ANALYSIS OF THE BEAM-LITHIUM INTERACTION AND THE FLOW STABILITY IN THE IFMIF TARGET ASSEMBLY TO DEFINE THE DIAGNOSTIC TOOLS REQUIRED FOR SAFE OPERATION

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The IFMIF target concept is based on a free surface, 25 mm thick Lithium film sent with high velocity (10-20 m/s) along a backwall of concave geometry (radius of 250-500 mm). The concave geometry generates a compression of the Li layer and thus increases the margin to boiling in the Bragg peak of the impinging deuteron beam (in a depth of 20 mm).
The thickness of the jet is determined by the two bounding conditions

- Neutron flux in the high flux test module (14.5 10^{14} n/cm^{2}s with 25mm Li): A thicker film reduces the flux
- Integrity of the backwall: Impingement of the deuteron beam on the backwall damages backwall due to heat input (W/particle) and radiation damage (dpa/particle)

These bounding conditions lead to the requirement that the film thickness must be maintained at 25 ± 1 mm. The difference between the actual penetration depth of the beam and the nominal film thickness is derived from a margin applied to take into account several factors:

- Beam energy variation and sharpness of stopping range
- Thermal effects within the Li (Goertler wakes) affecting the backwall
- Geometric tolerances of the flow channel

The current requirement thus implies that the waviness of the surface must be controlled in such a way that the thickness of the Li film within the beam footprint is always and on every location between 24 and 26 mm. This requirement imposes a challenge on the

- Design of the TA and the target facility to assure this performance
- Operational conditions to maintain this performance
- Diagnostics to detect any deviation from this requirement due to
    - Degradation
    - Incidents
    - Loss of performance of components

In the contribution, we will re-analyse the foundation for this limitation, define the requirements for flow structure diagnostics, explore the performance of potential diagnostic tools and develop a control strategy for the IFMIF operation.