

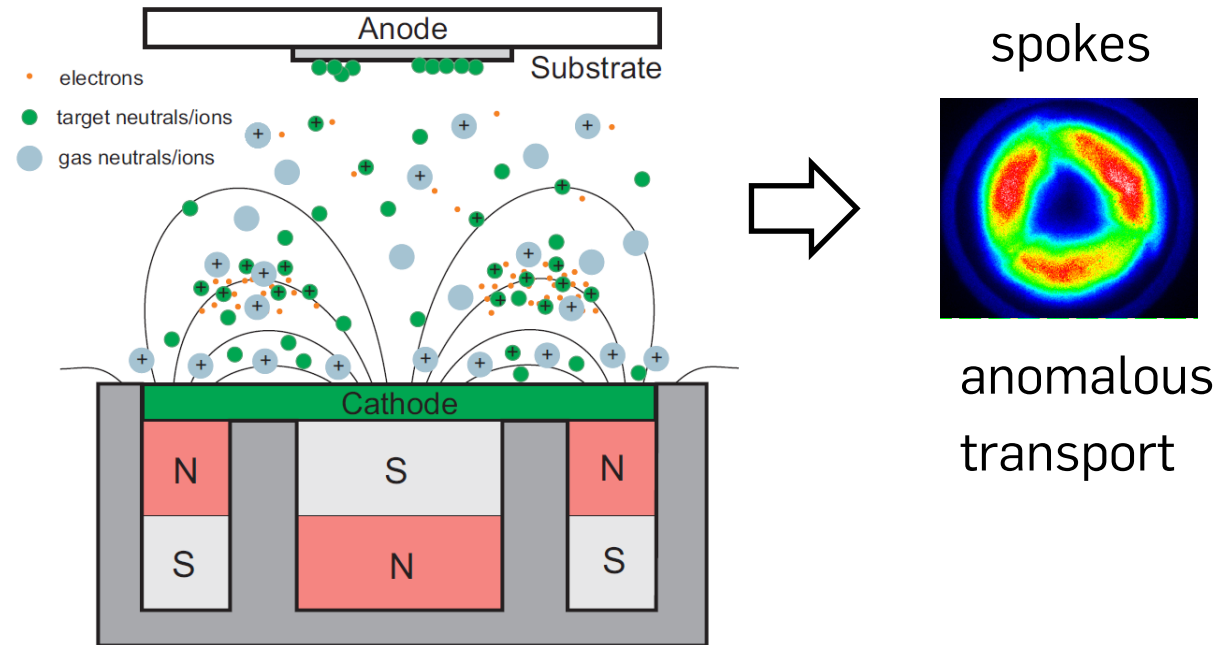


RUHR-UNIVERSITÄT BOCHUM

# PIC simulations of spokes in magnetron plasmas

Denis Eremin

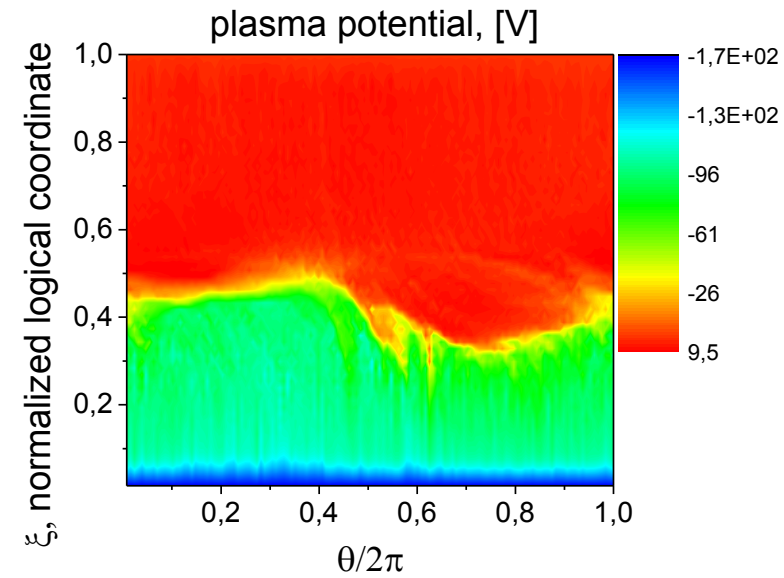
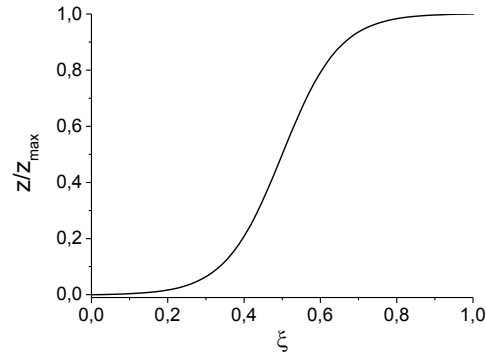
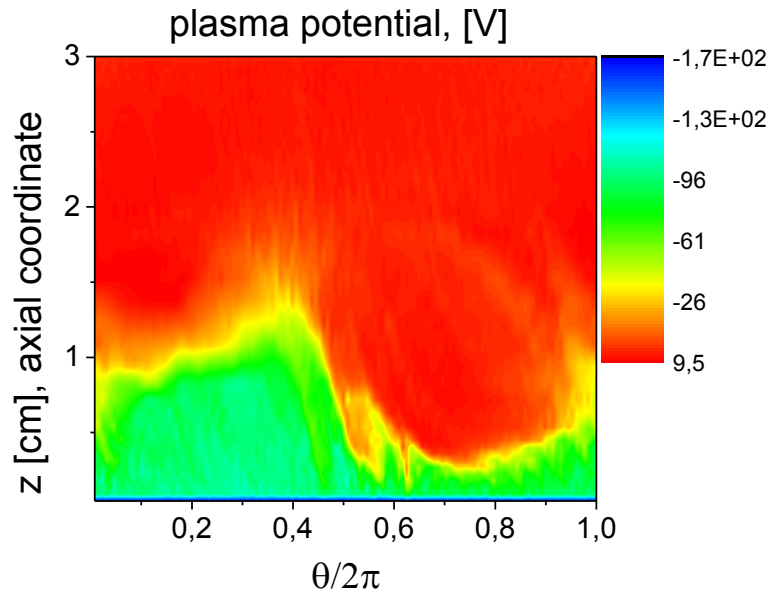
Fakultät für Elektrotechnik und Informationstechnik  
Lehrstuhl für Theoretische Elektrotechnik



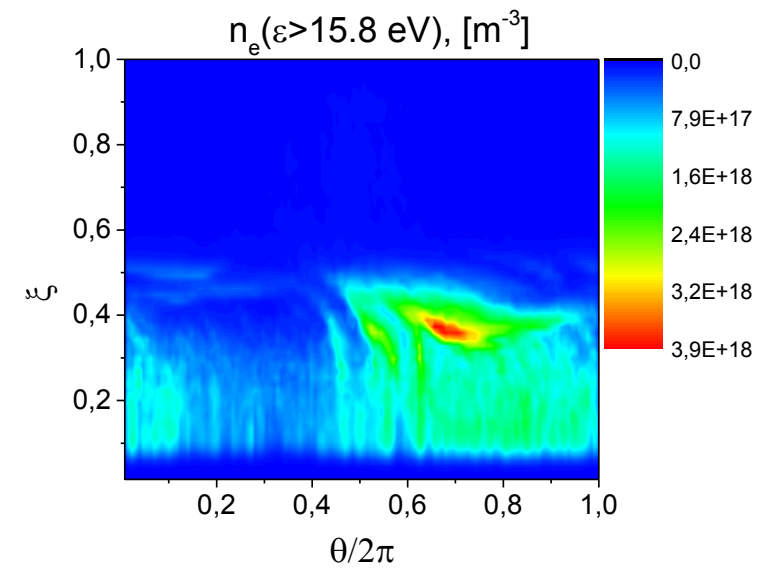
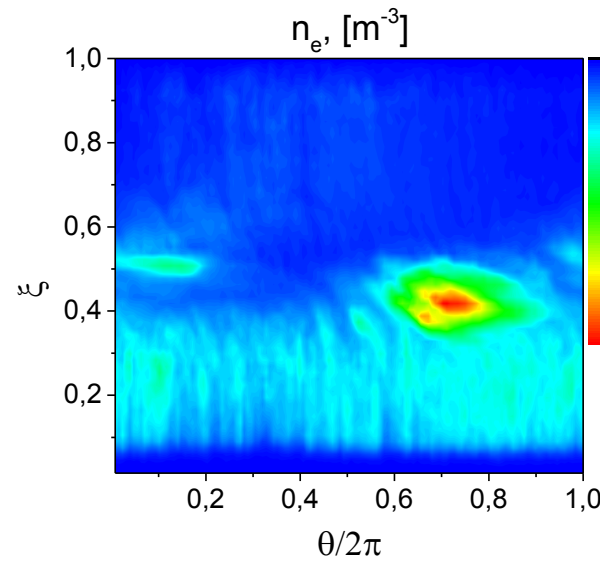
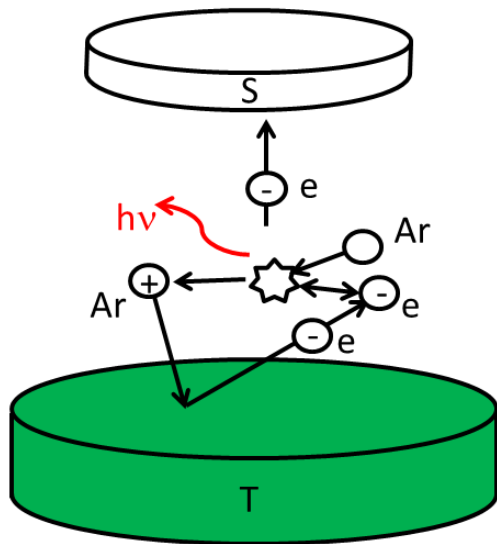
## Challenges:

- Large plasma densities
- Low neutral gas pressure
- Multiscale problem

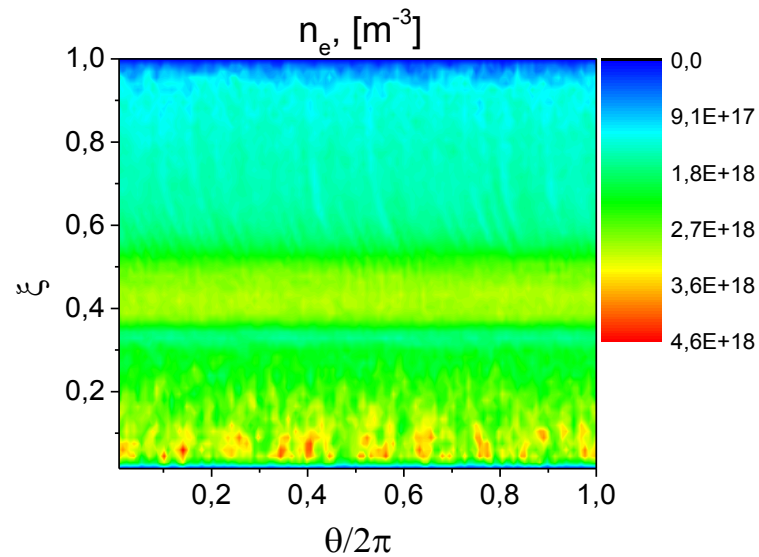
# Non-uniform grid to resolve the sheaths



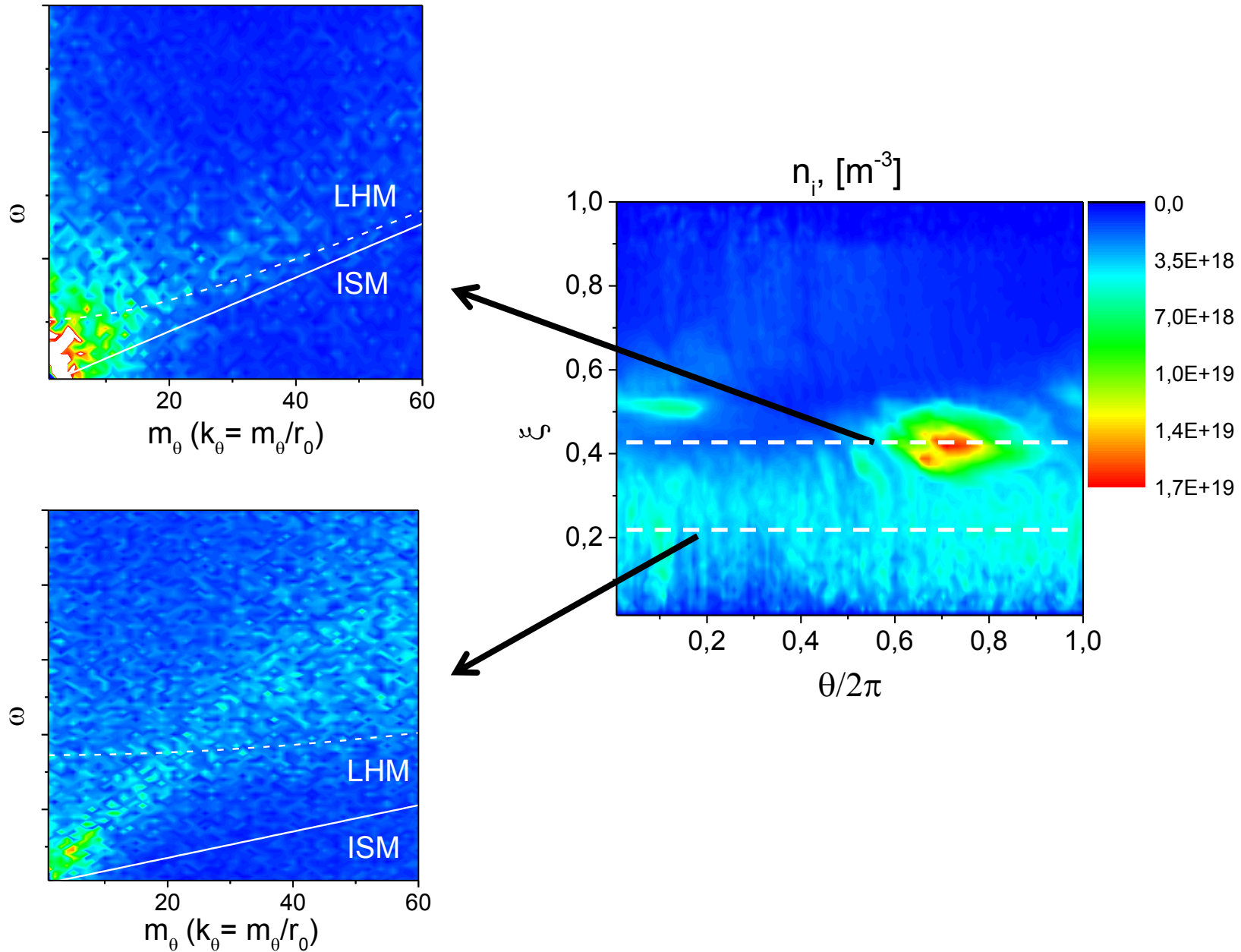
# Spoke structures in the dcMS regime



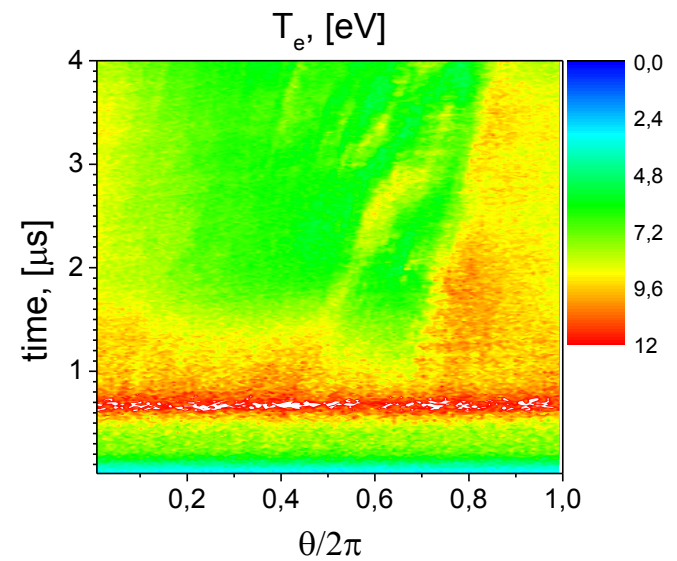
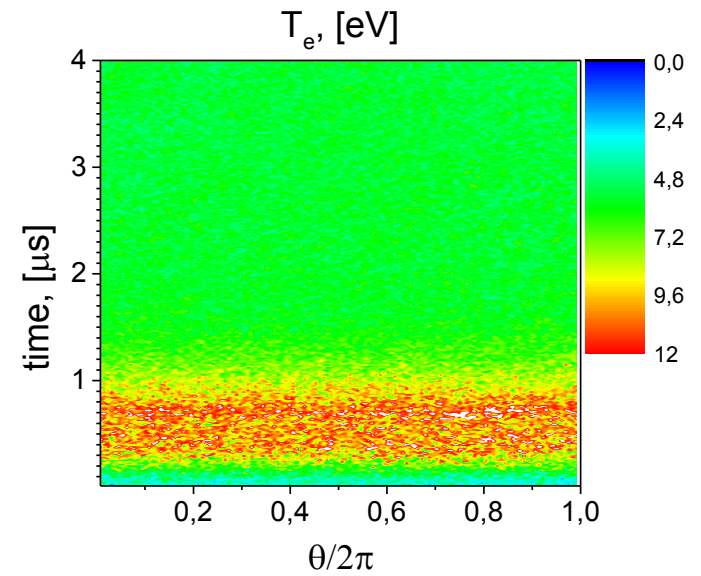
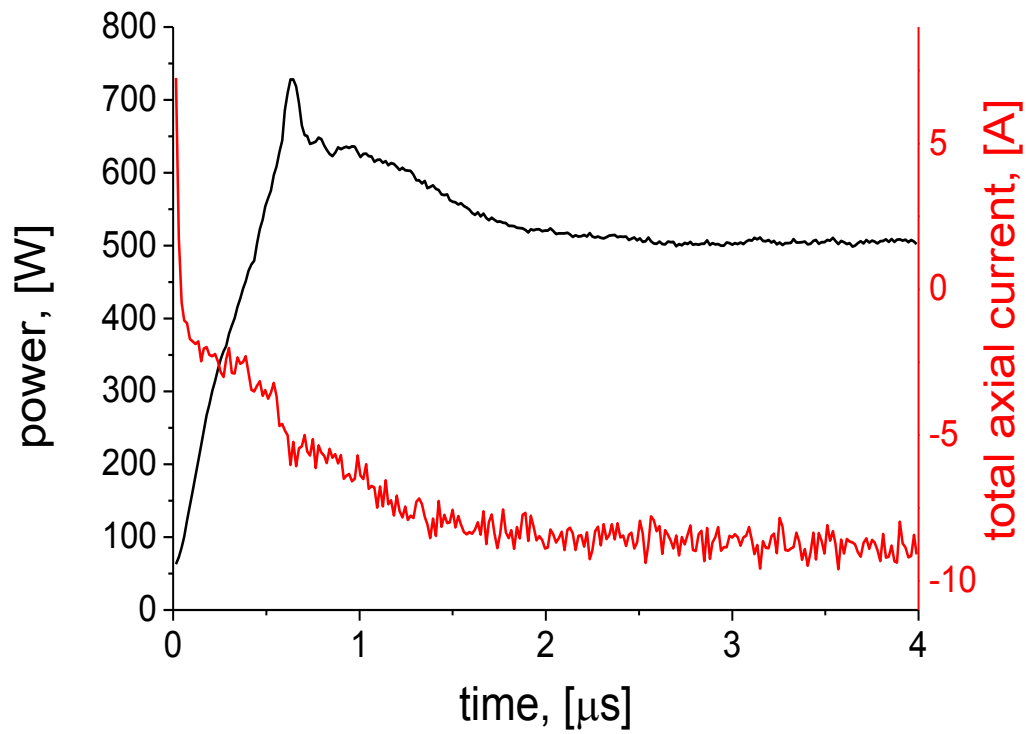
with uniform ionization



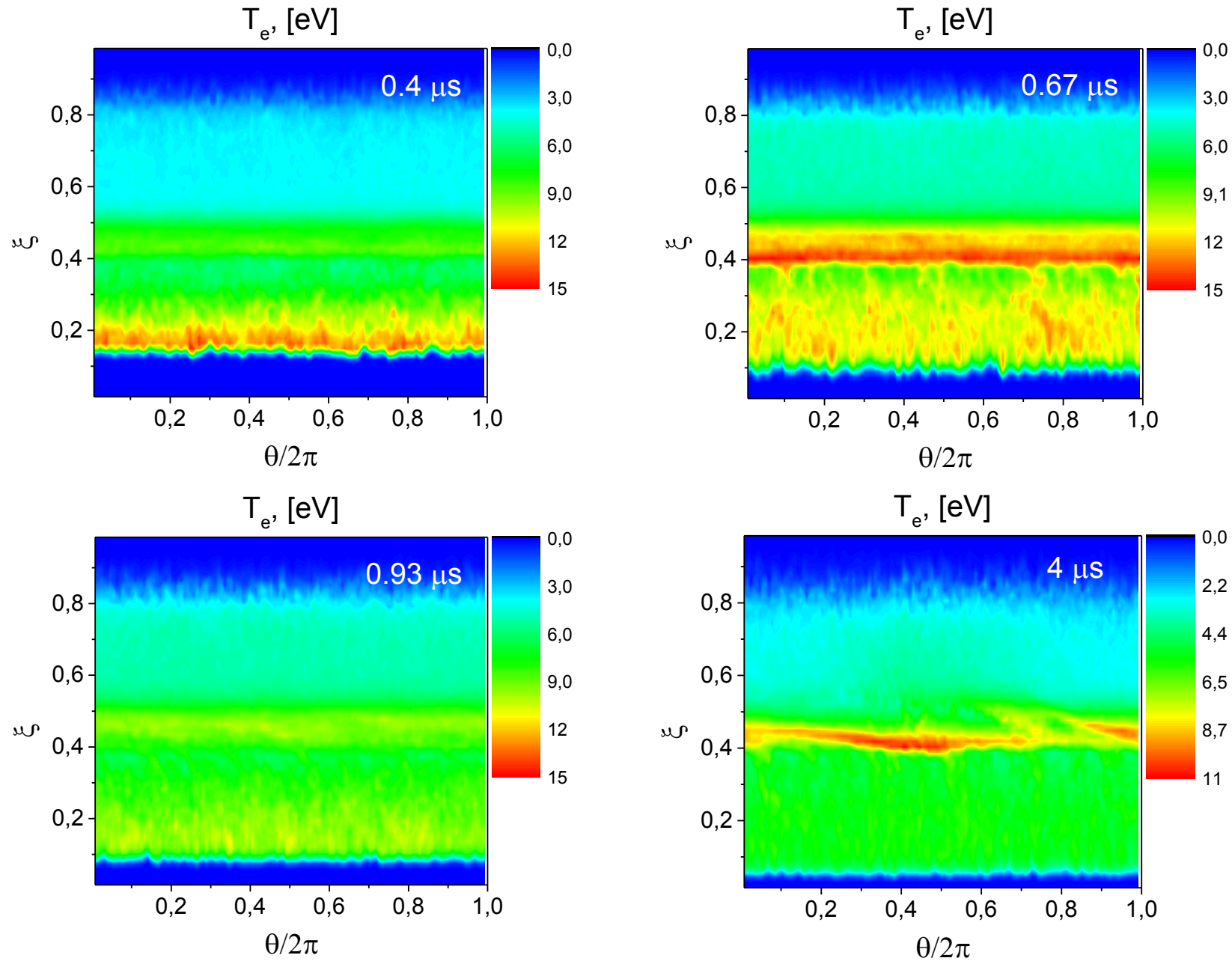
# Spectra of the unstable modes



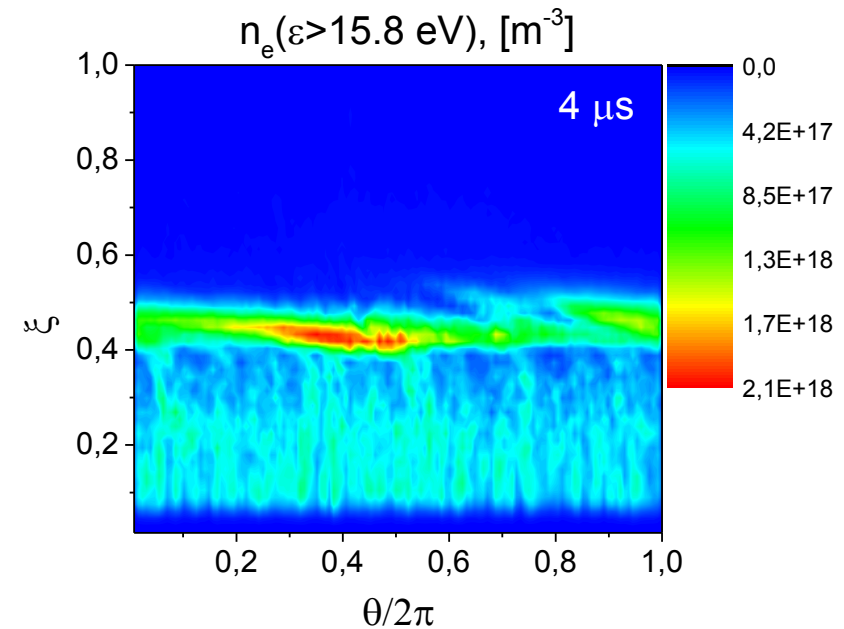
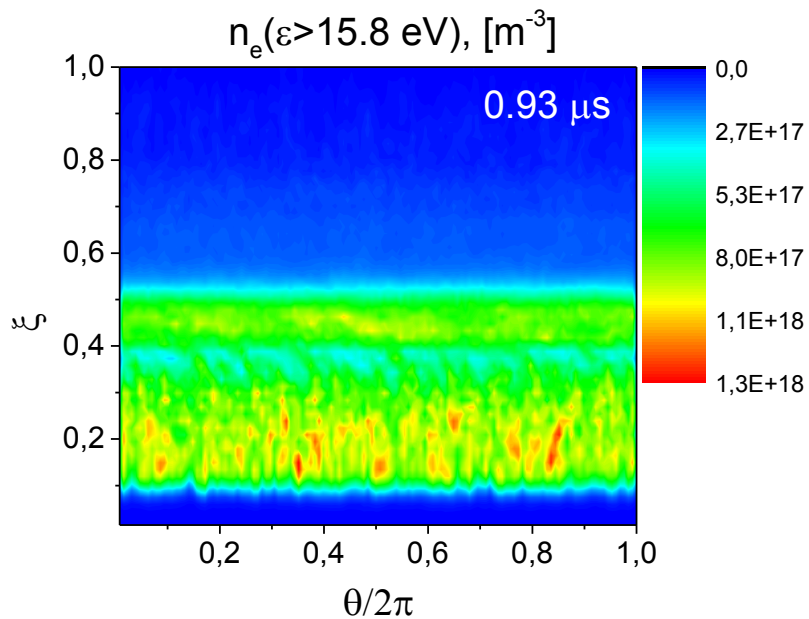
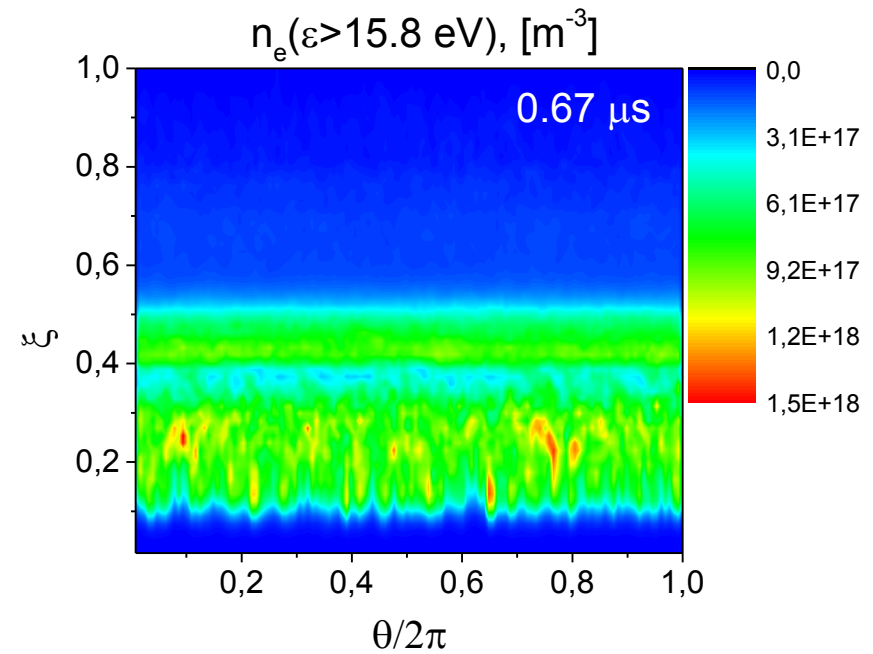
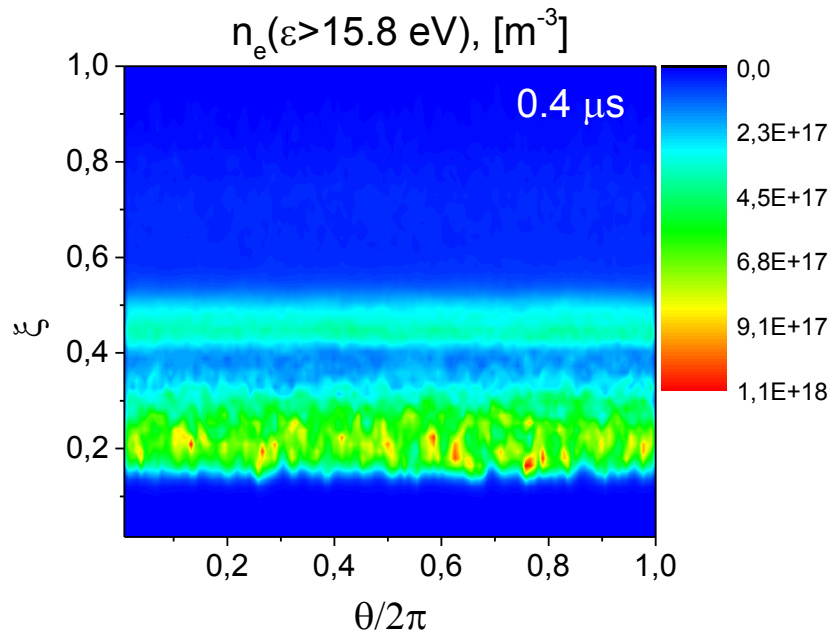
# Discharge evolution



# Discharge evolution: electron heating

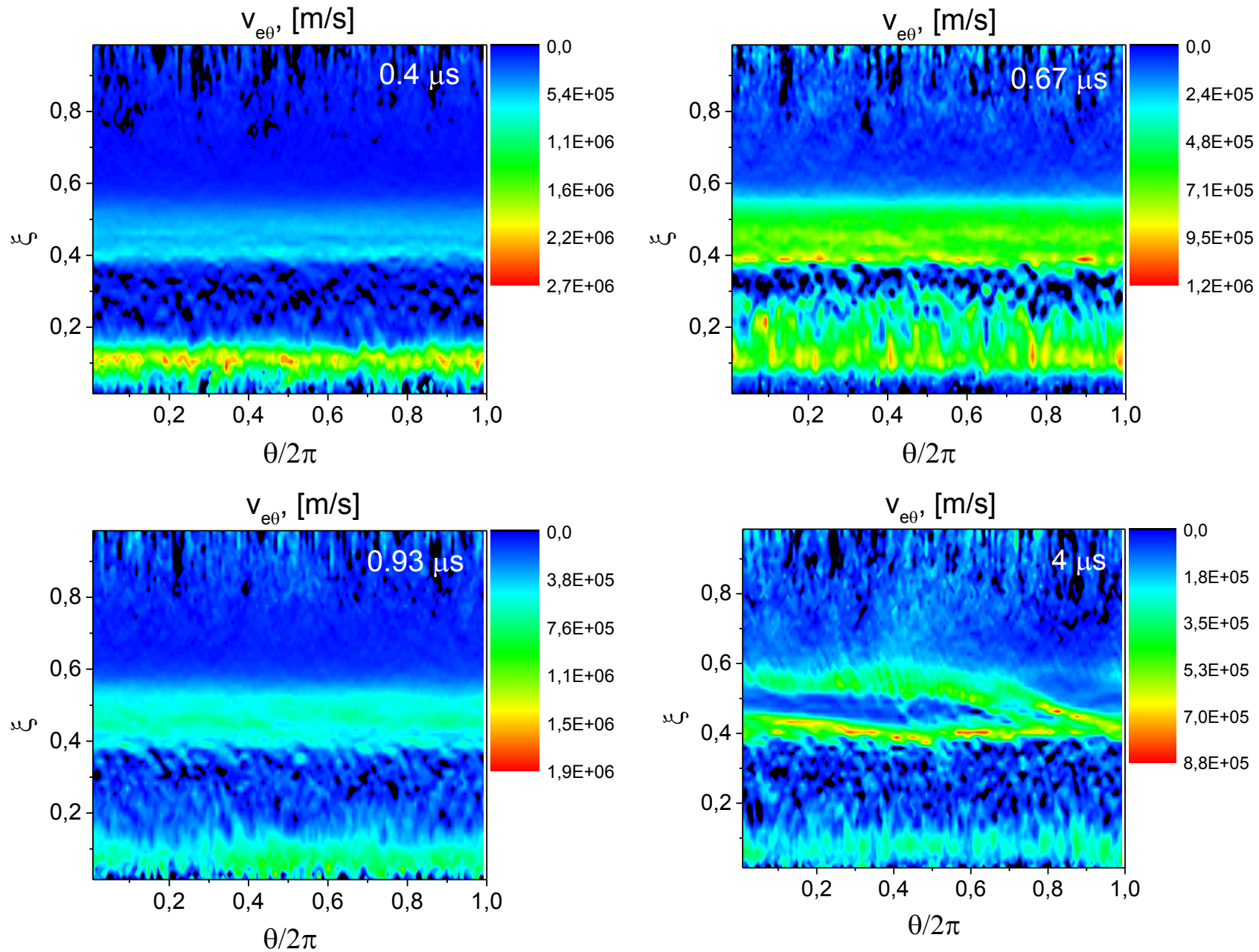


# Discharge evolution: energetic electrons

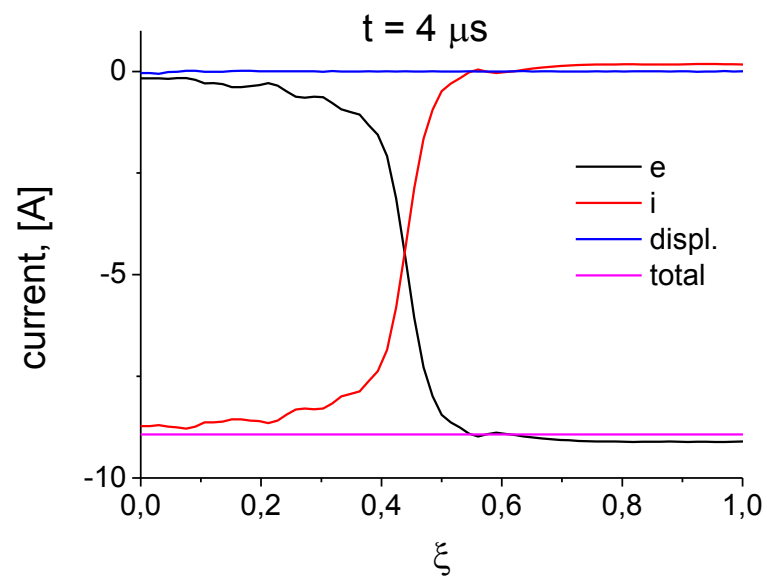
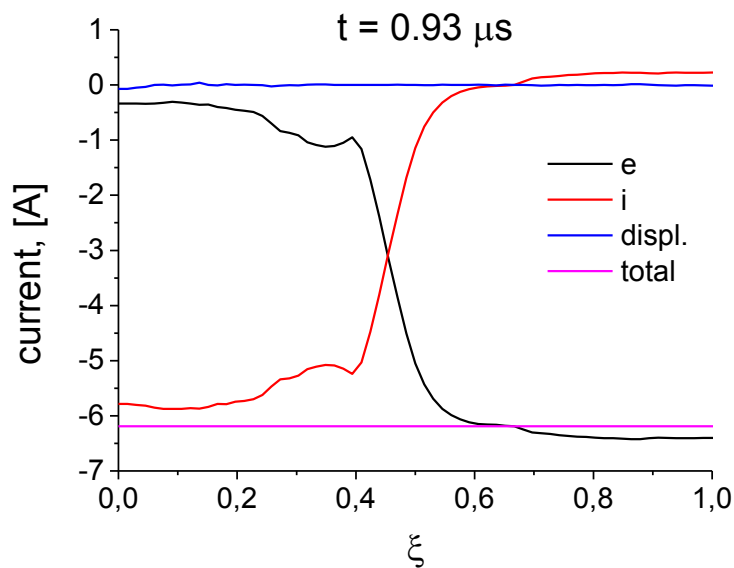
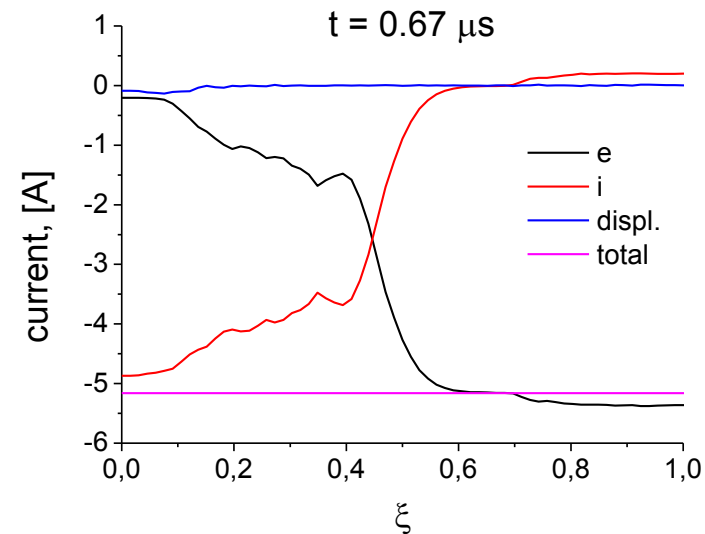
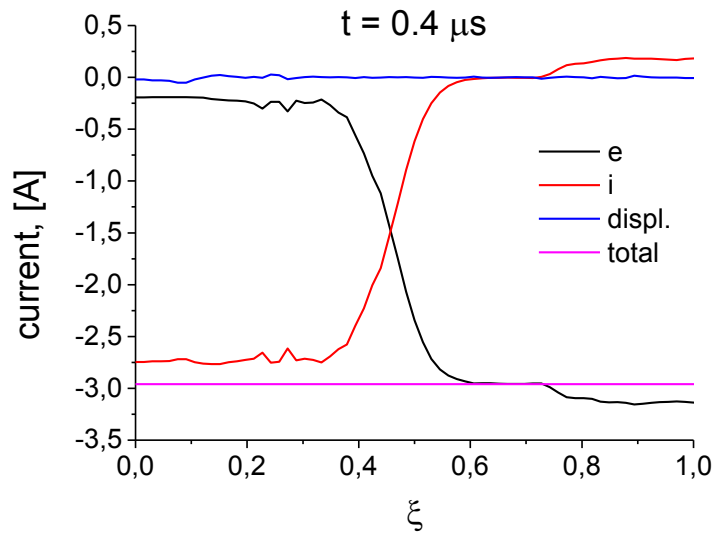




# Discharge evolution: electron azimuthal velocity

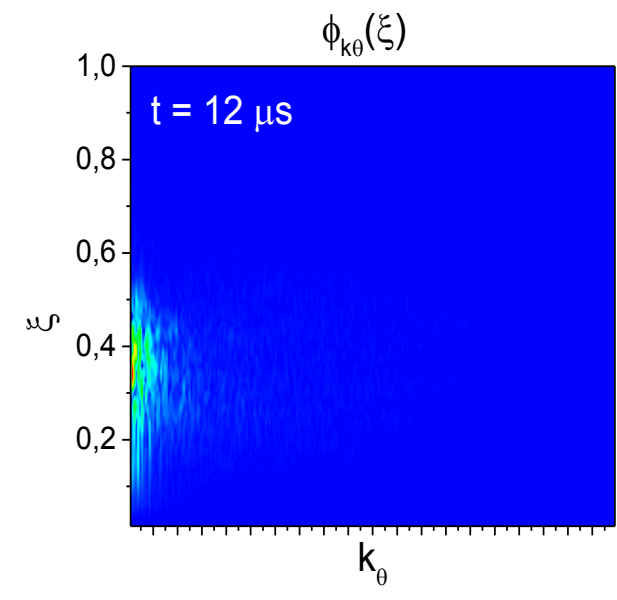
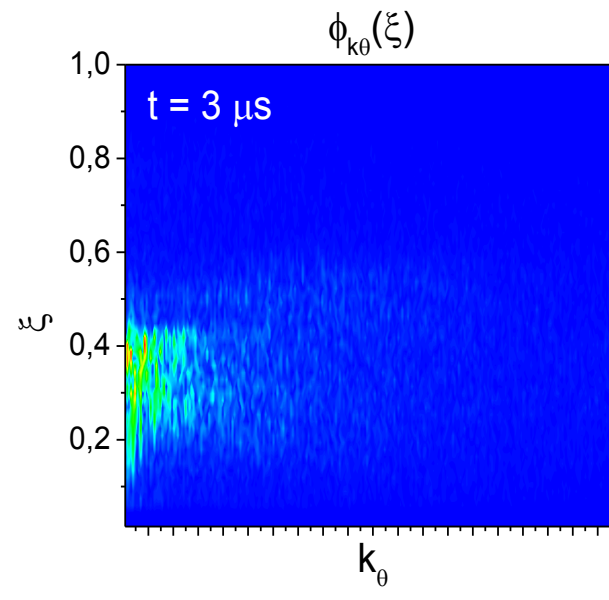
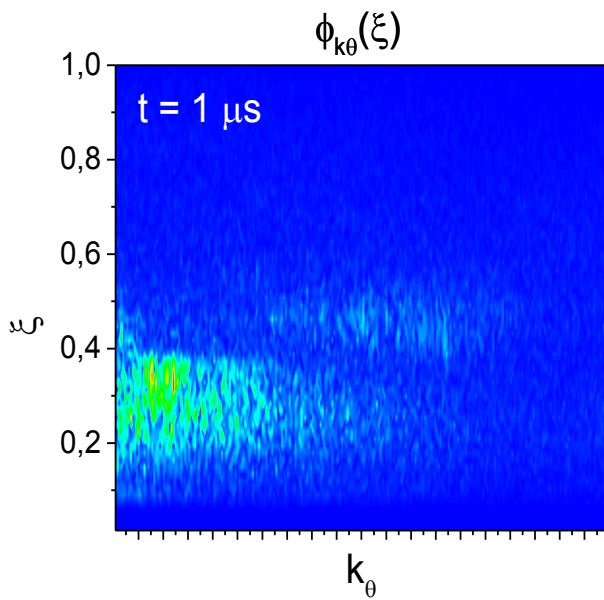


# Discharge evolution: axial current distribution

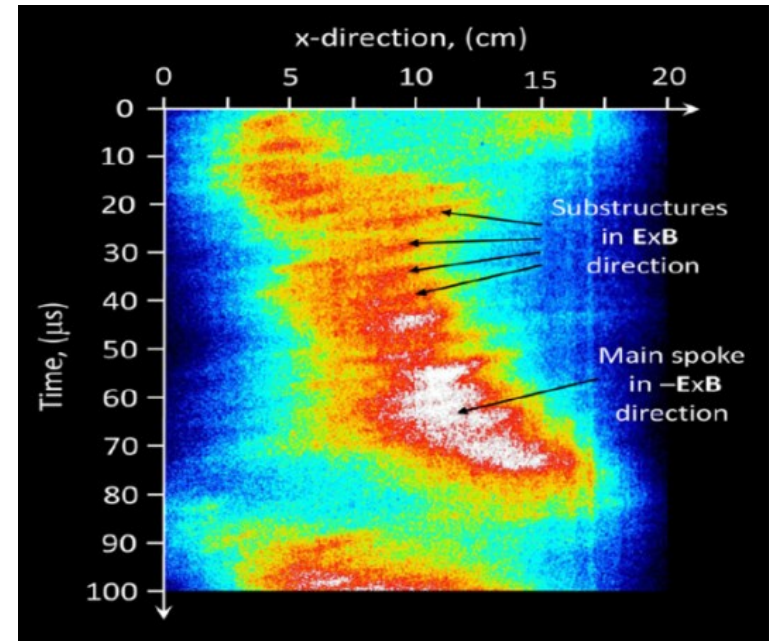
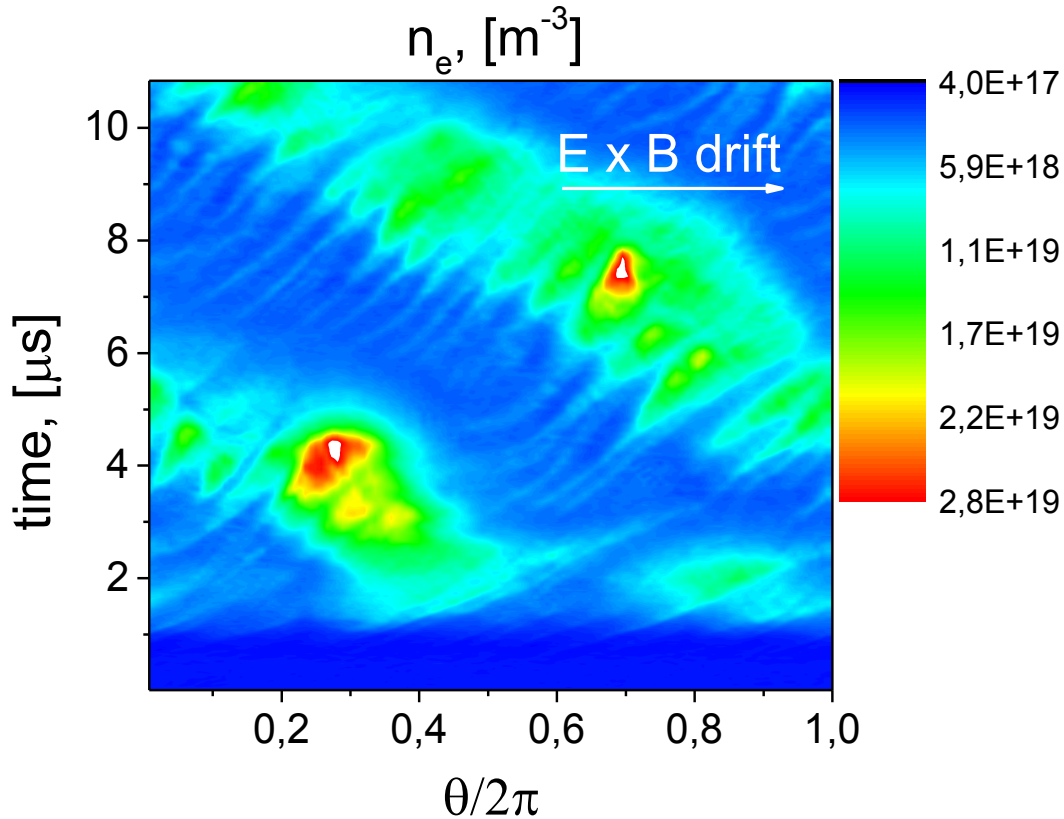


# Inverse cascade to long wavelengths

**K0 is resolved**

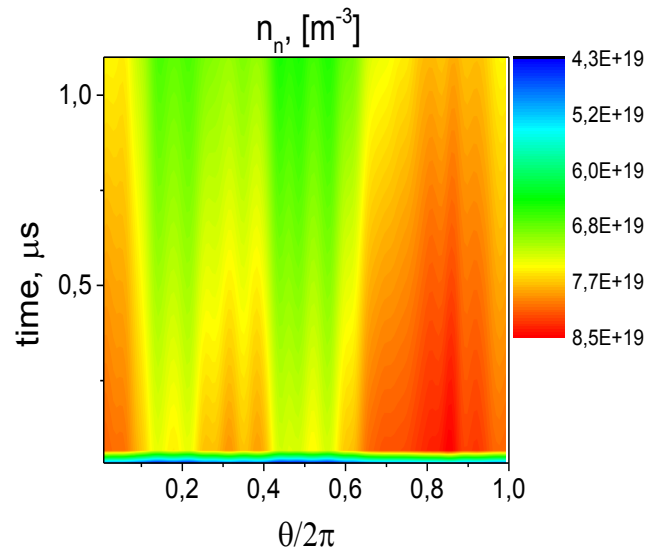
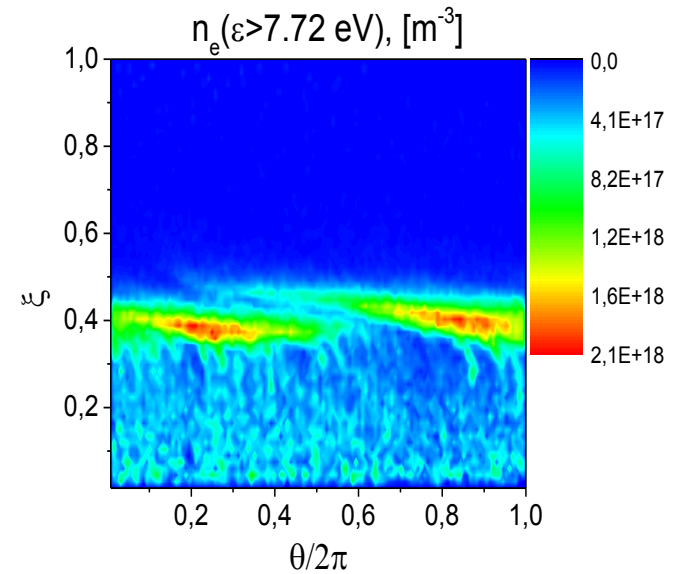
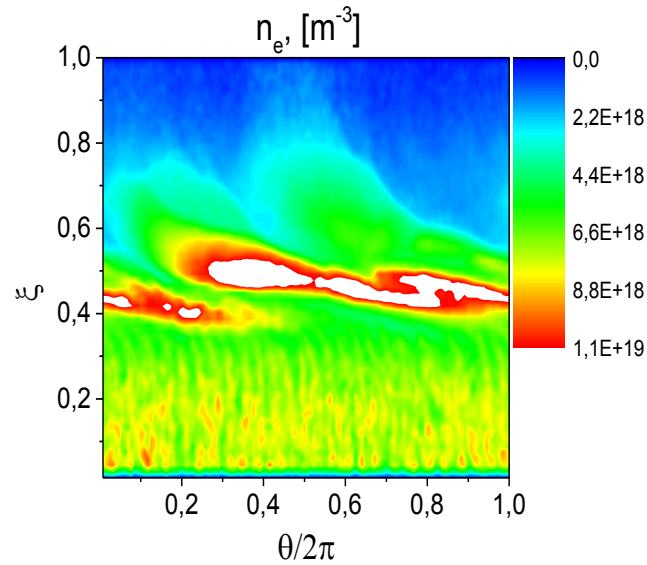
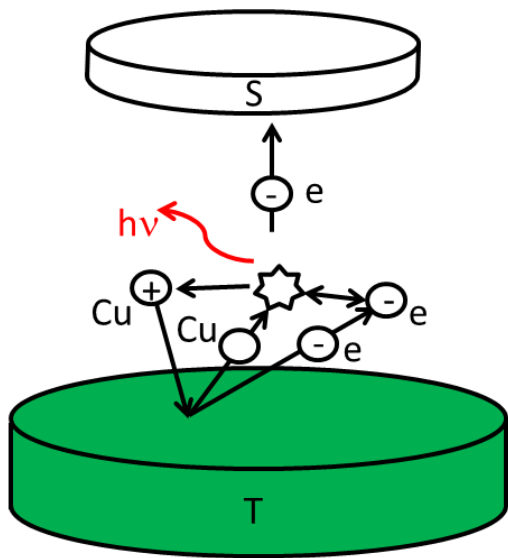


# Spoke motion: simulation vs. experiment

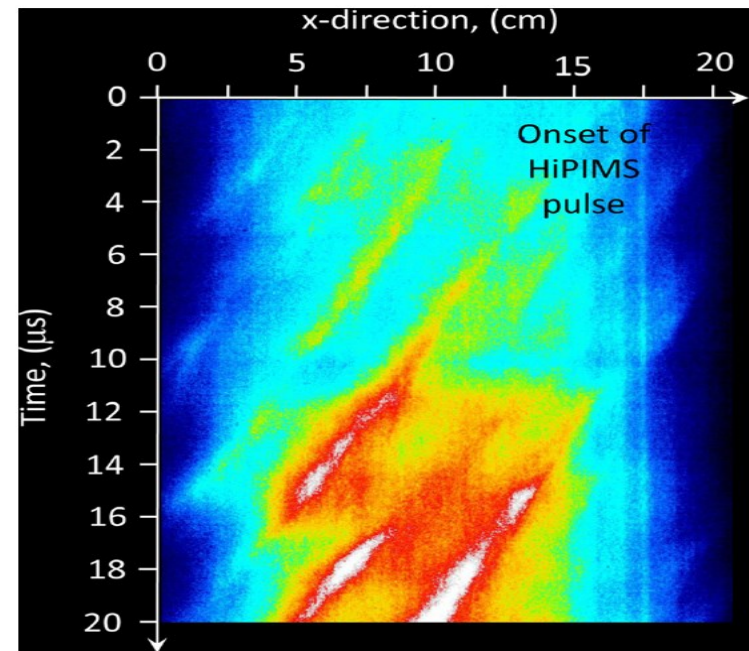
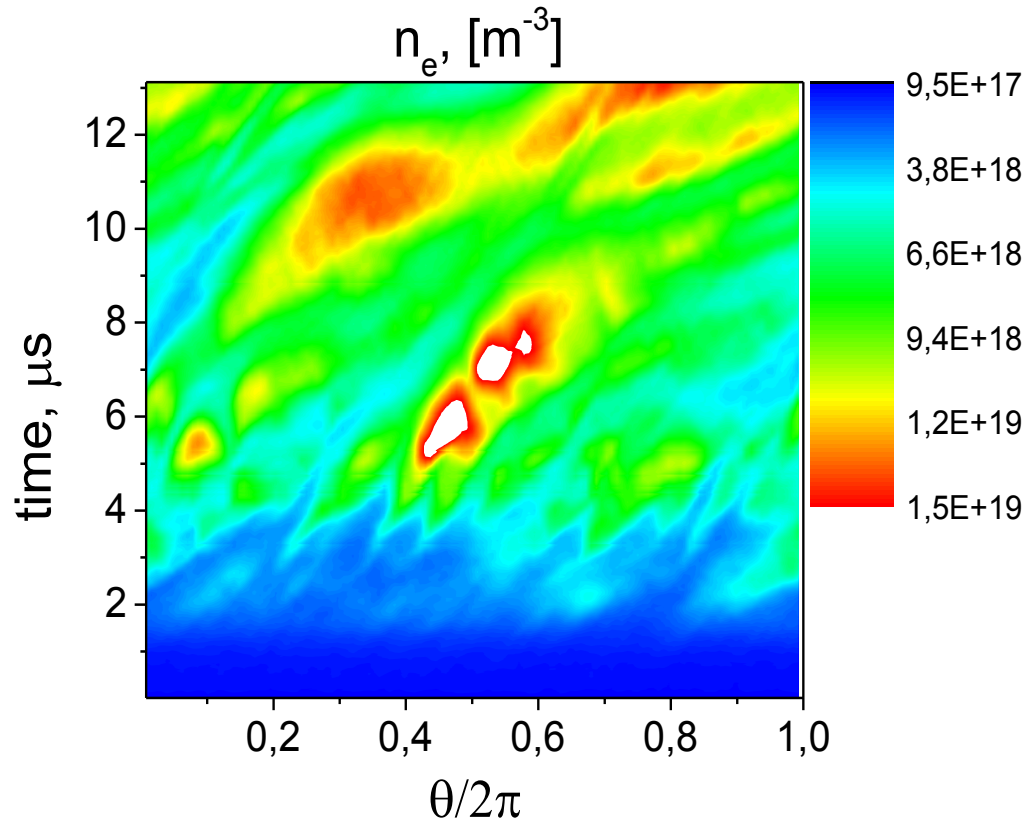


A. Anders et al. 2017

# Spoke structures in the self-sputtering regime



# Spoke motion: simulation vs. experiment



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