Design, Fabrication and Maintenance Considerations of Blanket Options for Magnetic Intervention

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THE UNIVERSITY of WISCONSIN MADISON

Outline

- Magnetic intervention chamber design
- Chamber maintenance
- SiC blanket module fabrication
- External dump housing concept
- Flibe blanket concepts

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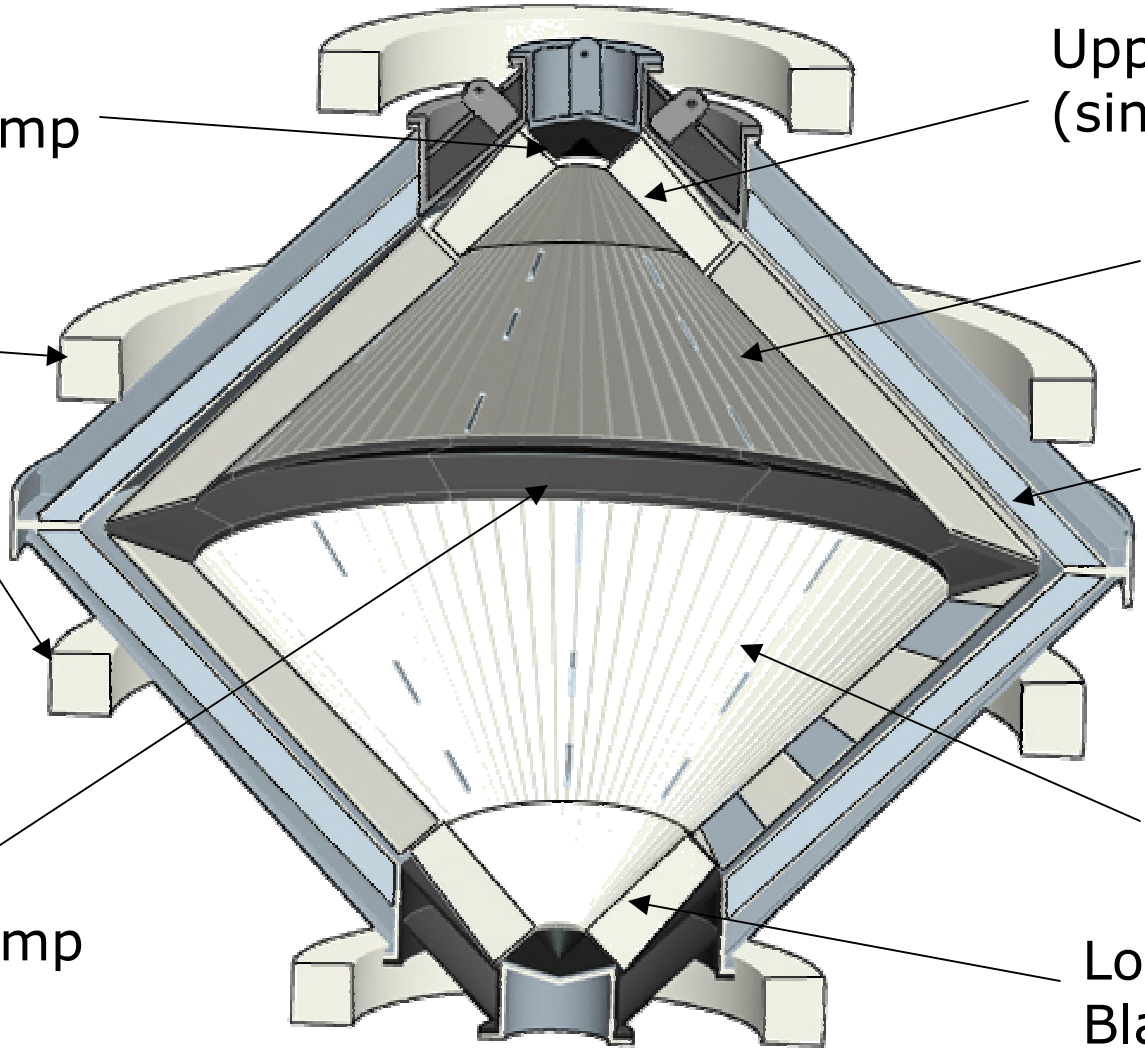
Blanket Design Overview

- PbLi Coolant
- Silicon Carbide Blanket structure
- Maximum FW temperature of 1000°C
- Maximum allowable PbLi/SiC Temp. 1000°C
- Concentric channel approach similar to earlier HAPL blanket designs
- Self-draining blanket modules
- Maintenance access is via removable shield modules at each pole

Chamber Design



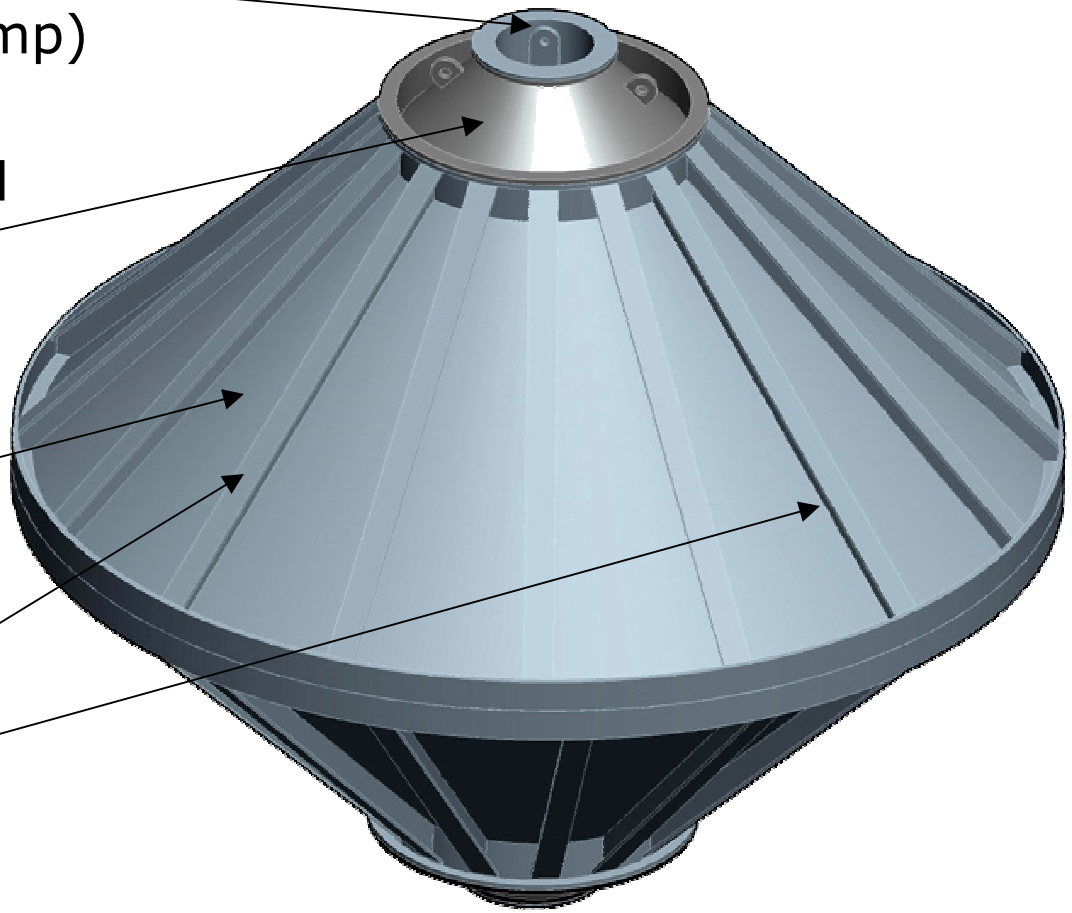
Chamber Shield (magnets not shown)

Removable Pole Shield
(contains polar cusp dump)

Removable Upper Shield
(contains upper
blanket modules)

50 cm thick
water-cooled shield

Support
I-beams



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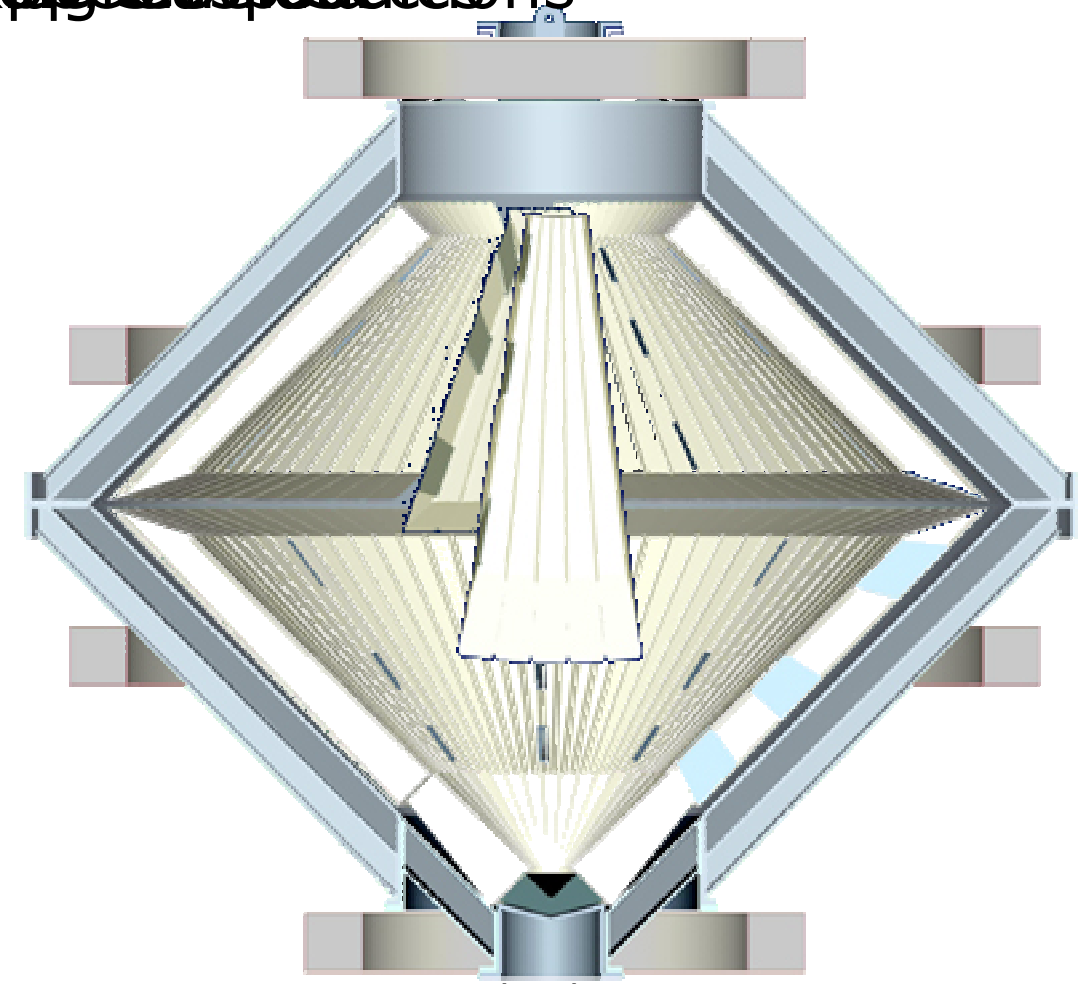
Chamber Maintenance Scheme

Remove Blanket Modules



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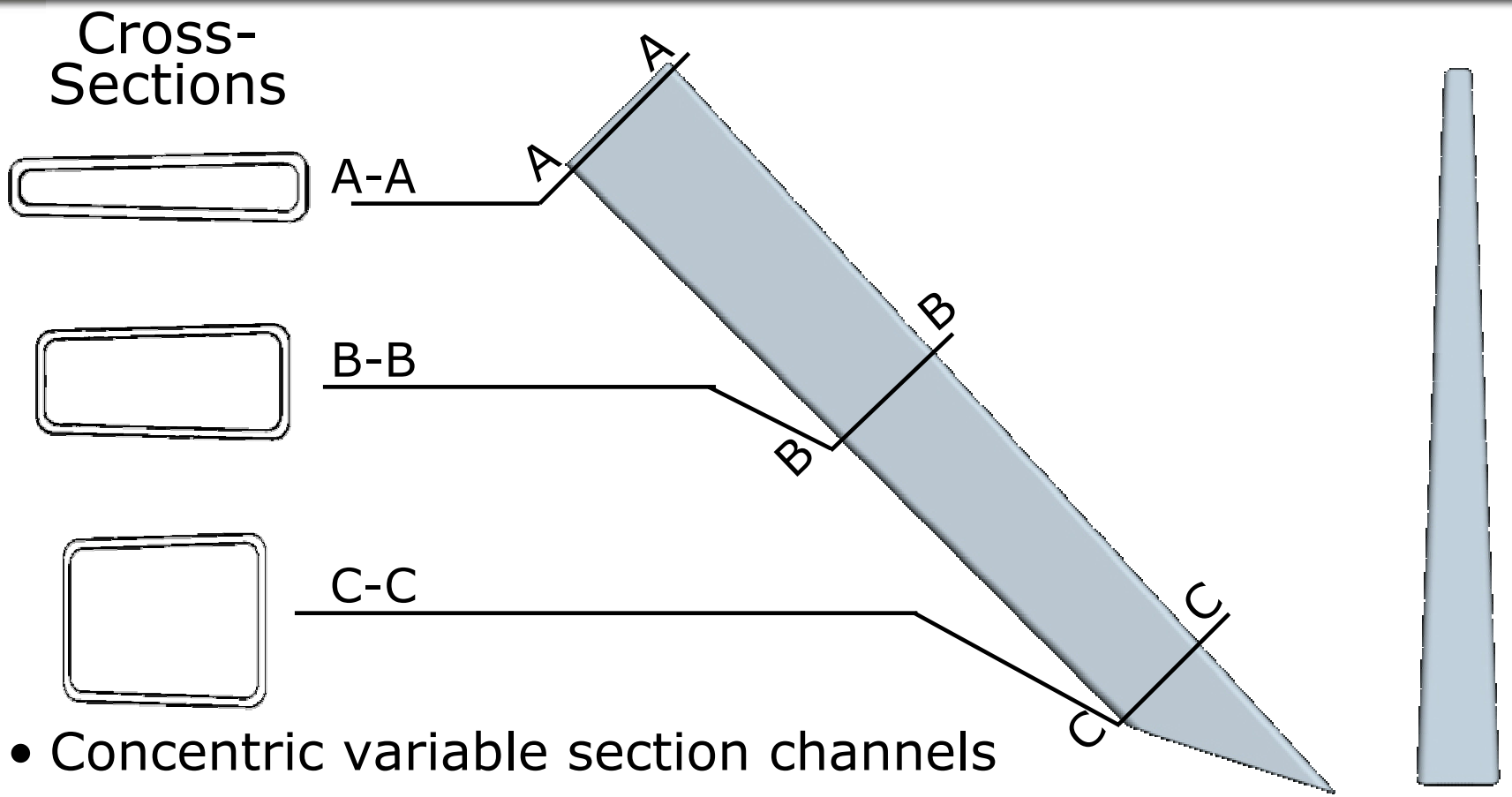
Blanket Sub-Module



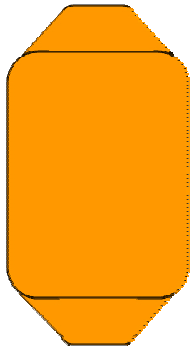
- Concentric variable section channels
- SiC cooled by high velocity flow in gap
- Low velocity return flow in center channel

Blanket Sub-Module Fabrication

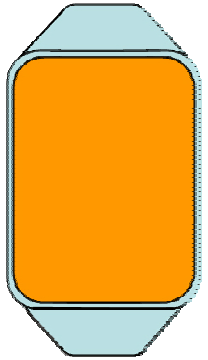
Issue:
Complex concentric walls prevent assembly of inner and outer channels

Solution:
Expendable core form fabrication

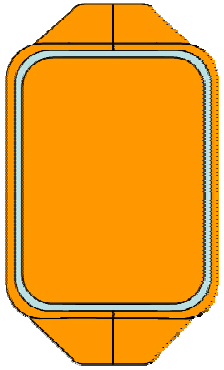
(1.5 mm tolerance for un-machined surfaces)



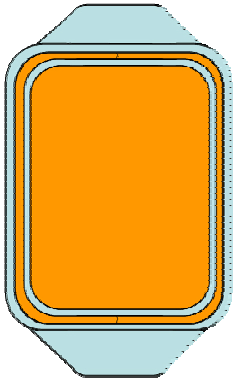
1. inner channel form



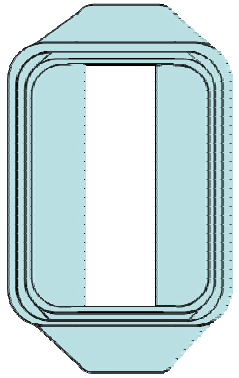
2. Lay-up & infiltrate inner channel



3. Two-piece form fitted over inner channel



4. Lay-up & infiltrate outer channel



5. Consume both forms via chemical or thermal process

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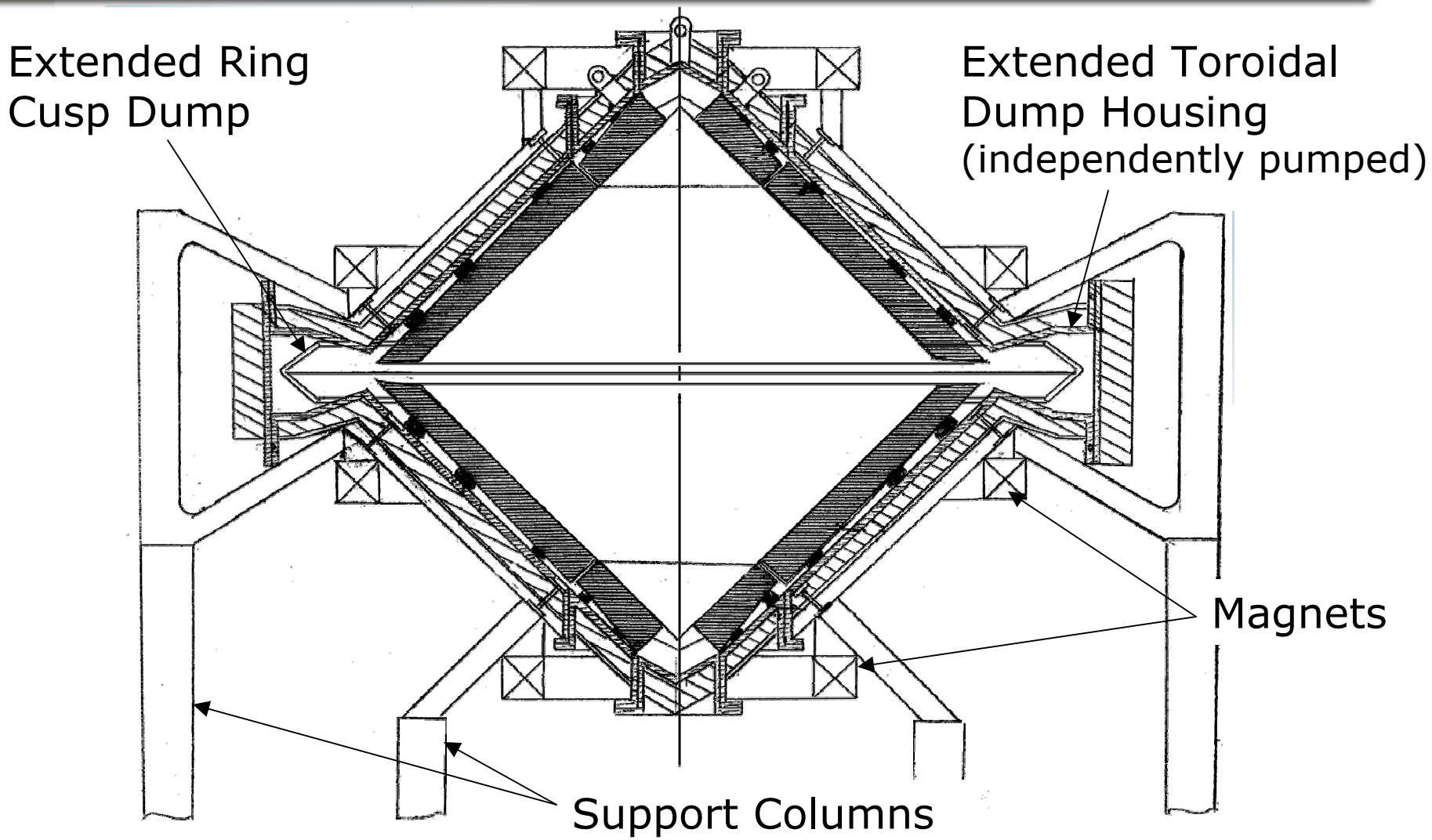
Ion Ring Cusp Lifetime Concerns

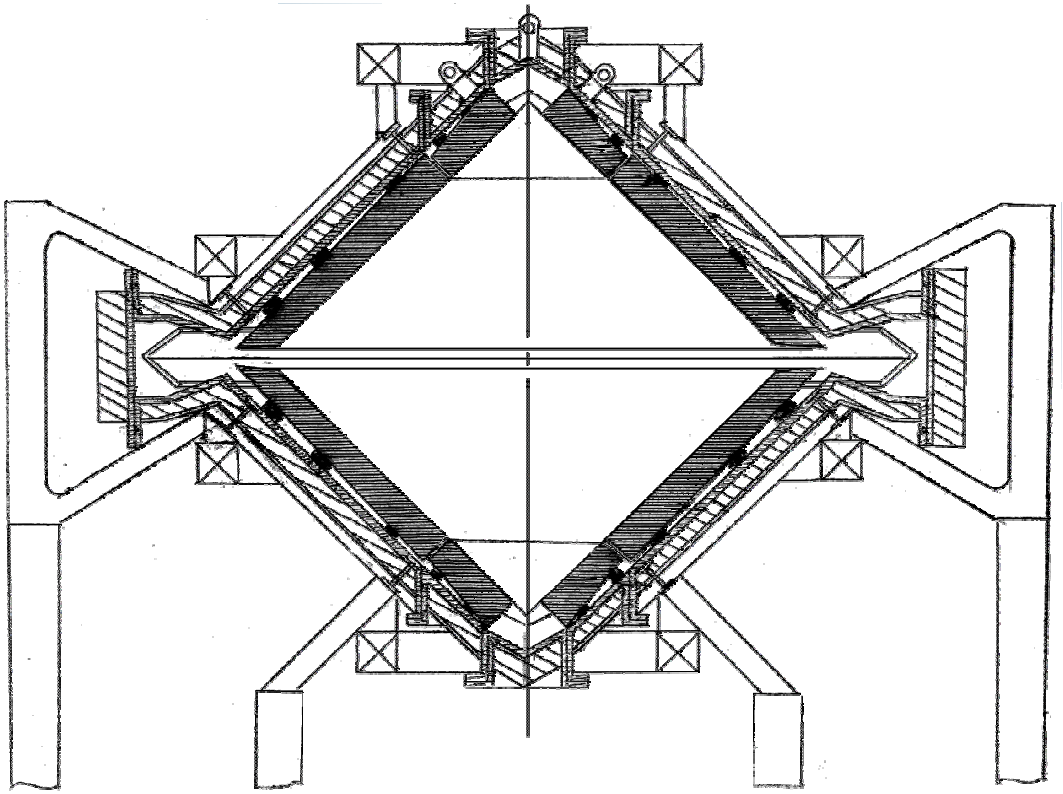
- **Issue 1**: Ion ring cusp dump must absorb very high levels of ion energy
  - See R. Raffray ion dump issues presentation
- **Solution 1**: Wetted ring cusp dump surface
  - Dump surface continuously replenished
- **Issue 2**: Vapor interfering with optics, target injection and chamber evacuation
- **Solution 2**: Externally Housed Dump

External Dump Concept



External Dump Issues

- Coil arrangement to divert ions through slot to external dump
- Difficulty limiting vapor entering chamber
- Complicates support of chamber upper half
- Complicates draining of mid-upper blanket modules



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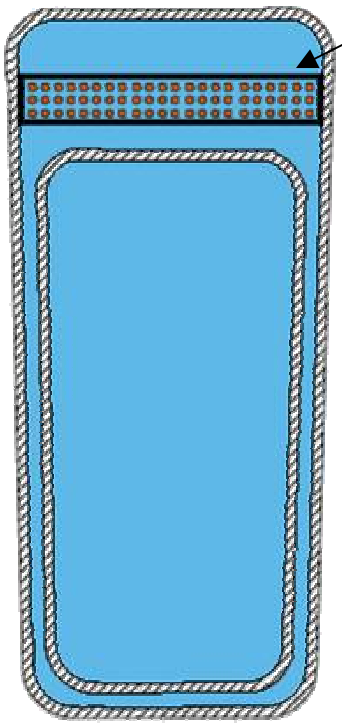
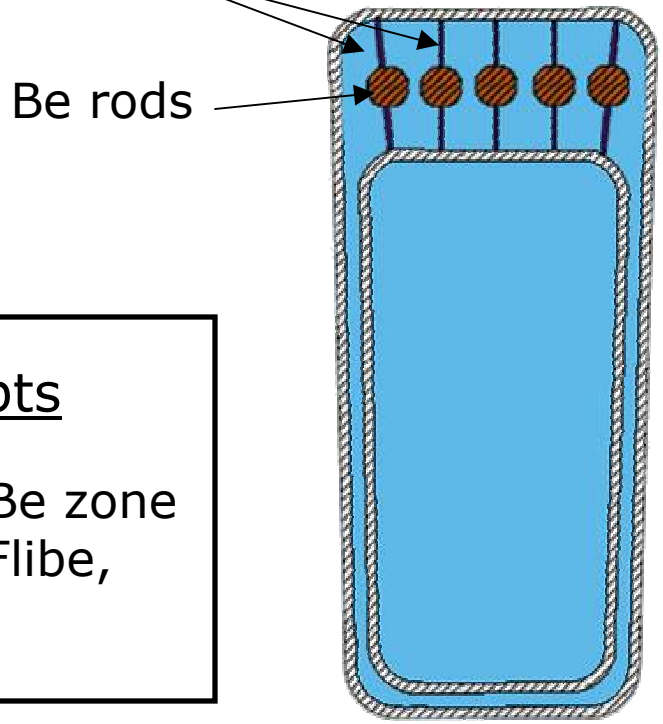
Sub-module cross-sections for two Flibe blanket concepts

Be balls contained in a SiC screen



Be rods



Both Concepts

- 3 cm effective Be zone
- 55% Be, 35% Flibe, 10% SiC

Conclusions & Recommendations

- Chamber maintenance scheme has little/no impact on magnets or lasers
- Expendable core fabrication viable for concentric channel configuration
- Concern over armored dump lifetime due to high level of ion energy
- Wetted ring cusp dump – externally housed
  - Mitigating chamber vapor introduces other issues
- Flibe blanket concepts incorporate Be for breeding
  - Adds complexity to an already complex design

Final Thoughts

Designing a chamber for magnetic intervention is challenging …

… Genius 99% perspiration …

… Got deodorant?