

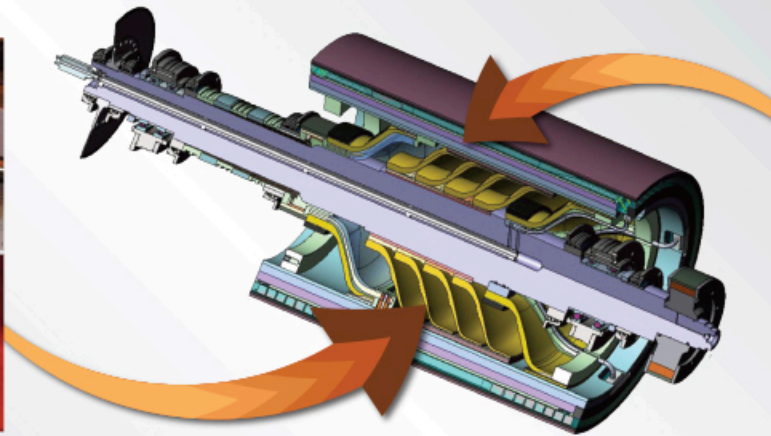
# Novel Composite Structures for Smaller, Lighter Advanced Rotating Machines

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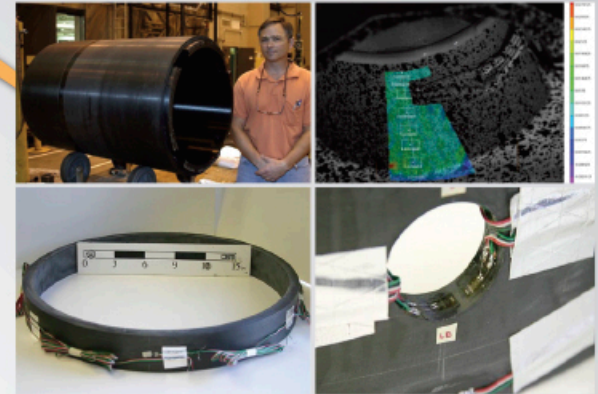
## Composite Arbors

- **Enable higher tip speeds**
  - Increased energy density
  - Higher power density
- **Extensive spin test validation completed**
  - Over-speed testing
  - Multi-cycle fatigue testing
  - Reinforced arbors supporting mechanical hardware
  - Multi-arbor stability
- **Advanced design code**
  - Geometry definition
  - FEA input files
  - Winding machine control files
- **Developed manufacturing processes**
  - Arbor to shaft and rim interface treatment
  - Arbor assembly techniques



## Benefits of Rotating Machines

- **Compact, modular, & multi-function devices**
  - High power and energy density
  - Can combine energy storage, pulse and continuous power generation
  - Extended operational life
  - Demonstrated path from prototype to deployment
- **Technology advancements offer further potential**
  - Advanced composite materials
  - Composite arbors
  - SiC power electronics
  - Thermal management materials and techniques



## Composite Bandings with Penetrations

- **Composites designed with radial penetrations enable advanced rotor topologies**
  - Useful for arbor-based rotor designs
  - Allow electrical power feeds or active cooling through composite layers
- **High fidelity (ply by ply) mechanical analysis required in area of penetrations**
- **Mechanical tests used to validate design**
  - Full scale representative samples
  - Composite rings tested to failure using internal tapered steel plug
  - Successfully utilized digital image correlation (DIC) to measure strain
  - DIC is useful for measuring strain in complex composite geometries