R. Meyrand[1,2] & S. Galtier[1,3]

1: IAS, Université Paris-Sud; 2: LPP, Ecole Polytechnique; 3: Institut universitaire de France

« Role of polarities in Hall MHD turbulence »

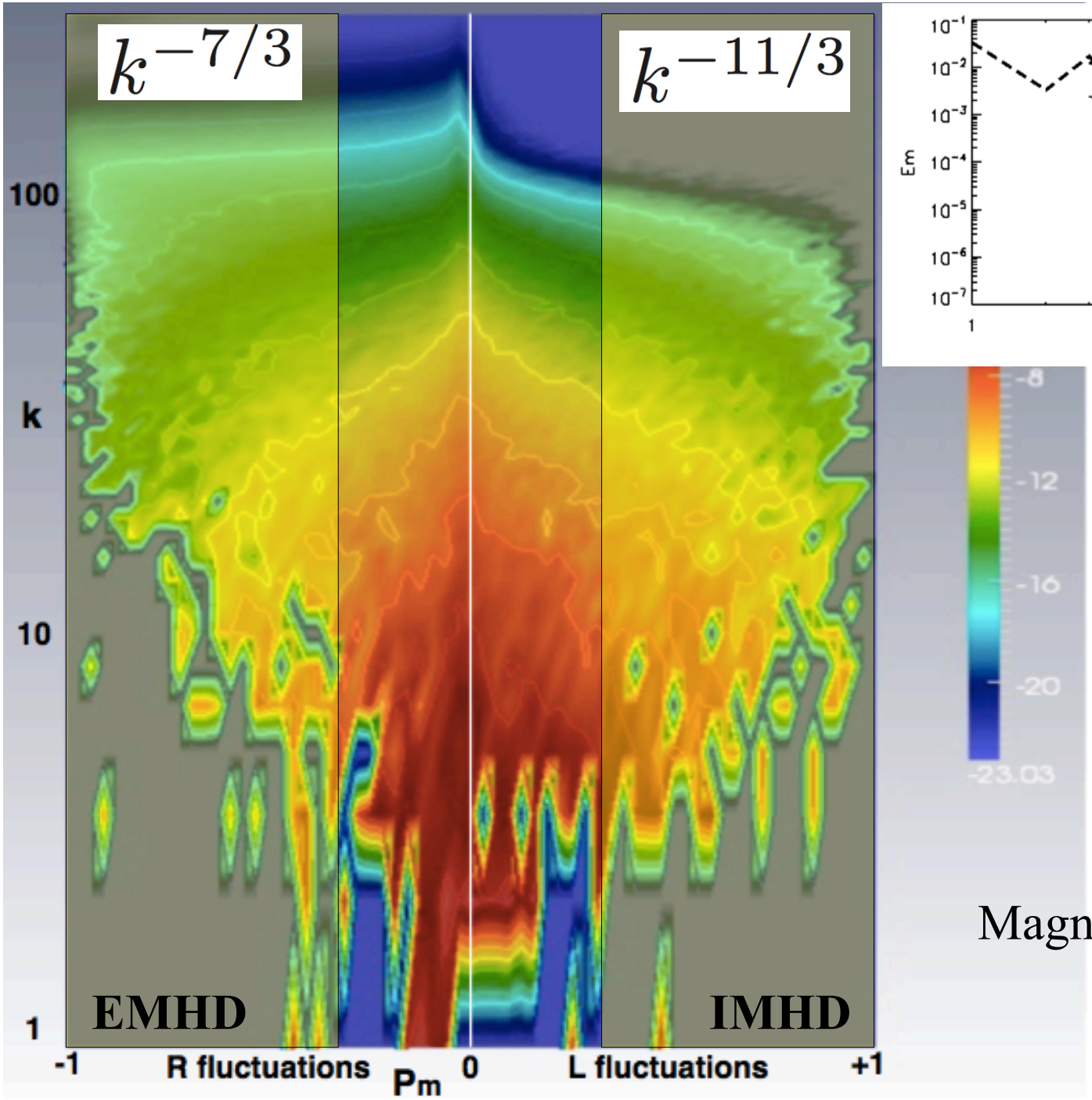
$$\begin{cases} \dfrac{\partial \mathbf{u}}{\partial t} + \mathbf{u}\cdot\nabla\,\mathbf{u} = -\nabla P_* + \mathbf{b}\cdot\nabla\,\mathbf{b}\,, \\ \dfrac{\partial \mathbf{b}}{\partial t} + \mathbf{u}\cdot\nabla\,\mathbf{b} = \mathbf{b}\cdot\nabla\,\mathbf{u} - d_I\,\nabla\times[(\nabla\times\mathbf{b})\times\mathbf{b}]\,, \end{cases}$$

$$\sigma_m = \frac{\hat{\mathbf{a}}\cdot\hat{\mathbf{b}}^* + \hat{\mathbf{a}}^*\cdot\hat{\mathbf{b}}}{2|\hat{\mathbf{a}}||\hat{\mathbf{b}}|}, \quad \sigma_c = \frac{\hat{\mathbf{u}}\cdot\hat{\mathbf{b}}^* + \hat{\mathbf{u}}^*\cdot\hat{\mathbf{b}}}{2|\hat{\mathbf{u}}||\hat{\mathbf{b}}|},$$

$$P_m = \sigma_m\sigma_c,$$

$$E^R(\mathbf{k}) = \frac{1}{2}(|\hat{\mathbf{u}}|^2 + |\hat{\mathbf{b}}|^2)\,,\ P_m < 0\,,$$

$$E^L(\mathbf{k}) = \frac{1}{2}(|\hat{\mathbf{u}}|^2 + |\hat{\mathbf{b}}|^2)\,,\ P_m > 0\,.$$



Magnetic spectrum

Theoretical interpretation

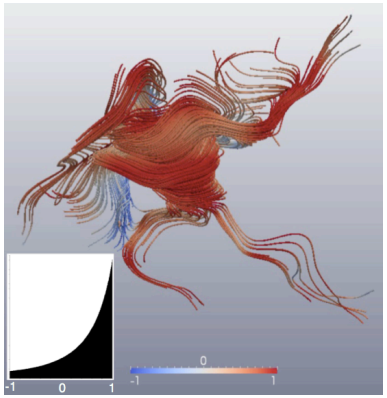
$$\frac{\partial \mathbf{\Omega_j}}{\partial t} = \nabla \times (\mathbf{u}_j \times \mathbf{\Omega_j}) \quad (j = R, L)\,,$$

$$\begin{cases} \mathbf{\Omega}_R = & \mathbf{b}\,, \\ \mathbf{u}_R = \mathbf{u} - d_I \nabla \times \mathbf{b}\,, \end{cases}$$

Electron MHD

$$\begin{cases} \mathbf{\Omega}_L = \mathbf{b} + d_I \nabla \times \mathbf{u}\,, \\ \mathbf{u}_L = & \mathbf{u}\,. \end{cases}$$

Ion MHD



→ *Meyrand & Galtier, PRL, 2012*