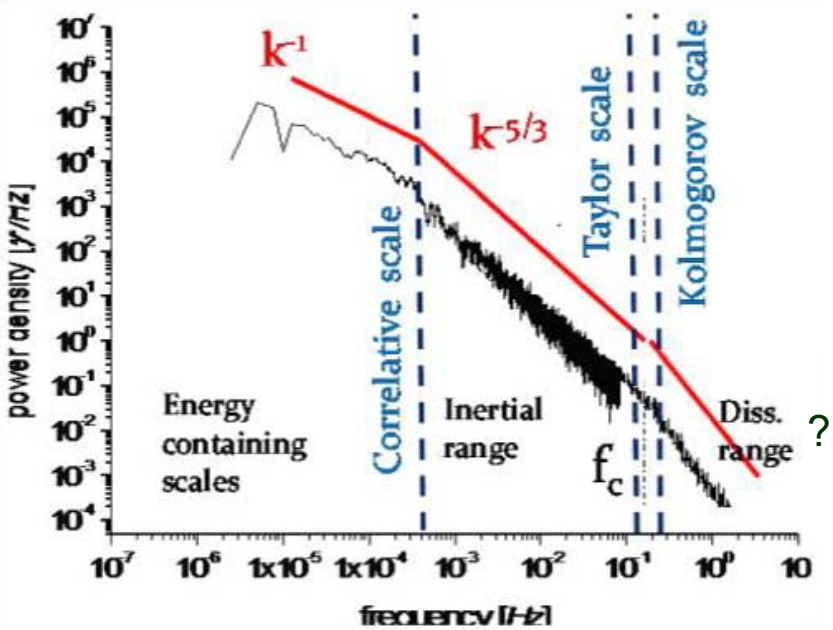
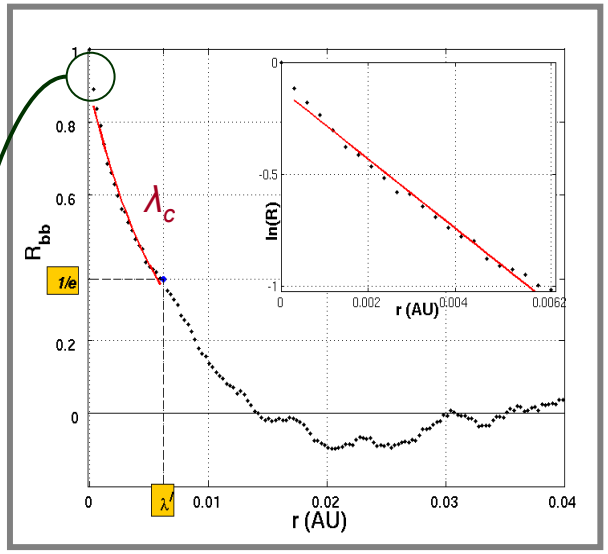
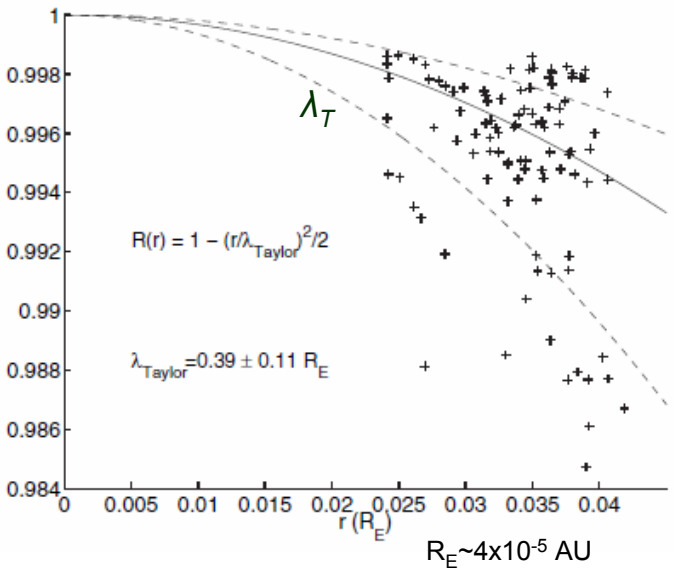
Solar wind as a wind tunnel
(largest Re accessible to *in situ* observations)





$$R_{bb}(r) \approx 1 - \frac{r^2}{2\lambda_{TS}^{\ 2}} + \ldots$$



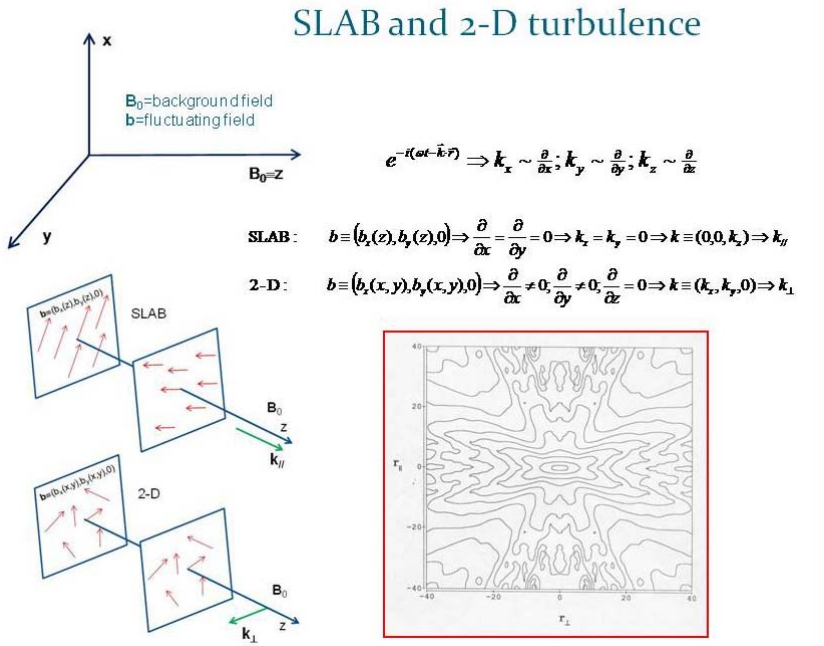
(Batchelor, 1970)

$$R_m^{eff} = \left(\frac{\lambda_C}{\lambda_T}\right)^2 \approx 2.3 \cdot 10^5$$

PRL 2005, JGR 2007

λ_c ~ 0.008 AU, λ_T ~ 1.6 x 10^{-5} AU

Anisotropy and transition to MHD turbulence from injection of Alfven waves



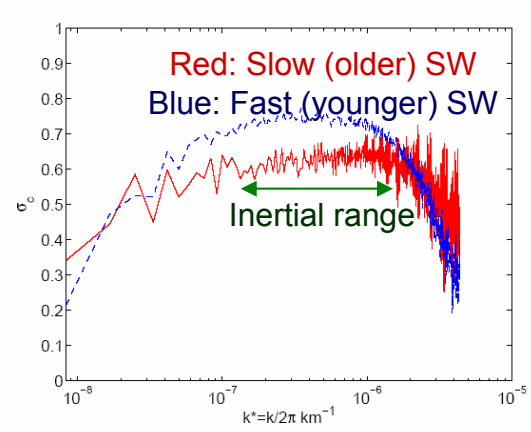
$$e^{-i(\omega t-\vec{k}\cdot\vec{r})} \Rightarrow k_x \sim \frac{\partial}{\partial x};\ k_y \sim \frac{\partial}{\partial y};\ k_z \sim \frac{\partial}{\partial z}$$

$$\text{SLAB}: \quad b \equiv (b_x(z), b_y(z), 0) \Rightarrow \frac{\partial}{\partial x} = \frac{\partial}{\partial y} = 0 \Rightarrow k_x = k_y = 0 \Rightarrow k \equiv (0,0,k_z) \Rightarrow k_{//}$$

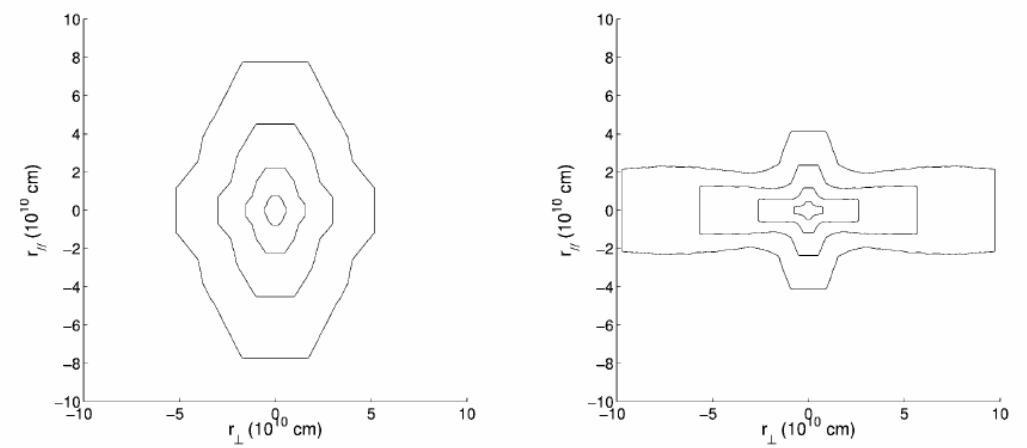
$$\text{2-D}: \quad b \equiv (b_x(x,y), b_y(x,y), 0) \Rightarrow \frac{\partial}{\partial x} \neq 0; \frac{\partial}{\partial y} \neq 0; \frac{\partial}{\partial z} = 0 \Rightarrow k \equiv (k_x, k_y, 0) \Rightarrow k_\perp$$

$$\mathbf{z}^{\pm} = \mathbf{v} \pm \frac{\mathbf{b}}{\sqrt{4\pi\rho}} \qquad \sigma_c(k) = \frac{E_{out}(k) - E_{in}(k)}{E_{out}(k) + E_{in}(k)}$$

$$\partial_t z^{\pm} + (z^{\mp} \cdot \nabla) z^{\pm} = -\frac{1}{\rho}\nabla(p + \frac{B^2}{8\pi}) + Diss$$



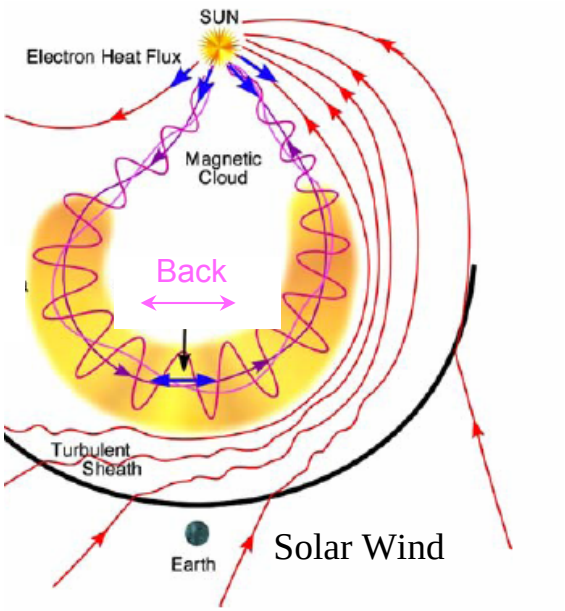
Slow wind (old) is $k_\perp$ Fast wind (young) is $k_{\|}$

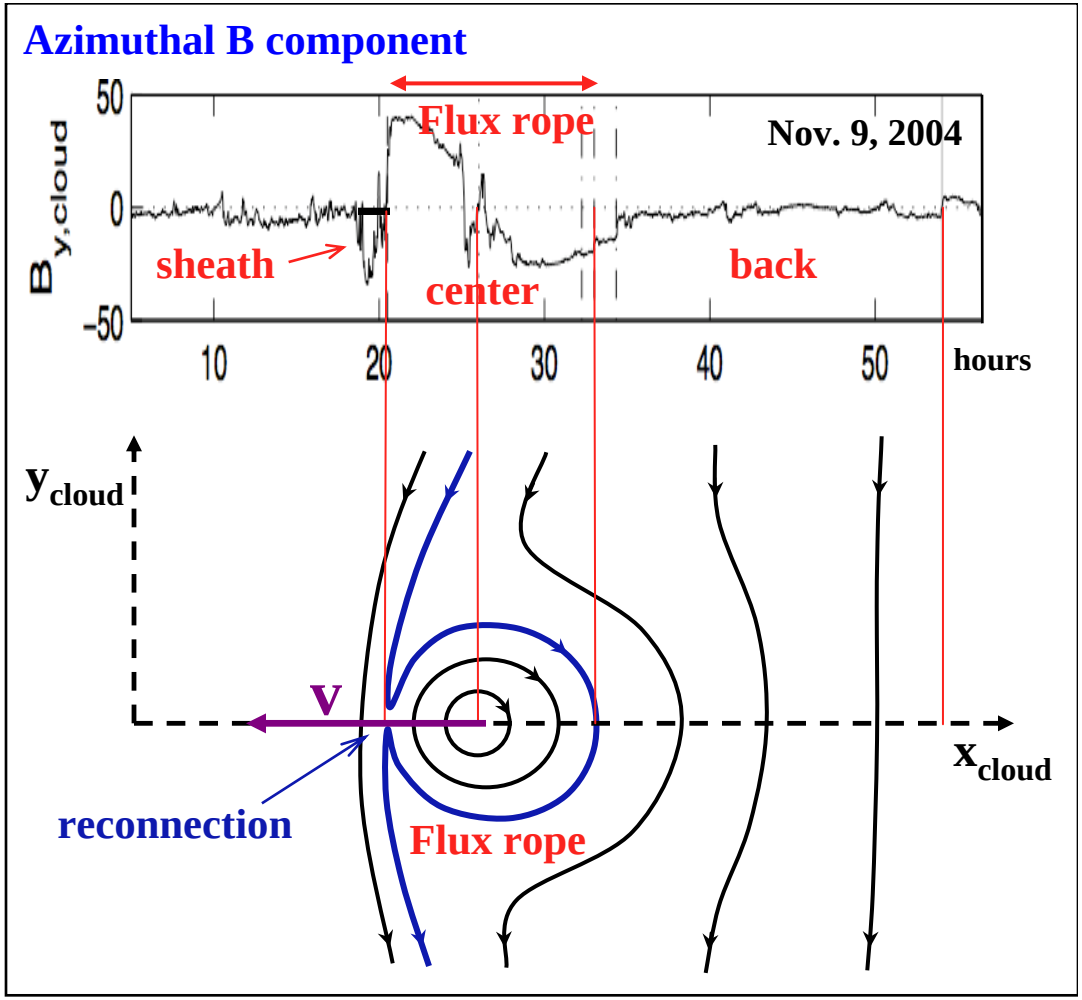


PRL 2004, APJL 2005, JGR 2011

Self-organization and evolution of magnetic vortex in a turbulent medium

SW as natural Lab





*Robust quantification of MHD invariants in magnetic flux ropes [JGR 2003, JASR 2005, JASTP 2008]

*Quantification of reconnected flux [A&A 2006, Sol Phys 2007]

*Mechanisms for self-organization of solar magnetic flux tubes by reconnection [Sol Phys 2007]

* 'kink' instability in solar corona [Sol Phys 2007, Ann Geophys 2008]

*Self-similar expansion of meta-stable MHD structures in SW [A&A 2009, A&A 2010]

*Interchange of **P** between MC/SW (wake, lack of vortexes, viscous elastic drag) [JGR 2009]

*Mass/B accretion from SW to the sheath [Sol Phys 2007, JGR 2009]