

# Mechanical Design for the Reference HAPL Chamber Blanket

I.Sviatoslavsky and Mohamed Sawan

Fusion Technology Institute

University of Wisconsin, Madison, WI

With contributions from

A. R. Raffray (UCSD) and X. Wang (UCSD)

and G. Sviatoslavsky, (FTI, UW)

HAPL Meeting

University of Rochester, Rochester, NY

November 8 & 9, 2005

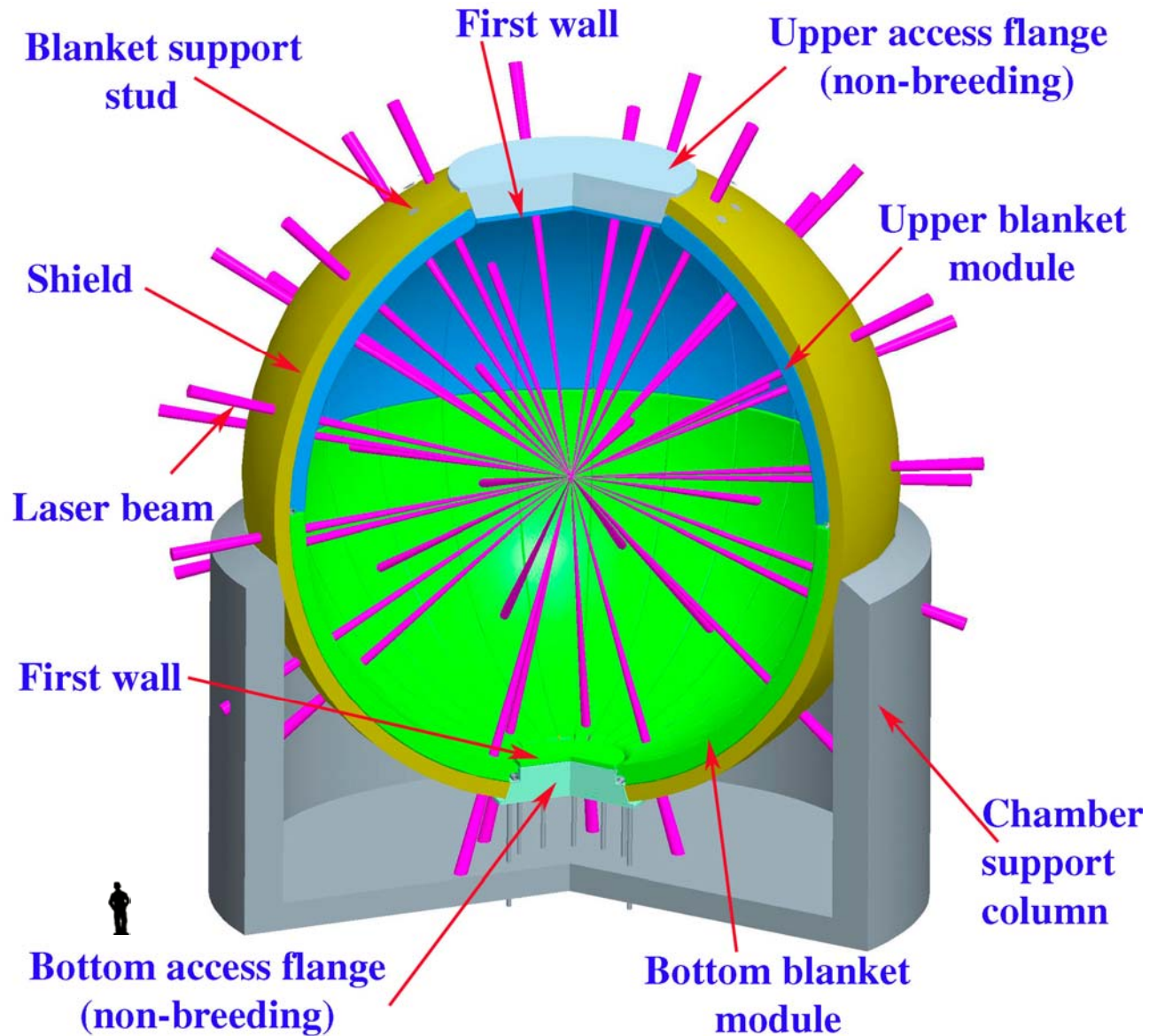


# Description of the Large Reference HAPL Chamber

- The chamber is spherical with the first wall at 10.5-10.75m radius followed by a Li blanket 60 cm thick at mid-plane, increasing to 82 cm at the extremities.
- The blanket is followed by a shield 50 cm thick consisting of curved I-beams oriented vertically with a 3 cm thick plate on the surface behind the blanket and a 10 cm thick plate on the back. The spaces between the I-beams are filled with balls made of  $B_4C$  which are cooled with He gas.
- At the north pole of the chamber there is an access flange 4 m in radius and at the south pole an access flange 2m in radius. These access flanges are non-breeding, consisting of a He cooled FW followed by a shield, and are used for maintenance purposes.



# Large Radius Chamber Configuration with Li Blanket



# Description of Blanket

- The chamber is equipped with two sets of blanket modules, an upper set and a lower set. The lower set extends from the bottom access flange to the mid-plane, and the upper set extends from the mid-plane to the top access flange.

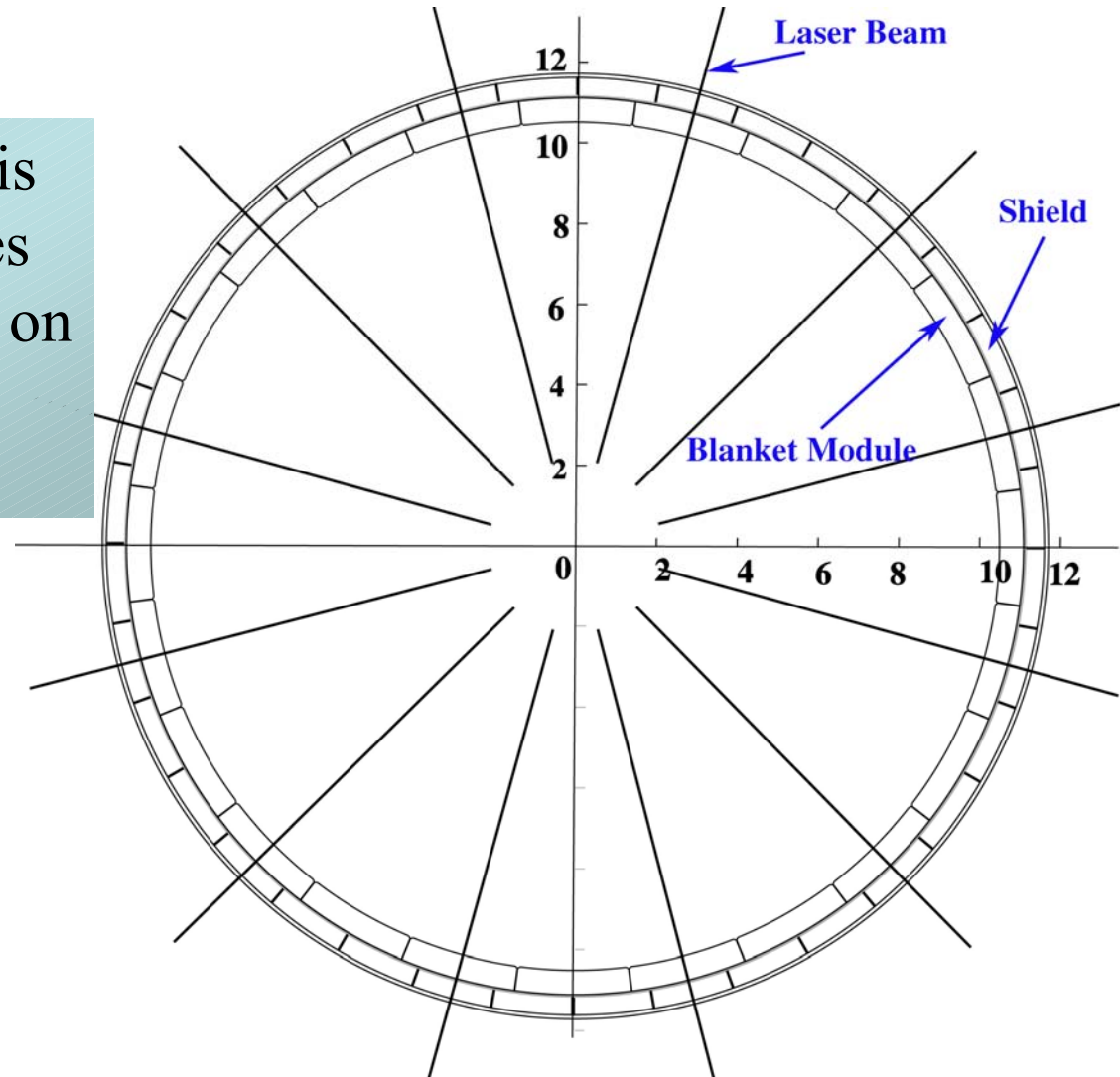
Both sets have supply and return Li coolant connections in the form of coaxial tubes located at the mid-plane.

- Each module consists of nine sub-modules arranged toroidally. Each sub-module has two concentric rectangular tubes separated by a constant gap. As the shape of the sub-module changes, the hydraulic diameter is maintained constant.
- The blankets are secured to the shield with a mechanical latching device on one end and by a bolt on the other end.

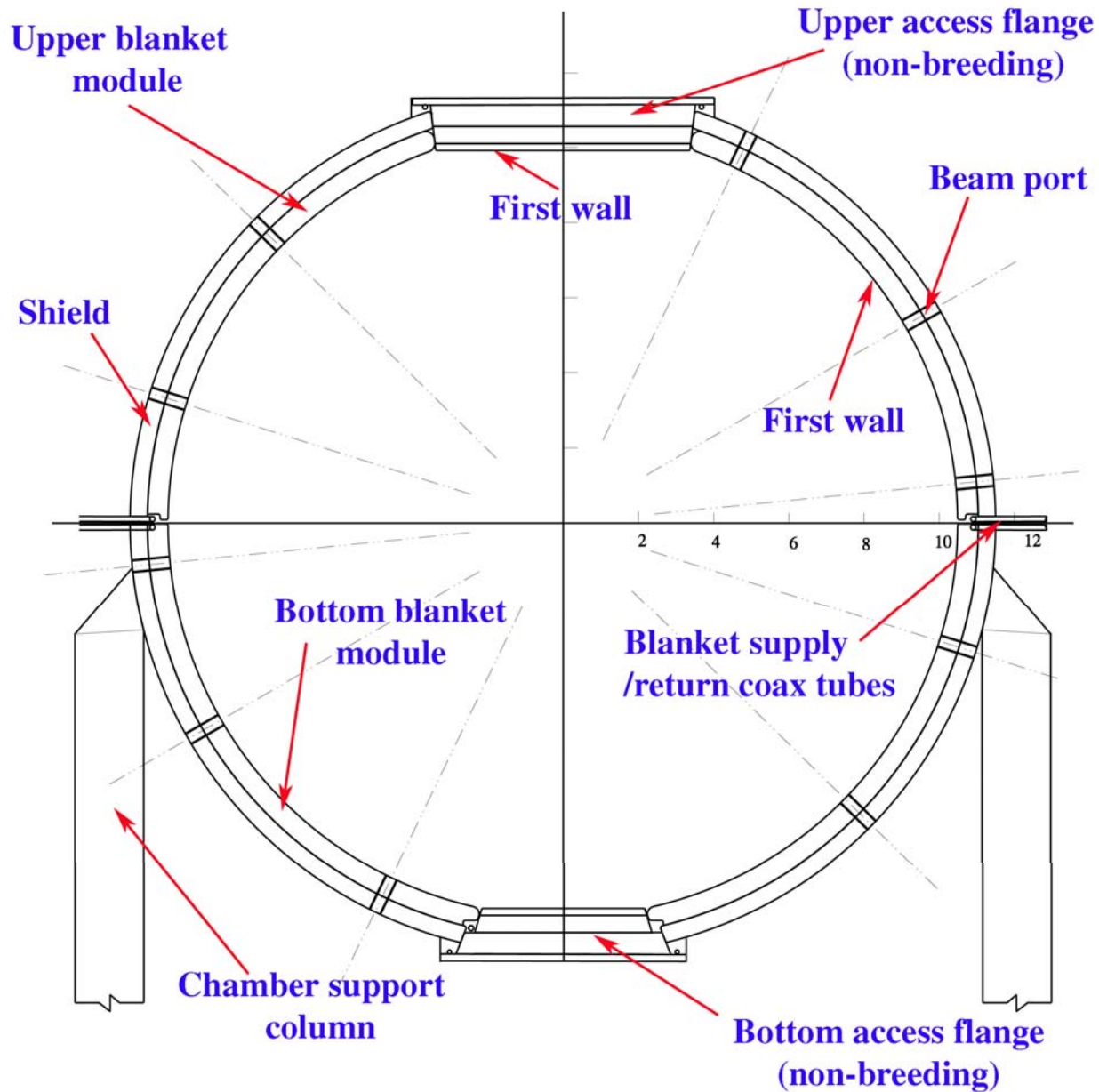


# Top View of the Chamber at Mid-plane Showing Blanket Modules and 12 Laser Beam Directions

Toroidally the blanket is divided into 24 modules on top and 24 modules on bottom, each covering  $15^\circ$  of circumference

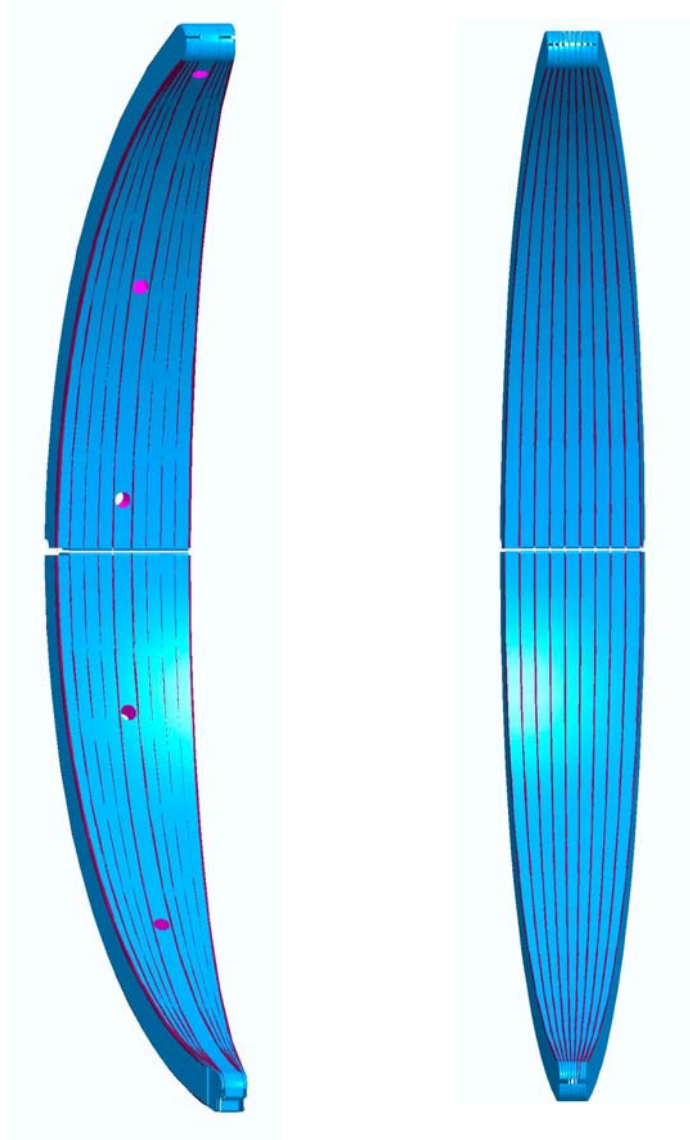


# Side View of 10.5 m Radius Chamber

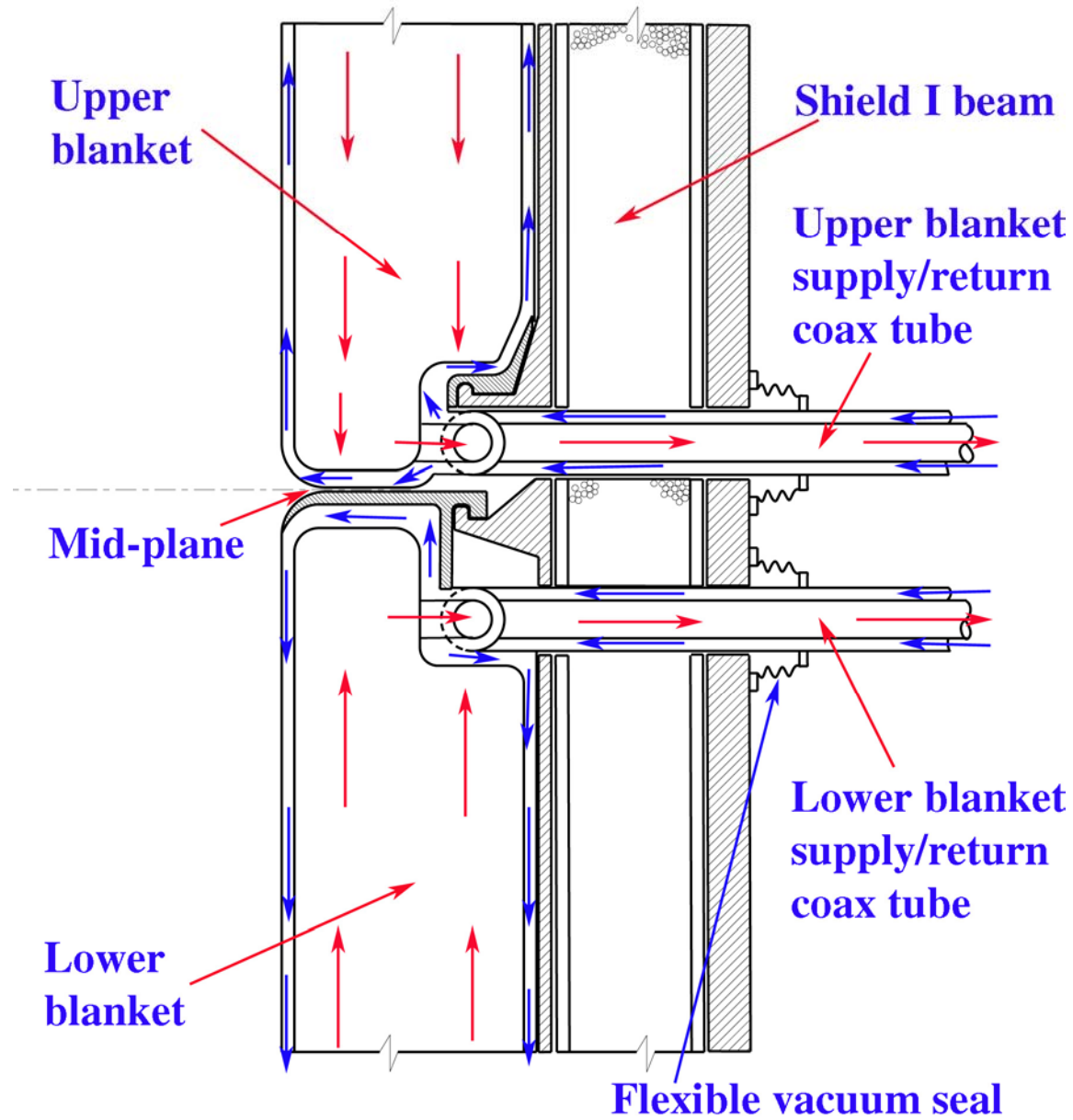


# Several Complementary Blanket Modules

Two types of complementary modules are shown, one type without beam ports and the other with beam ports

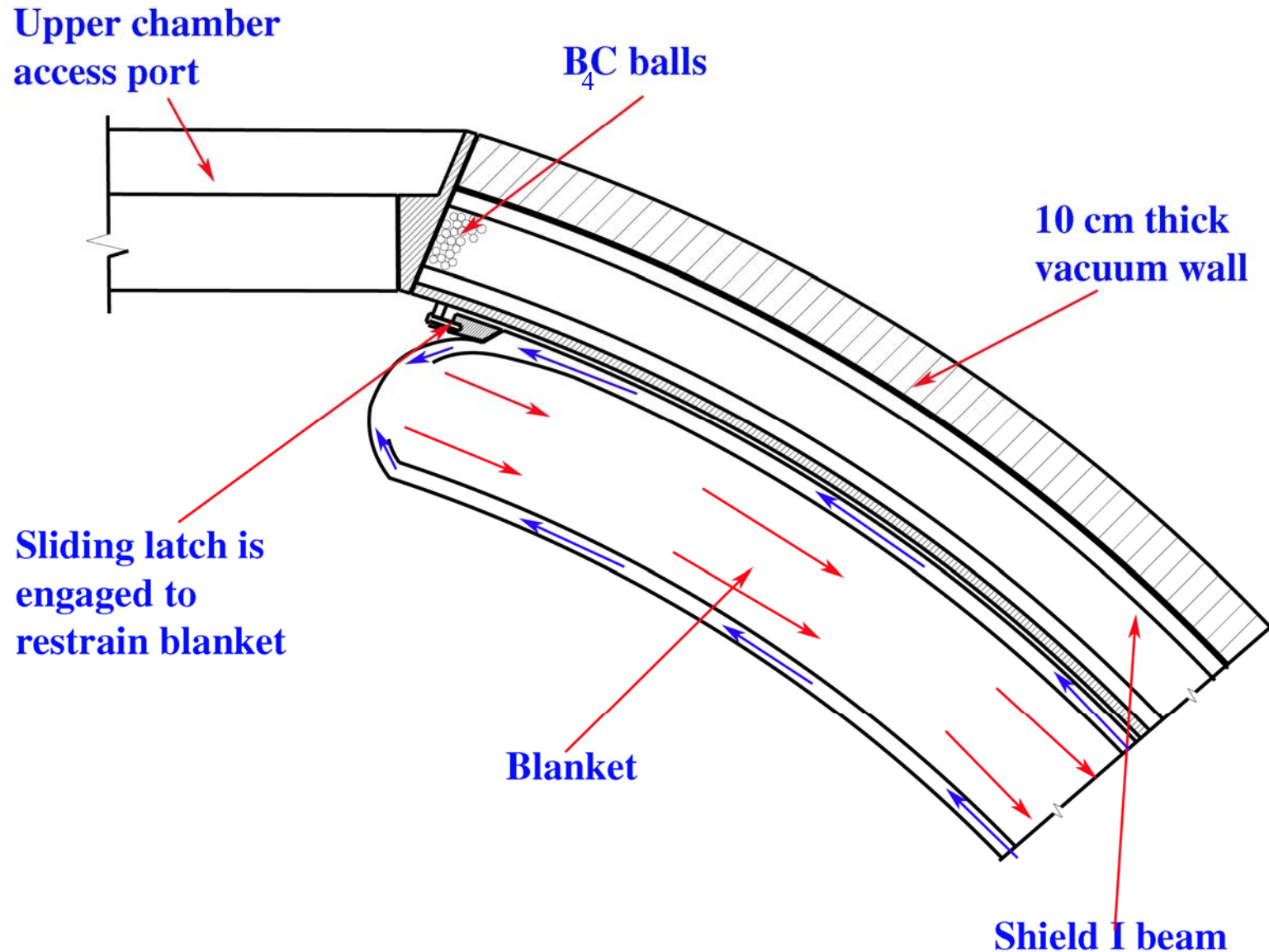


# Interface Between Blankets at Mid-plane





# Blanket Restraint at Opposite End from Mid-plane

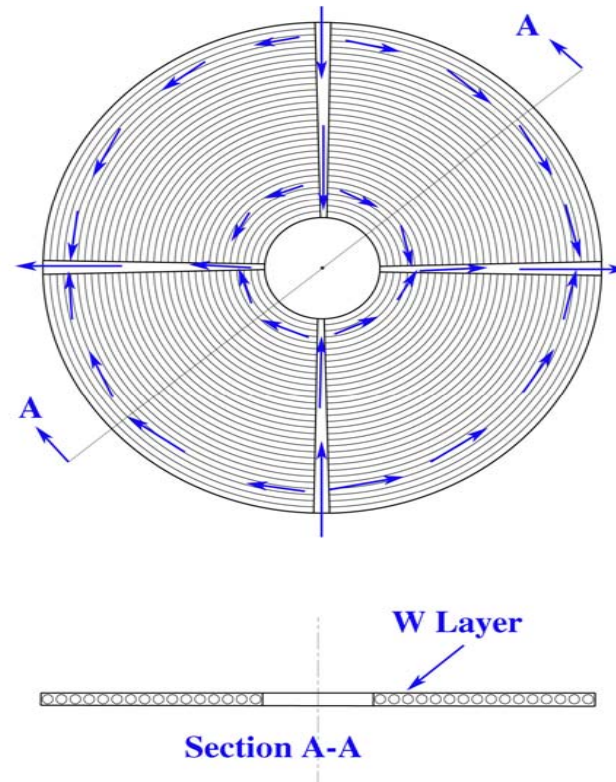
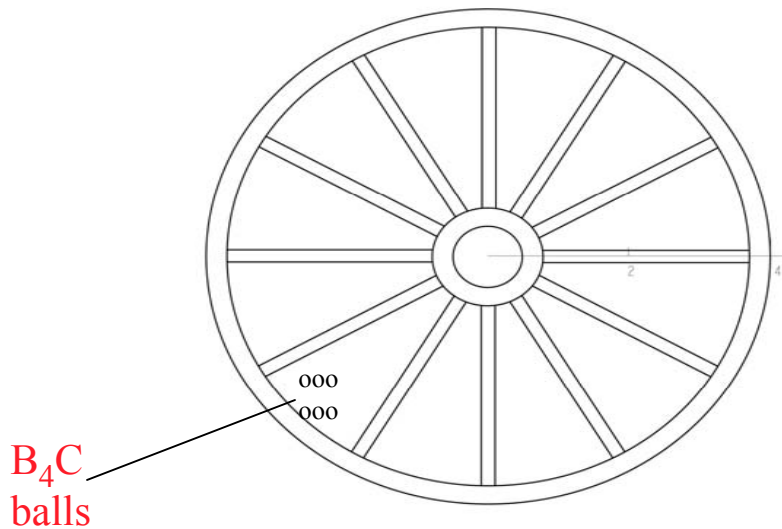


# Upper Removable Access Flange

(bottom access flange has the same construction but is smaller)

## Shield

I-beam structure forms the shield. Spaces filled with  $B_4C$  balls cooled with He gas



## First Wall

FW facing target consists of square coiled channels diffusion bonded to each other and to sheets on both sides. He gas as shown above circulates through. Bottom sheet is W coated.

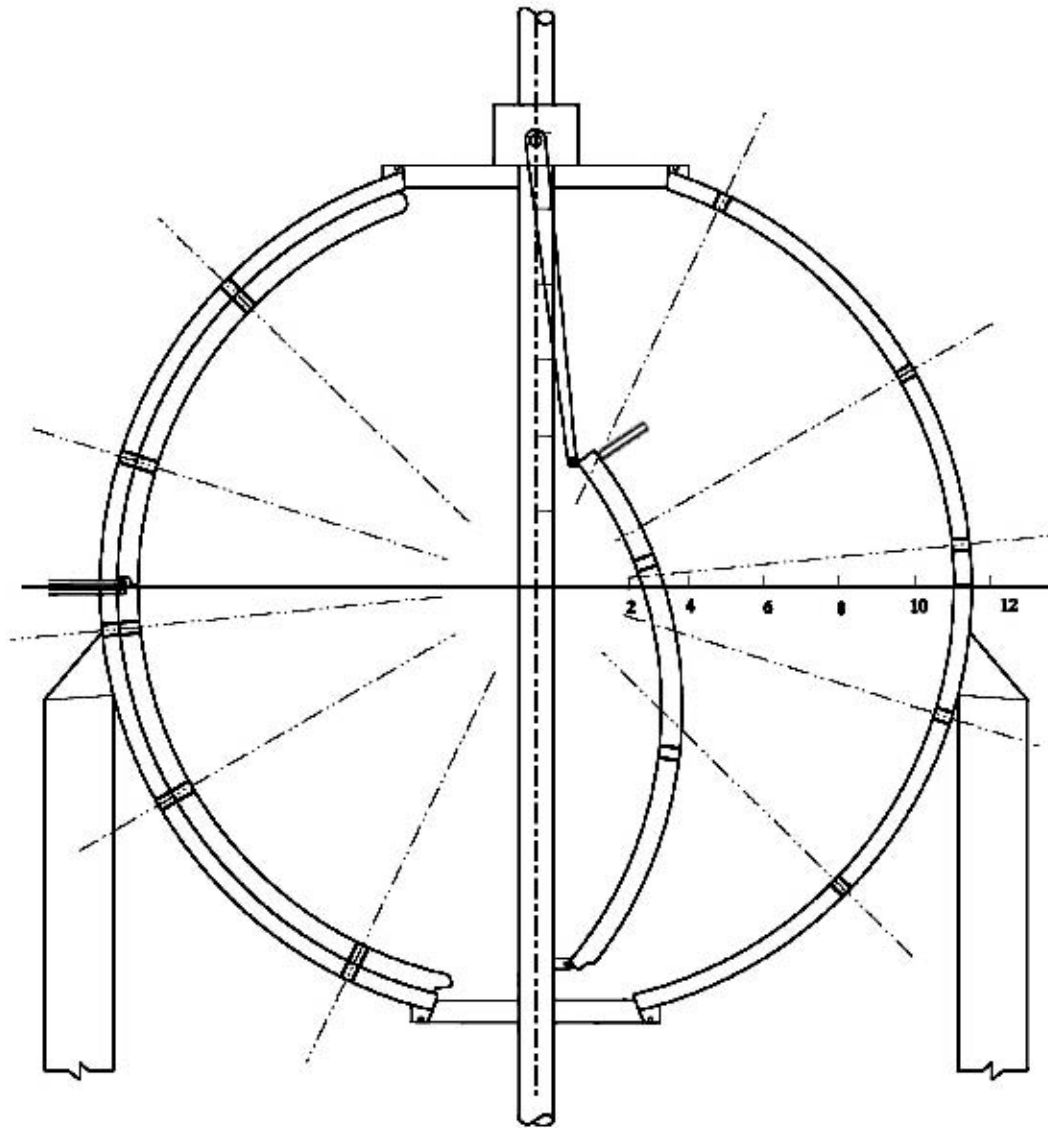


# Blanket Maintenance Scheme

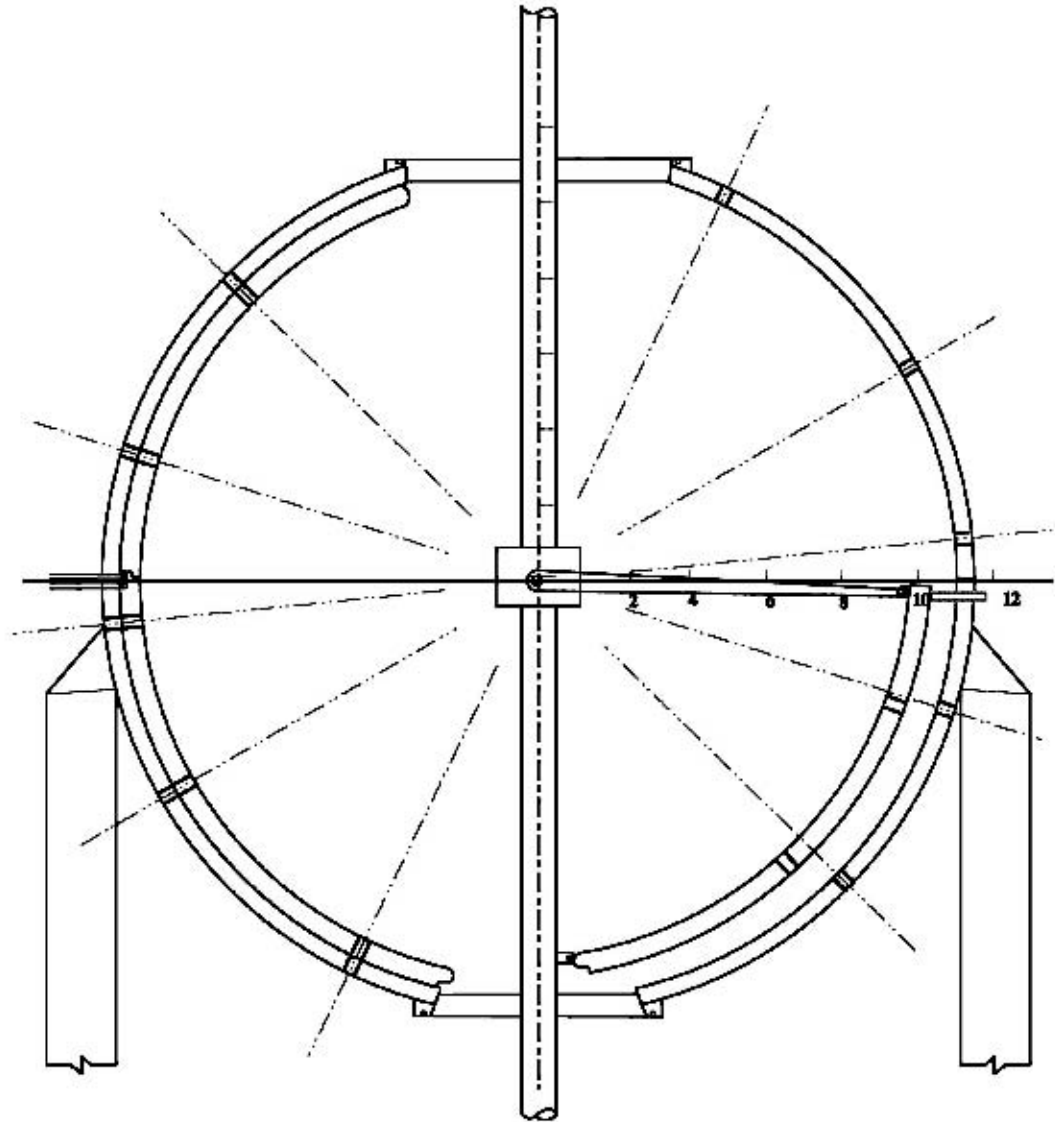
- The blanket modules are maintained from inside the chamber. A column is inserted through the polar access ports equipped with a sliding sleeve. A blanket module is attached to the sleeve which is then lowered into the chamber.
- The module is attached to the sleeve with pivots. The narrow end of the module is pivoted near the column, while the wide end (mid-plane) is pivoted on a shaft attached on a second sleeve. When this sleeve is lowered (or raised) it moves the mid-plane end of the module sideways to make it conform to the curvature of the shield.
- The column is then displaced sideways, such that the module engages with the shield. A slight upward motion allows the module to be hooked to the shield.
- On the opposite end from the mid-plane, the module is secured by activating a latch which fixes the module to the shield.
- The same scheme is used for maintaining both upper and lower modules, by simply reversing the sliding sleeves. For the upper modules, the pivoted shaft is moved up to displace the mid-plane end of the module toward the shield, and down for the lower modules to do the same



# Blanket Module Maintenance I



# Blanket Module Maintenance II



# Blanket Module Maintenance III

