Plasma fluid theory
(Magneto-Hydro-Dynamics)

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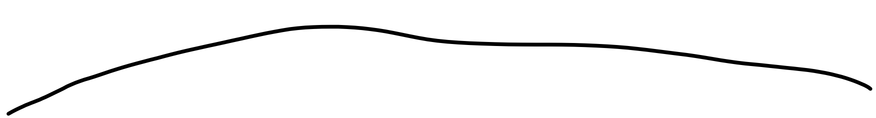
Applications

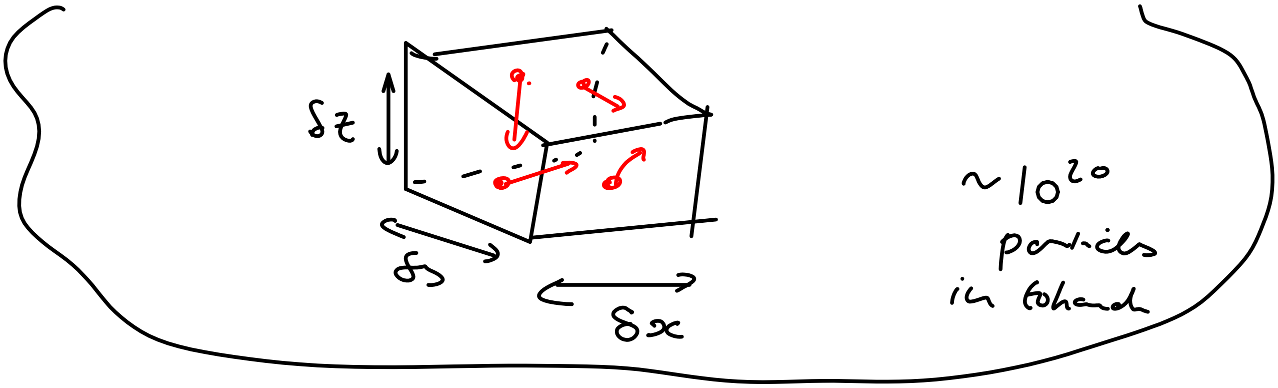
- Fusion MCF e.g. Tokamaks
- Ionospheric physics
- Solar
- Astrophysics

Aspects

- Equilibrium $\frac{\partial}{\partial t} = 0$
- Linear waves, instabilities
- nonlinear evolution
  conservation laws
- Numerical methods

Fluid theory



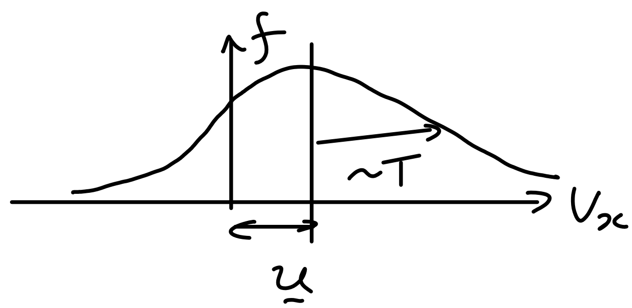


$f(t, \underline{x}, \underline{v})\, d\underline{x}\, d\underline{v}$ Distribution function

Kinetic

6D + time

Fluid – <u>Collisions</u> ⟶ Maxwellian



Solve for moments

n density

$m_i n \underline{u}$ momentum density

p pressure

$$n^{(t,\underline{x})} = \int f(t, \underline{x}, \underline{v})\, d\underline{v}$$

$$m_i n \underline{u}(t, \underline{x}) = m_i \int \underline{v}\, f(t, \underline{x}, \underline{v})\, d\underline{v}$$

↑ $\underline{u}$ is fluid flow

↖ velocity (coordinate)

$$p = m_i \int (\underset{\sim}{v} - \underset{\sim}{u})^2 \frac{1}{3} f(t, \underset{\sim}{x}, \underset{\sim}{v})\, d\underset{\sim}{v}$$

This series:

- Solving n, $n\underset{\sim}{u}$, p, ...