# LIF diagnostic in the magnetic nozzle of an ECR thruster

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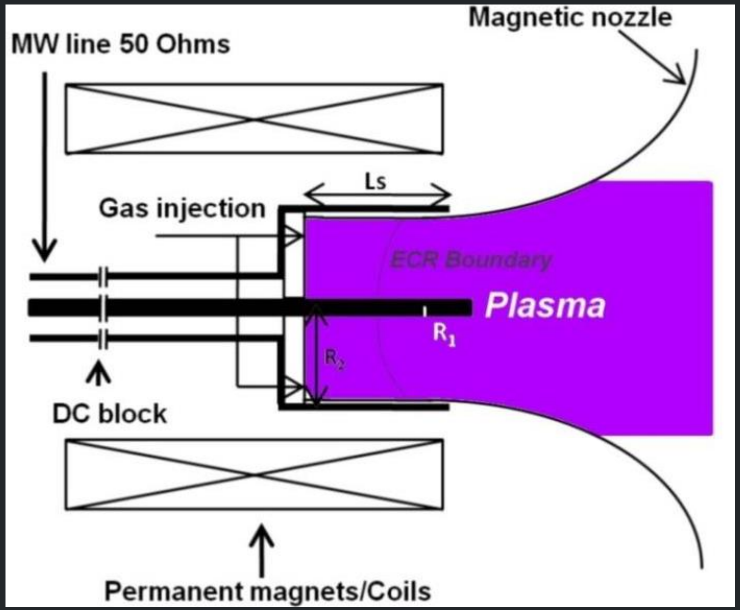
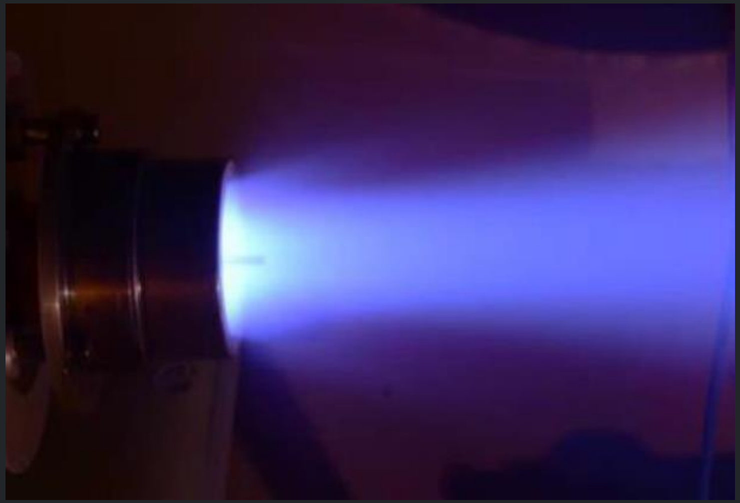
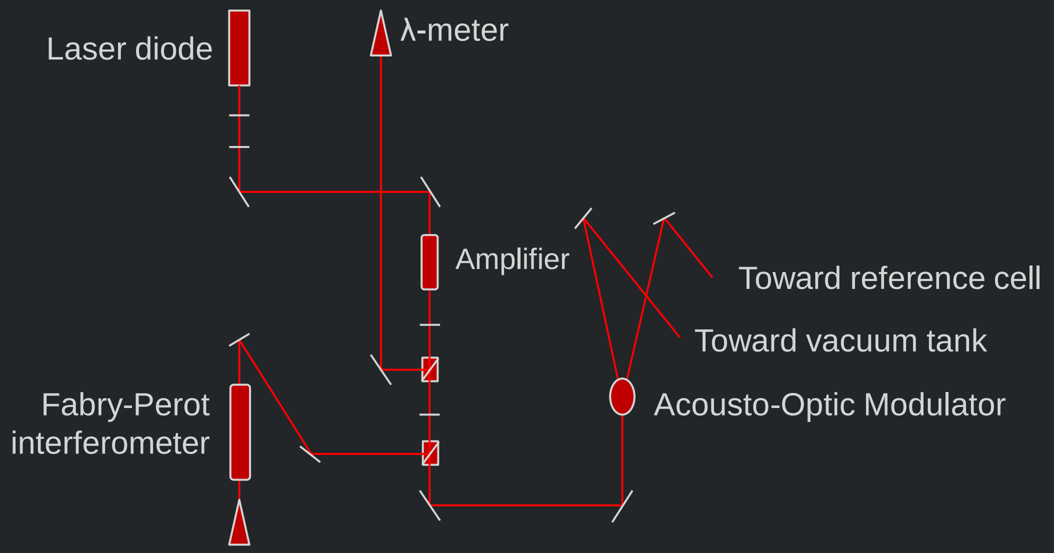
# The ECR thruster

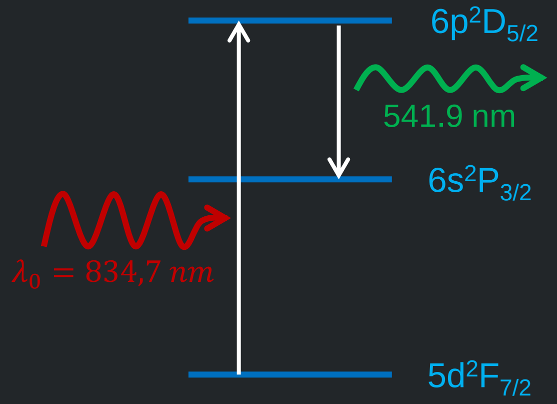
- **Conception**
  - 30 W of µ-wave power at 2.45 GHz
  - A ring shaped magnet with $B_{throat}$ = 875 G
  - Xenon injected at 1 sccm
- **Performances**
  - T = 1200 µN
  - Isp = 2500 s
  - Promising performances



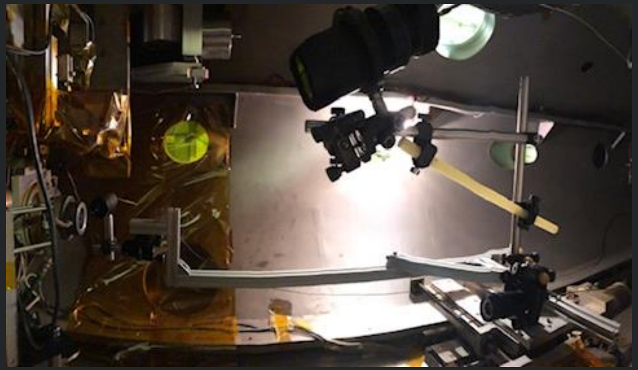
# LIF Diagnostic setup

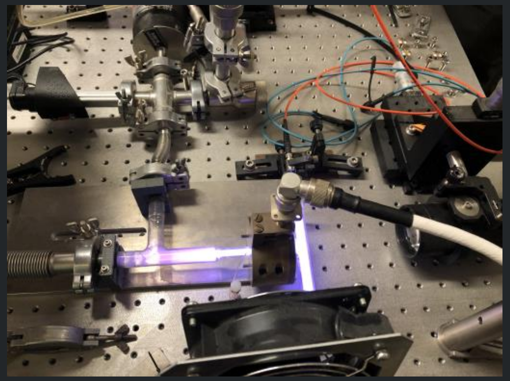


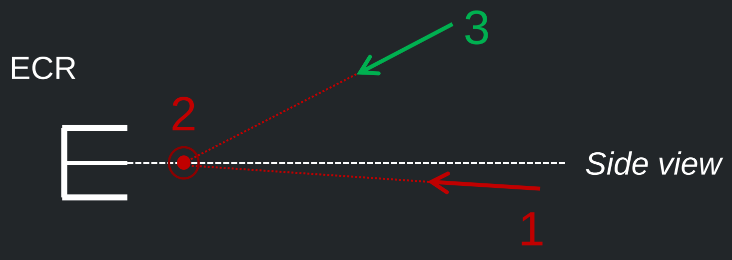



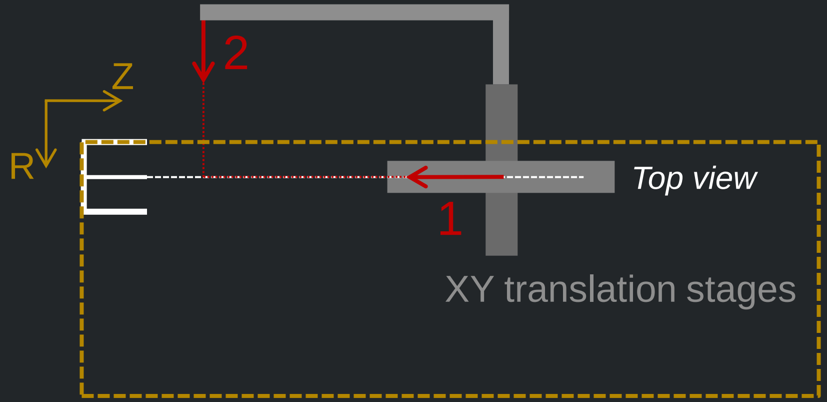

Doppler effect :

$$v_i = \lambda_0(\nu - \nu_{ref})$$



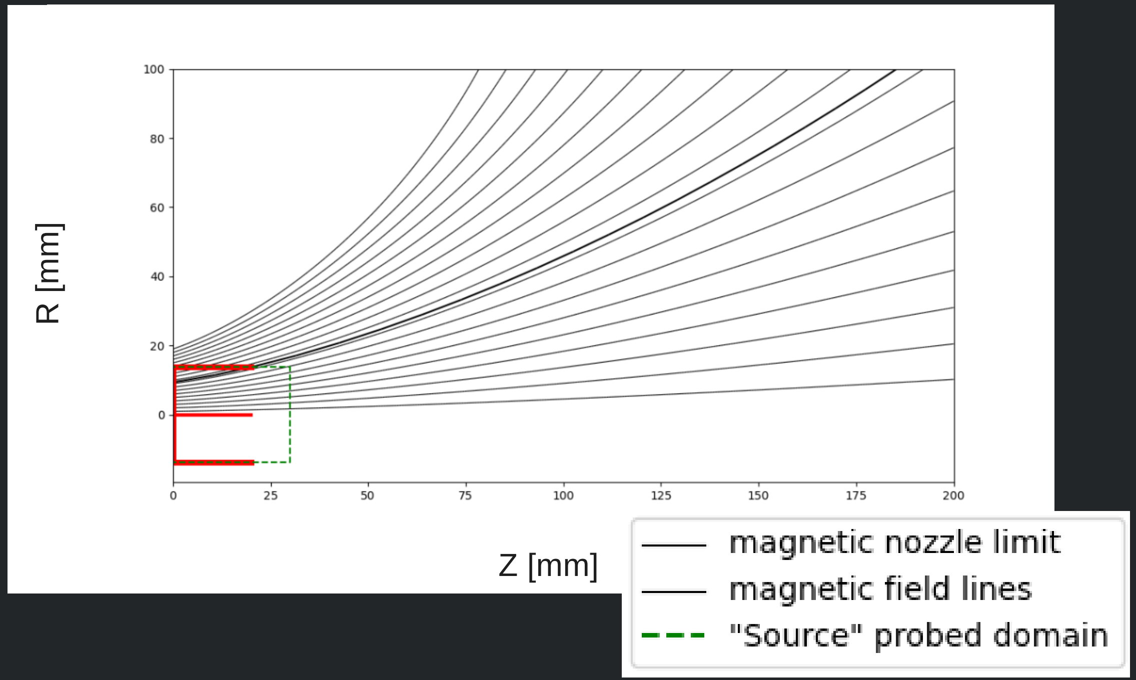




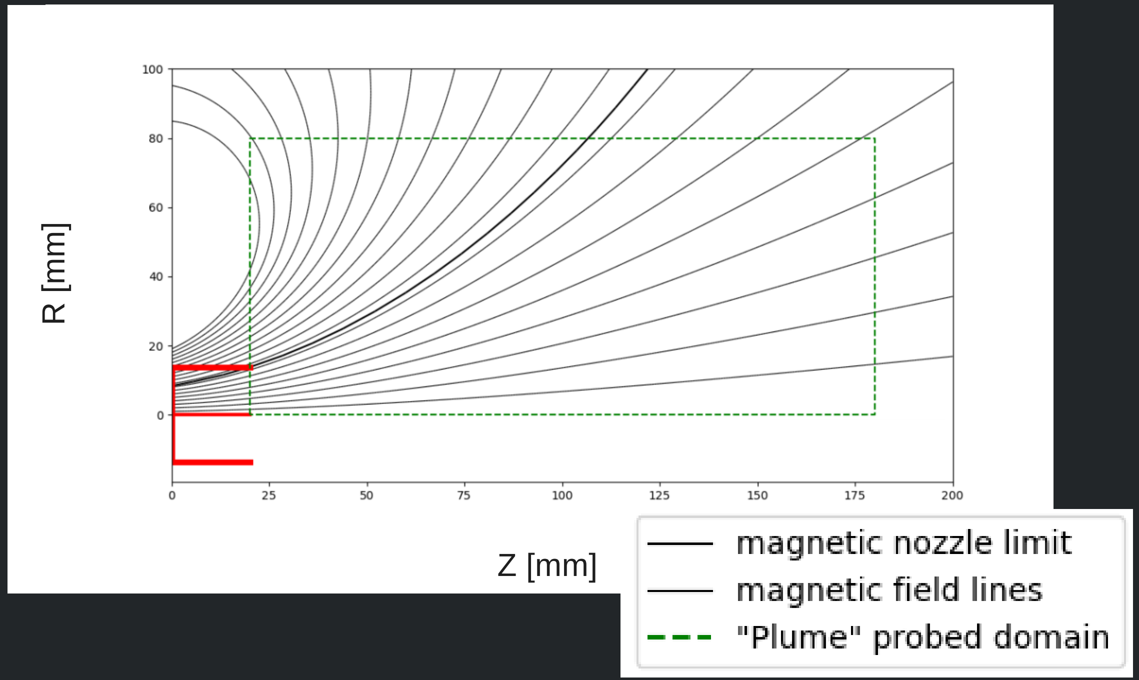

1 : Longitudinal measurement
2 : Transversal measurement
3 : Detection

# Different magnetic configurations




**Configuration « Small Magnet »**

- $R_{source}$ = 27.5 mm
- $Z_{source}$ = 20.0 mm




**Configuration « Big Magnet »**

- More diverging magnet
- Has been shown to lead to better performances than Small Magnet

# LIF results : Longitudinal velocity

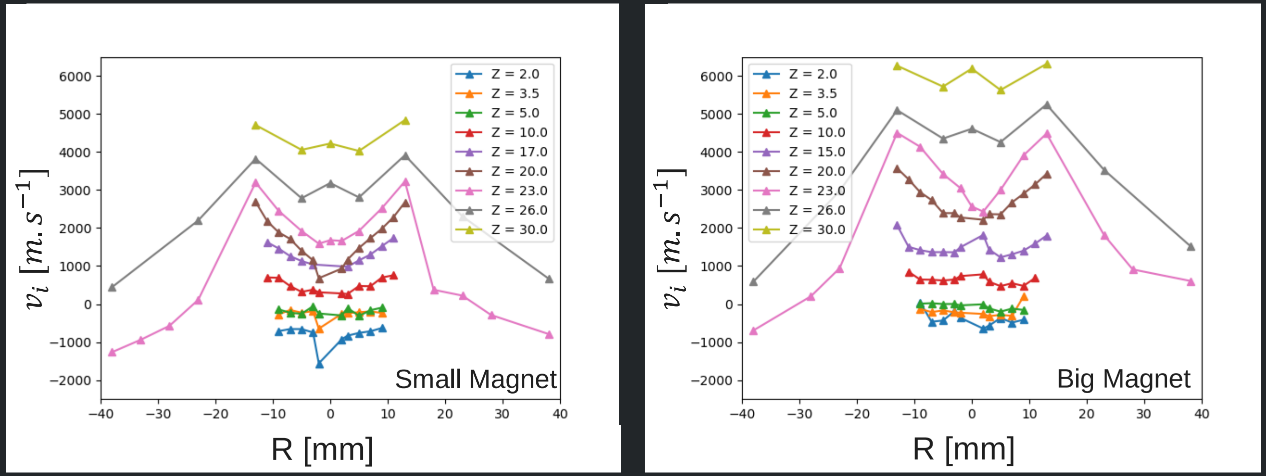



FIGURE : Ion velocity at different axis location in the source of an ECR thruster

- The magnetic topology has an impact on the accelerating potential even in the source of the ECR thruster
- A more diverging magnet (Big Magnet configuration) yields greater ion acceleration
- Ions flow backward near the bottom of the source

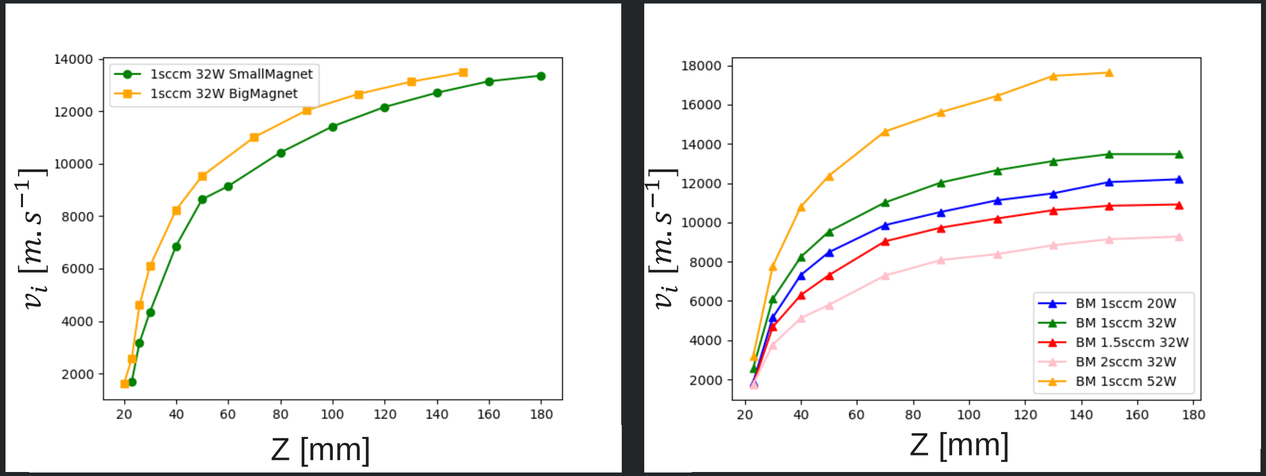
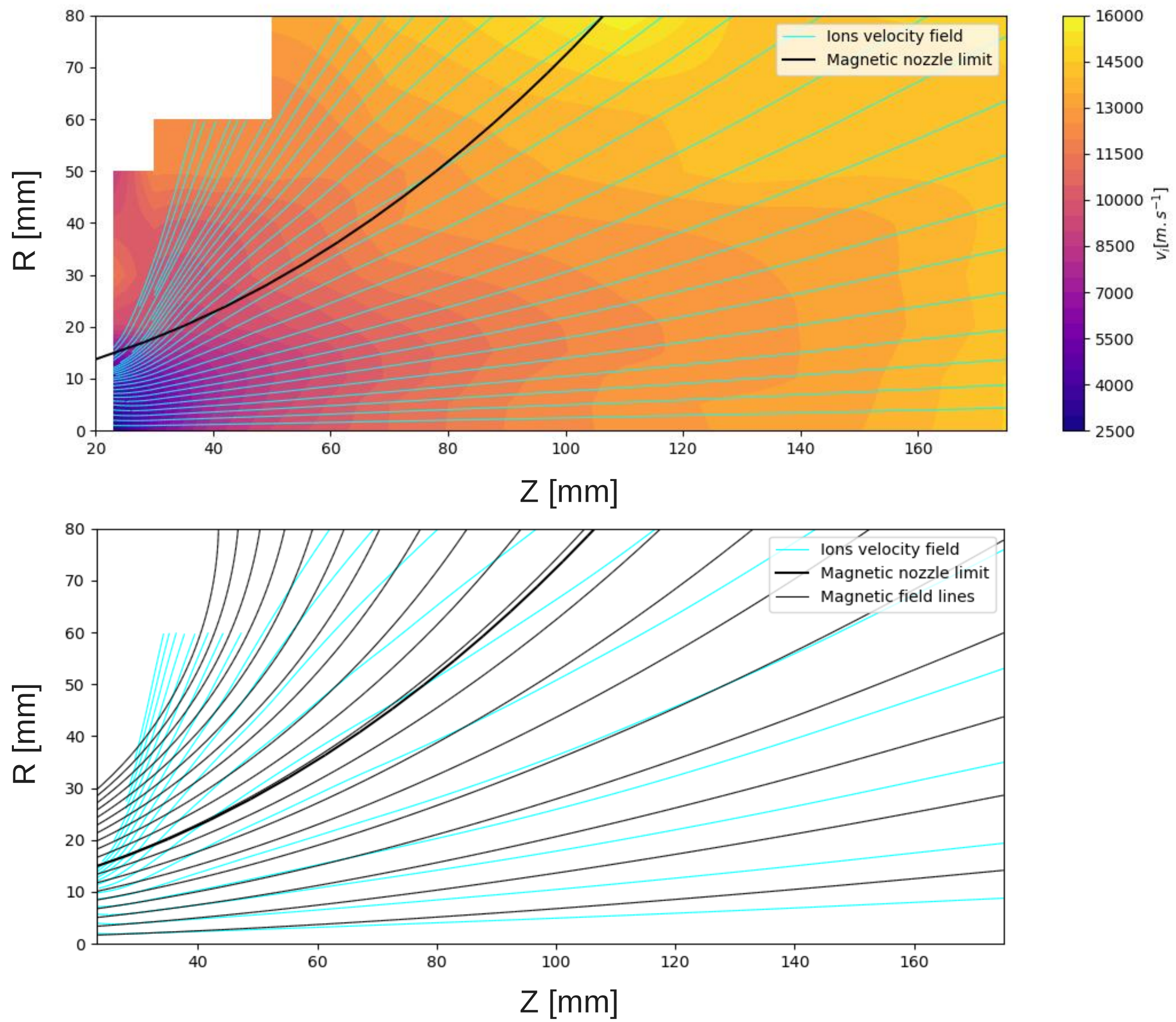



FIGURE : Longitudinal ion velocity in the thruster axis at different location for two magnetic nozzles (left) and several condition (right)

- (*left*) Higher ion velocity with more diverging magnet
- (*right*) In the axis of the ECR thruster :
  - $v_i$ increases with power
  - $v_i$ decreases with gas flow

# LIF results : plume of the ECR thruster – Big Magnet configuration

- $\overrightarrow{v_i}$ available through almost all the domain
- Ion velocity field lines are more convergent than the magnetic field lines
- Within the plume, the angle between ion trajectories and magnetic field lines does not exceed 5°



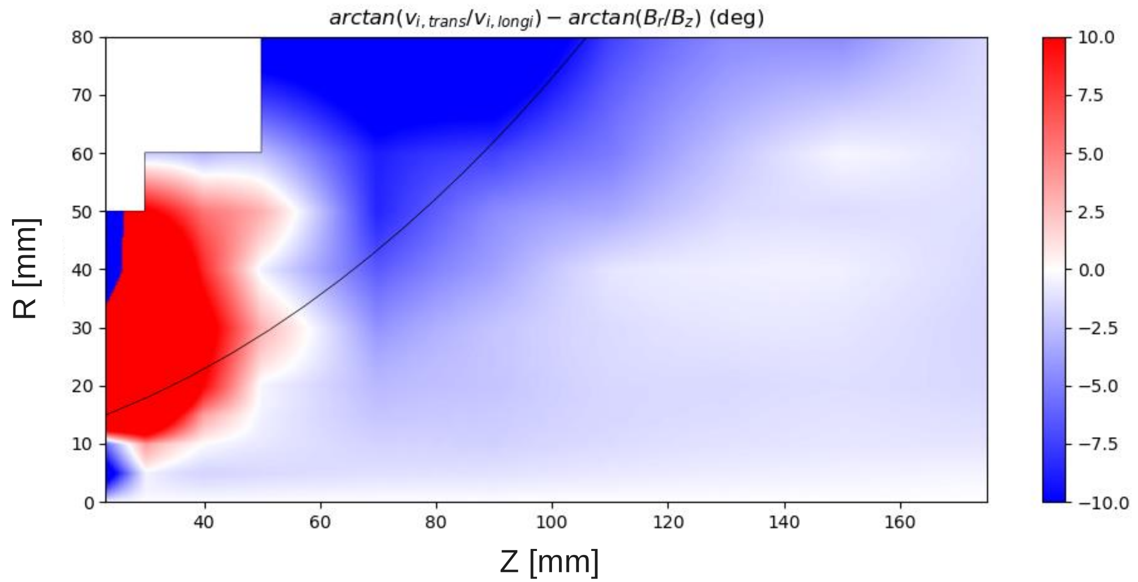




FIGURE : Comparison between ion velocity and magnetic field lines

# Conclusion and perspectives

- **Conclusion**
  - Implementation of a LIF setup to measure the two components of the ion velocity
  - Two magnetic configurations were tested
  - Ions trajectories are more convergent than the magnetic field lines

- **Perspectives**
  - Compute the relevant quantities along the velocity field lines
  - Investigate the detachment of the ions from the magnetic field lines
  - Compare the results with what can be found in literature

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