Blanket Design for a Magnetic Diversion Chamber

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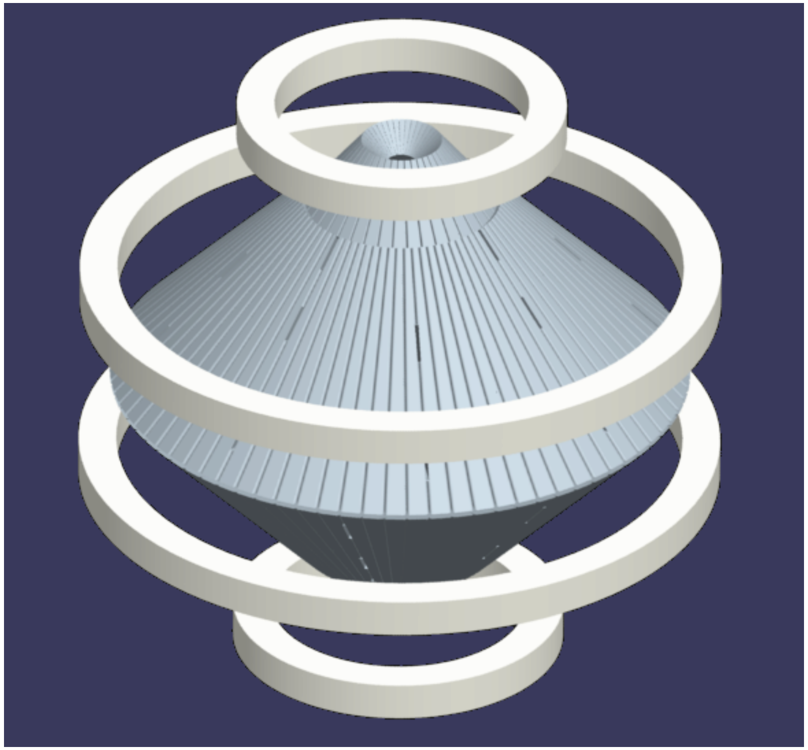

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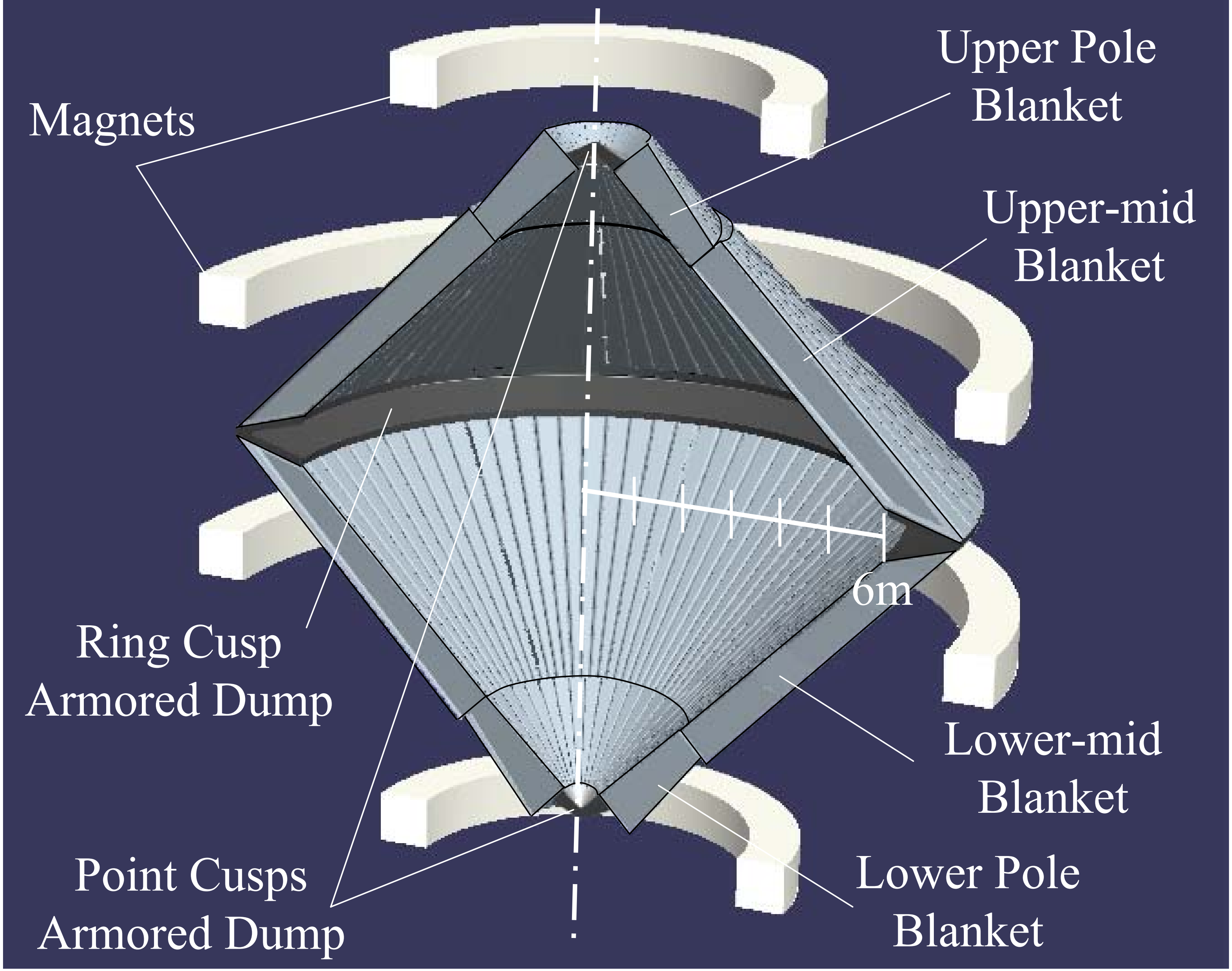
Presentation Outline

- Introduction and Guidelines
- Chamber Description
- Blanket Design
- Neutronics Analysis

Introduction and Guidelines

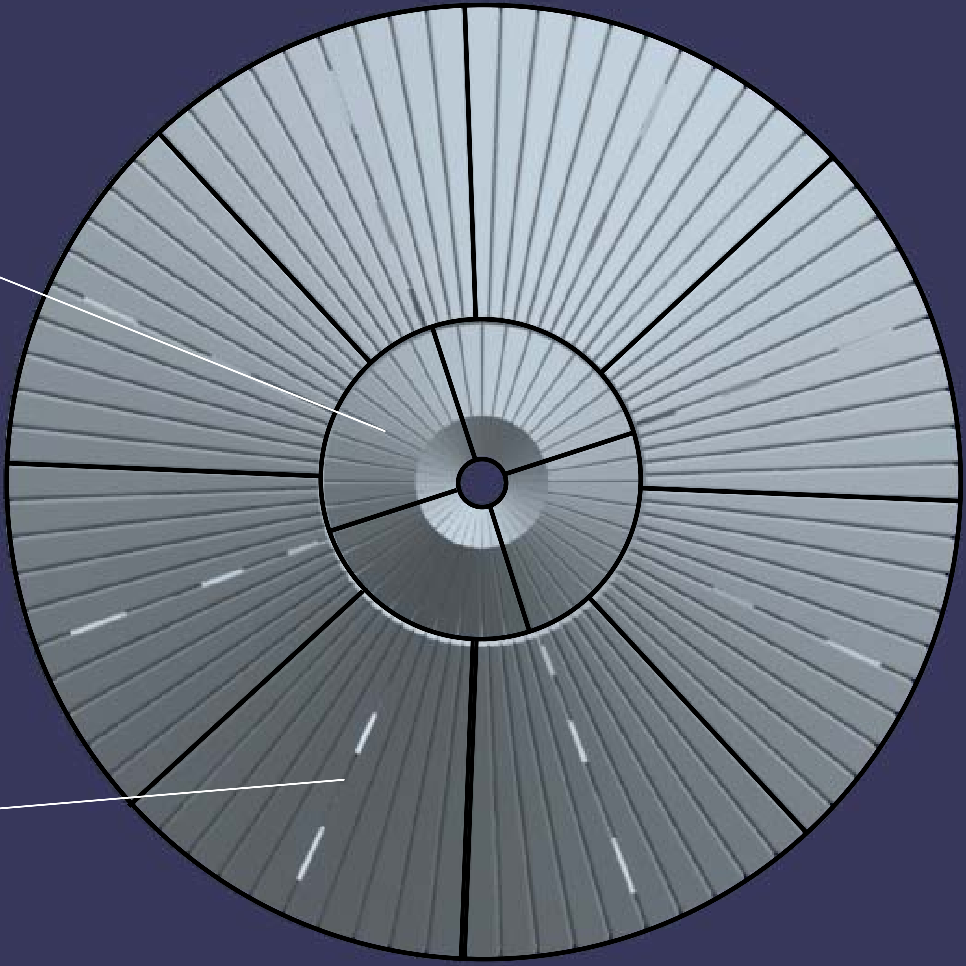
- Coolant is PbLi
- Blanket structure is Silicon Carbide
- Maximum FW temperature of 1000°C
- Maximum allowable PbLi/ SiC 1000°C
- Utilize concentric channel approach of previous blanket designs
- Blanket modules must be self-draining
- Maintenance access is likely via expandable equator space

Chamber Cross-Section



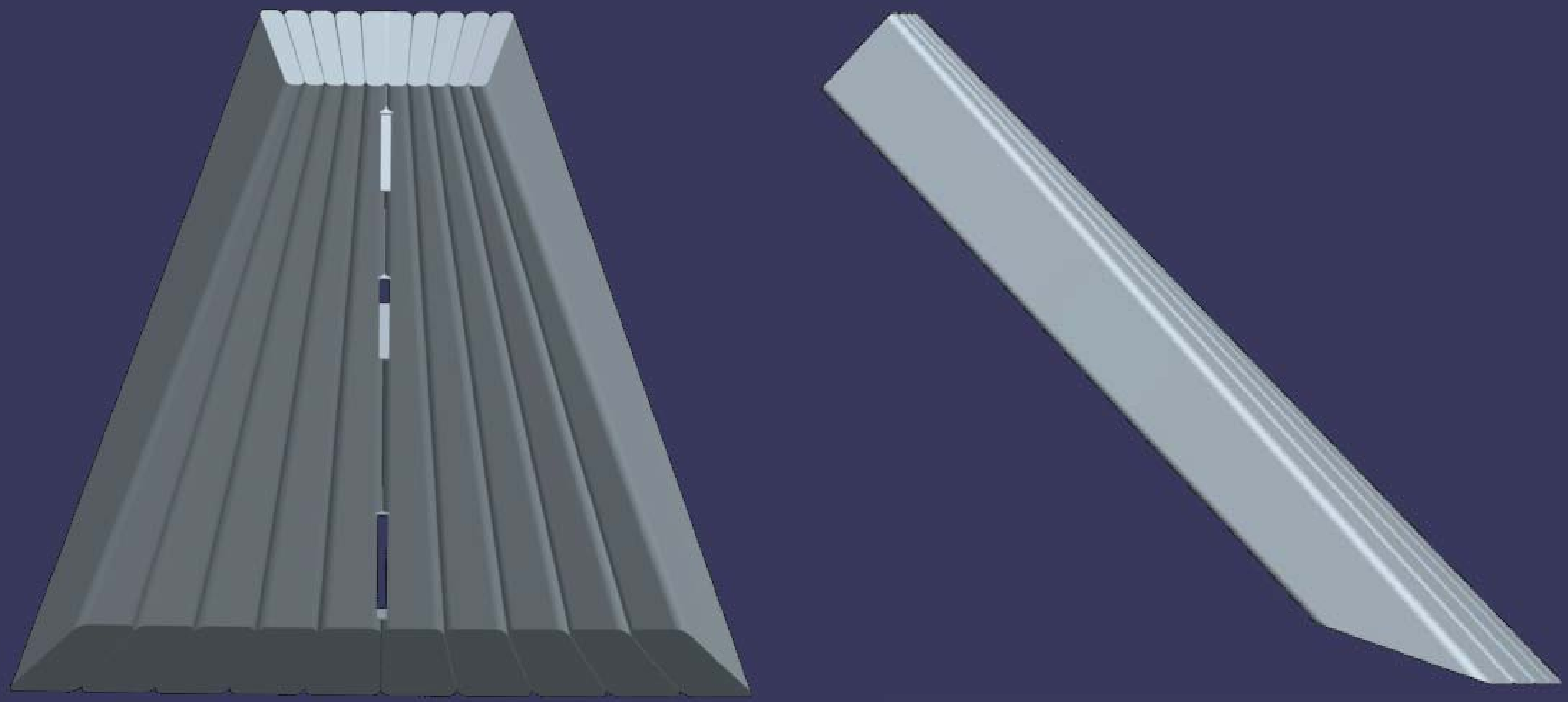
Blanket Module Layout

Four blanket modules at each pole with ten channels/module (40 channels total)



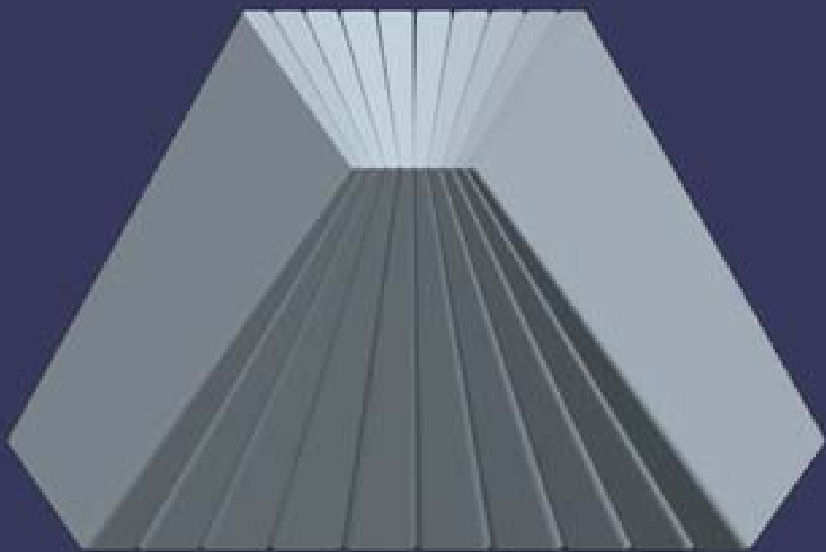
Eight blanket modules at each mid-section with ten channels/module (80 channels total)

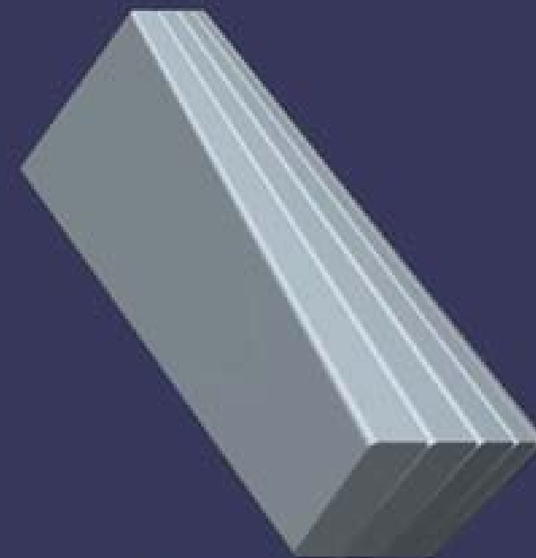
Mid Blanket Module

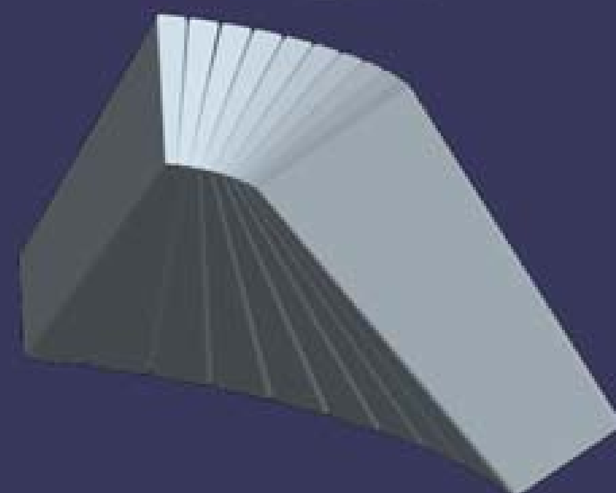


- Ten channels each
- Beam Ports located between center channels
- Coolant enters and exits at bottom

Pole Blanket Module



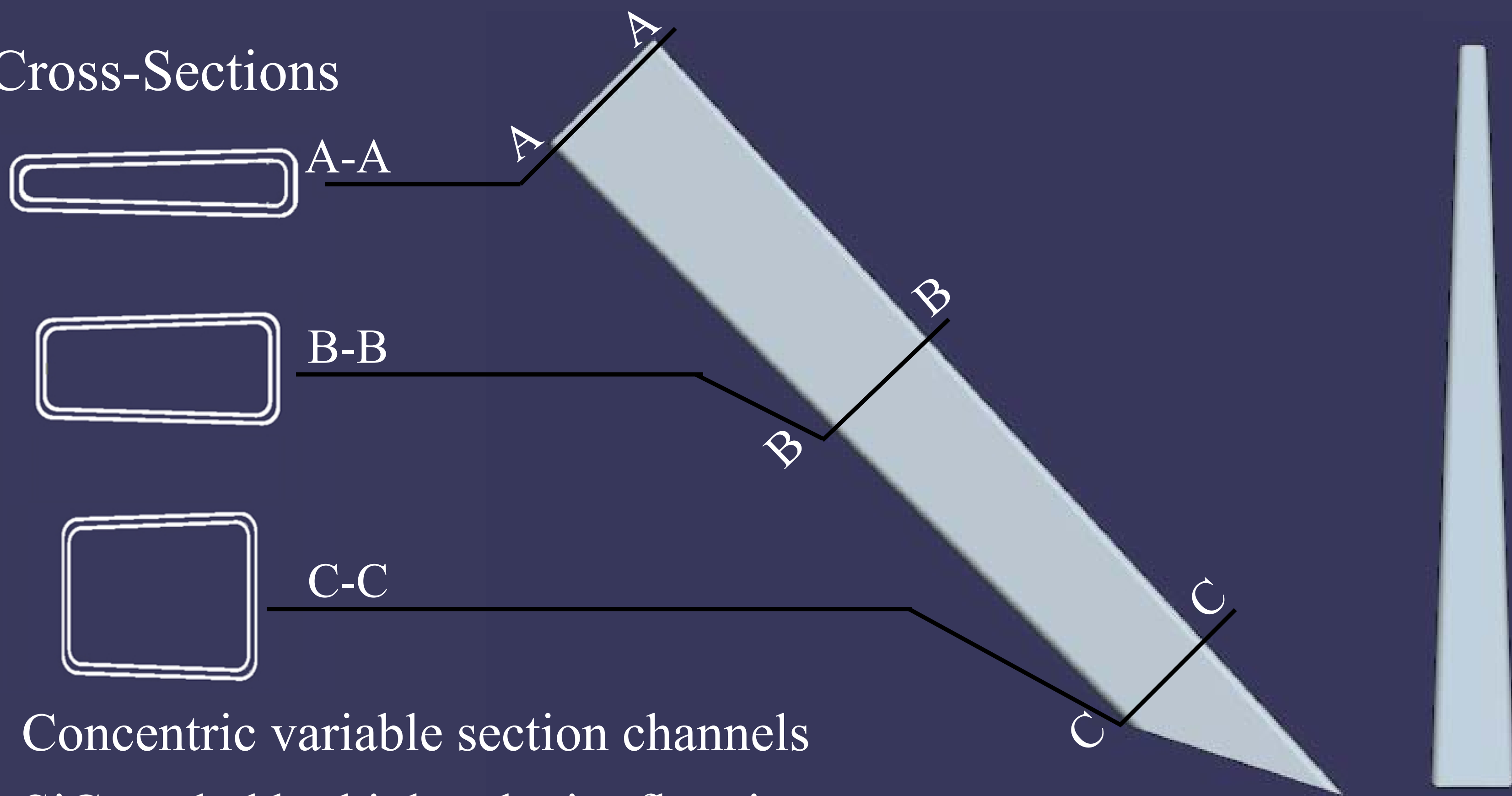




- Ten channels each
- Coolant enters and exits at bottom

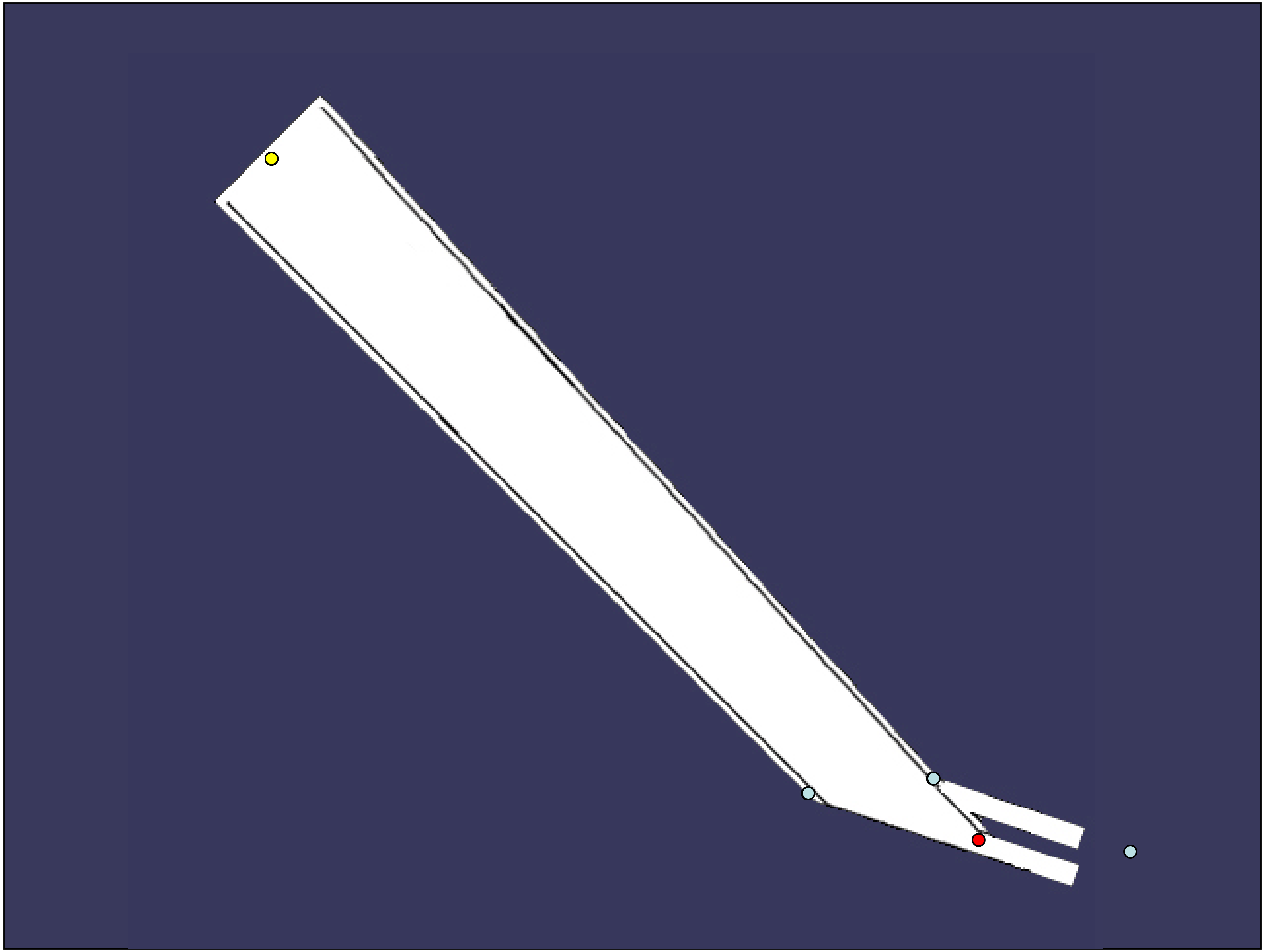
Channel Sub-Module

Cross-Sections

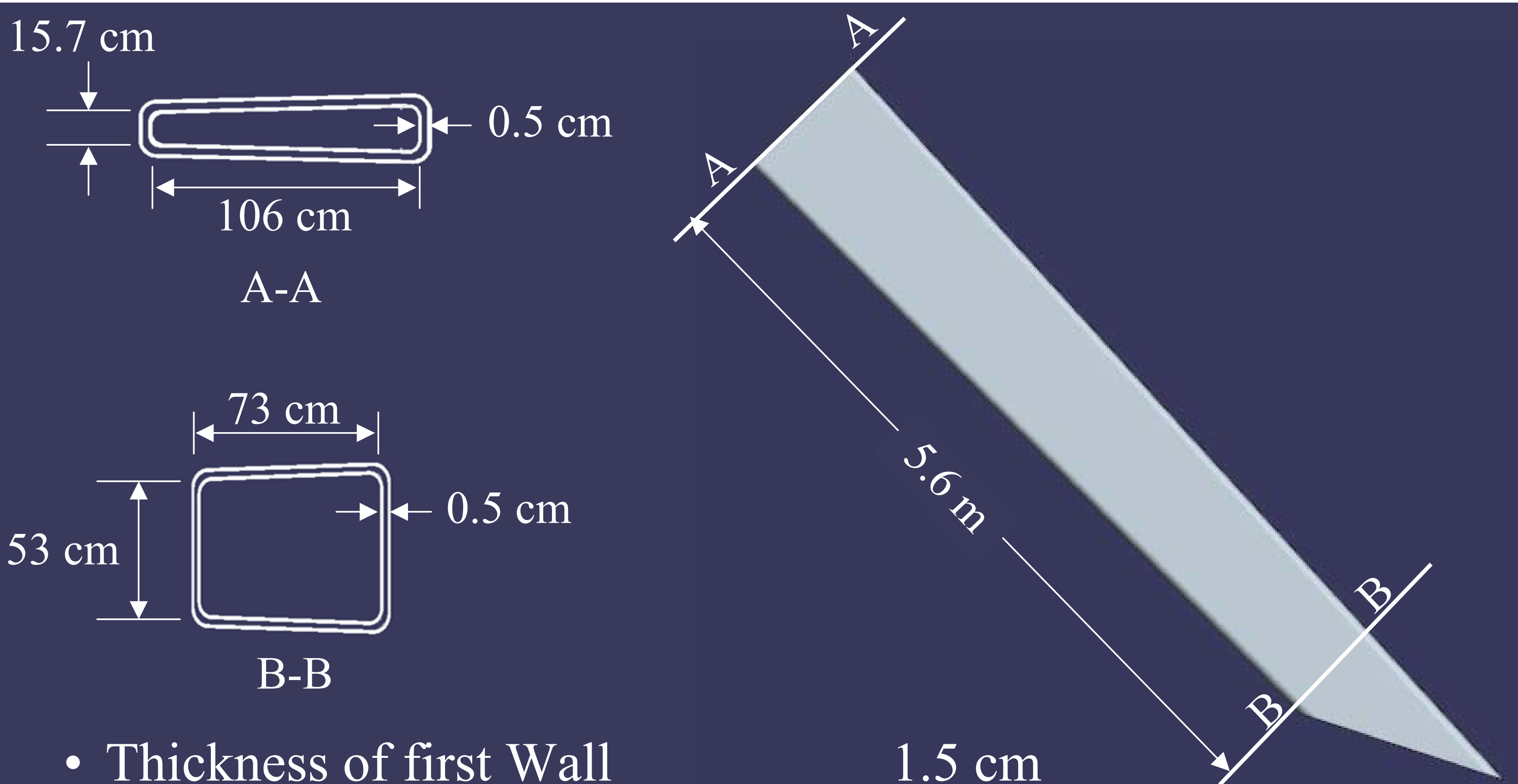


- Concentric variable section channels
- SiC cooled by high velocity flow in gap
- Low velocity return flow in center channel
- Constant gap cross-section area and hydraulic diameter maintains a constant flow velocity in the gap

Channel Sub-Module Flow Schematic



Geometric Parameters of Upper/Lower Mid-blanket



- Thickness of first Wall 1.5 cm
- SiC fraction in blanket 20 %
- Outer channel flow area 113.5 cm^2
- Hydraulic diameter 1.0 cm

Thermal Parameters of Blanket

Upper/Lower Mid-blanket

• Neutron heating per channel (MW)	8.7
• Ions resistive heating in SiC per channel (MW)	2.58
• X-ray heating per channel (MW)	0.156
• Total heating per channel (MW)	11.433

Upper/Lower Pole-blanket

• Neutron heating per channel (MW)	2.1
• Ions resistive heating in SiC per channel (MW)	0.61
• X-ray heating per channel (MW)	0.037
• Total heating per channel (MW)	3.04

Tritium Breeding Requirement with Magnetic Diversion

- Tritium breeding affected by space taken by ring cusp, point cusps, and beam ports
- Full angle subtended by the ring cusp and each of the point cusps is ~8.5°

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  - Breeding blanket coverage lost by the ring cusp is *7.4%*
  - Breeding blanket coverage lost by the two point cusps is *0.3%*
- GIMM @24 m is 3.4 m high x 4.05 m wide with 85° angle of incidence

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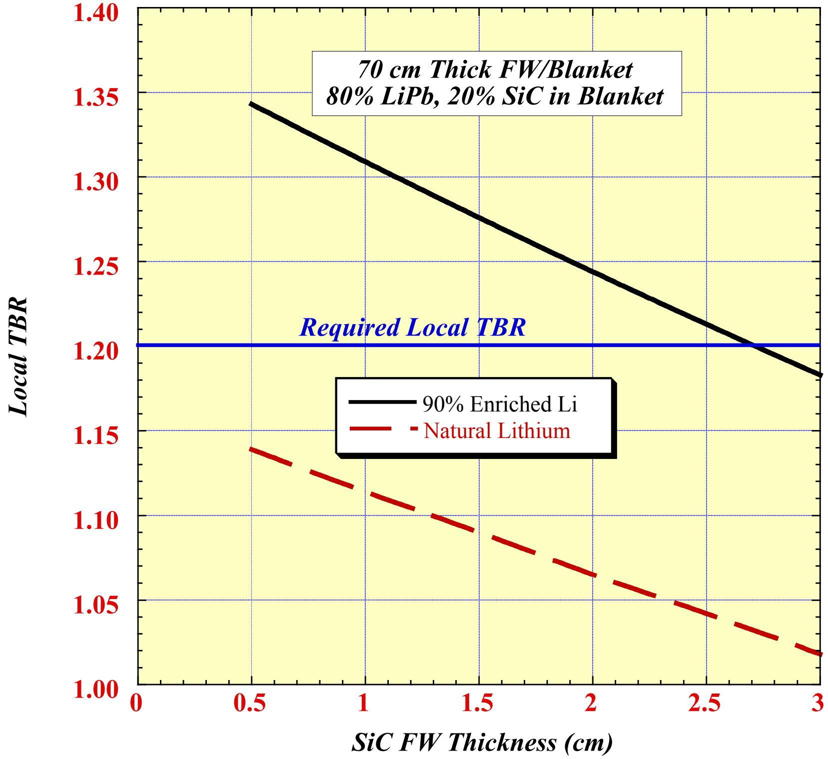
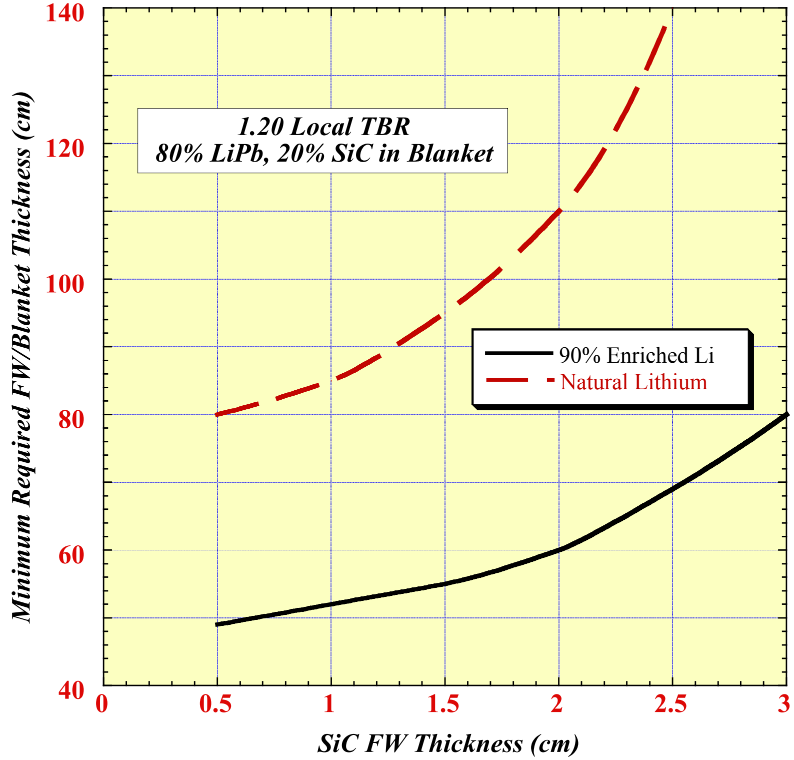
  - Breeding blanket coverage lost by 40 beam ports is *0.7%*
- Total breeding blanket coverage lost is ***8.4%***
- For an overall TBR of 1.1 required for tritium self-sufficiency, ***the local TBR should be 1.2***

How Thick a SiC FW Can Be Used?

- Blanket consists of 80% LiPb and 20% SiC
- 70 cm thick FW/blanket followed by 100 cm thick SS/H_2O shield





- With 90% ^{6}Li up to 2.7 cm thick SiC FW can be used
- With natural Li, blanket thickness has to be increased even with 0.5 cm FW

- With 90% ^{6}Li reasonable blanket thicknesses can be used with thick FW
- With natural Li, much thicker blankets should be used with thick FW

Conclusions

- Relatively simple self-cooled PbLi blanket made of SiC
- Geometrically compatible with the laser beam ports and magnetic field requirements
- All parts of blanket are self-draining
- Maintenance of blanket and dumps will be addressed in the future
- Adequate tritium breeding with 3 cm FW and 20% SiC in 80 cm thick blanket