Golem- analysis of rake probe data

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Golem

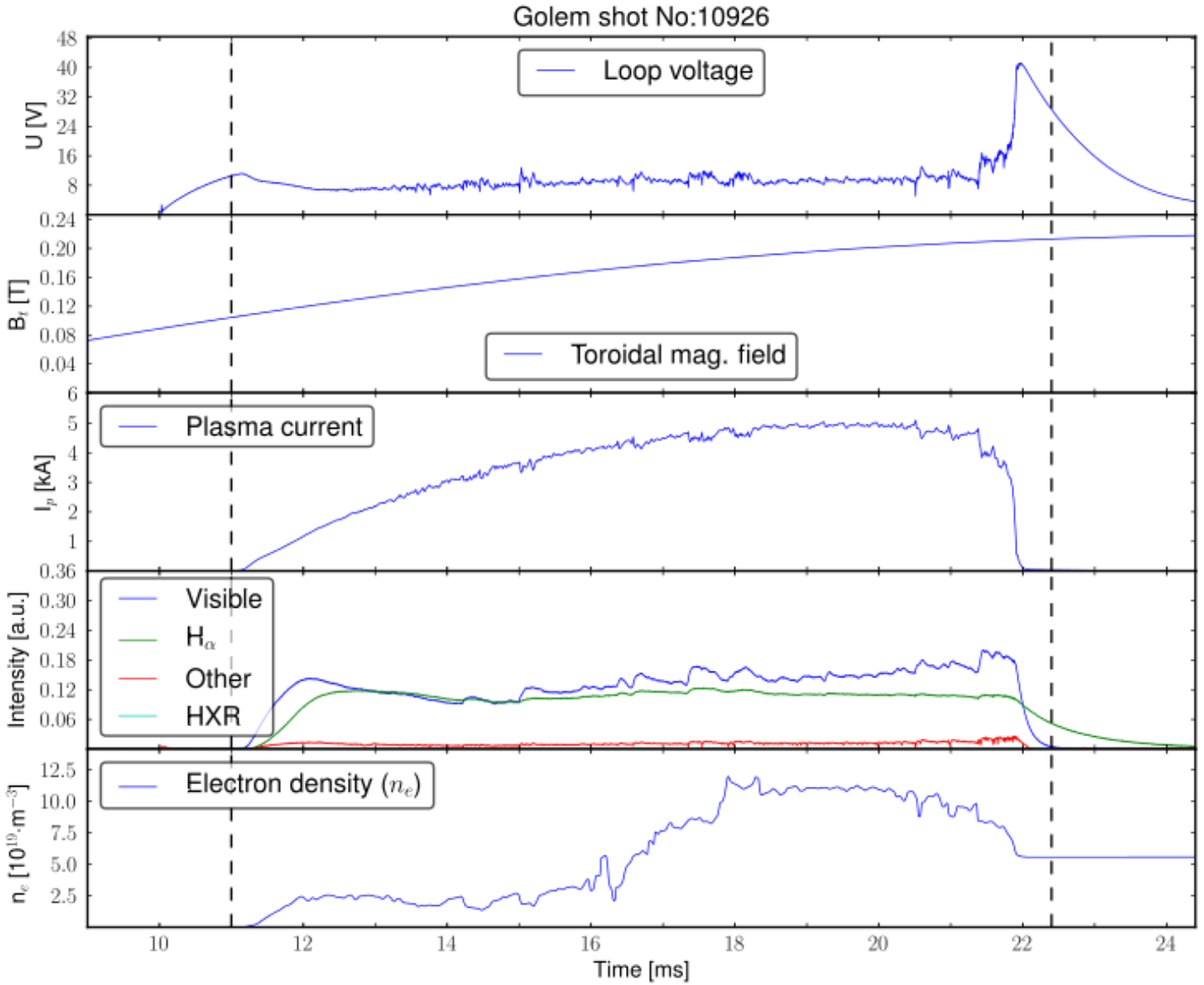
The oldest working tokamak in the world

- Located in Prague
- Can be remotely operated

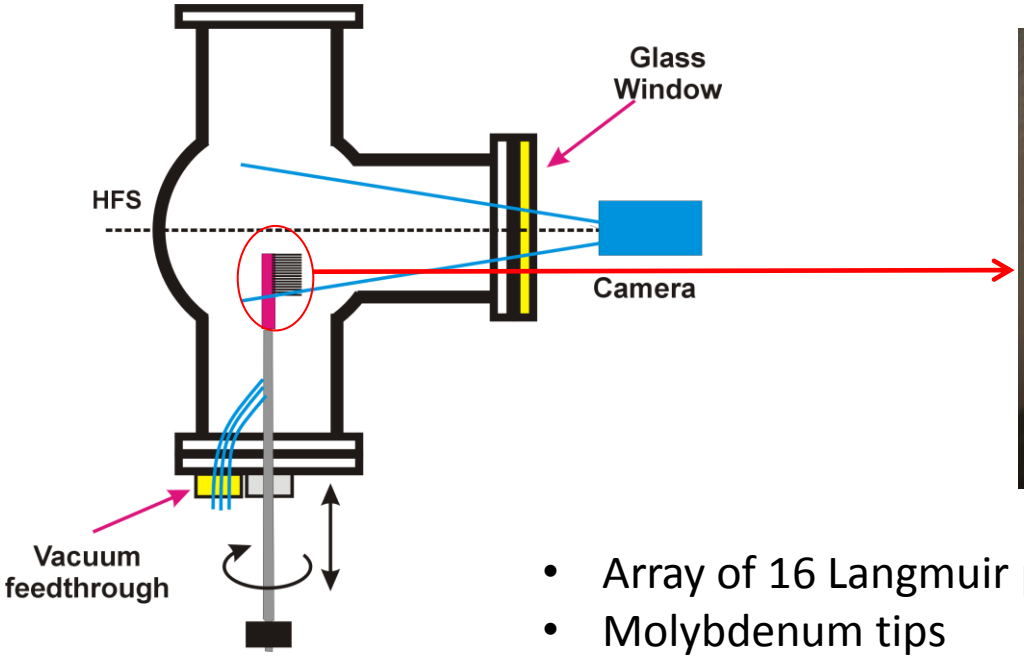
Parameters

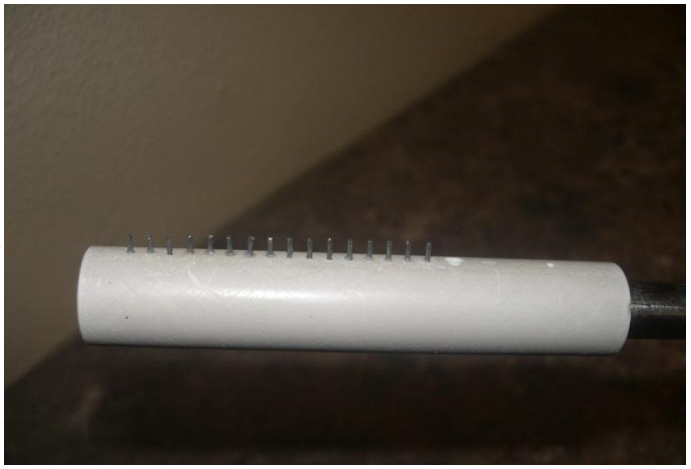
Toroidal magnetic field	**< 0.5 T**
Plasma current	**< 10 kA**
Plasma density	**< 10^{19} m^{-3}**
Electron temperature	**< 100 eV**

An example Golem shot



The rake probe

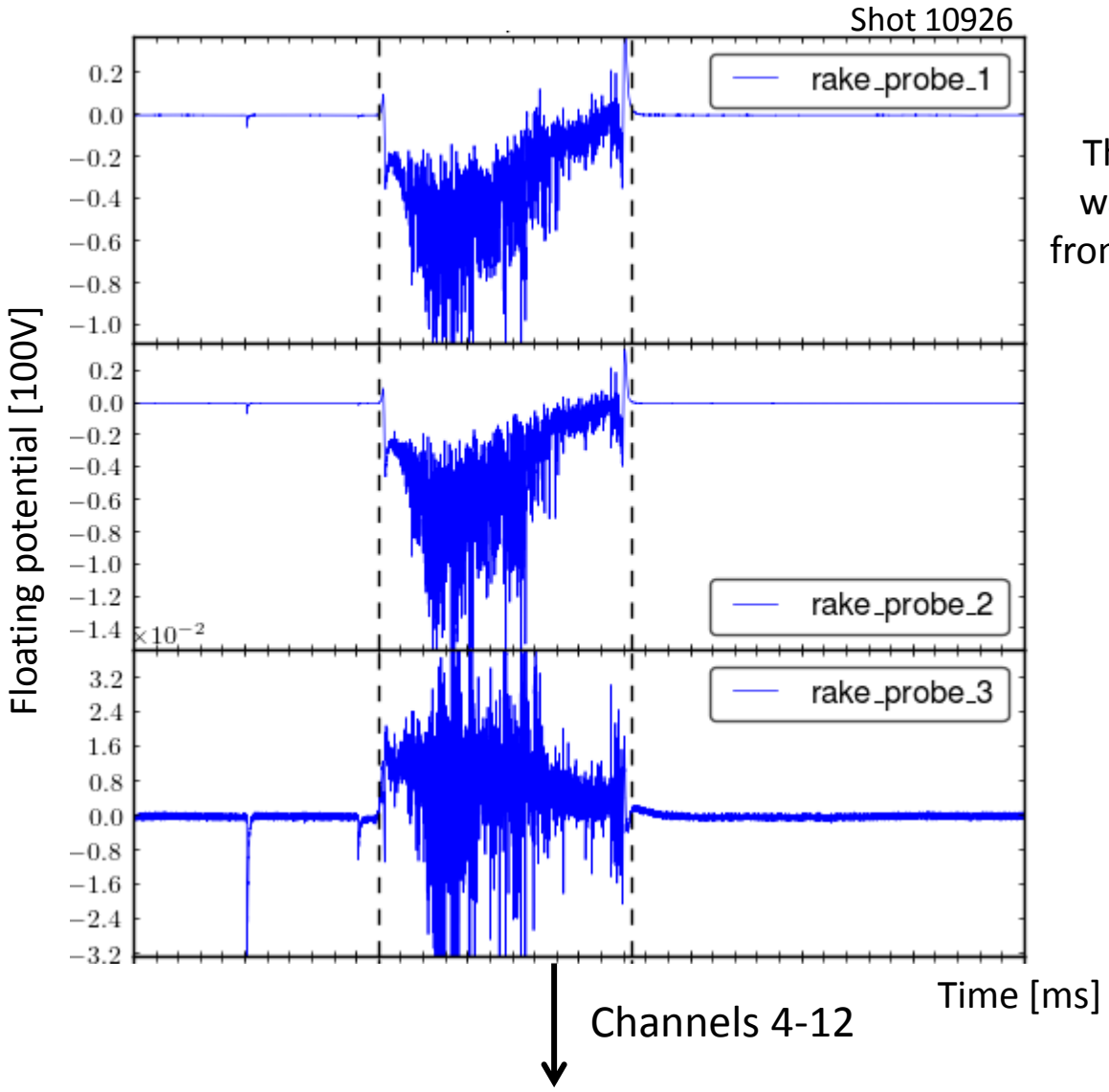




- Array of 16 Langmuir probes (only 12 were operational)
- Molybdenum tips
- Diameter: 0.7 mm
- Length: 2 mm
- Separation: 2.5mm

$$U_{fl} = U_{pl} - \alpha T_e \xrightarrow{T_e \approx Const.} E = -\nabla U_{pl} \approx -\nabla U_{fl}$$

Rake probe signal

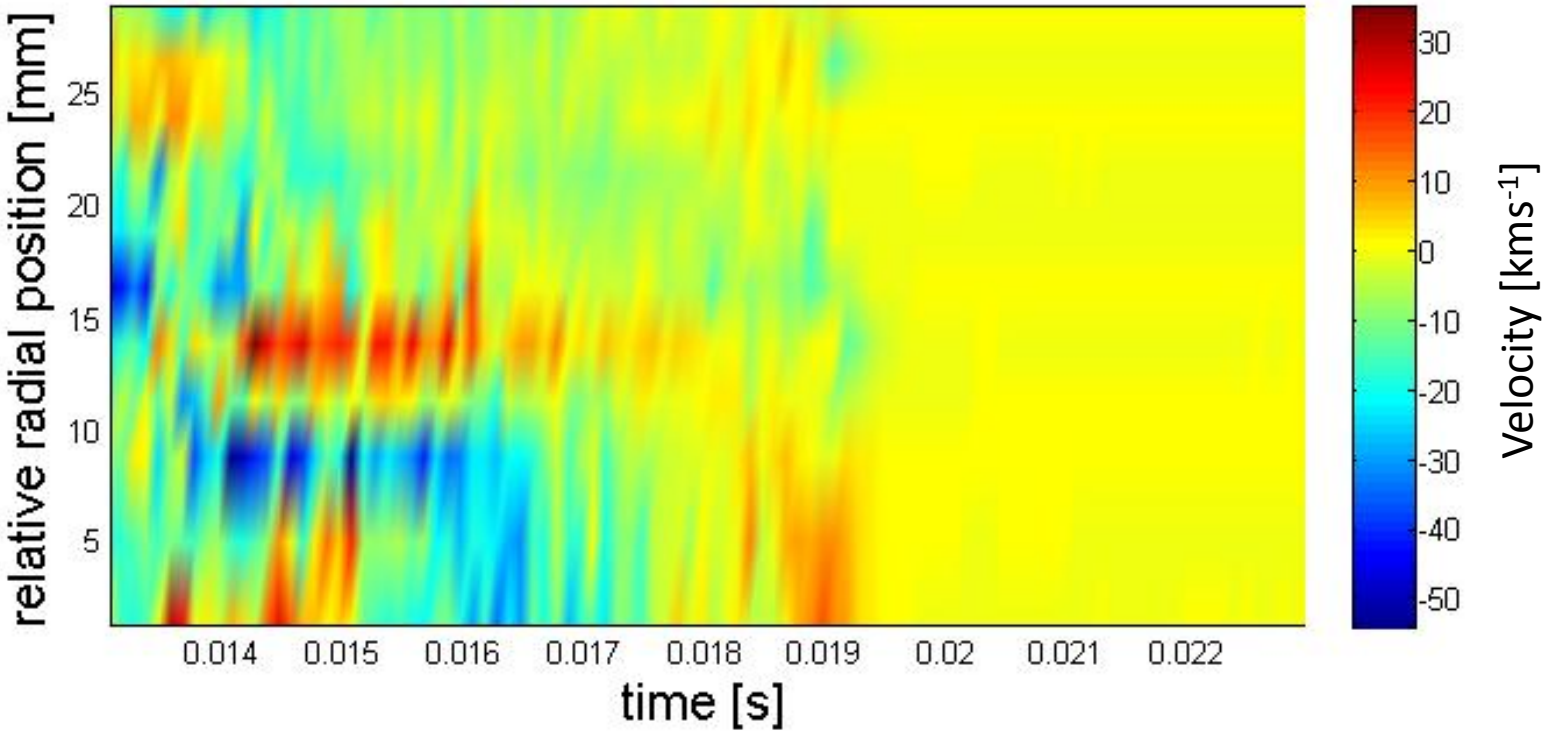


The first probe tip was located 60mm from the vessel centre

Measuring ExB drift velocity

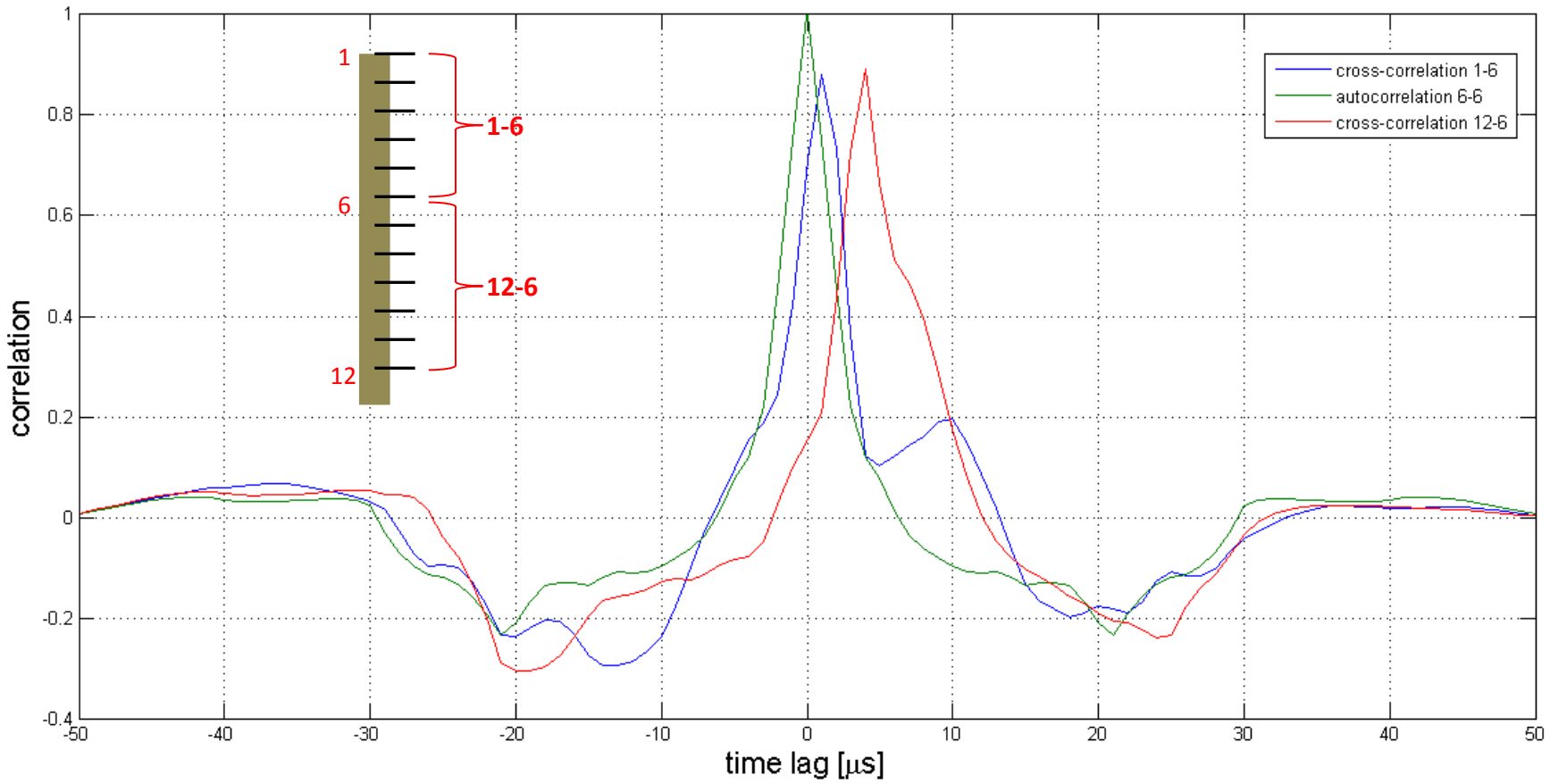
- The ExB drift is in the poloidal direction
- E_{rad} is calculated from the gradient in U_{pl}
- B_{tor} is deduced using a magnetic coils

$$v_{pol} = \frac{E_{rad}}{B_{tor}}$$

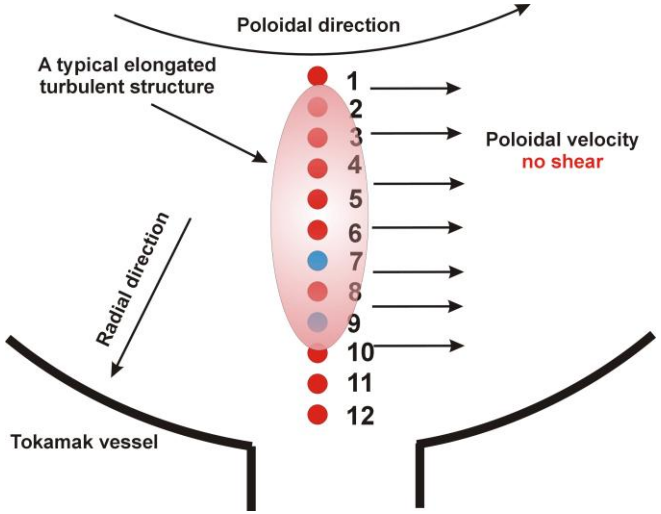


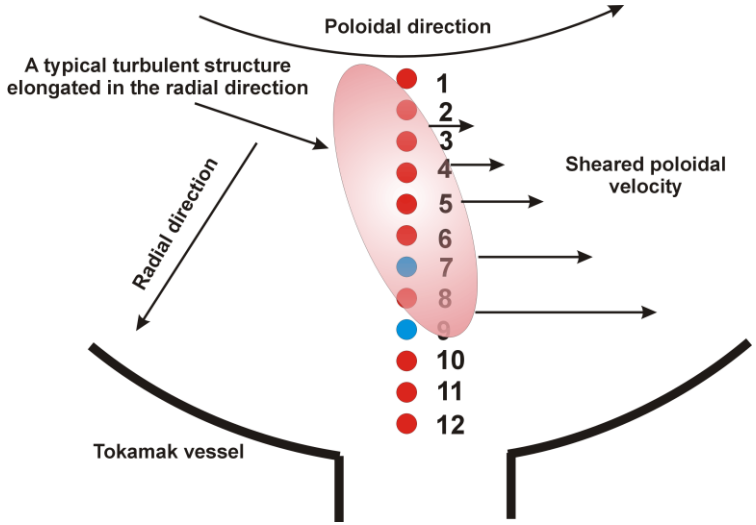
Correlation

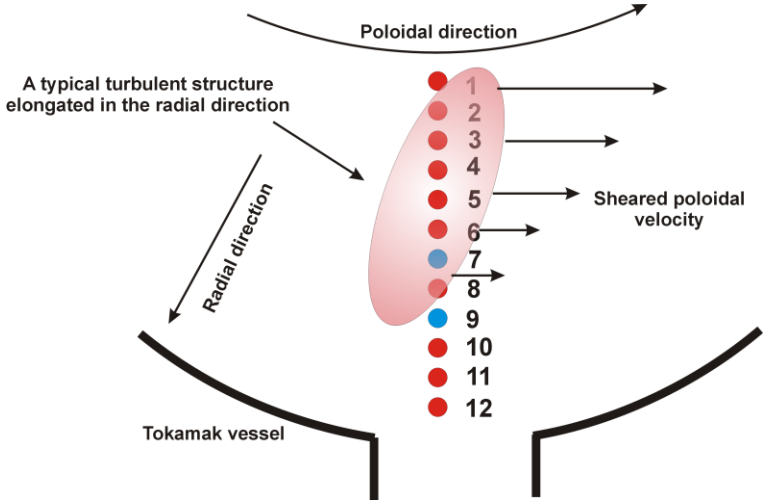
- Cross-correlation was calculated between the central probe, 6, and every other probe.
- From correlations, we can obtain information about structures moving in the plasma



Detecting plasma structures 1



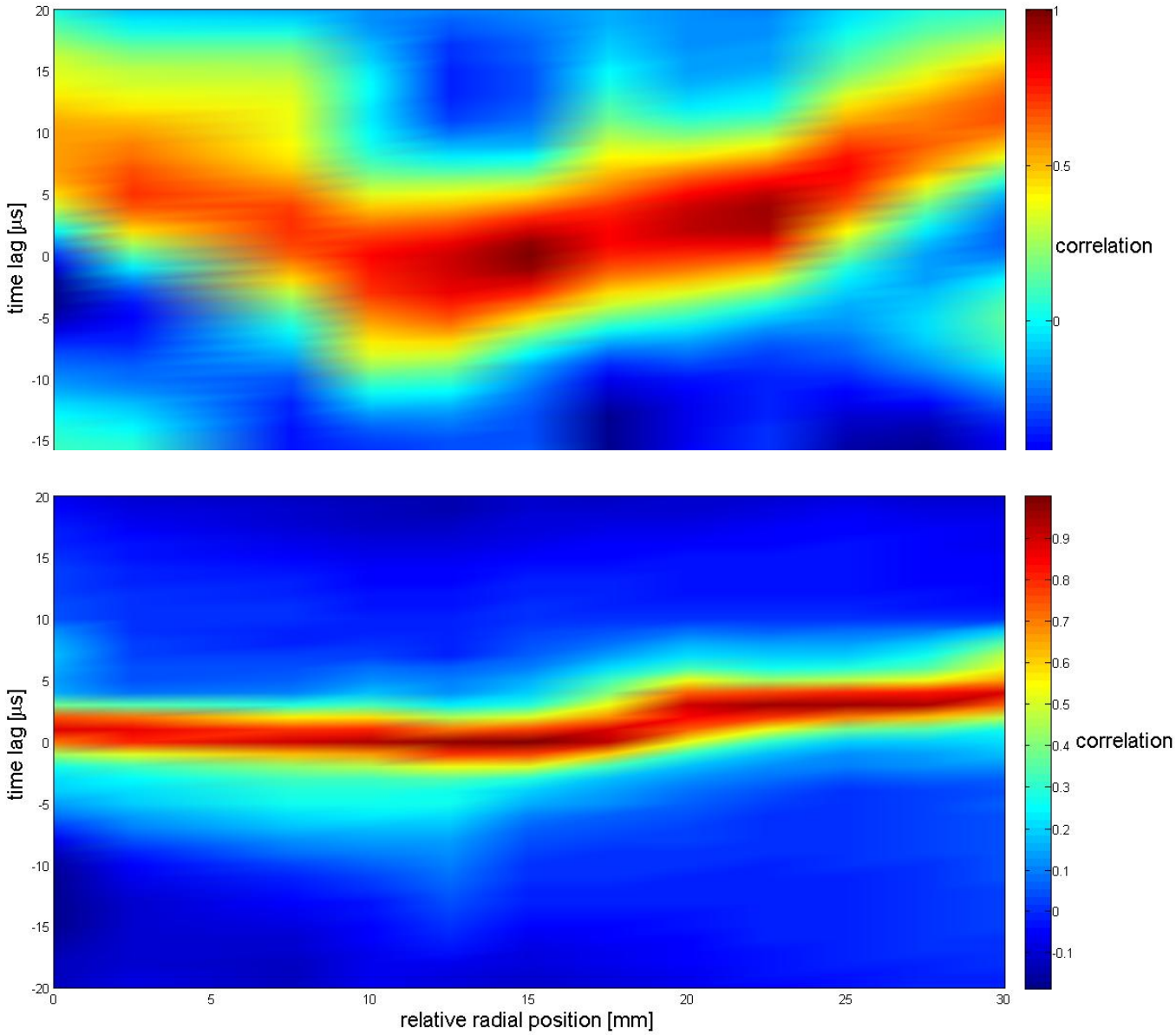




Detecting plasma structures 2

Detecting plasma structures 3

- 80 time slices from a 10ms shot
- Time bins of width 75µs (75 data points)



The next step…

- Analyse different shots with different parameters
- Check repeatability of measurements
- Compare with results taken using different time windows
- Deduce velocities of plasma structures
- Deduce the type of instability (maybe)
- Compare with other diagnostics (e.g. fast camera, magnetic coil arrays…)