.

Concepts must consider end-to-end process evaluation with considerations to modeling of the joint/joining process and to full-size scale-up factors which will limit autoclave and oven access for joint cures (if needed). Concepts that are amenable to in-situ and/or on-orbit implementation are also of interest. Research should be conducted to demonstrate novel approaches, technical feasibility, and basic performance characterization for large-scale PMC structures and joint concepts during Phase I, and show a path toward a Phase II design allowables and prototype demonstration. Emphasis should be on demonstrable manufacturing technology that can be scaled up for very large structures.

References:

- 
- Kirsch, M. T., "Composite Crew Module: Primary Structure"; (<http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20110020665.pdf>).
  - Tenney, D. R. et al., "NASA Composite Materials Development: Lessons Learned and Future Challenges"; (<http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20090037429.pdf>).