Seminar/Proseminar Plasma Physics
winter semester 2018/19

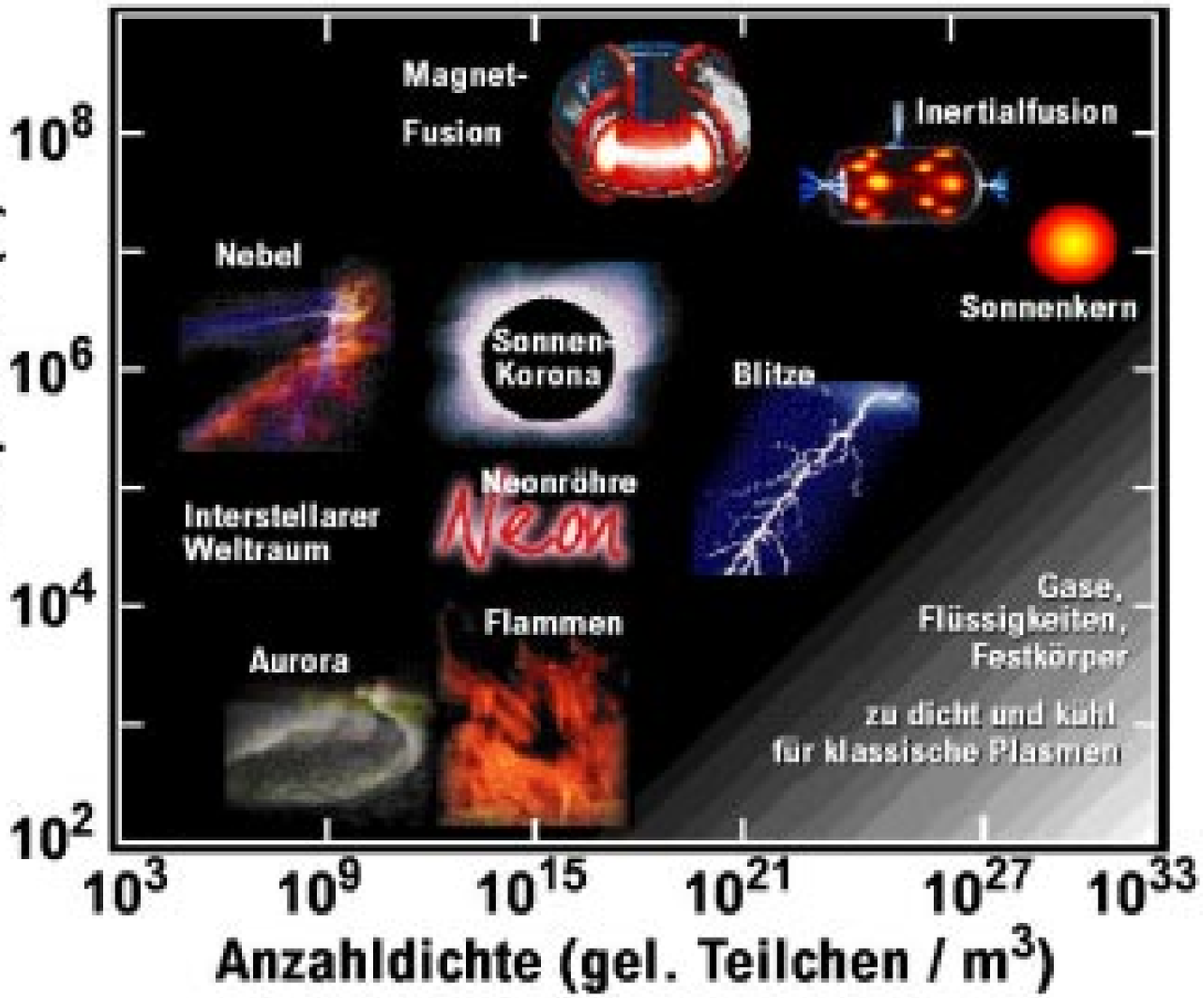
http://www2.ipp.mpg.de/~pwl/tum/2018_WS.html

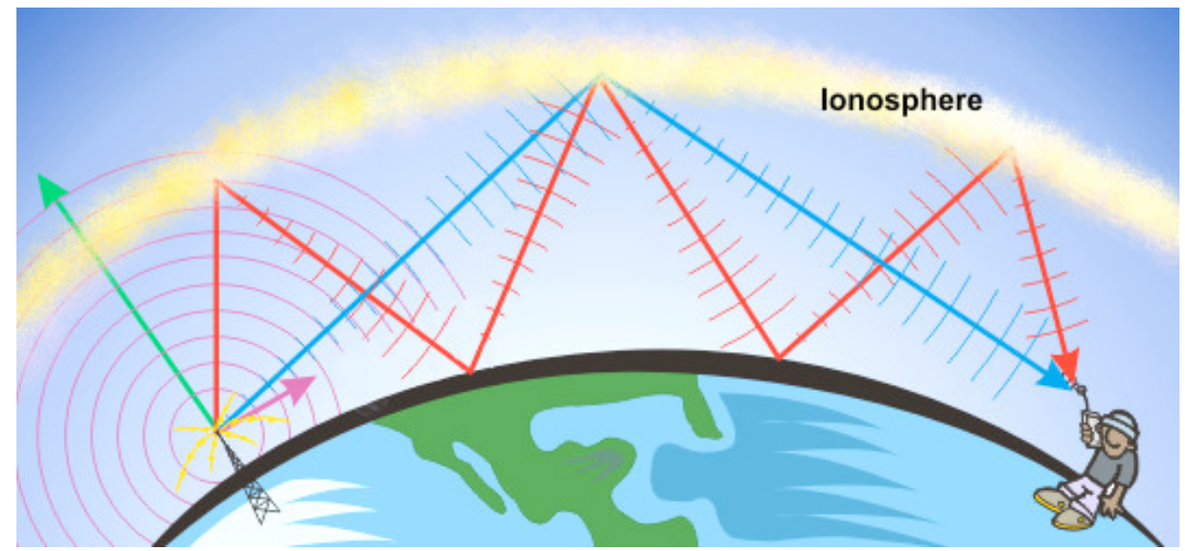
possible topics:

1. Classification of plasmas, plasma properties, plasma frequency
2. MHD
3. Charged particle motion and drifts
4. Low temperature discharges, plasma TV
5. Plasma thrusters
6. The sun: fusion processes, stellar models
7. The corona, solar wind
8. Electron-Positron Plasmas
9. Confinement concepts, intertial fusion
10. Tokamaks: Present day, ITER, DEMO
11. Energetic Particles in Tokamaks
12. Runaway Electrons
13. Stellarators

…

Basic Plasma Properties





classification of plasmas,
Debye theory

derivation, consequences,
application to ionosphere/
plasma diagnostics

Magnetohydrodynamics (MHD)

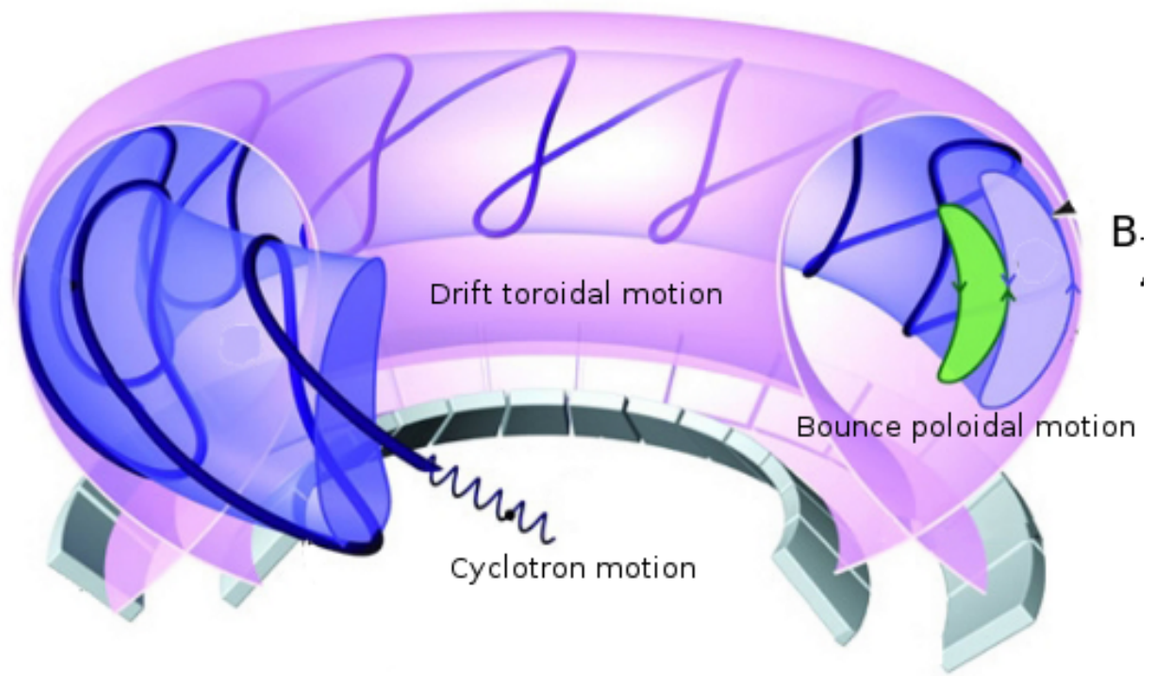
$$\frac{d\rho}{dt} + \rho \nabla \cdot \mathbf{V} = 0,$$

$$\rho \frac{d\mathbf{V}}{dt} + \nabla p - \frac{(\nabla \times \mathbf{B}) \times \mathbf{B}}{\mu_0} = 0,$$

$$-\frac{\partial \mathbf{B}}{\partial t} + \nabla \times (\mathbf{V} \times \mathbf{B}) = 0,$$

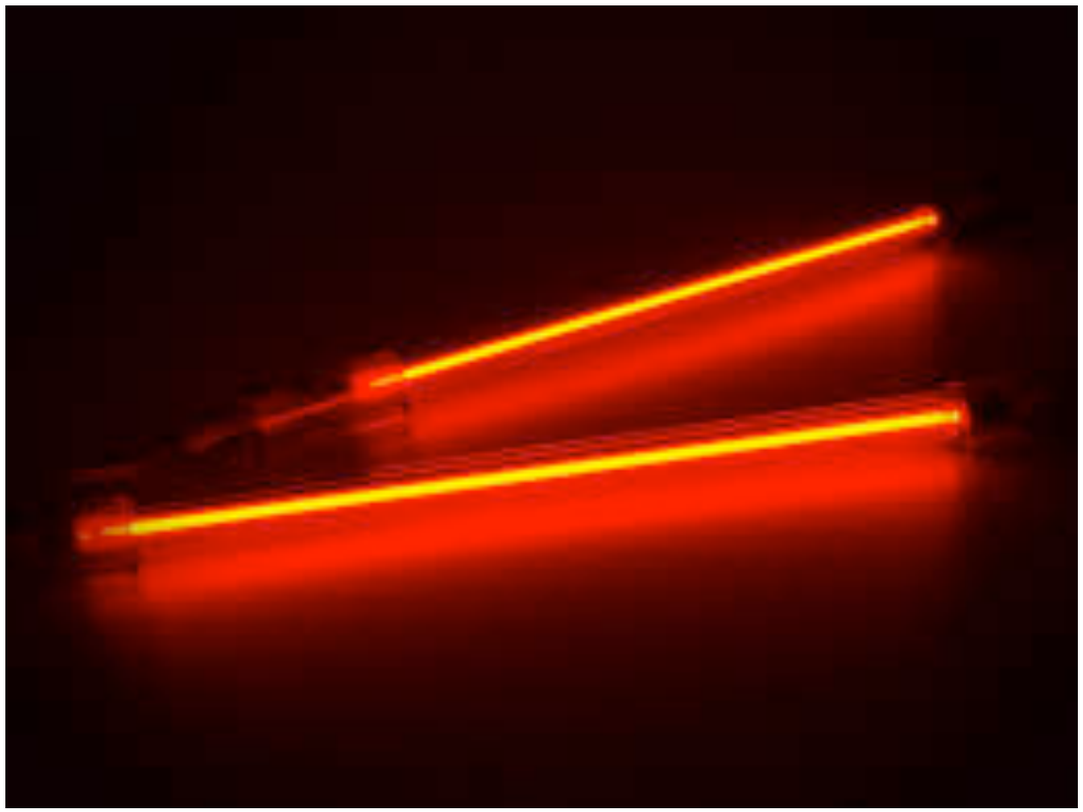
$$\frac{d}{dt}\left(\frac{p}{\rho^{\Gamma}}\right) = 0,$$

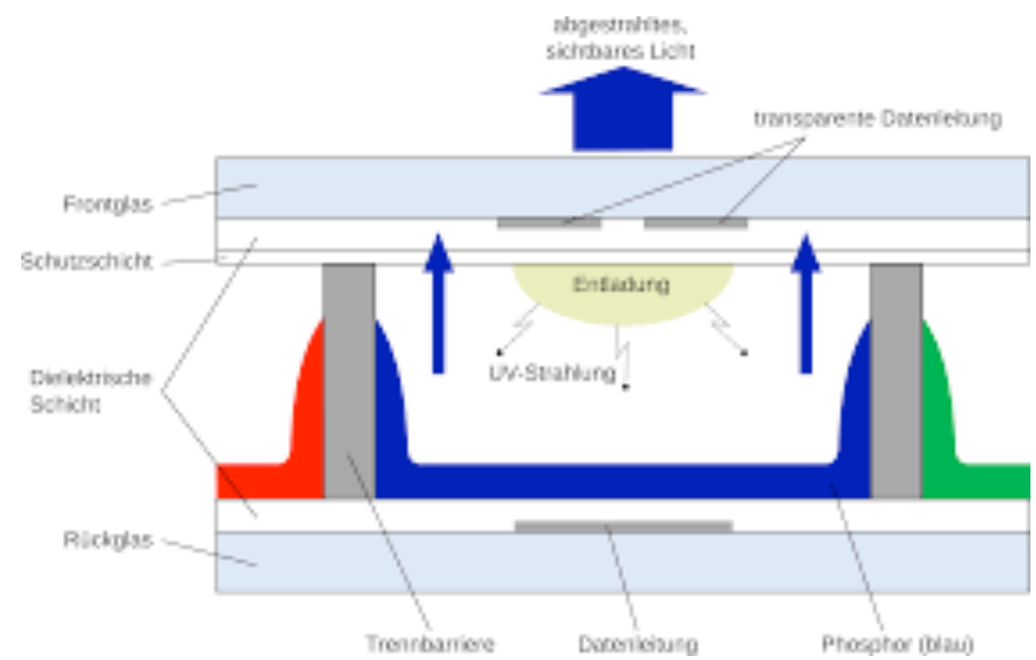
Charged particle motion in inhomogeneous magnetic fields

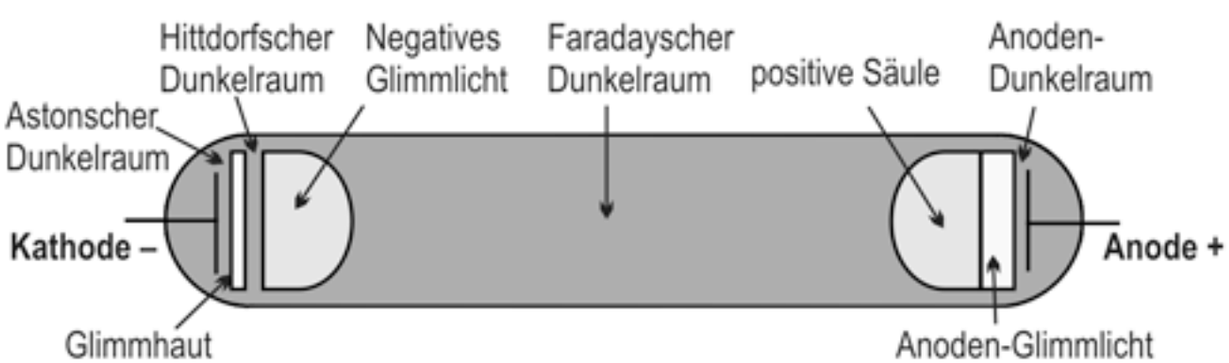


drifts, guiding centre description
(numerical approaches: implicit, explicit, symplectic)

Low temperature plasmas: principles and applications

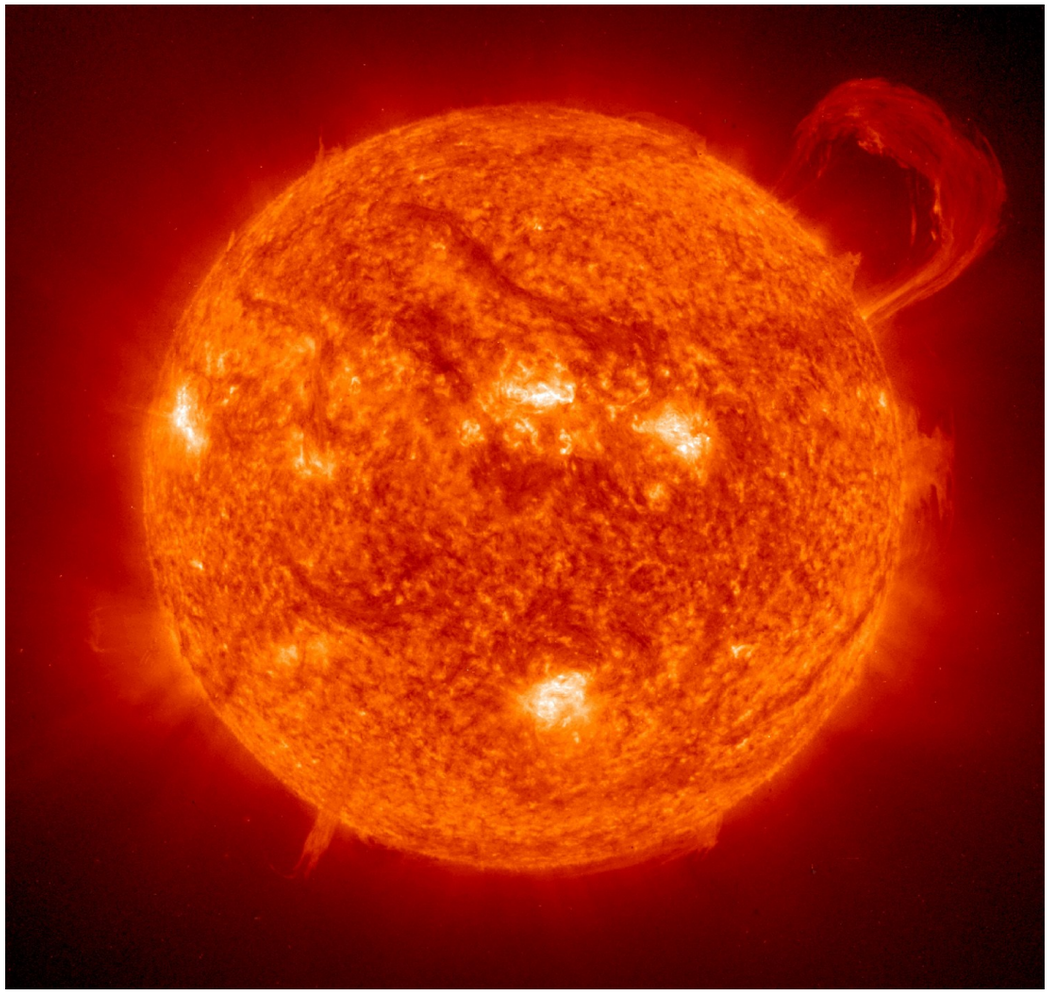


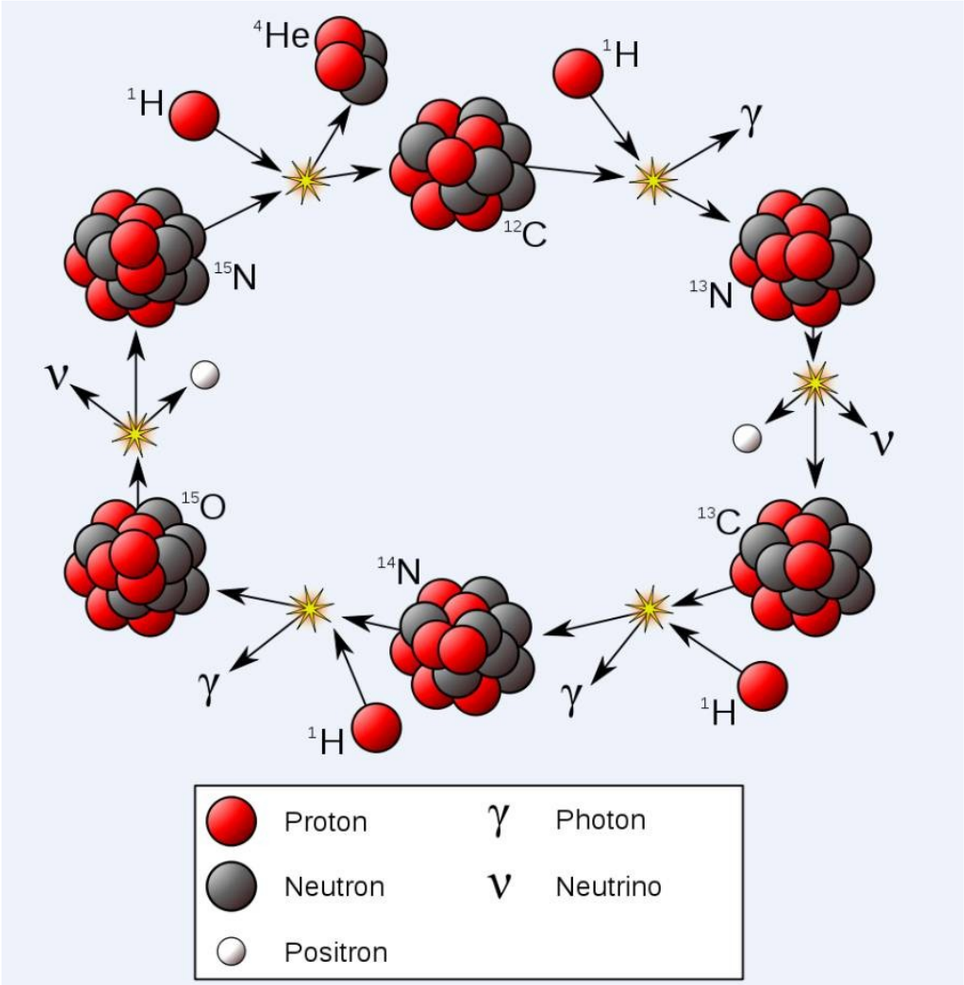




Plasma Thrusters

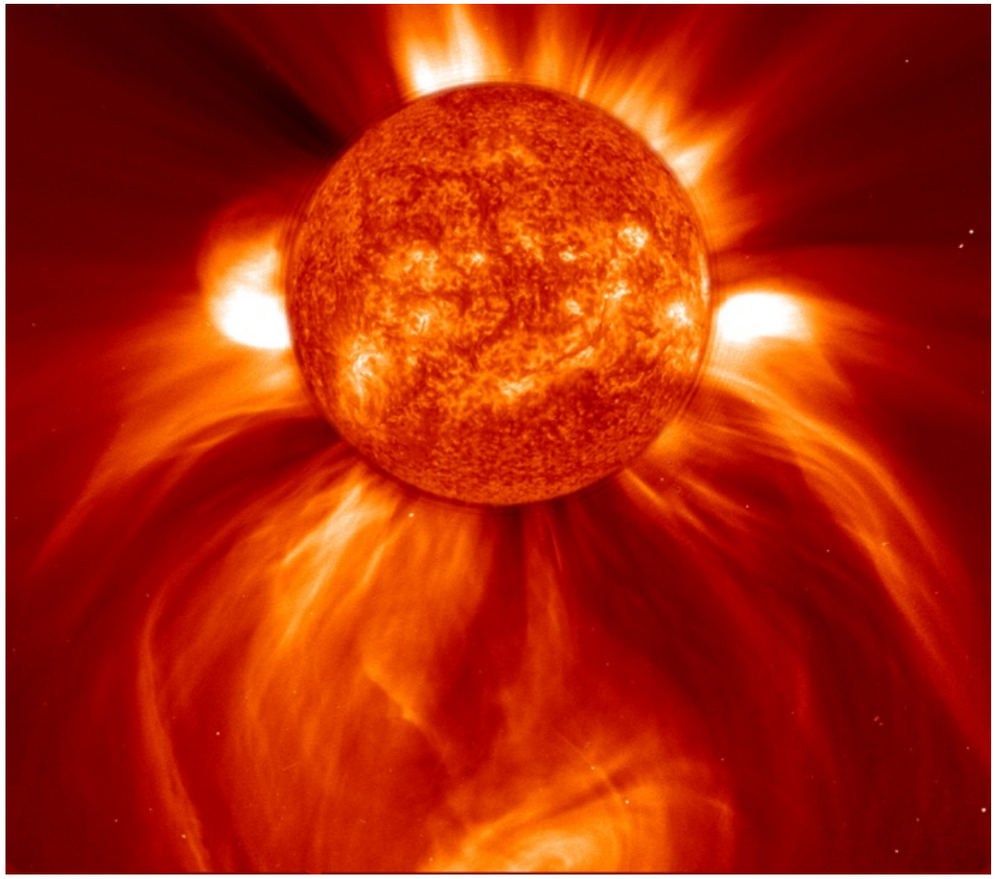
The Sun



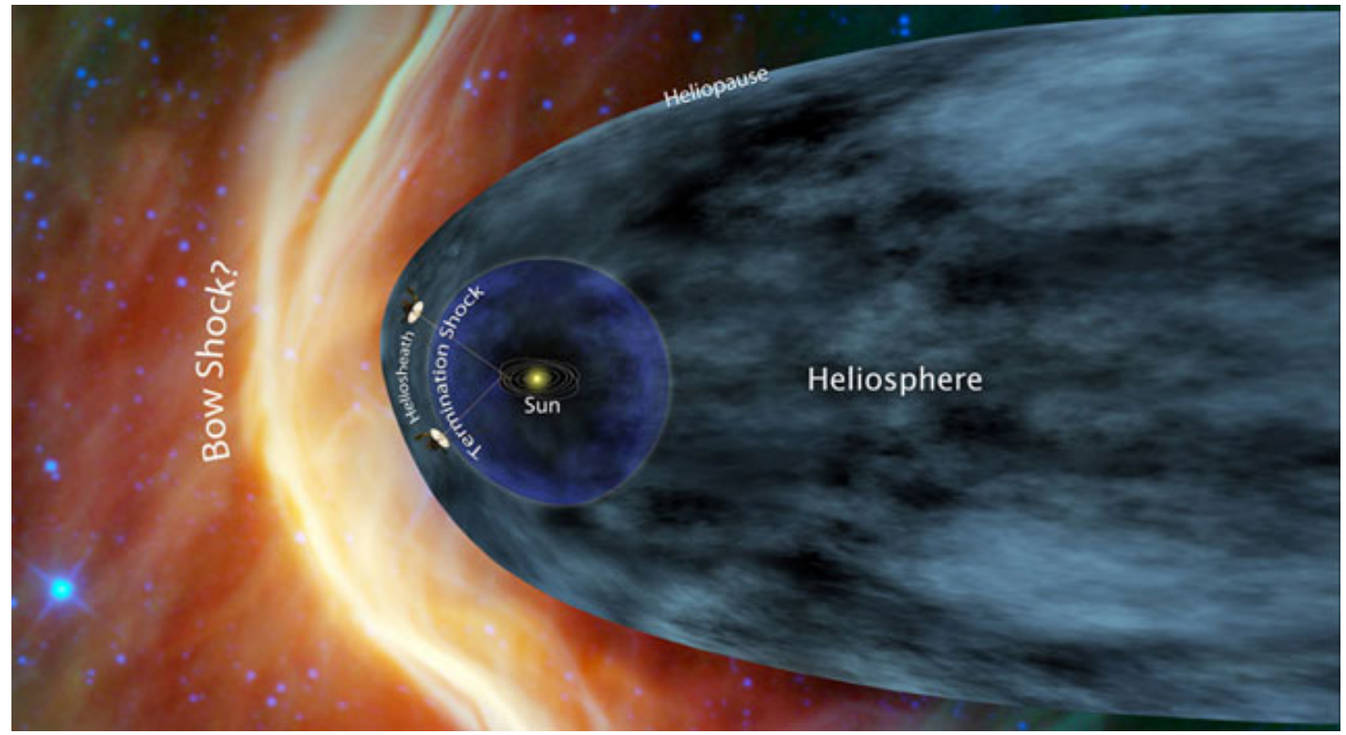


nuclear processes, solar structure, solar equilibrium and equations of state, life cycle of the sun and stars in general

Corona and the solar wind



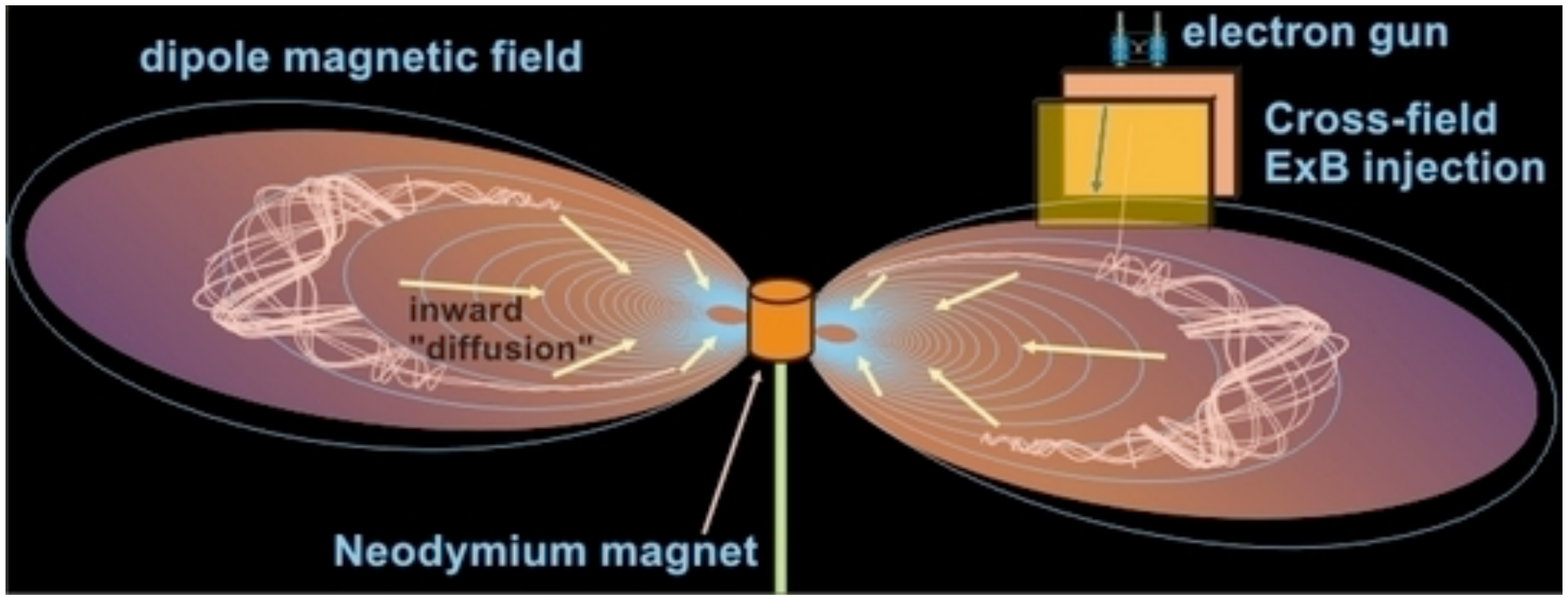
NASA, easa/SOHO



solar structure, magnetic fields in the sun(dynamo), solar spots, the corona heating problem

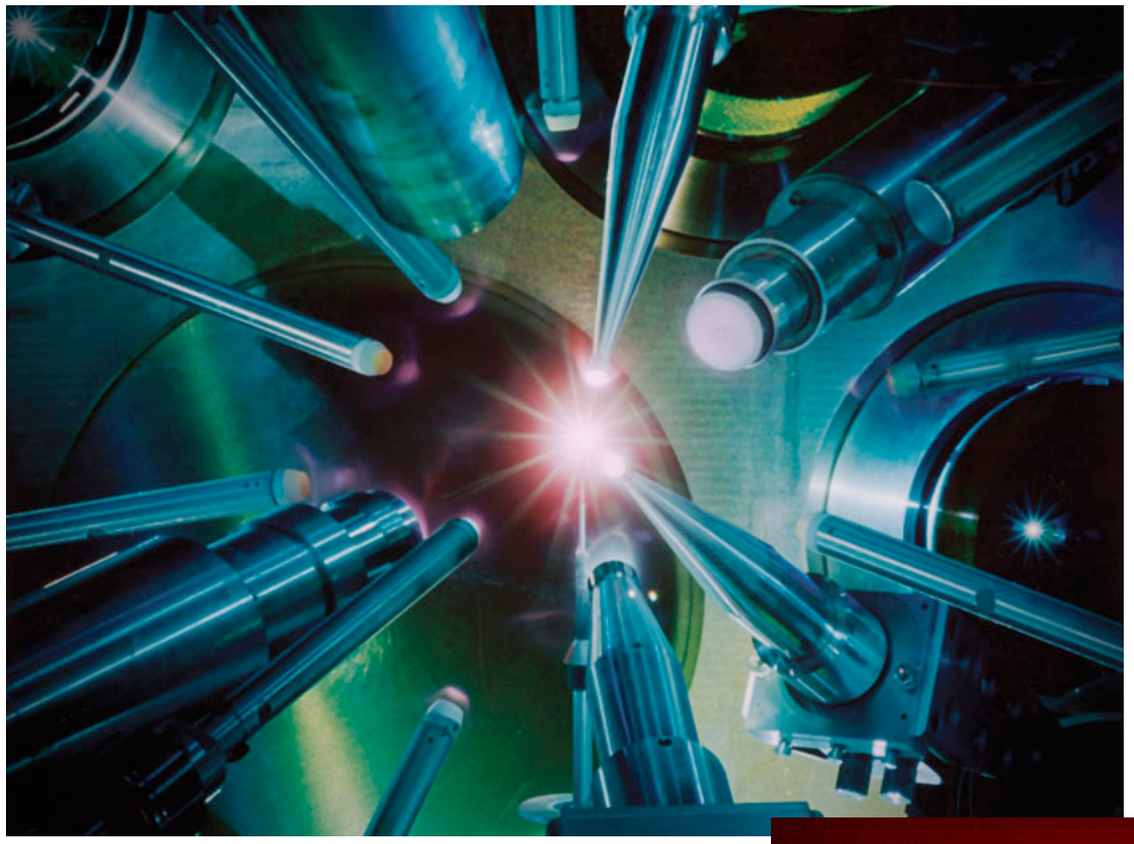
history, origin, Chapman model (static), Parker Model, interaction with earth magnetic field

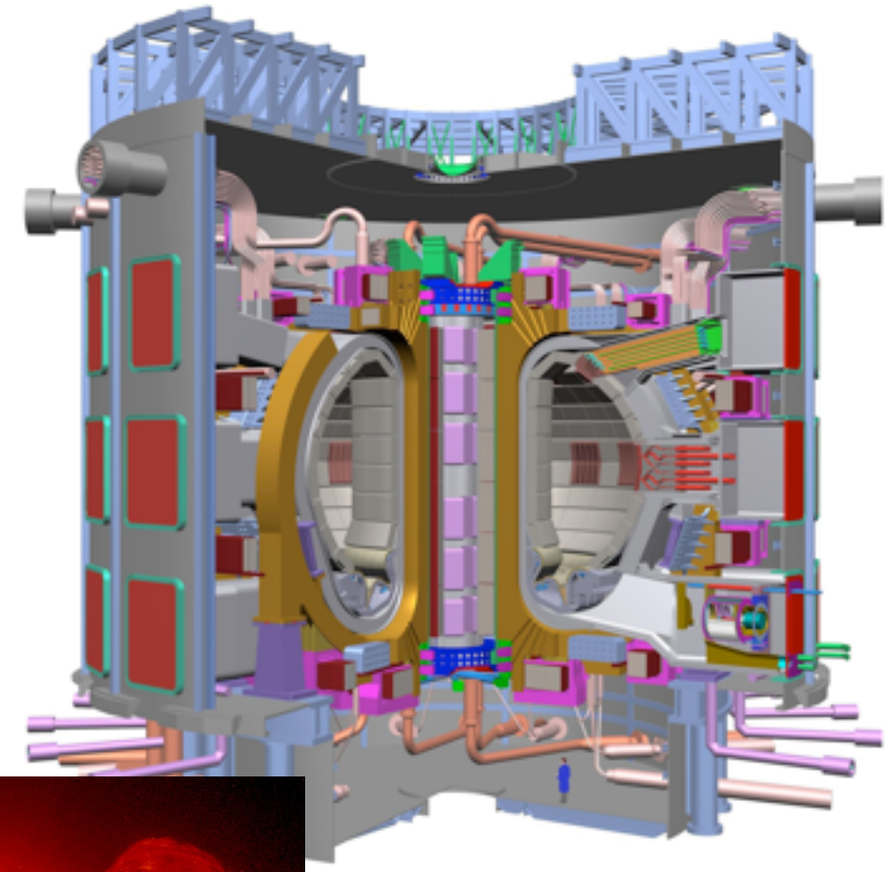
Electron-Positron Plasmas

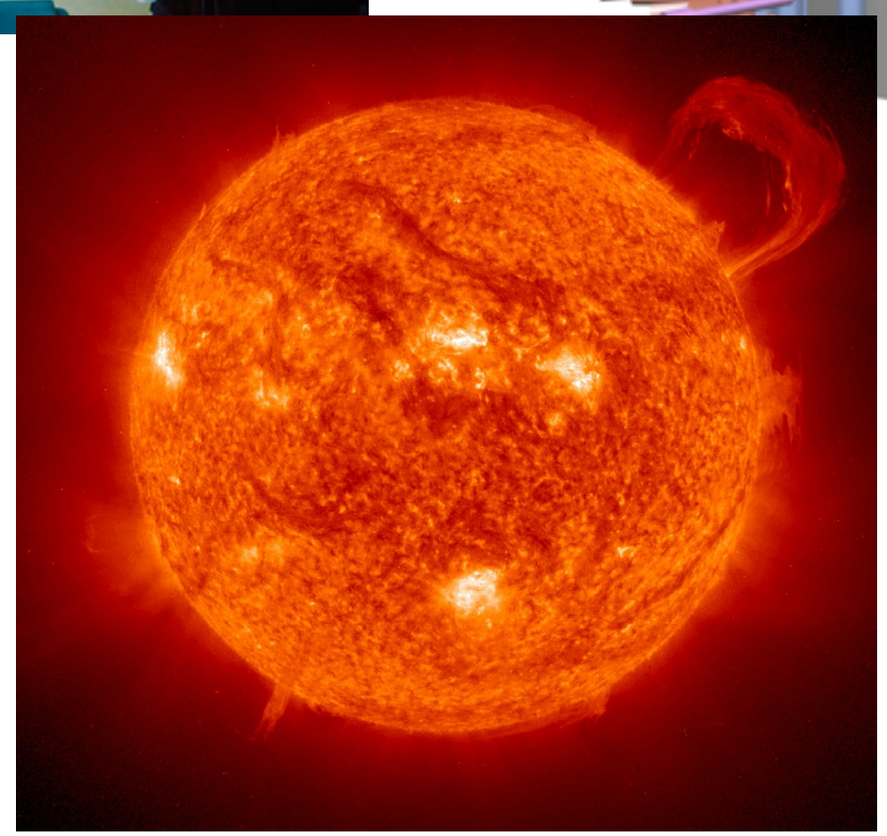


theoretical properties, experimental setup

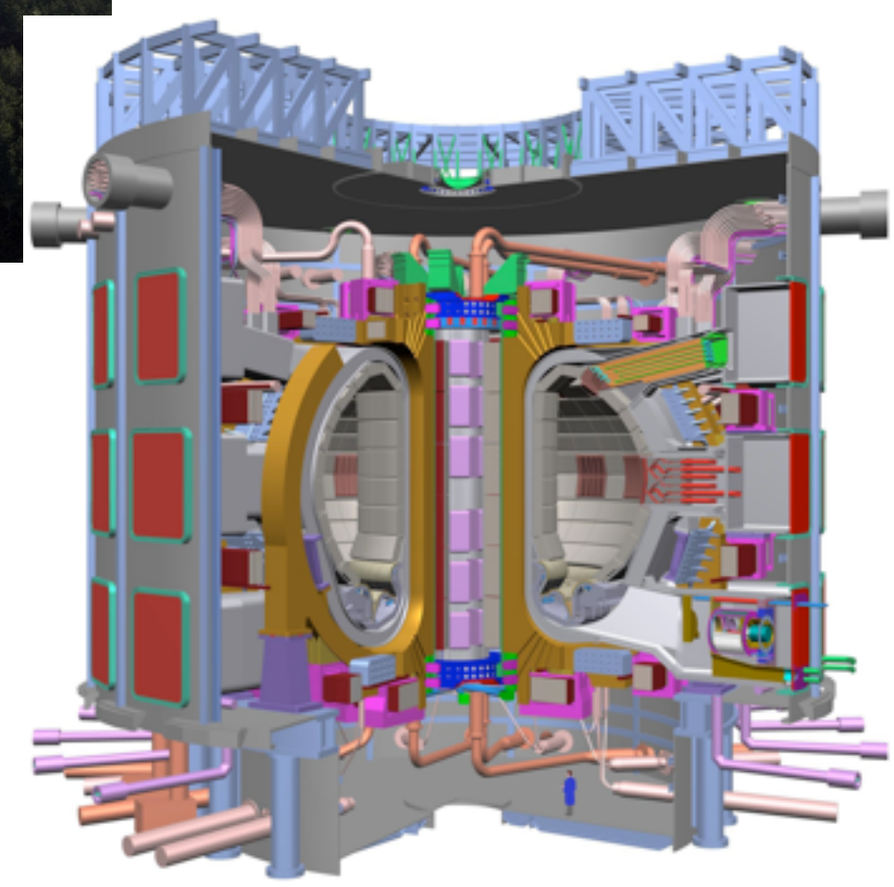
Confinement concepts, inertial fusion





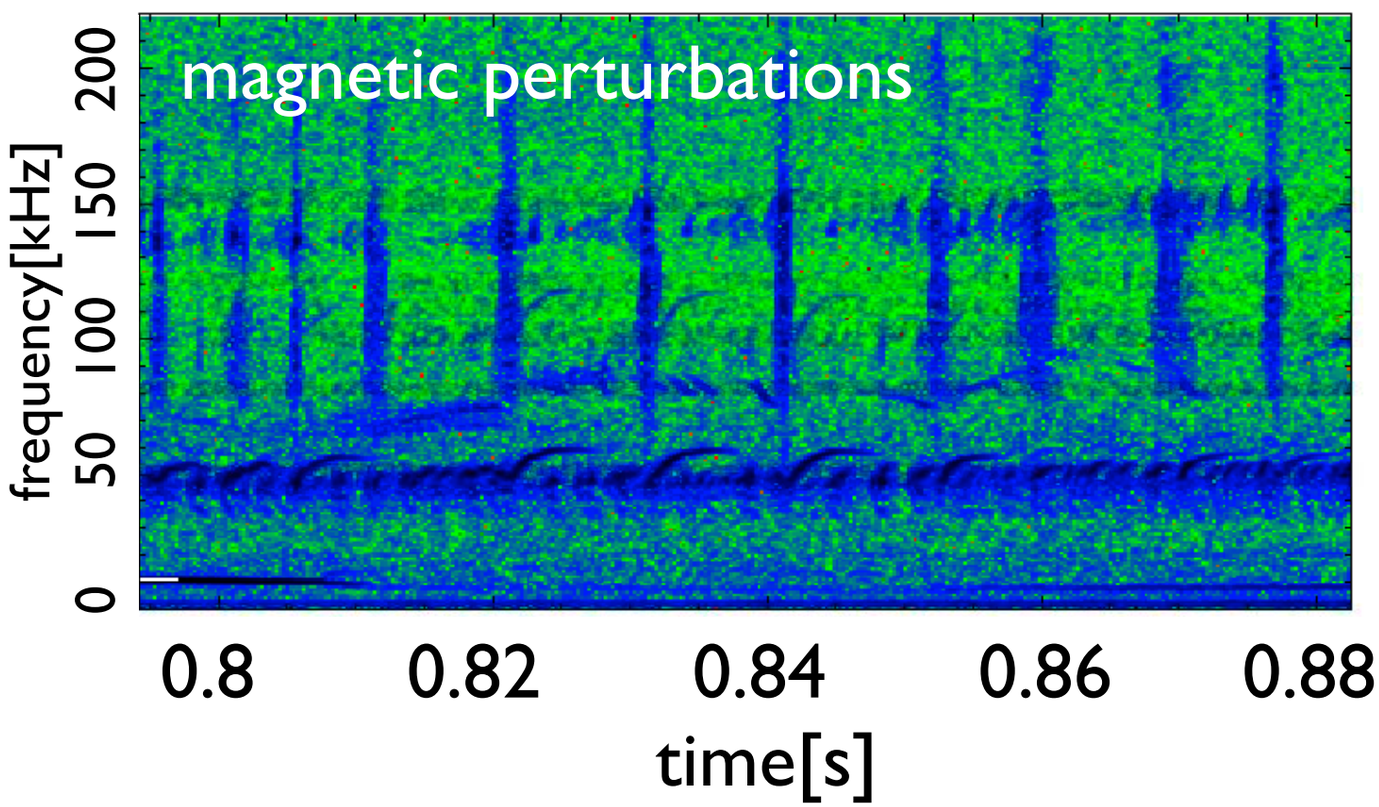


Tokamaks (JET/AUG/JT60SA/ITER/DEMO)



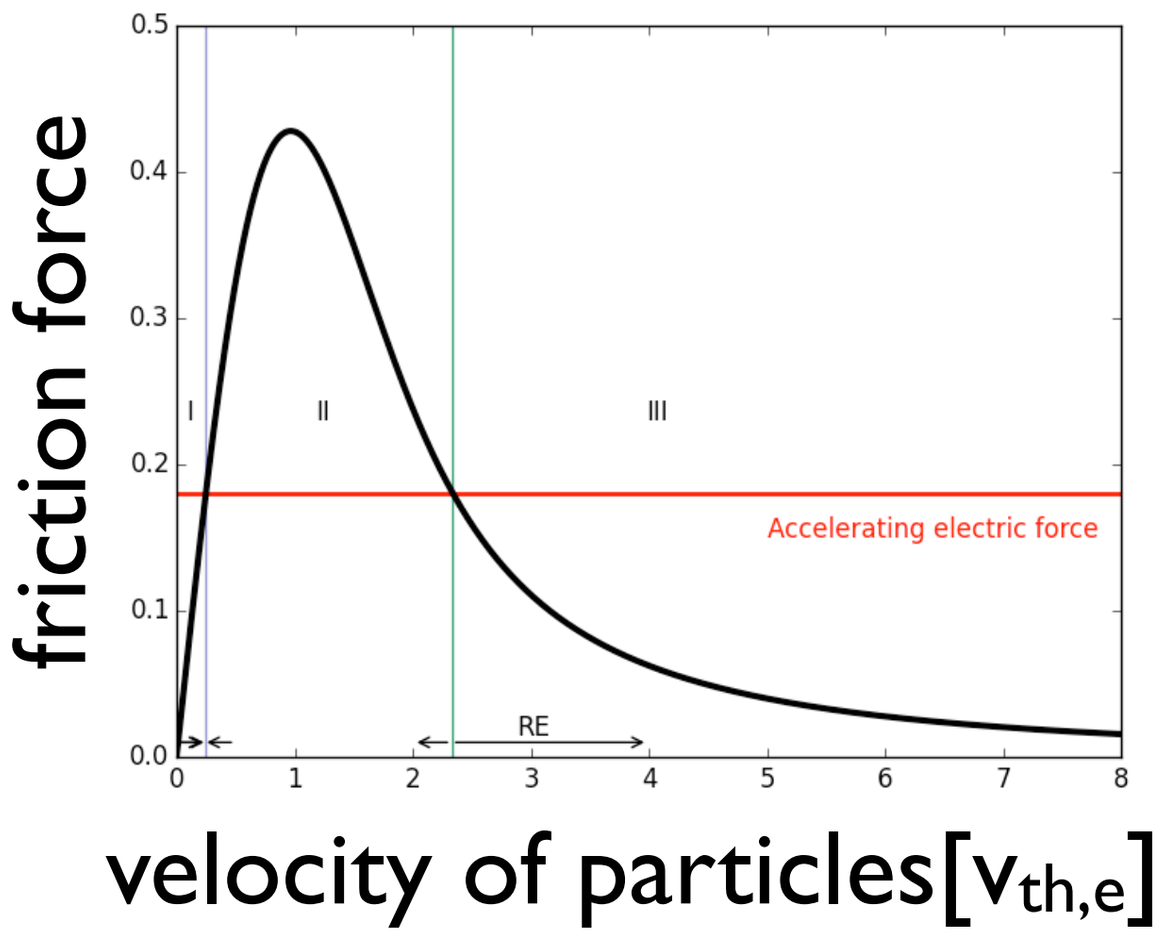
Energetic Ions in Tokamaks

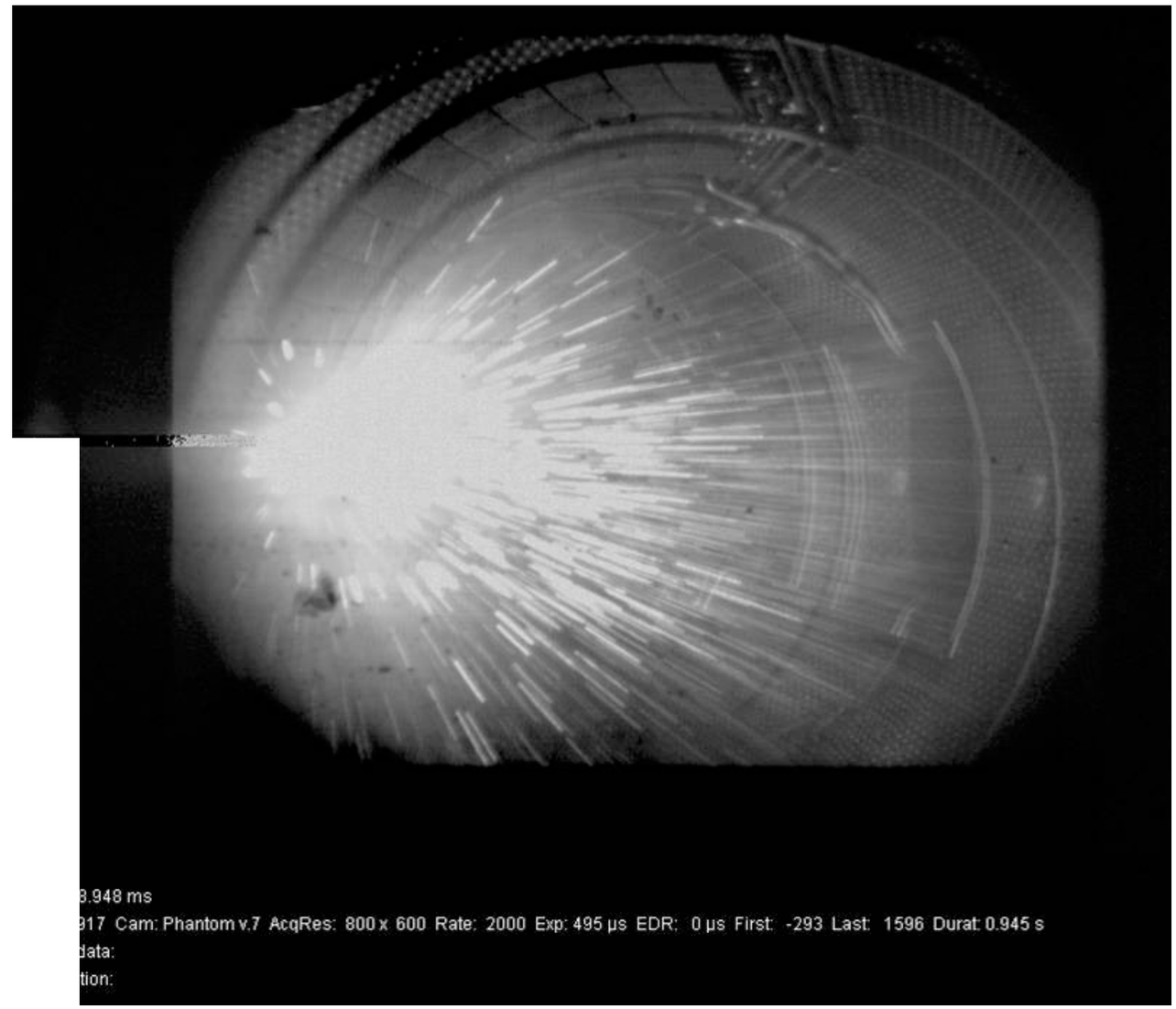
Alfvén waves, resonant interaction, non-linear saturation



1. theoretical framework
2. experimental detection and implications

Runaway electrons





Stellarators

basic concepts
particle confinement
W7X