

The Advanced Power Extraction Study APEX

Chamber Technology Goals Used in APEX to Calibrate New Ideas and Measure Progress

1. High Power Density Capability
Average/Peak Neutron Wall Load ~ 7 / 10 MW/m²
Average/Peak Heat Flux ~ 1.4 / 2 MW/m²
2. High Power Conversion Efficiency (>40%)
3. High Availability (MTBF>43 MTTR)
4. Simpler Technological and Material Constraints

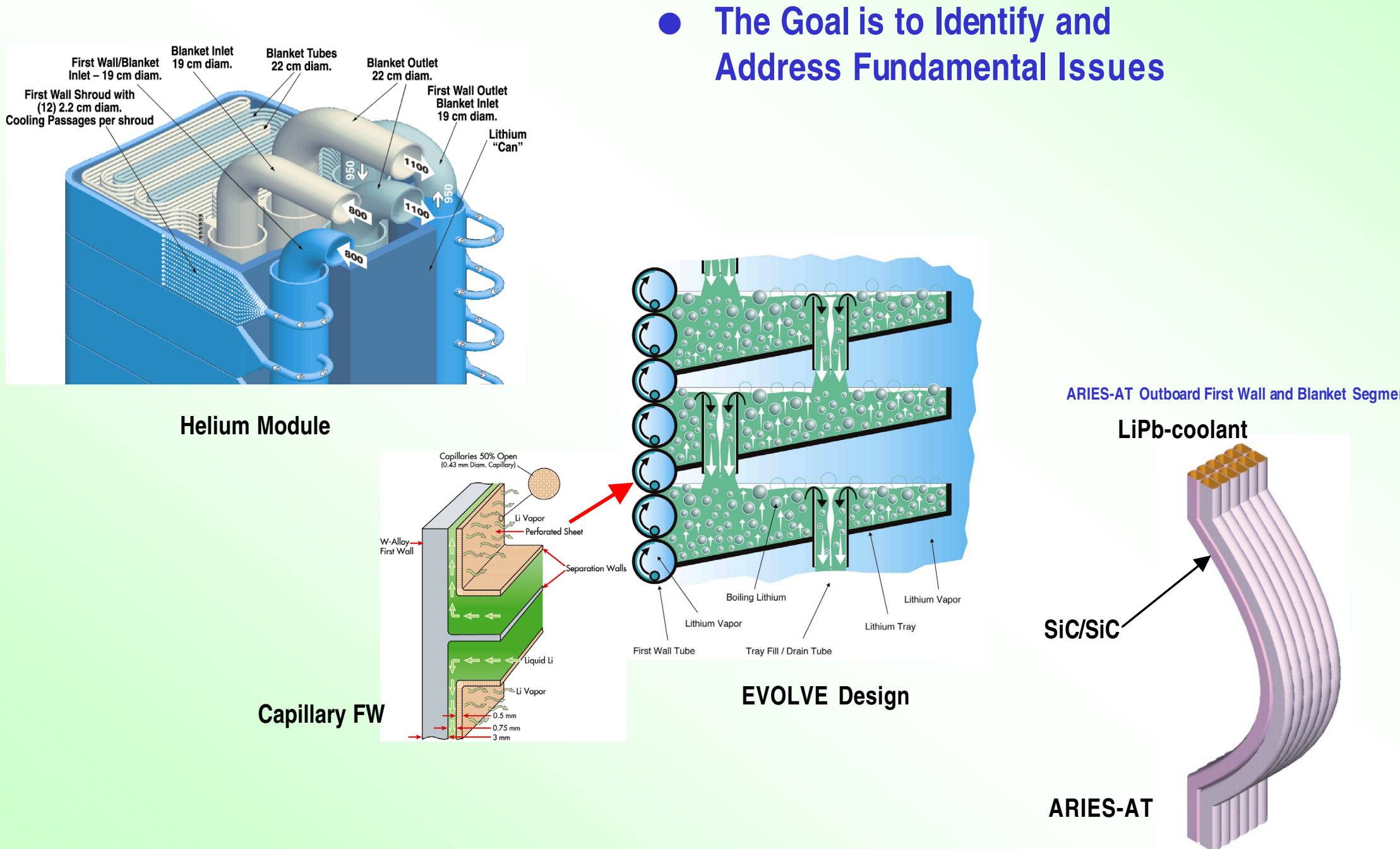
* "APEX will explore concepts with lower power density capabilities if they provide significant improvement in power conversion efficiency or other major features."

APEX Goals

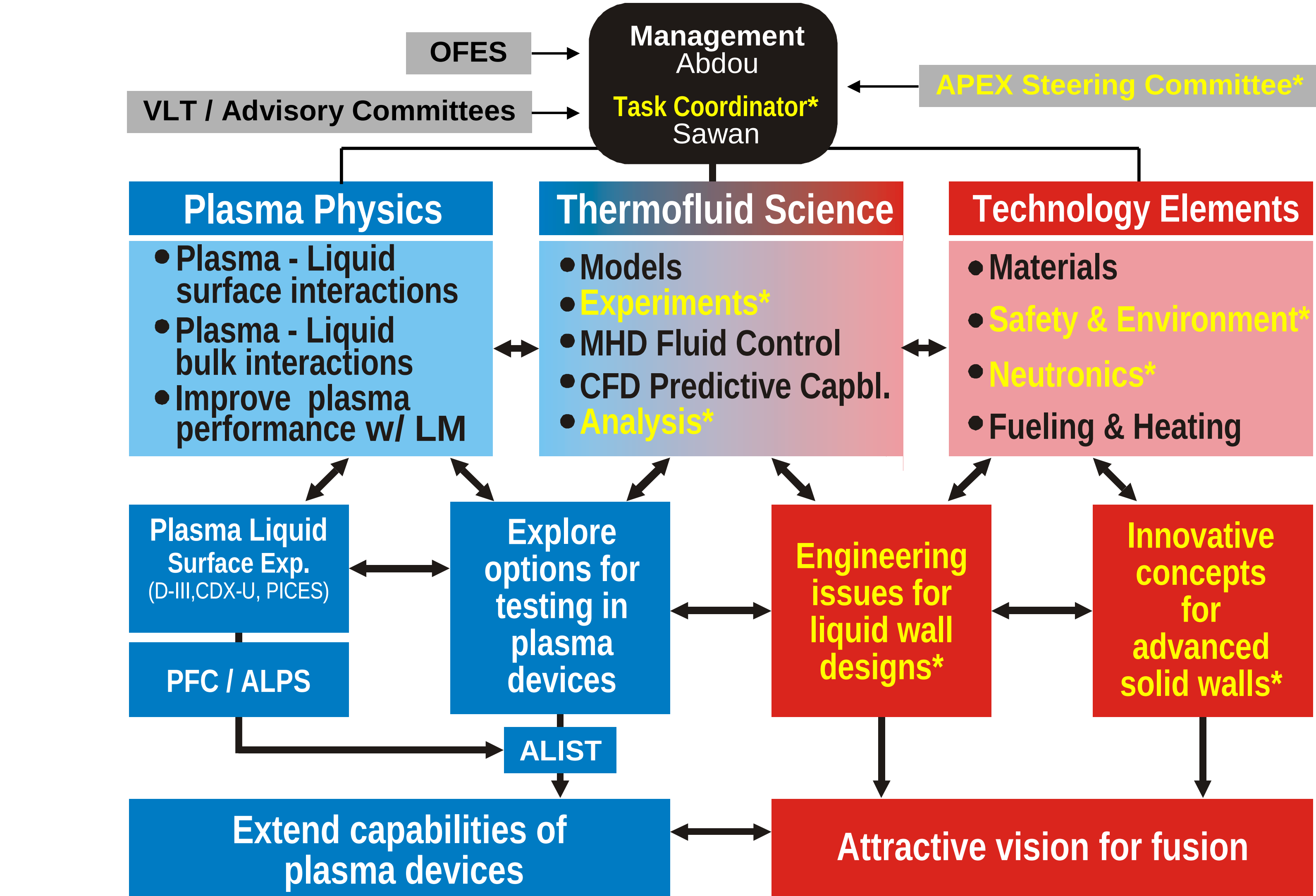
Identify and explore NOVEL, possibly revolutionary, concepts for chamber technology that might:

1. In the near-term: enable plasma experiments to more fully achieve their scientific research potential
2. In the long-term: substantially improve the attractiveness of fusion as an energy source
3. Lower the cost and time for R&D

Exploration of Innovative Advanced Solid Wall Concepts



APEX is Organized as a Partnership Between Plasma Physics and All Elements of Science & Technology



*UW Contribution

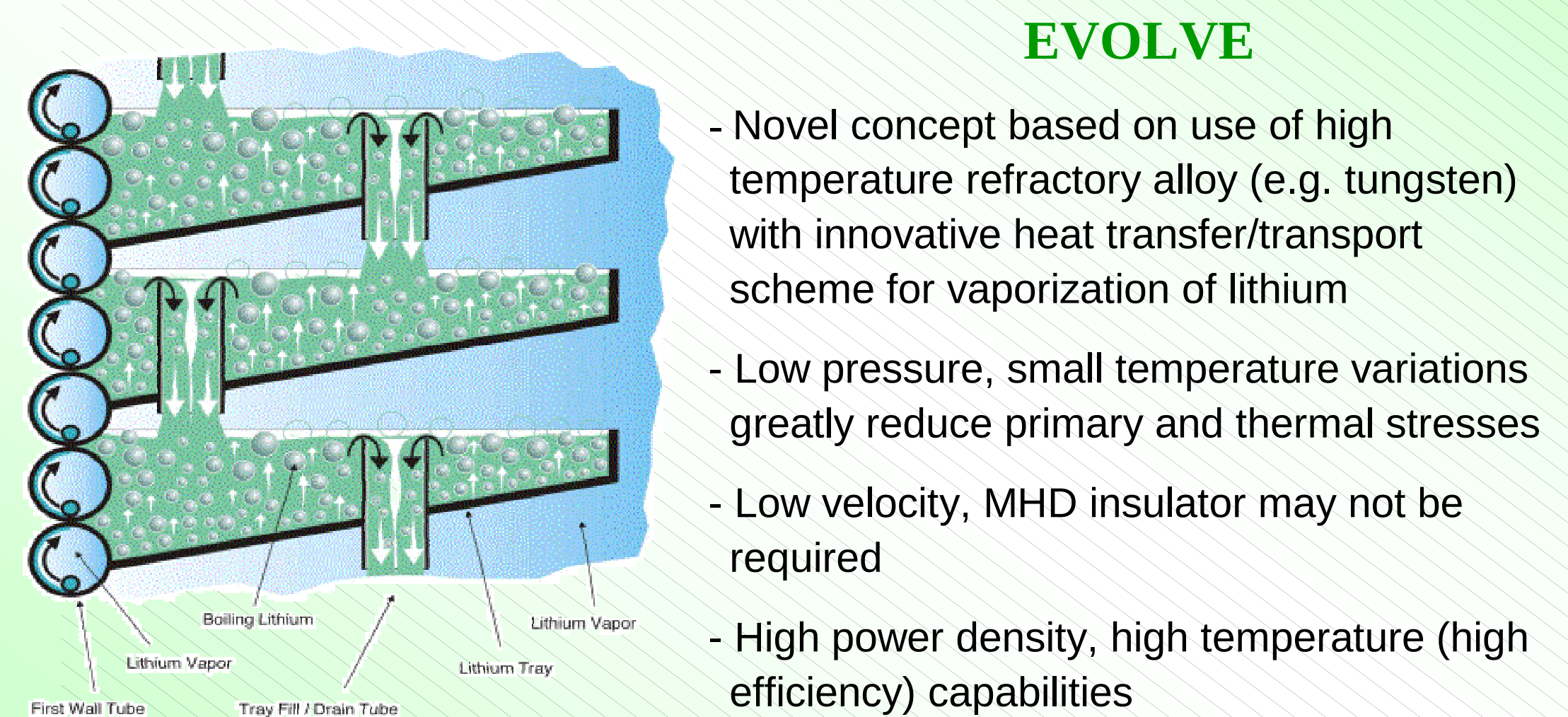
Motivation for Liquid Wall Research

What may be realized if we can develop good liquid walls:

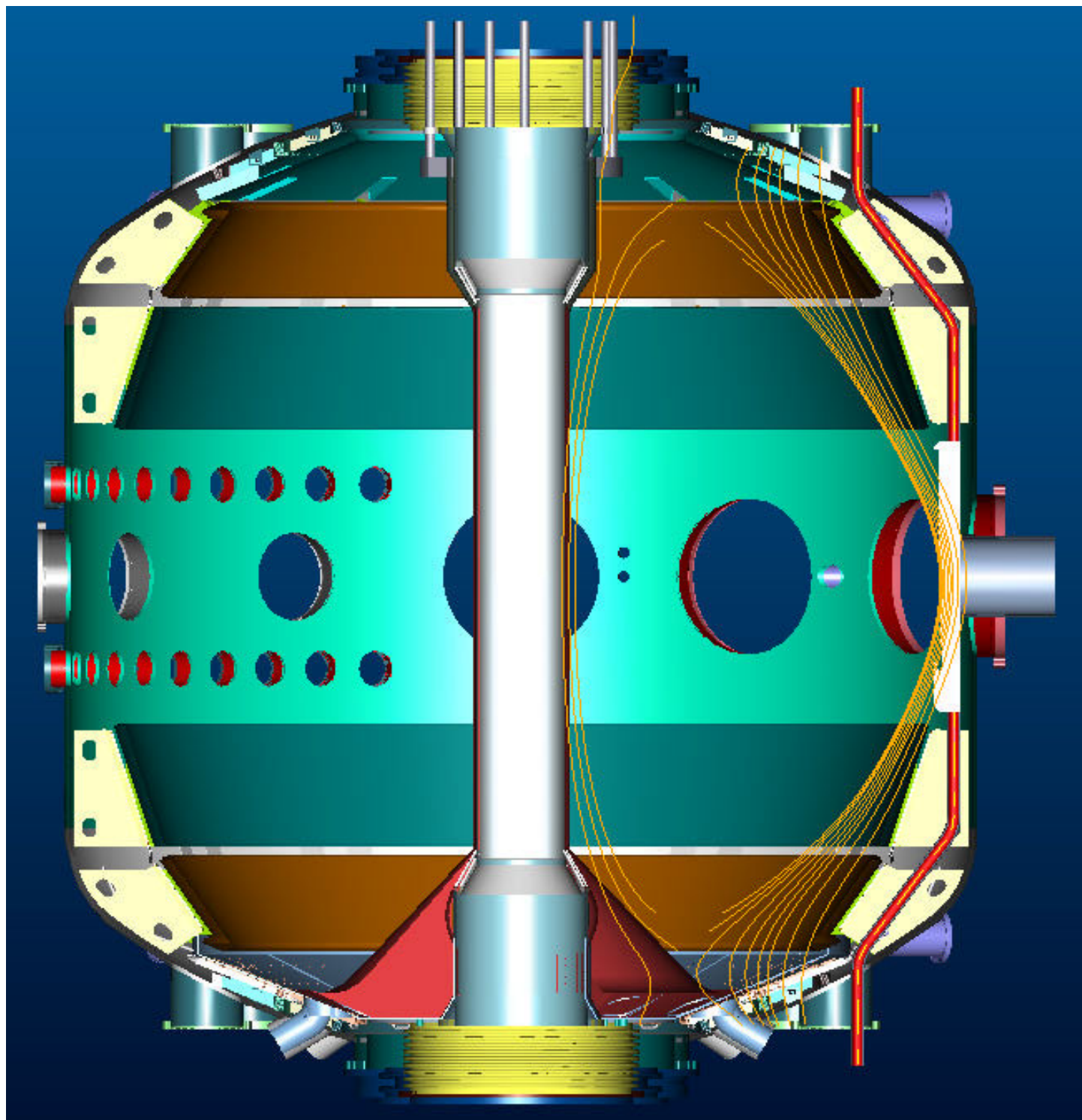
- Improvements in Plasma Stability and Confinement
Enable high β , stable physics regimes if liquid metals are used
- High Power Density Capability
- Increased Potential for Disruption Survivability
- Reduced Volume of Radioactive Waste
- Reduced Radiation Damage in Structural Materials
-Makes difficult structural materials problems more tractable
- Potential for Higher Availability
-Increased lifetime and reduced failure rates
-Faster maintenance

No single LW concept may simultaneously realize all these benefits, but realizing even a subset will be remarkable progress for fusion

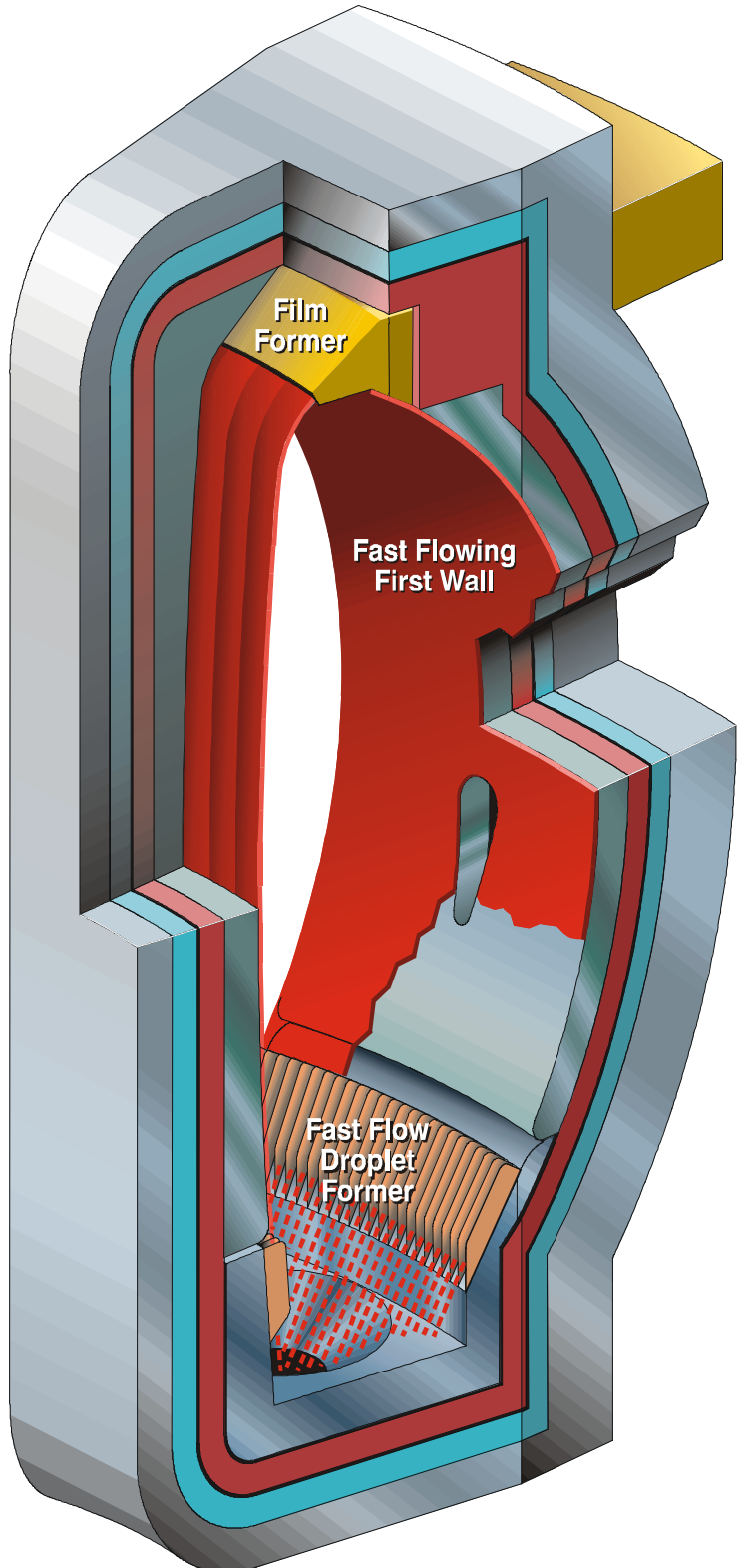
Innovative Concepts Proposed by APEX Can Extend the Capabilities and Attractiveness of Solid Walls



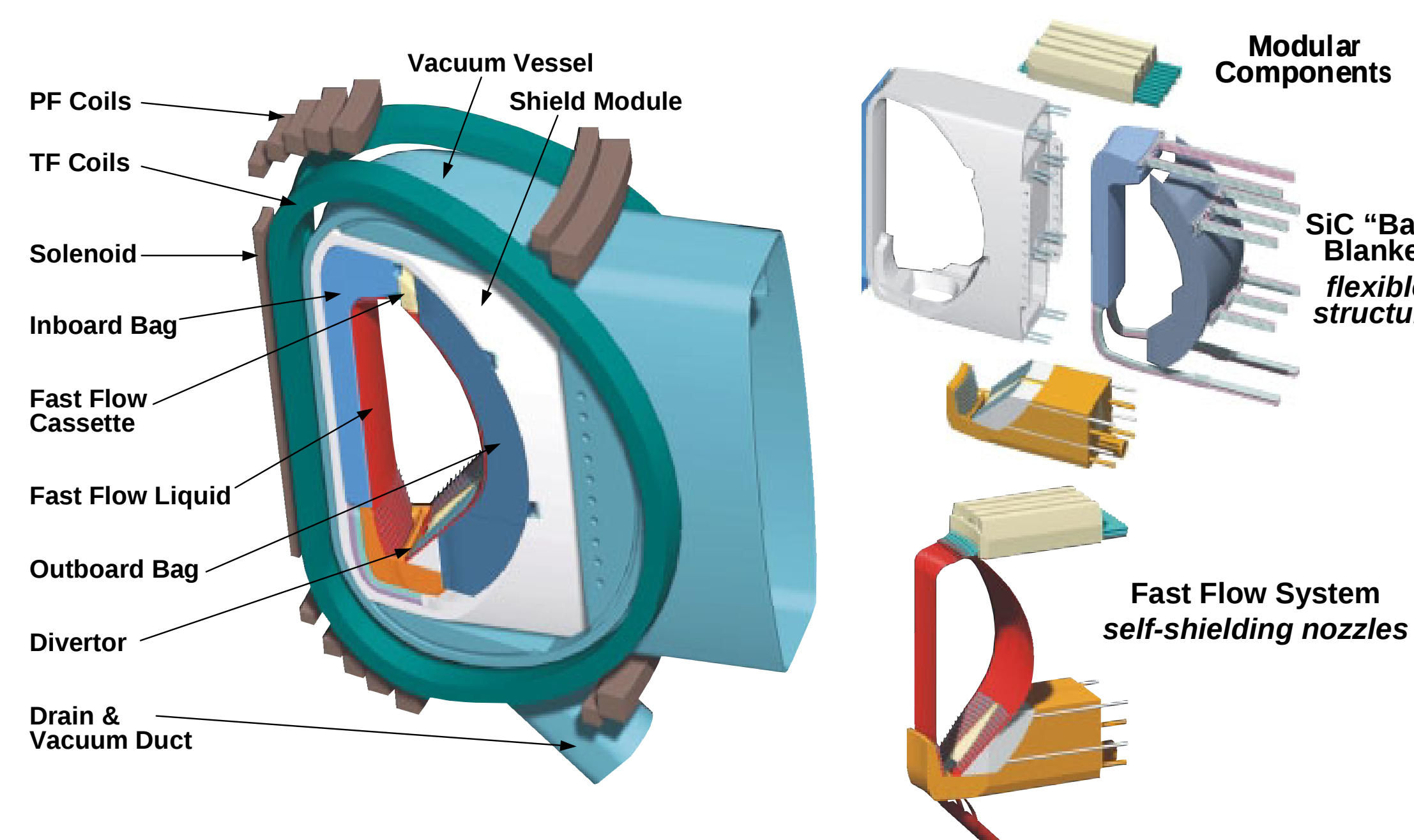
Midplane and Lower Divertor Liquid Surface Modules in NSTX



CLiFF - Convective Liquid Flow First Wall



Liquid Wall Fusion Reactor Concept



Experimental Determination of Vapor Fraction and Boiling Flow Regime in Magnetic Field

An experiment is necessary to determine if the postulated EVOLVE vapor channel concept is possible and to investigate the MHD effects on the boiling flow regime

Previous experiments indicate that the onset of nucleate boiling is not altered substantially by the B-field. It is not clear what will happen to the flow regimes

The key non-dimensional numbers involved in boiling Li can be reproduced by injecting He into NaK

- Experimental design uses an X-ray image technique to image the flow regime of a conductive metal in a magnetic field

