Interplay between magnetic topology, density fluctuations and confinement in high-β Wendelstein 7-AS plasmas

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1. Discharge overview
2. Magnetic topology
3. Density fluctuations
4. Conclusions

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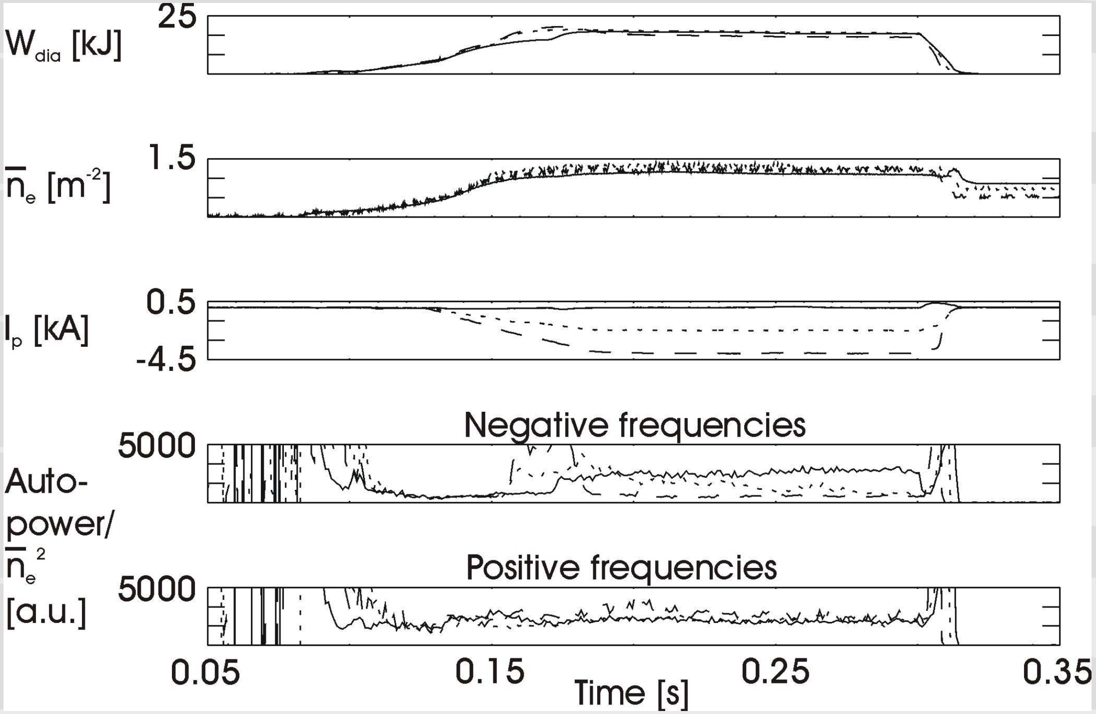
Discharge overview



- Basic parameters: Edge rotational transform ι_a = 0.41, B_{tor} = -1.25 T and P_{NBI} = 4 MW
- Scan of plasma current I_p = 0 (solid), -2 (dotted) and -4 (dashed) kA

Negative/positive frequencies are due to inward/outward moving fluctuations, respectively

Magnetic topology

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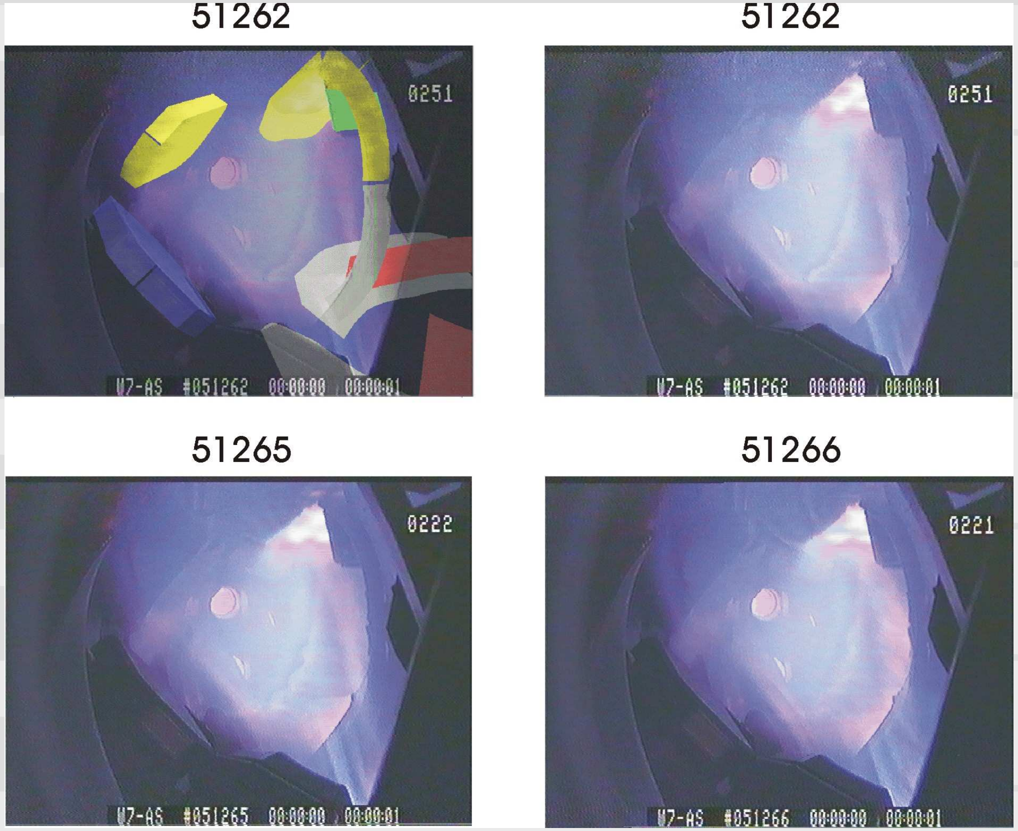
Visible radiation (Jürgen Baldzuhn & Andreas Werner)

- Left-hand (outboard) structures are control coils, top/bottom right-hand (inboard) elements are divertor parts
- As ι_a increases, the plasma edge exhibits a smooth → island → ergodic transition



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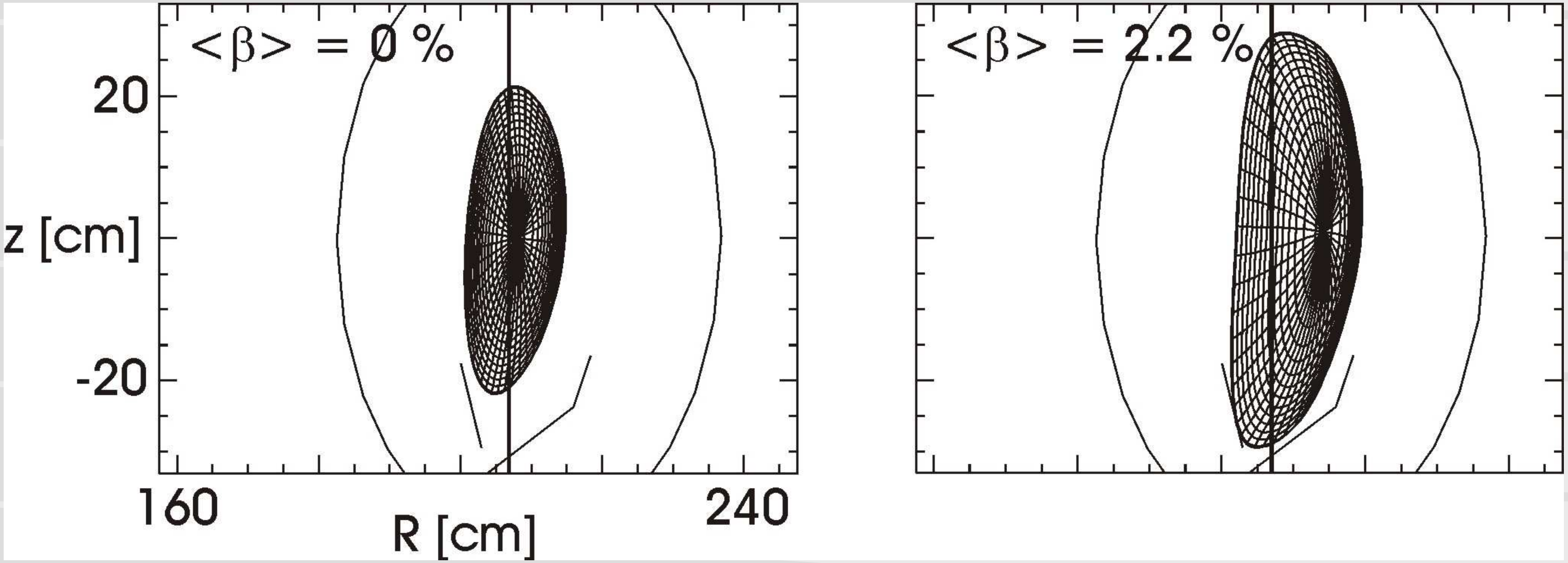
Magnetic topology

Finite-β calculations (Joachim Geiger)



- The reconfiguring of the neutral beam injection system allowed us to obtain a record <β> of 3.1 %
- The NEMEC code enables the calculation of finite-β flux surfaces, but cannot handle natural magnetic islands

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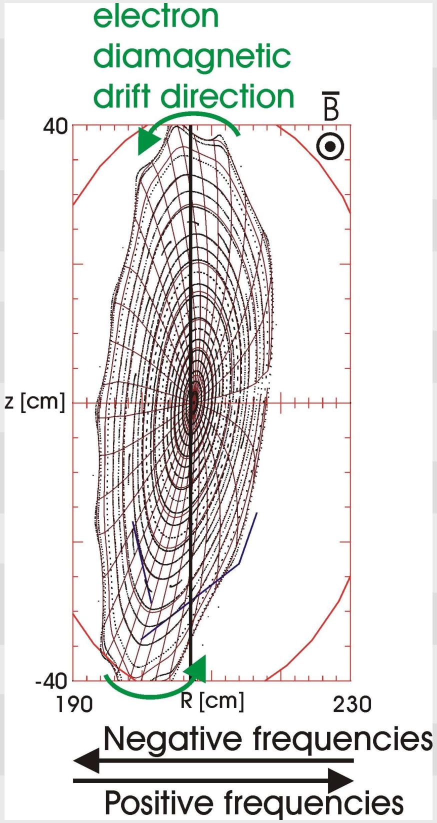
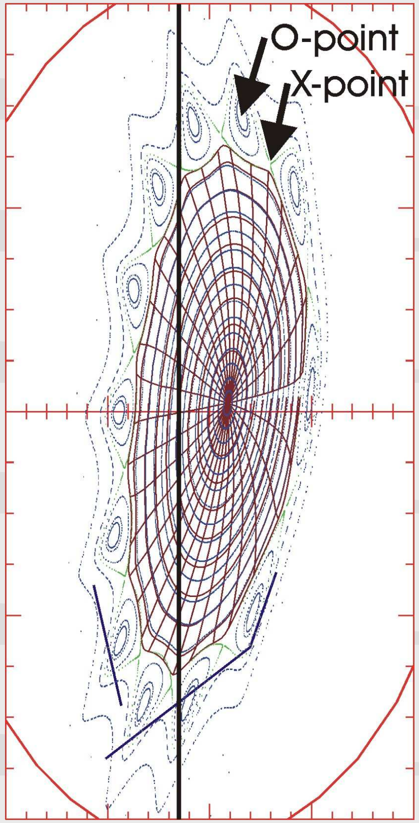
Magnetic topology

Natural 5/m islands (Andreas Werner)

- The Gourdon code can be used to study magnetic islands, but only for vacuum
- An increase of ι_a leads to island chains having a decreasing m number





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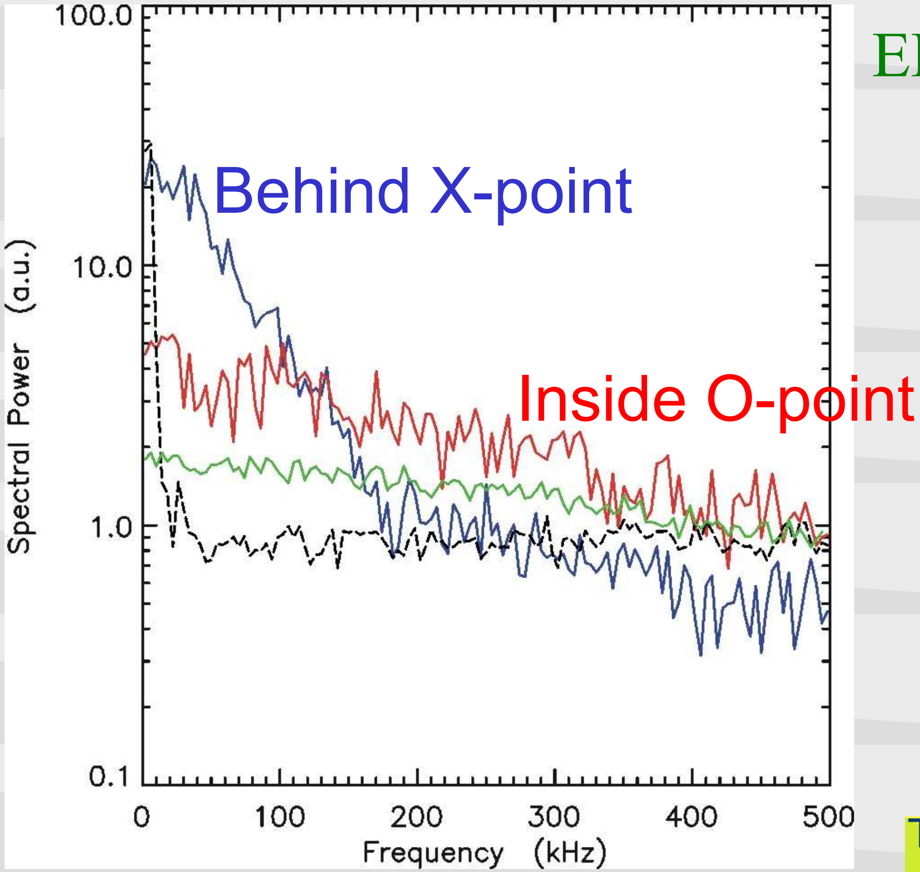
Density fluctuations

Reflectometry (Jaco van Gorkom)

- Density fluctuations in rotating MHD-modes have been investigated in TEXTOR
- Density fluctuations inside an O-point are larger than those behind the X-point



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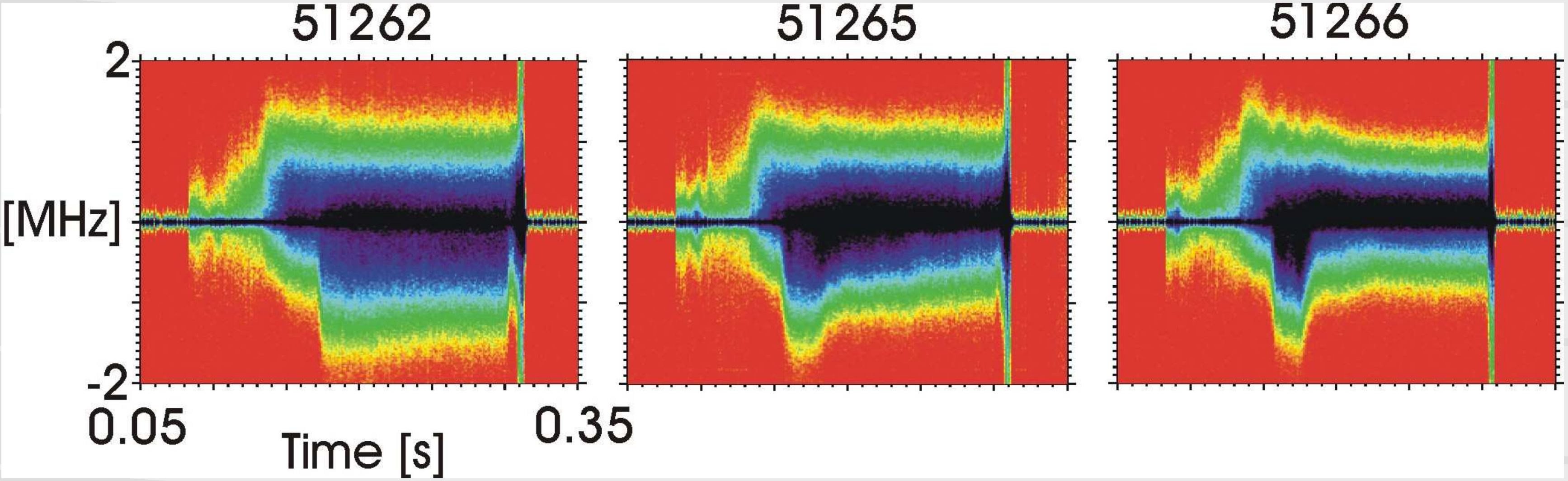
Density fluctuations

Autopower spectra (3D)



- Positive frequency fluctuations decrease/increase at high/low frequencies with increasing current
- Negative high frequency component disappears completely
- Negative low frequency component remains at a constant level

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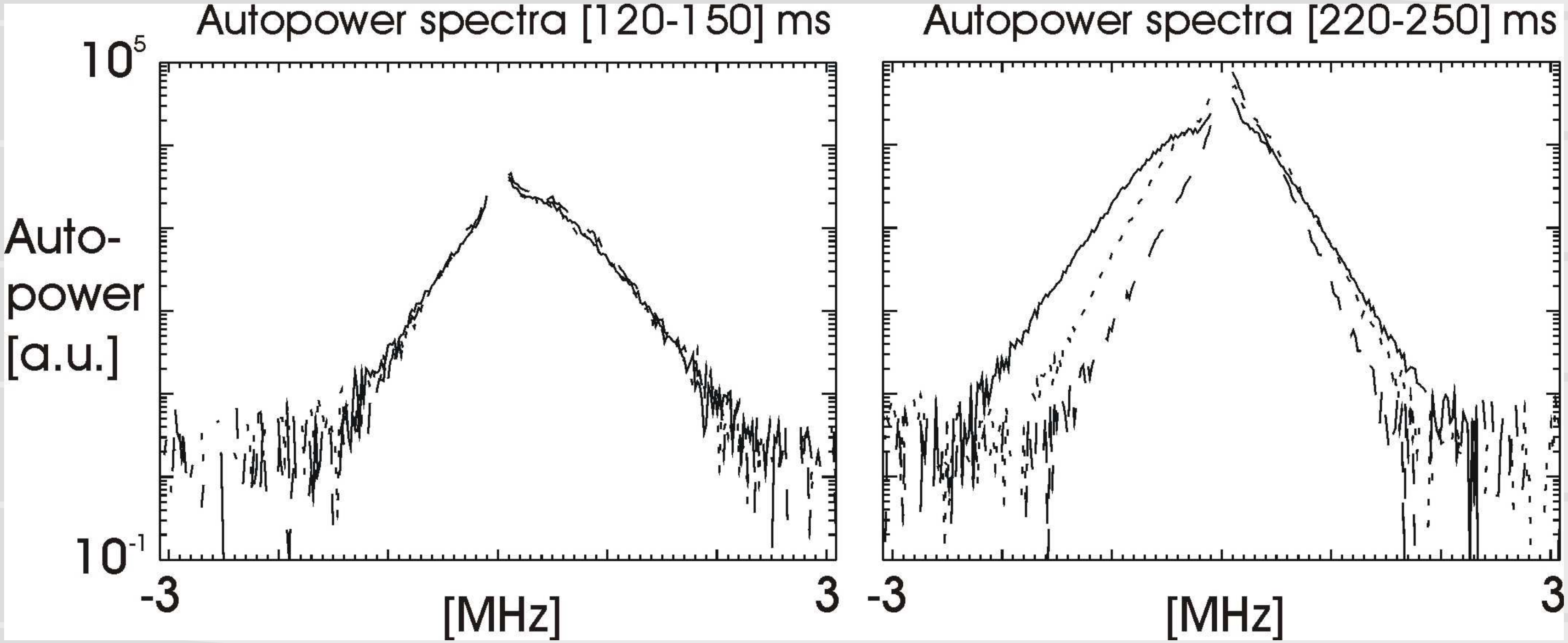
Density fluctuations

Autopower spectra (2D)



- Left-hand plot: Initial plasma phase, all spectra identical
- Right-hand plot: Later high-β phase; note the pronounced decrease of high frequency fluctuations, especially for negative frequencies

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Conclusions

The investigation of density fluctuations in high-β plasmas was triggered by the interesting phenomena seen in TEXTOR

In the work presented we have assumed that natural islands in W7-AS behave similarly to MHD-islands in TEXTOR

If this is indeed the case, our observations can be explained as follows:

1. An O-point is observed in the early phase for positive frequencies
2. Later, what seems to be an O- to X-point transition occurs for negative frequencies
3. O-point at the bottom, O- to X-point transition at the top (assuming that high frequency fluctuations travel in the electron diamagnetic drift direction)
4. The observed island chain is probably 5/12 (12 islands in a poloidal cross section)
5. Asymmetry is likely to be due to the flux surface tilt at the diagnostic position

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