



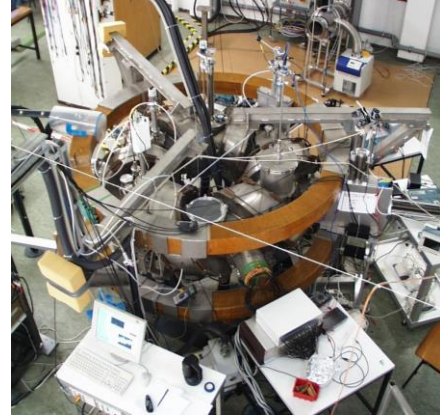
Microscopic Structure of Turbulence in the Torsatron TJ-K



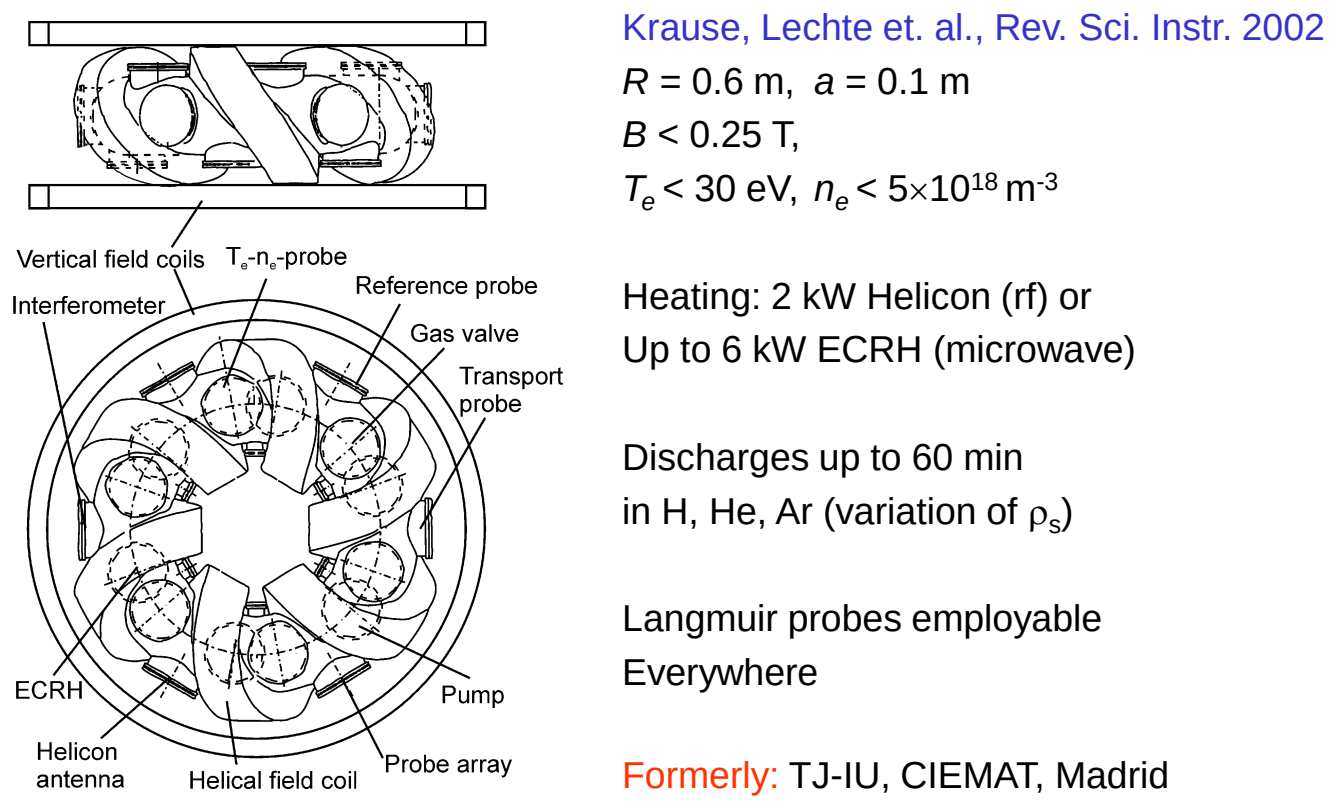
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Motivation

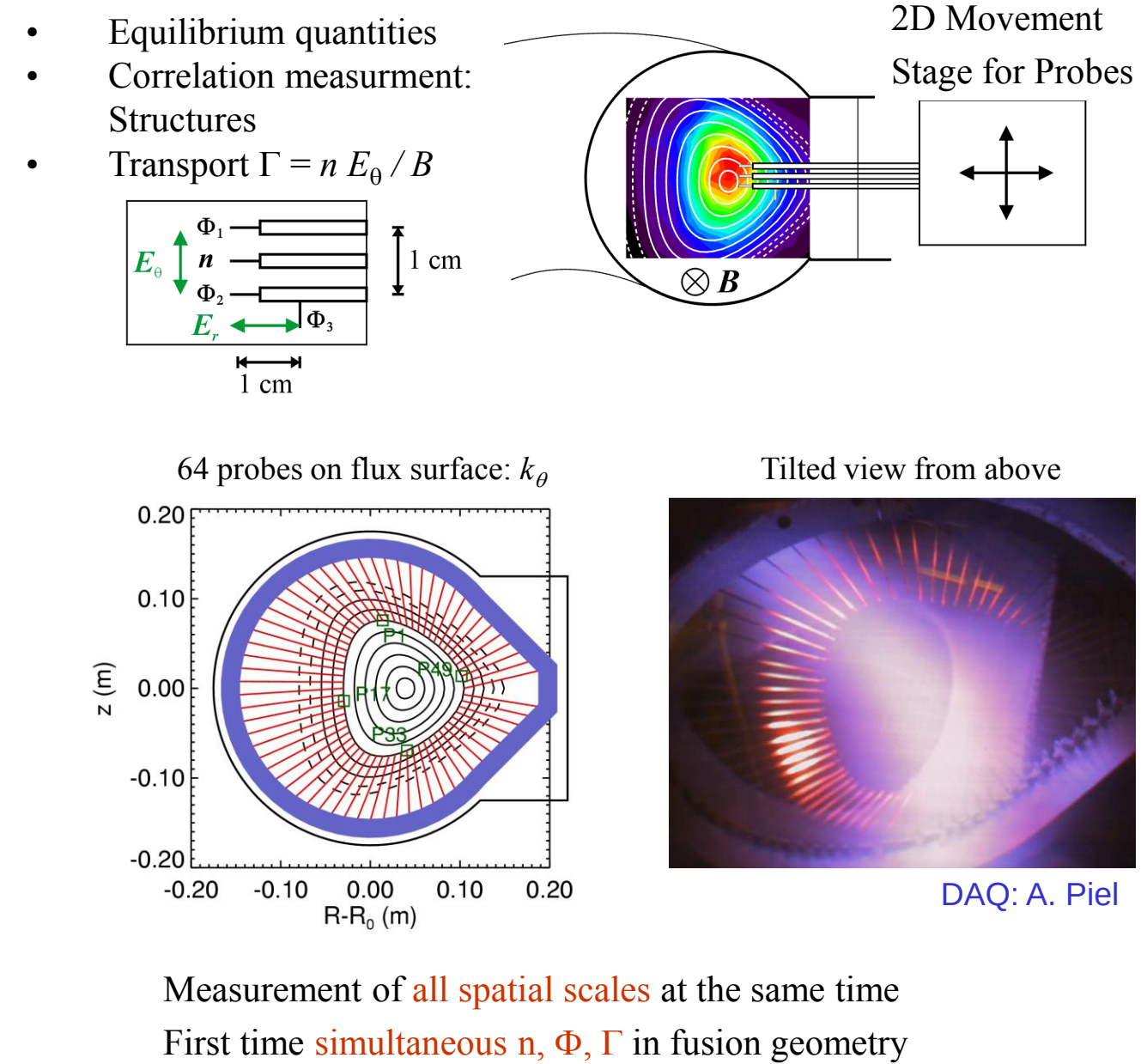
Motivation: turbulent transport in fusion plasmas
The experiment TJ-K: powerful turbulence diagnostics
Form and propagation of turbulent events
Spatial scales of fluctuations and transport



The Torsatron TJ-K



Probe Diagnostics



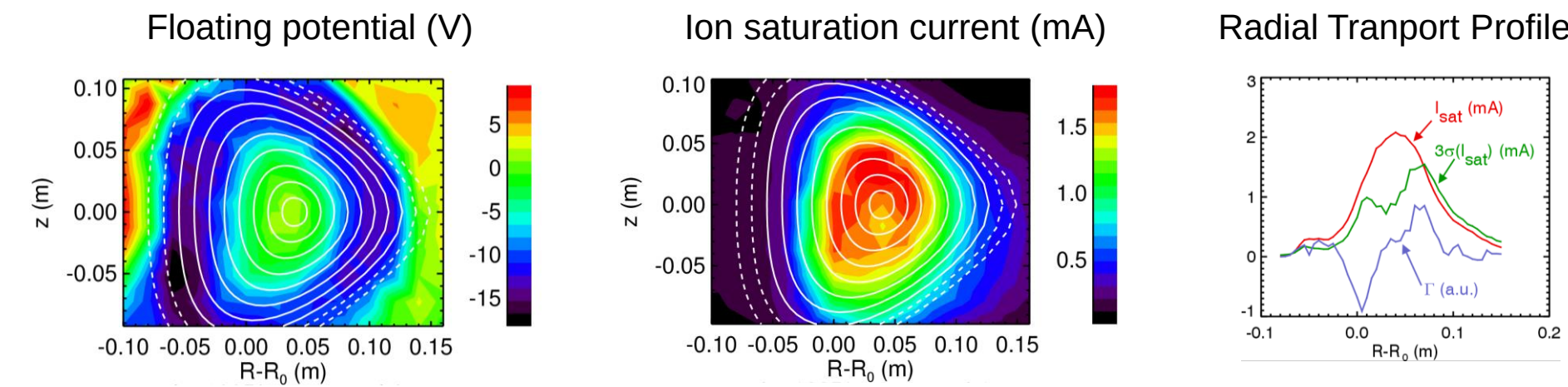
Turbulent Mean $E \times B$ Transport

$$\tilde{\Gamma}(t) = \tilde{n} \cdot \tilde{u}_{E \times B} = \tilde{E}_\theta \tilde{n} / B$$

$$\tilde{\Gamma}(k) = |k \Phi_k| |n_k| \sin(\gamma_k^n) / B$$

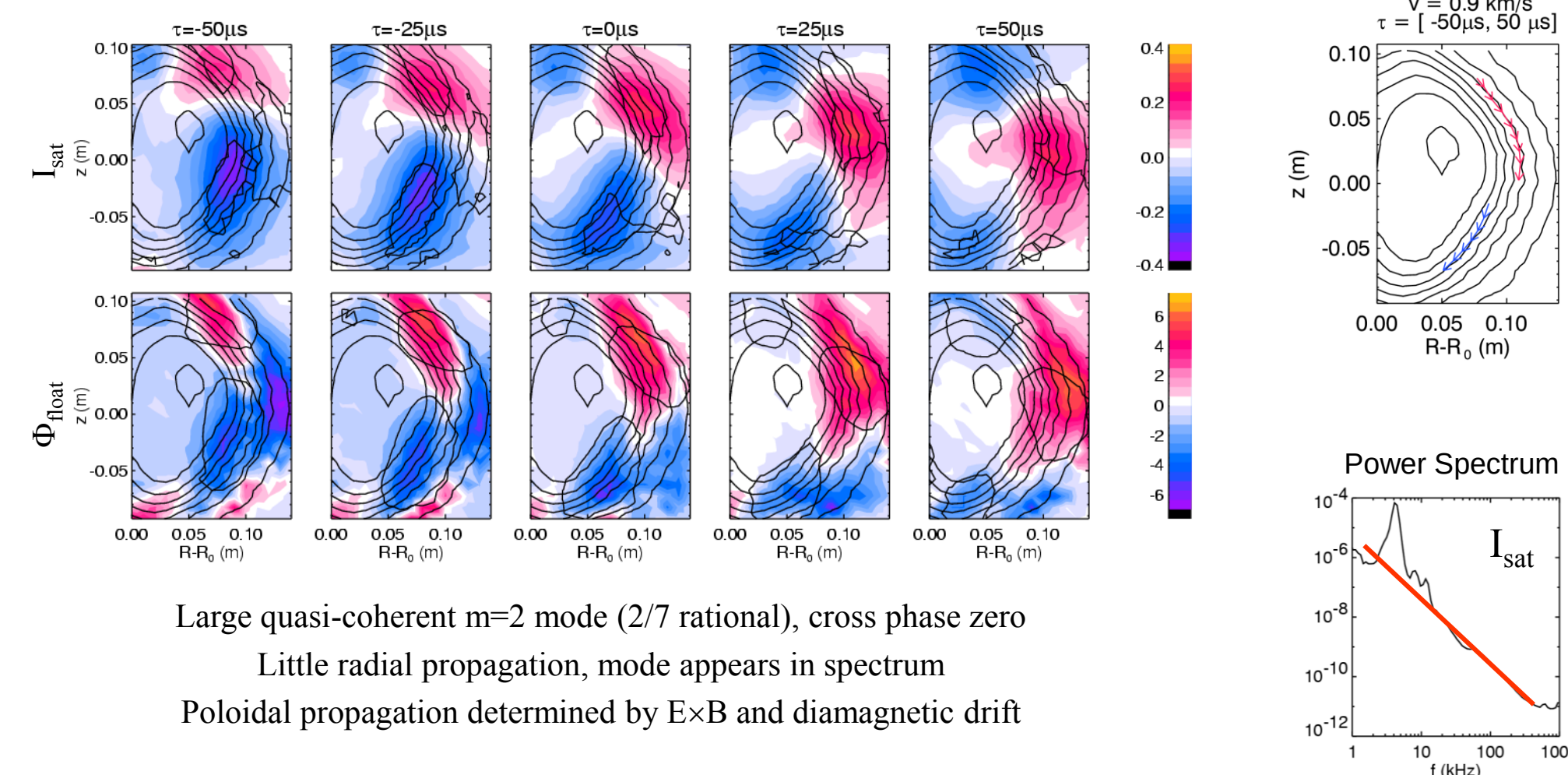
Cross phase γ governs mean transport

Equilibrium Plasma Parameters

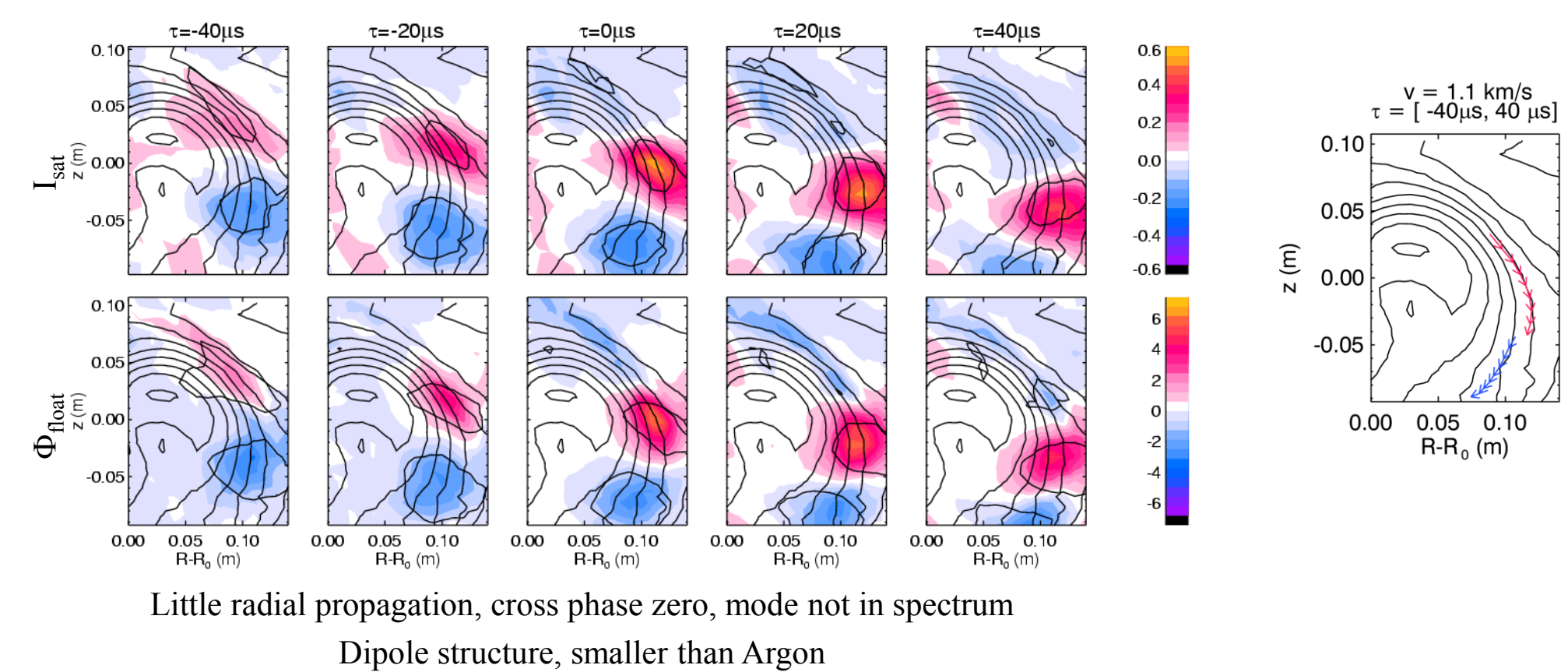


Conditional Averaging

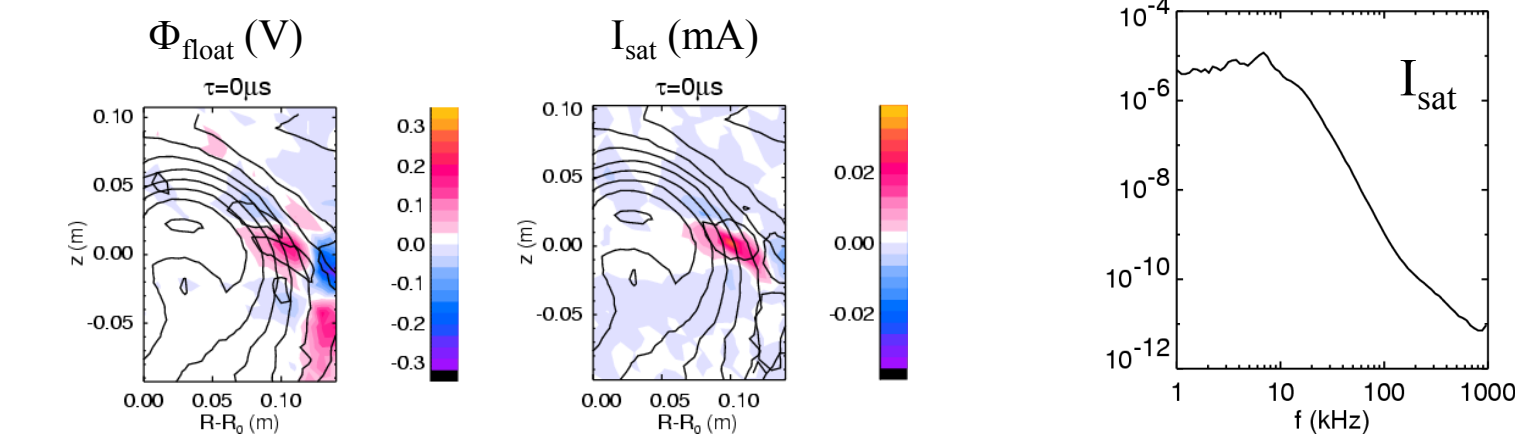
Argon, $\rho_s = 31$ mm



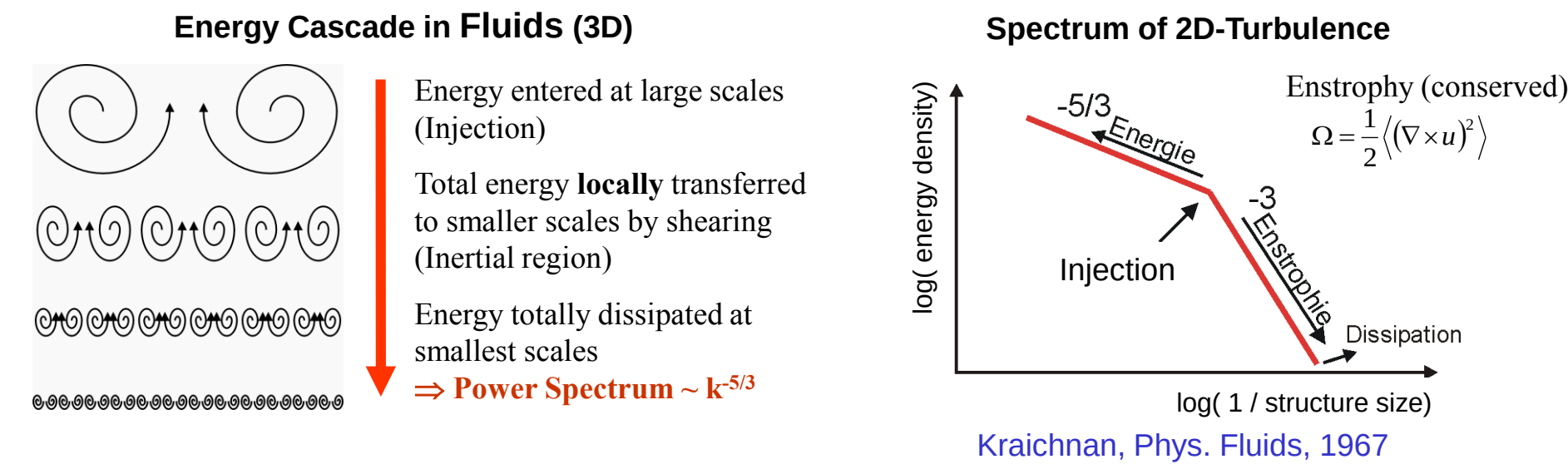
Helium, $\rho_s = 10$ mm



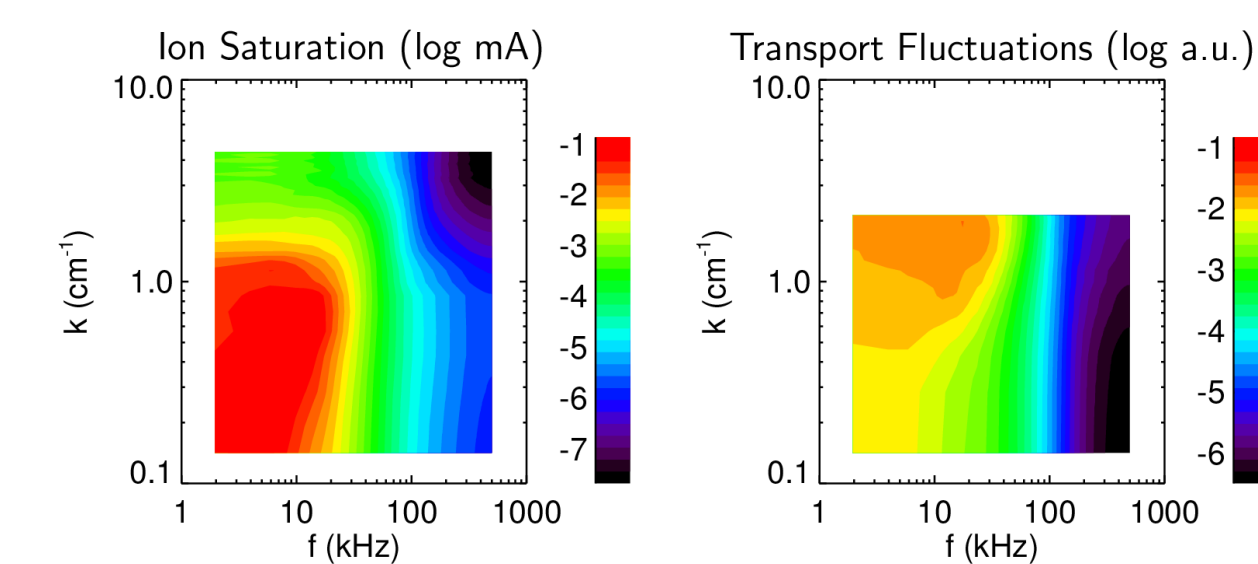
Highpass filtered data: smaller structures



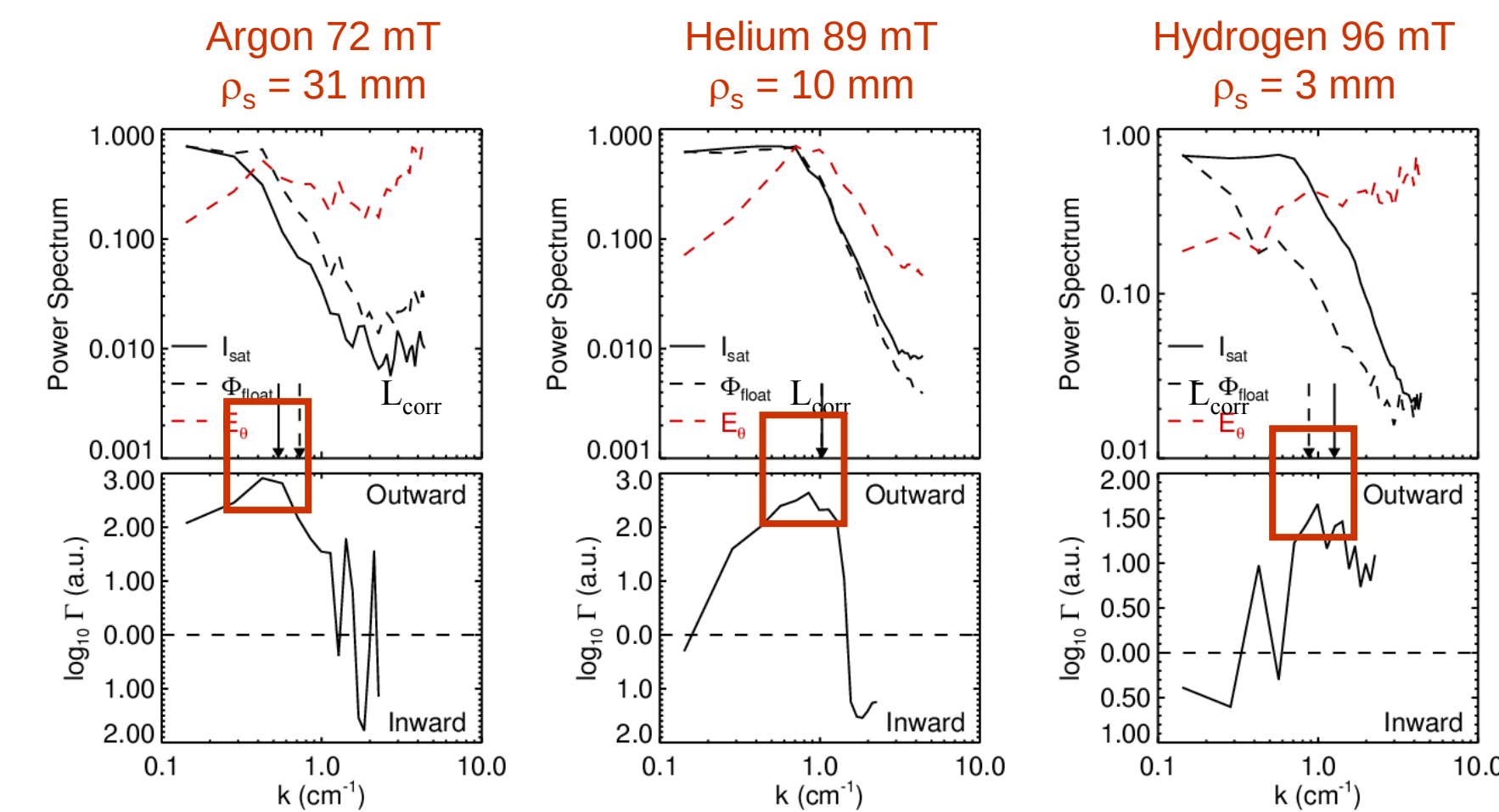
Turbulent Wave Number Spectra



TJ-K Spectra display broadband turbulence



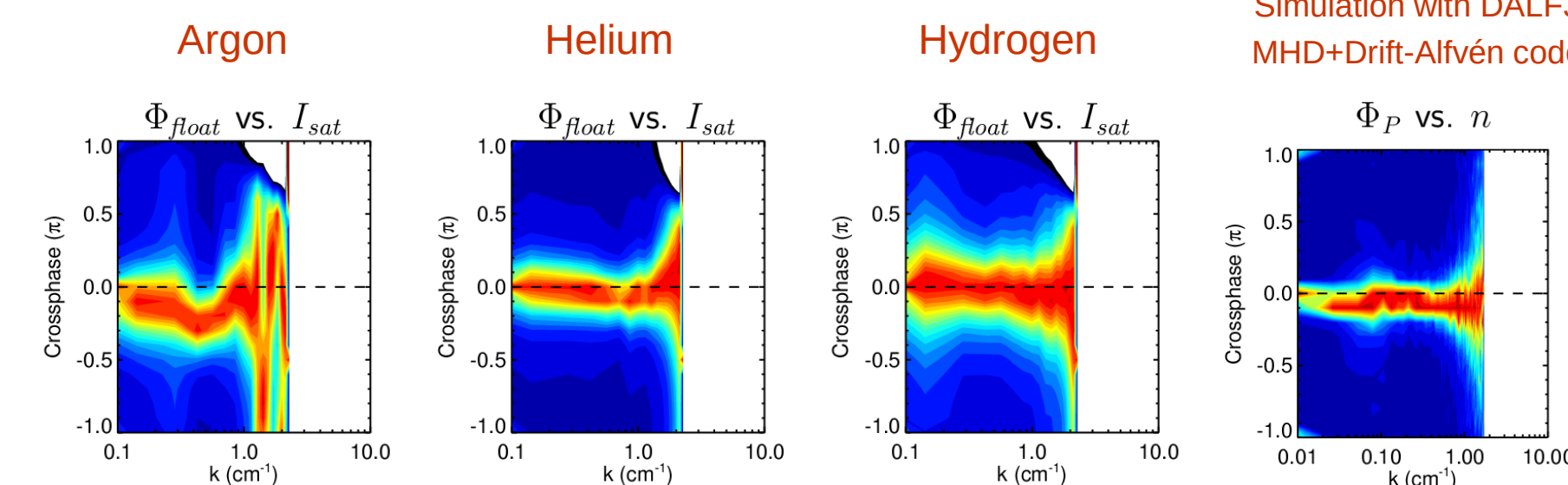
Turbulent Transport Scales



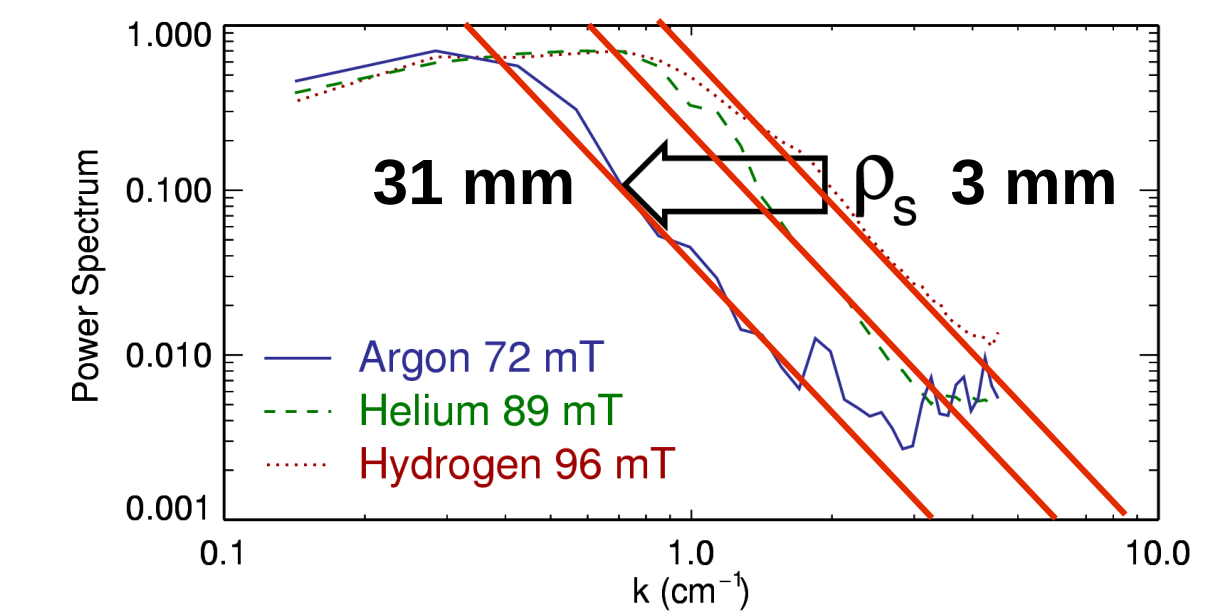
H, He, Ar similar, Kolmogorov-like,

Transport maximum at correlation length of fluctuations

Cross Phases ≈ 0 : Drift Waves in TJ-K

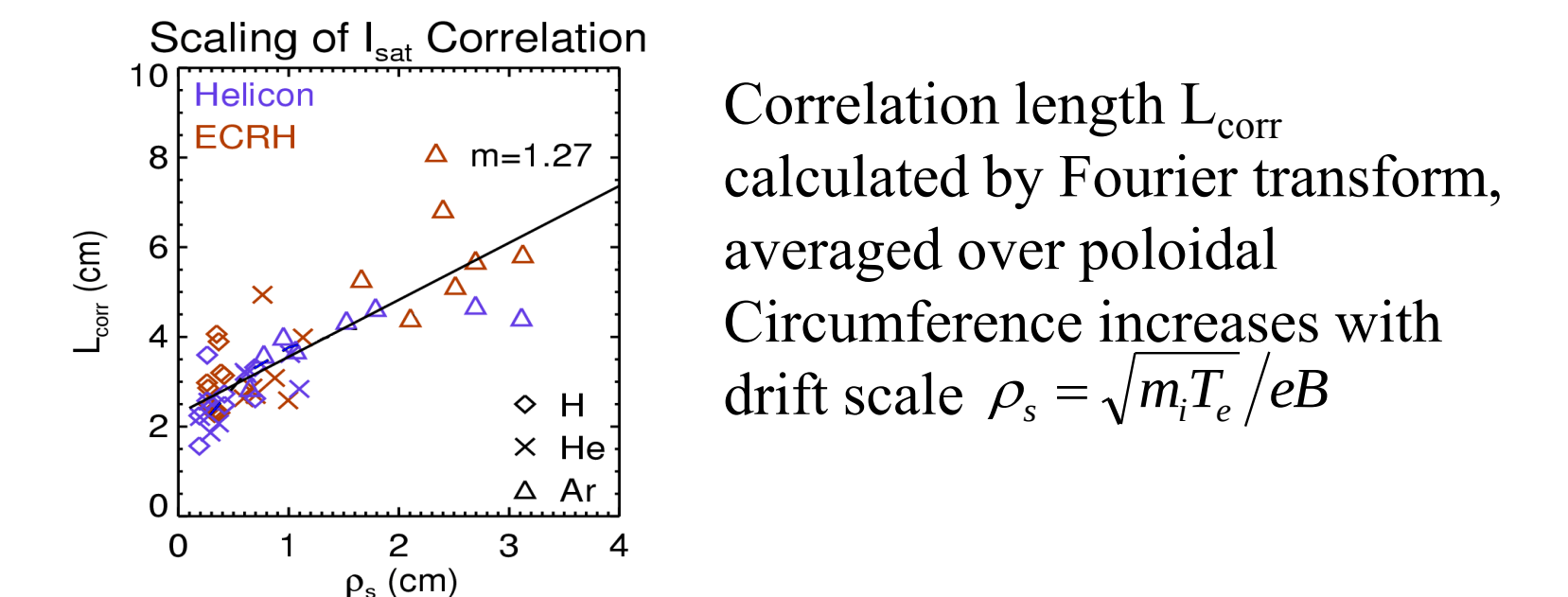


Spectral Index



Spectra shifted according to ρ_s
spectral index -3 $\Rightarrow$ Enstrophy cascade
No space left for inverse energy cascade

ρ_s -Scaling of Structure Sizes



References and Acknowledgements

- [1] Lechte, C., Mahdizadeh, N., Ramisch, M., Stroth, U., *Phys. Rev. Lett.*, submitted 2003
- [2] C. Lechte, S. Niedner, and U. Stroth, *New J. Phys.* **4**, 34 (2002).
- [3] Krause, N., Lechte, C., Niedner, S., Westphal, R., Stroth, U., *Rev. Sci. Instrum.* **73**, 3474 (2002).
- [4] S. Niedner, B. D. Scott, and U. Stroth, *Plasma Phys. Controll. Fusion* **44**, 397 (2002).
- [5] B. Scott, *Plasma Phys. Controll. Fusion* **39**, 1635 (1997).

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