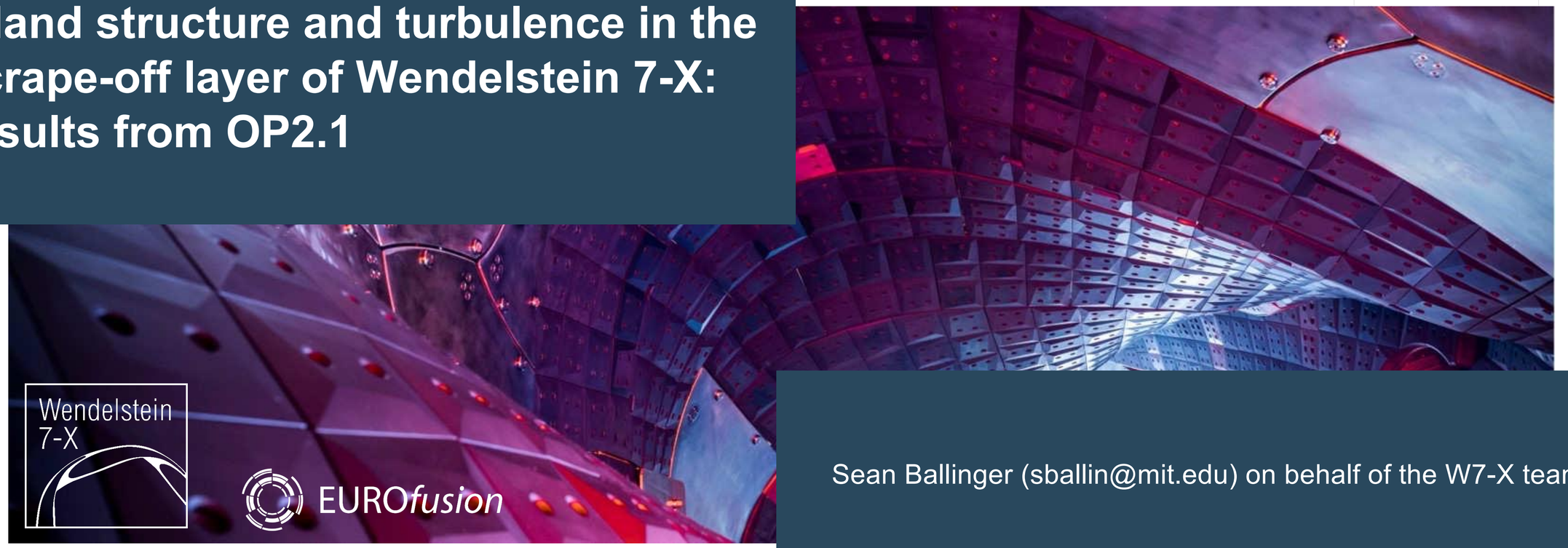
MAX-PLANCK-INSTITUT
FÜR PLASMAPHYSIK

Island structure and turbulence in the scrape-off layer of Wendelstein 7-X: results from OP2.1



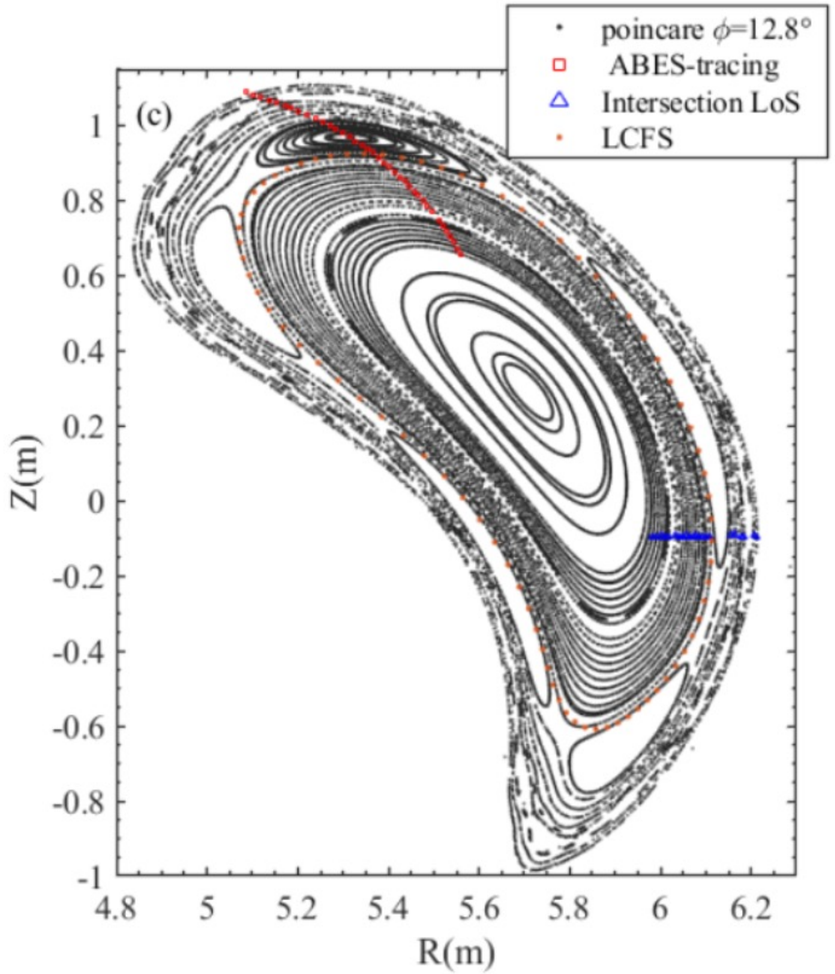
Sean Ballinger (sballin@mit.edu) on behalf of the W7-X team

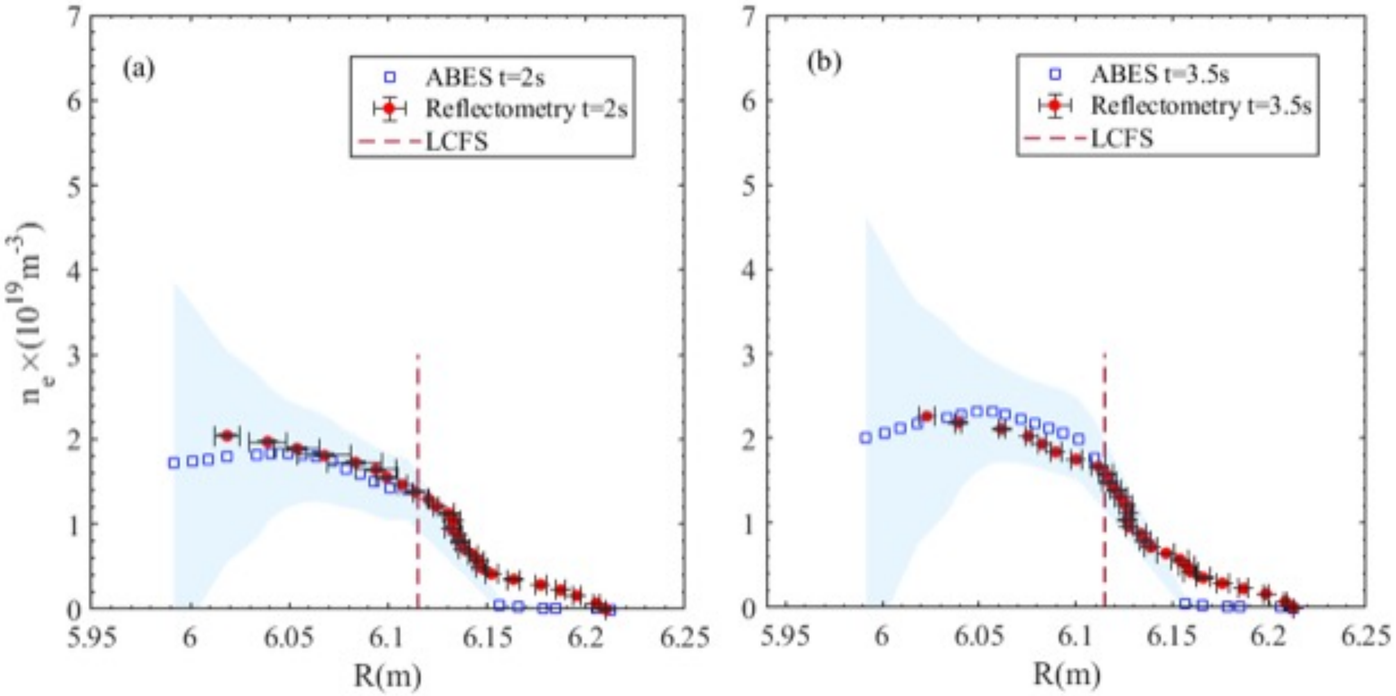
Part 1: 3D profiles vs magnetic island details

Part 2: attempt at mapping GPI and MPM data

Part 3: SOL currents and modes/turbulence

Good agreement between ICRH density profile reflectometer and Alkali Beam Emission Spectroscopy (ABES)

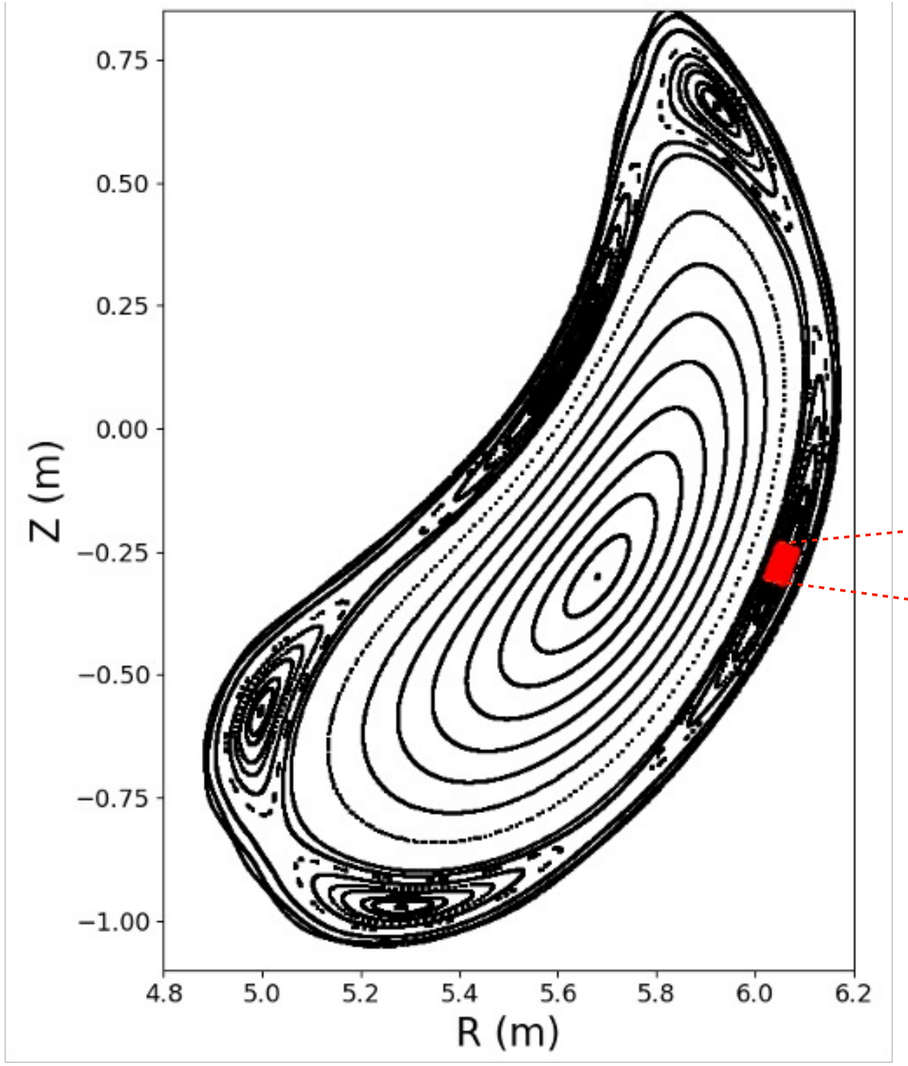


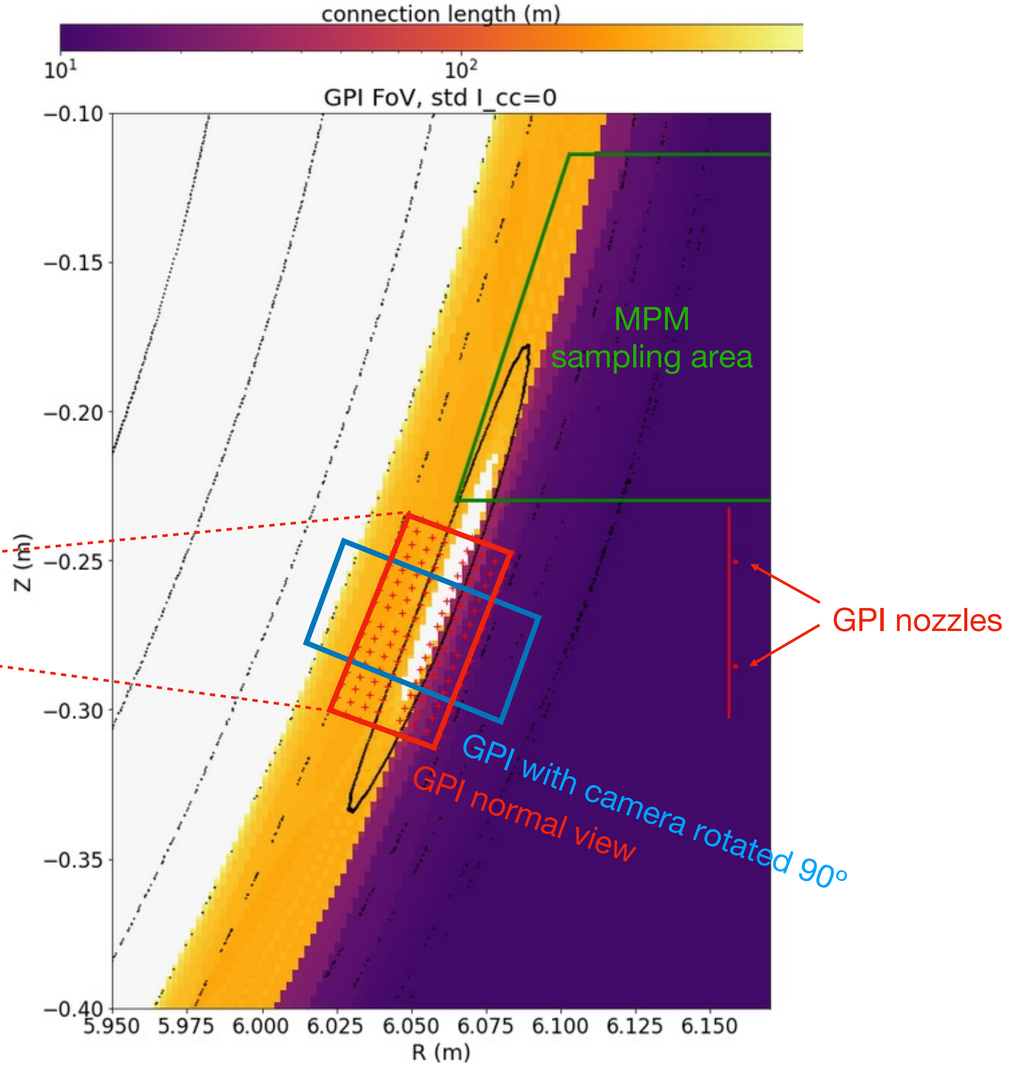


H.M. Xiang et al., Nuclear Science and Techniques (submitted), 2023

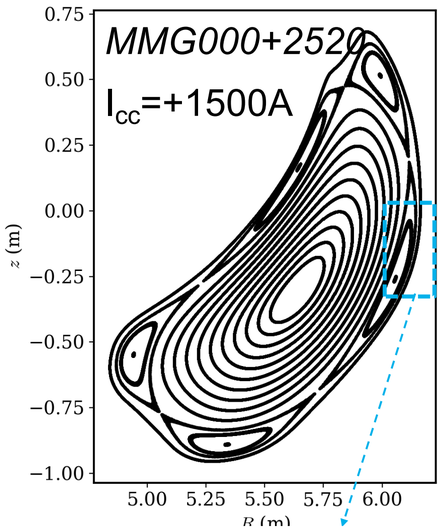
GPI and MPM provide complementary measurements of turbulence in the outboard island region of W7X

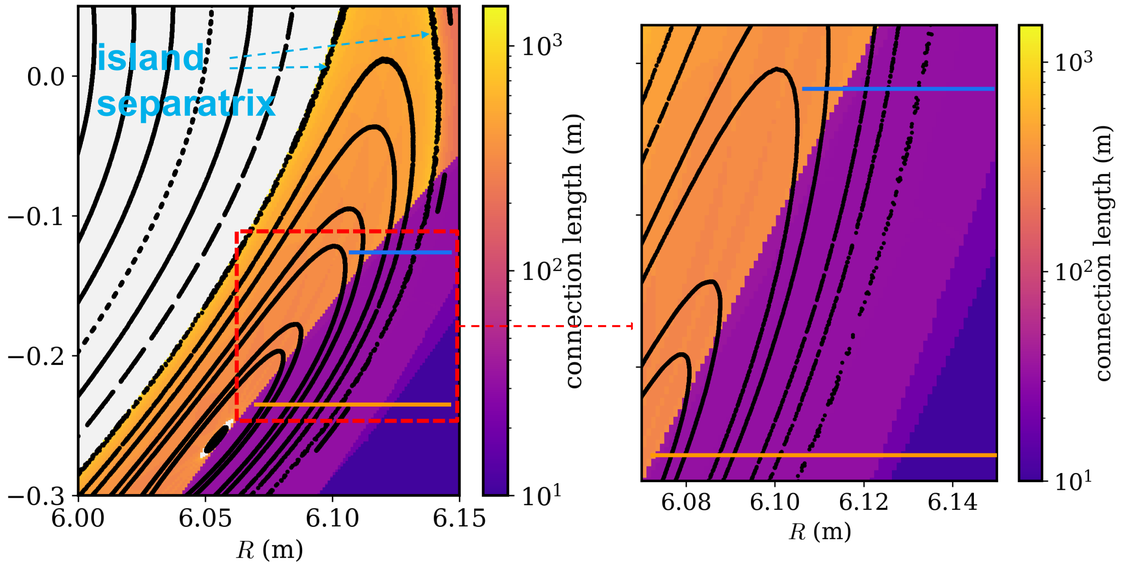
Standard magnetic configuration

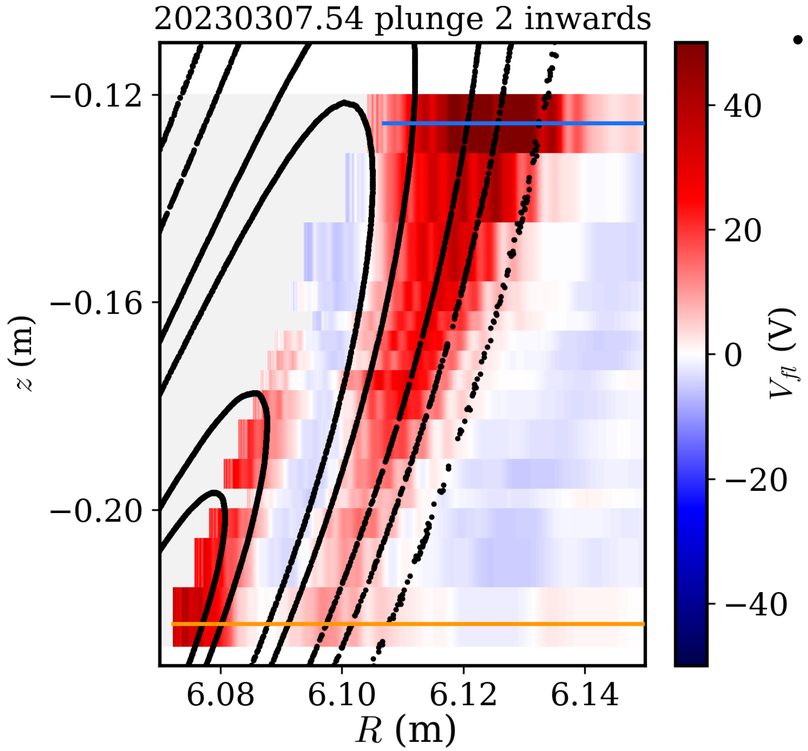




MPM finds that the island potential structure is aligned with flux surfaces





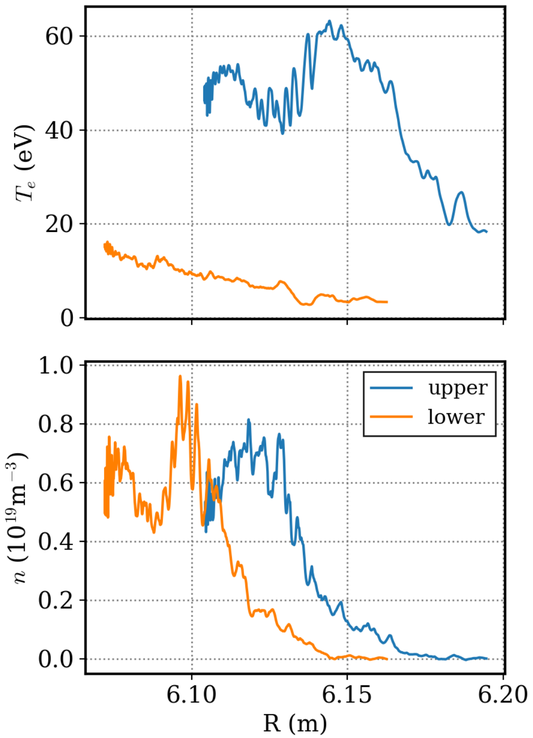


- **V_{fl} structure follows flux surface (outer island separatrix) rather than connection length transition!**

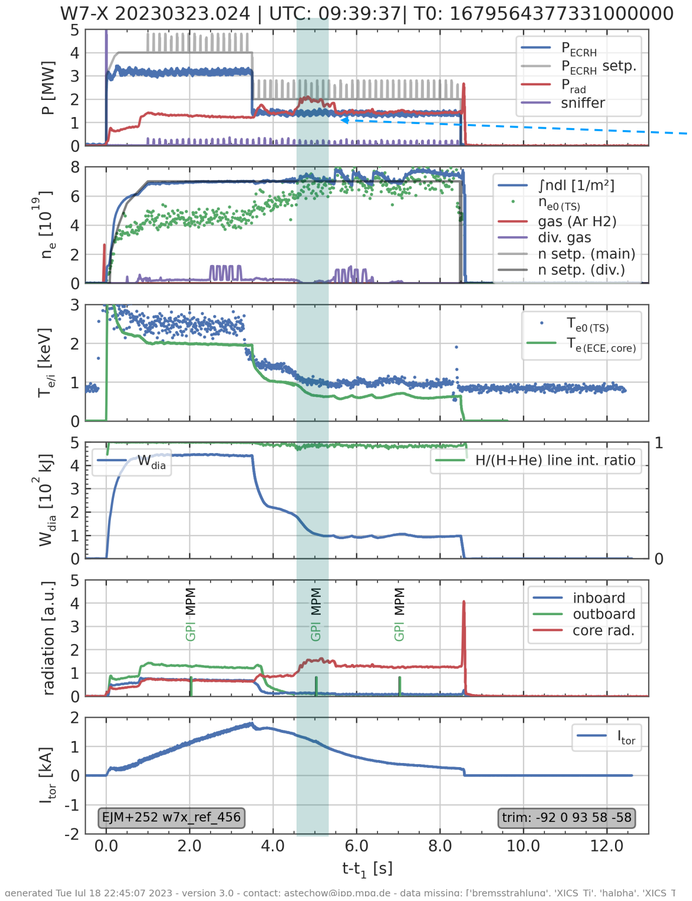
poloidal structure:

- higher V_{fl} and T_e for upper pins (towards X point)
- positive V_{fl} around island O point

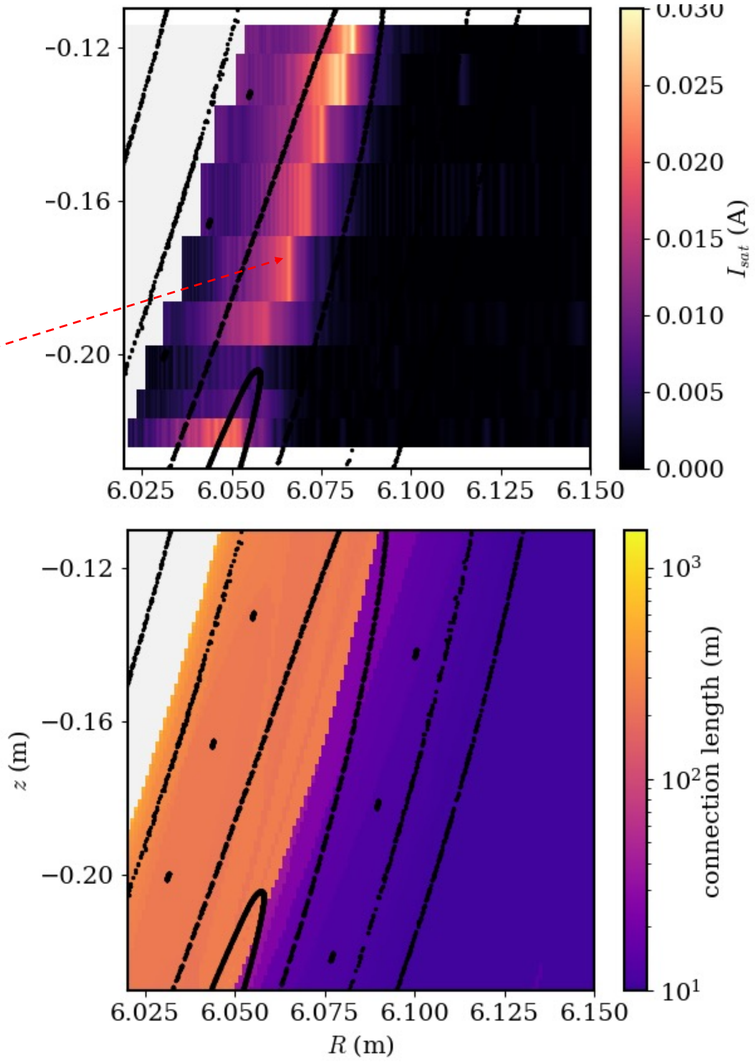
Triple probe profiles



MPM: magnetic structure still important in far SOL of a small plasma

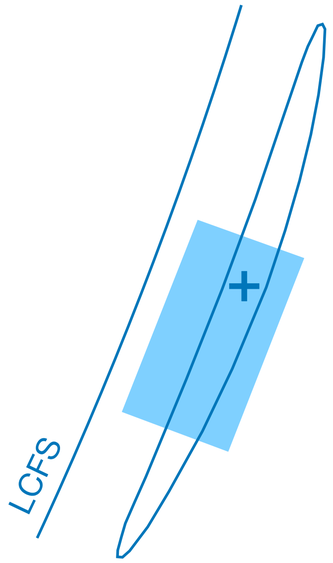


- small / detached plasma with almost no SOL density left
- still, a small but clearly localized Isat current is measured at the Lc transition

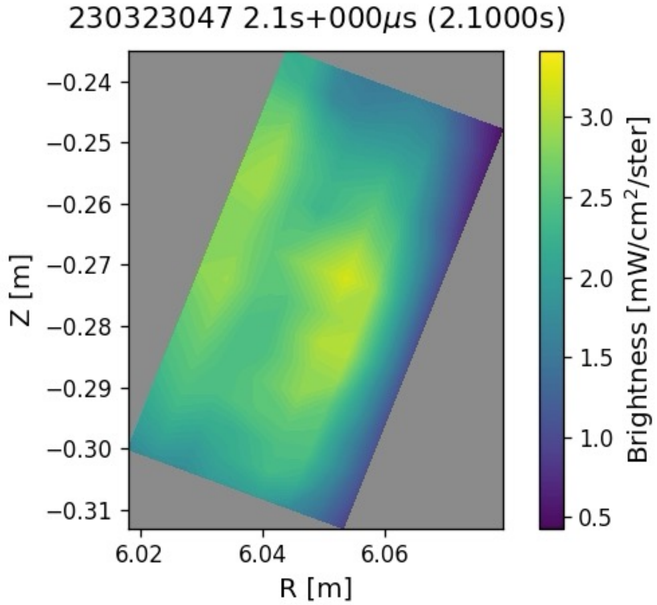


Poloidal motion is seen to dominate in GPI videos

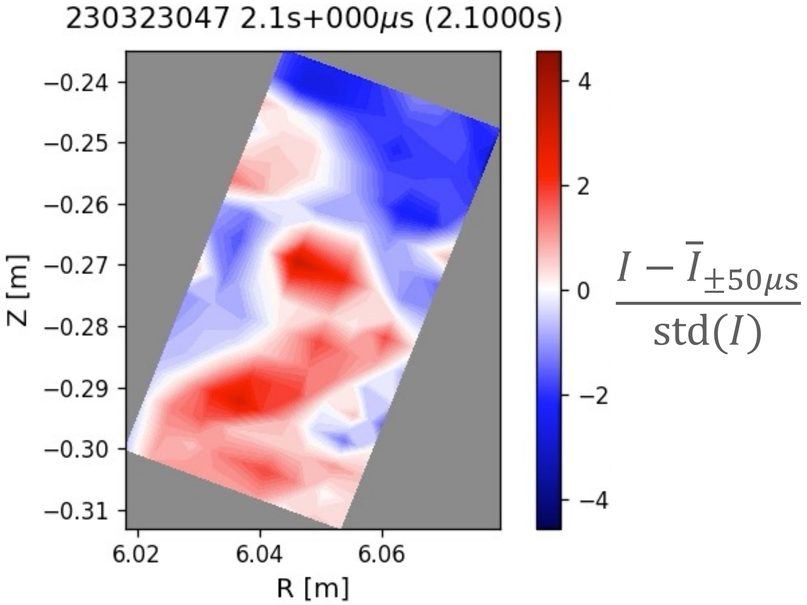
Standard magnetic configuration



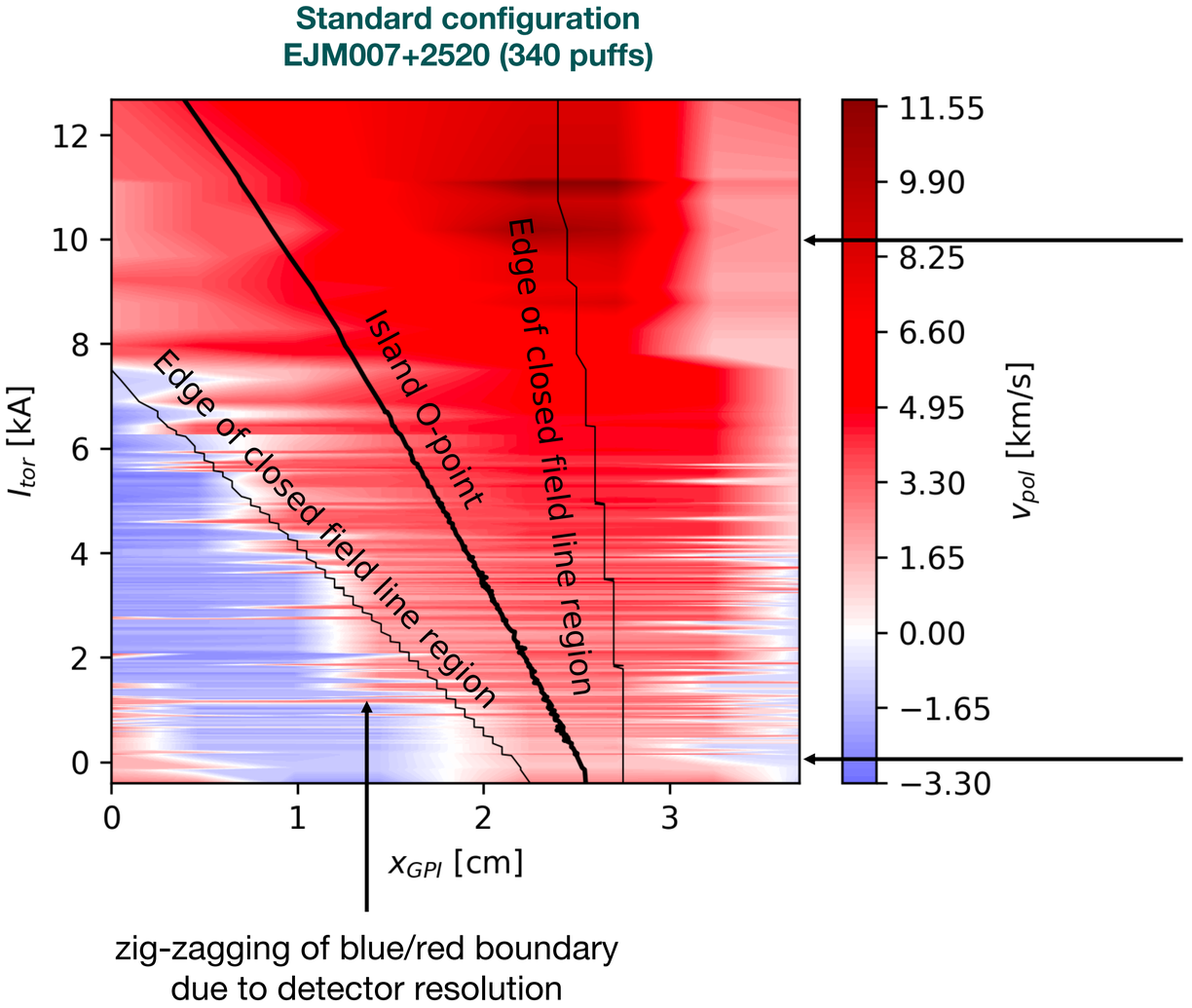
Original video

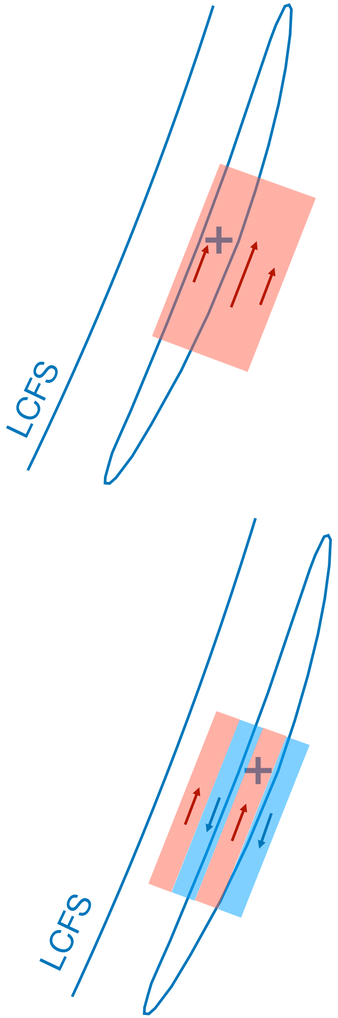


Background-subtracted



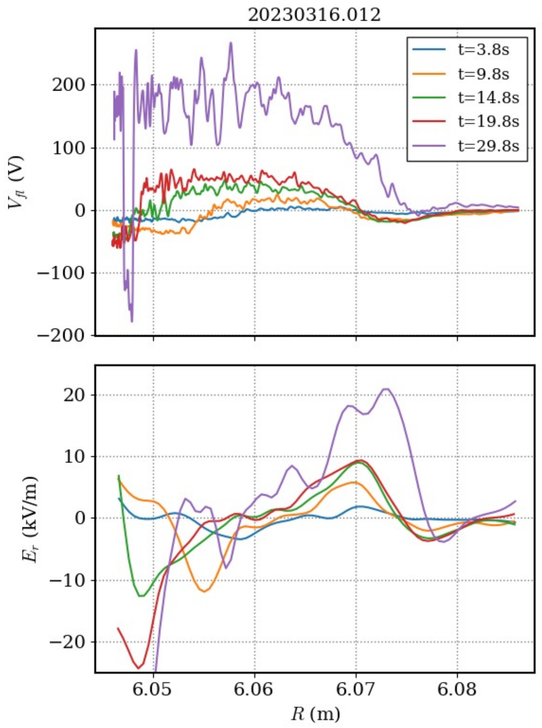
GPI finds consistent poloidal flow pattern near O-point and trend with toroidal current



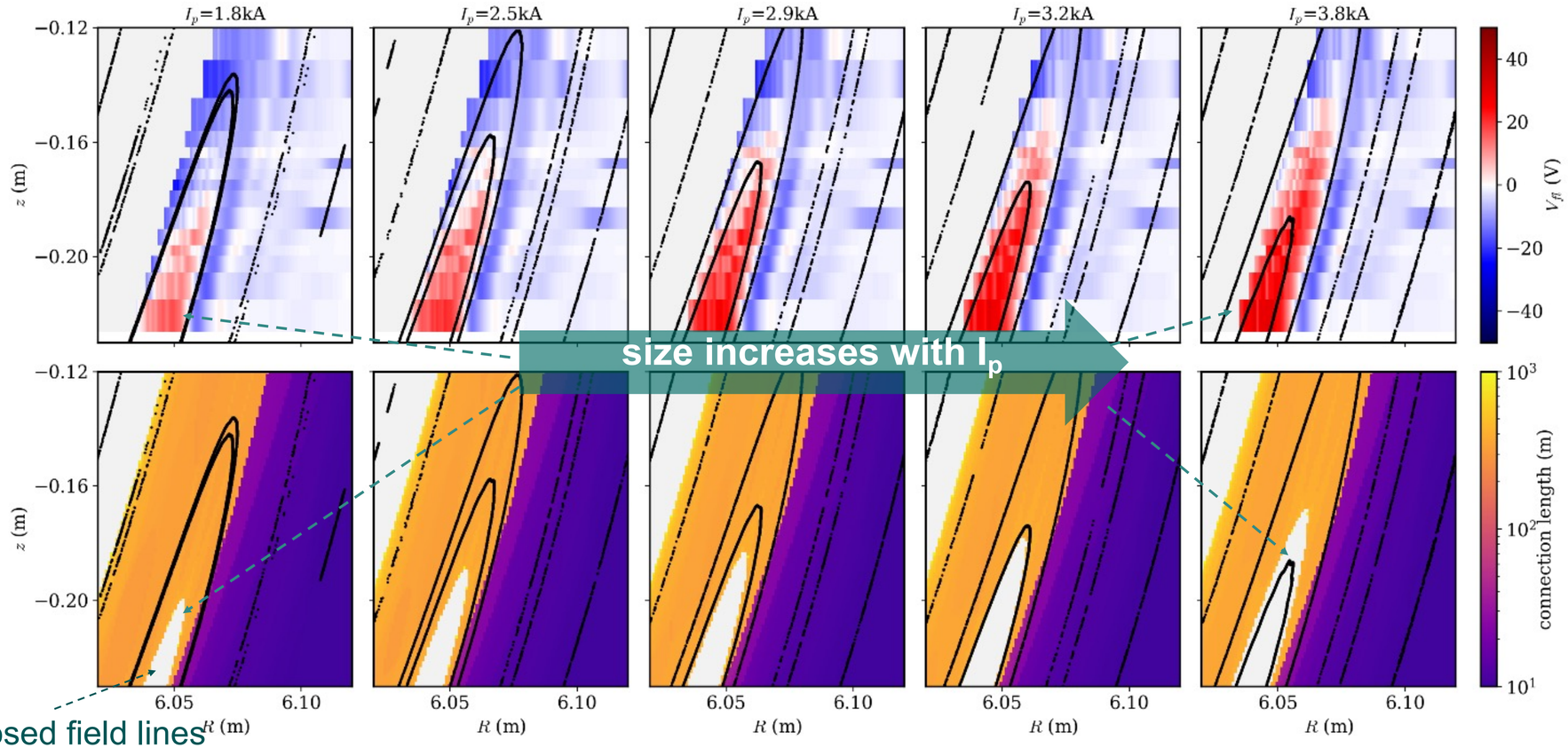


MPM confirms GPI observation of high poloidal velocities at high toroidal current

MPM confirms particularly high v_{pol} (~8km/s) for high I_p (10kA)



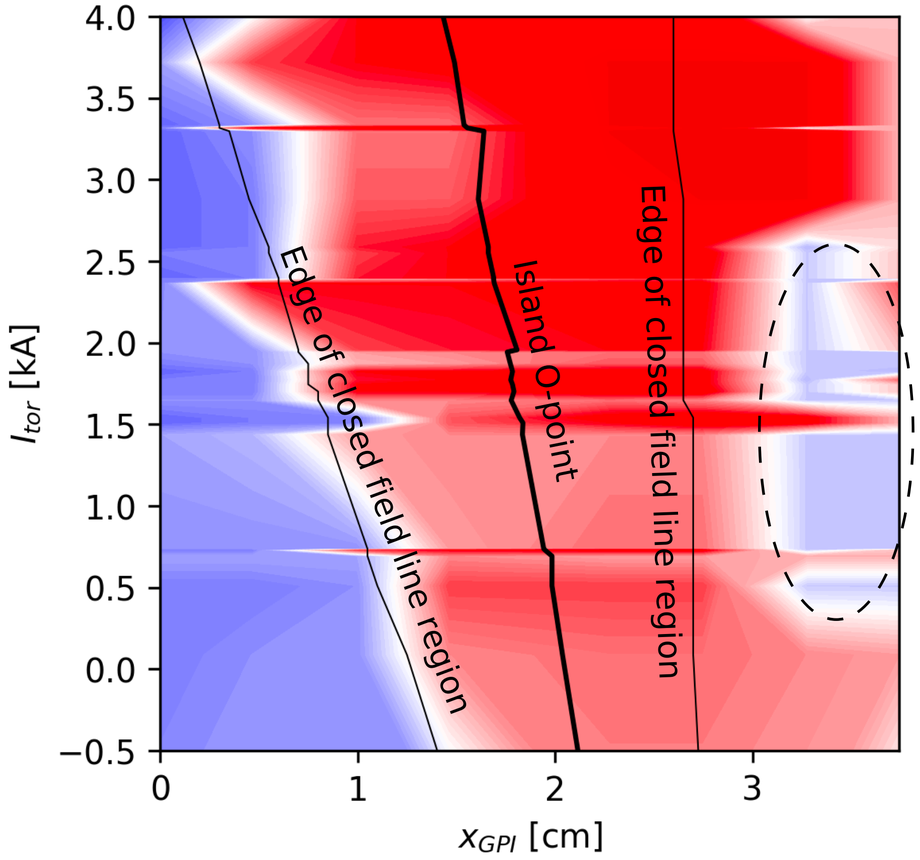
Size of MPM-measured potential structure and island confined region increase with Ip



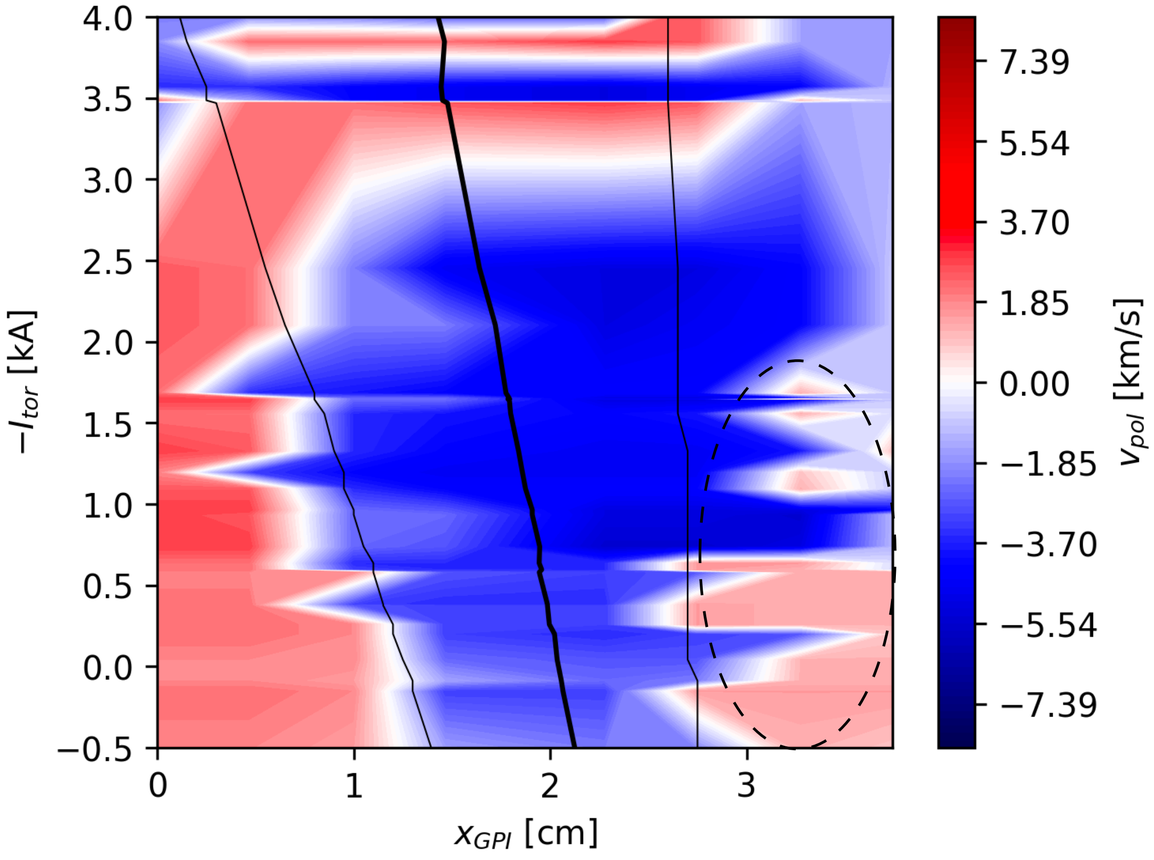
closed field lines around island O point

GPI-observed poloidal velocities are due to E_rxB drift: when toroidal field is reversed, poloidal velocities reverse

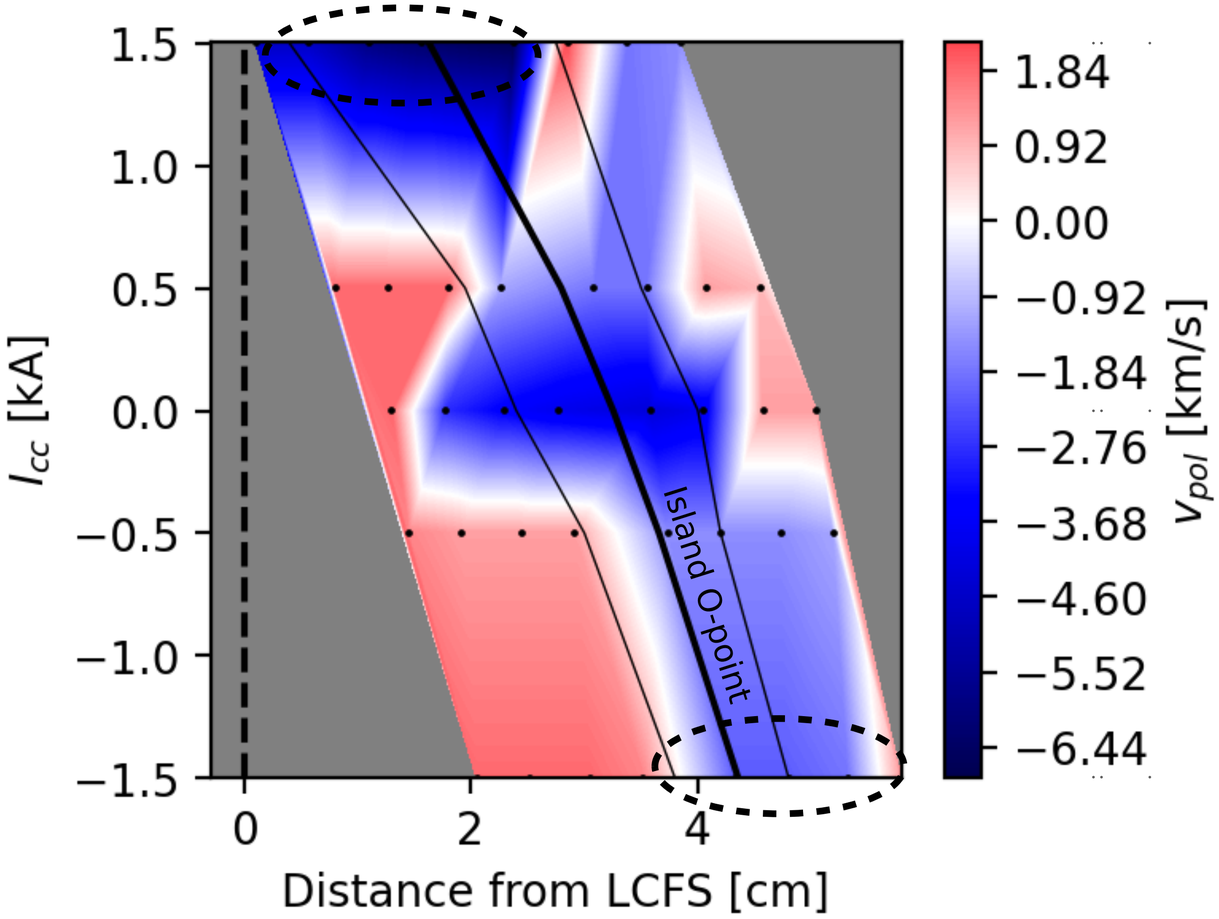
Standard configuration
EJM001+2520 (57 puffs)

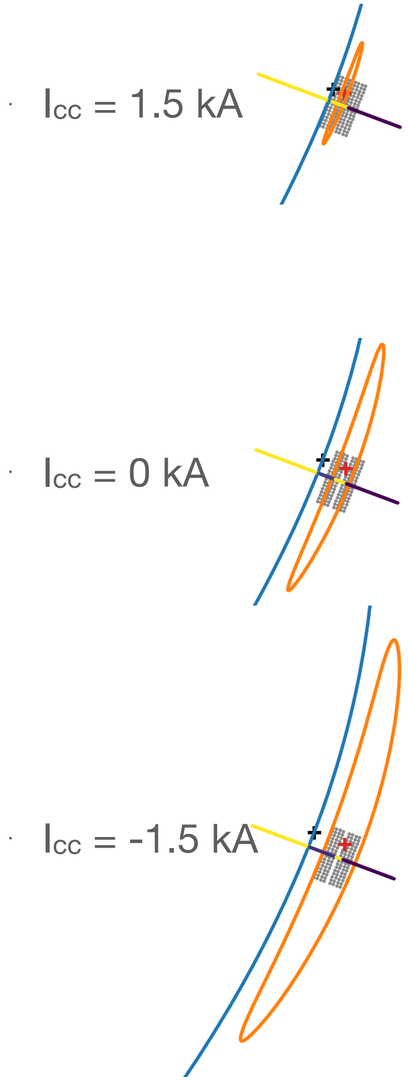


Standard configuration, reversed field
EJM016-2520 (40 puffs)



GPI: island size change experiments in standard configuration (reversed field) may indicate that flow directions depend on island O-point location

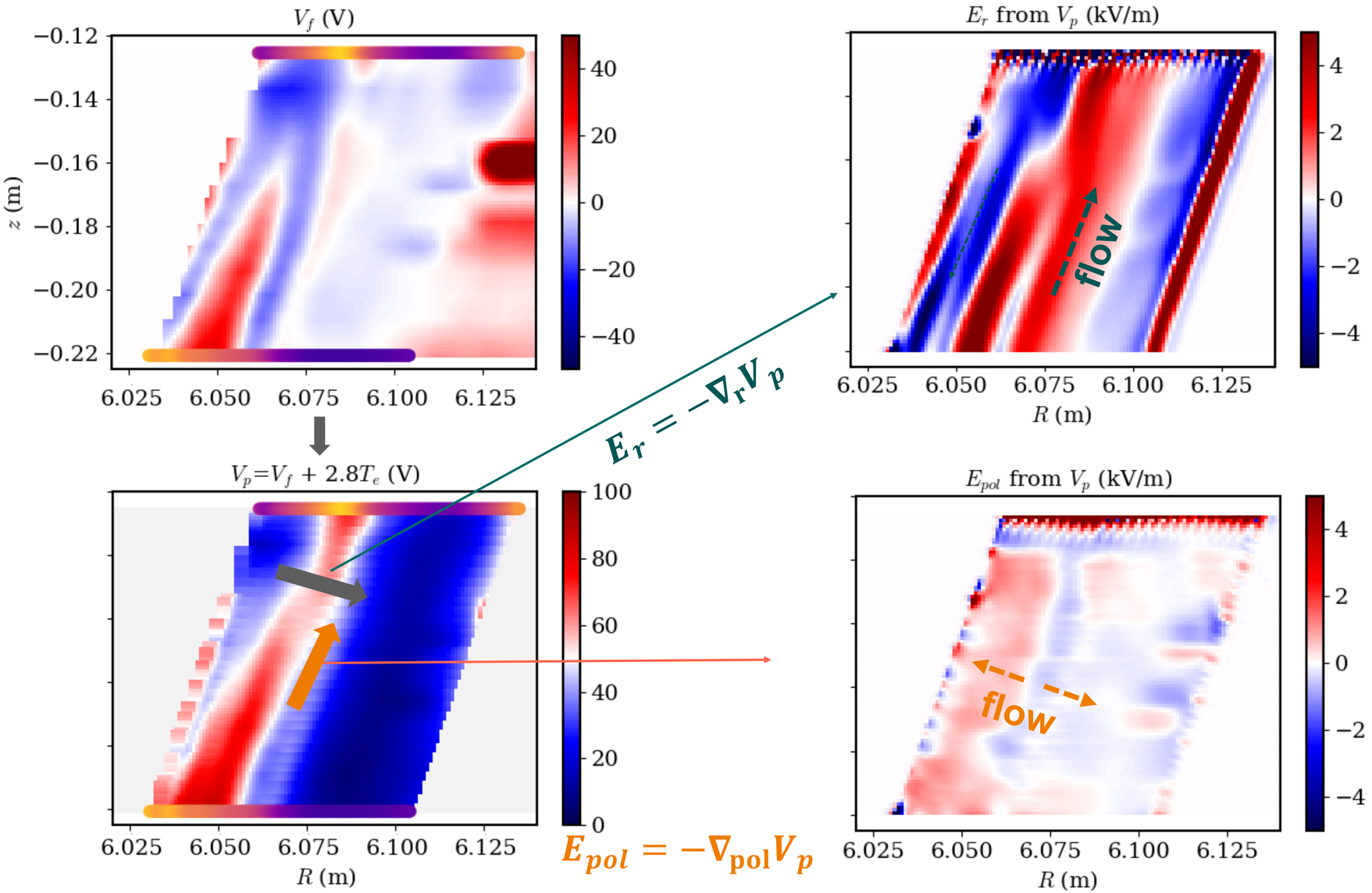




- Note I_{cc} on y-axis instead of I_{tor}; $I_{tor} \approx 0$ in cases analyzed
- Region of negative velocities roughly follows the island O-point
- Could be helpful to repeat with more intermediate Icc values

XP_20230118.* (S23, S24)

ExB velocities estimated from MPM potential are roughly consistent with GPI velocities



- E_r structure implies sheared poloidal flows
- v_{pol} ~ few km/s (B=2.3T)

- E_{pol} implies (small) inwards radial flow, ≈100m/s