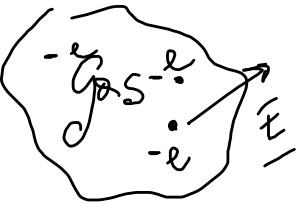
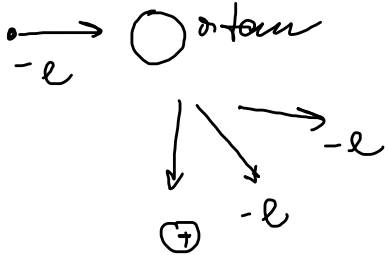



{Ionization
{Recombination

Fusion plasmas
$T_i \sim T_e \sim$ some keV

$T_{room} \sim 300\ K$

$k_B T$ : eV keV

$T \sim 12000\ K \Rightarrow k_B T \sim 1\ eV$

Industrial plasmas
(cold)
$T_e \sim 1\ eV$
$T_i \sim 300\ K$

$H_2O$ density particles/$m^3$

$1\,l \rightarrow 1\,kg$ $\quad m_{H_2O} = 2 \cdot 1.67 \cdot 10^{-27}\,kg + 16 \cdot 1.67 \cdot 10^{-27}\,kg =$

$= 18 \cdot 1.67 \cdot 10^{-27}\,kg$

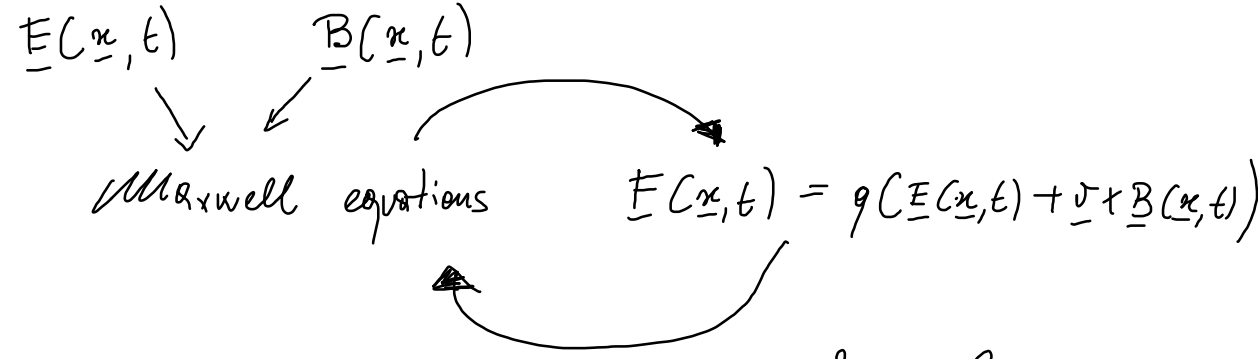
$$\#\,\text{particles} = \frac{1\,kg}{18 \cdot 1.67 \cdot 10^{-27}\,kg} \simeq 3 \cdot 10^{25}\ \text{molecules}$$

$$\frac{\#\,\text{particles}}{\text{volume}} = \frac{3 \cdot 10^{25}\ \text{molecules}}{10^{-3}\,m^3} \simeq 10^{28}\ \text{part}/m^3 \quad (\text{density of a solid})$$

Gas STP $T \sim 300\,K$ $\quad p \sim 1\,atm$ $\quad p = n k_B T$ $\quad [n] = m^{-3}$

$$n = \frac{p}{k_B \cdot T} = \frac{10^5\,Pa}{1.38 \cdot 10^{-23}\,J/K \cdot 300\,K} \simeq 10^{25}\,m^{-3}$$

Ions + electrons → charges




Magnetic fusion plasma $n \sim 10^{20}\ m^{-3}$

$1\ m^3 \sim 10^{20}$ equations coupled at each time slice

# Assumptions and approximations

1) Fields: $\underline{B} = \underline{0}$

Neglect inductive fields

Neglect self generated magnetic fields

Assumptions on geometry: $\underline{E}$ and $\underline{B}$ { are uniform / are time independent

2) Charges: a) $f_e(\underline{x}, t)$ $f_i(\underline{x}, t)$ : Vlasov equation

b) $\underline{u}_e(\underline{x}, t)$ $p_e$ $\underline{u}_i(\underline{x}, t)$ $p_i$ Two fluid description

c) Plasma as a whole: $\underline{V}(\underline{x}, t)$ taking moments of the Vlasov equation

MHD description magneto hydro dynamic

d) Assumptions on time

Phenomena faster and/or slower w.r.t. a time scale

e) Assumptions on space

Uniform plasma w.r.t. a spatial scale

f) Assumptions on velocity: velocities faster/slower w.r.t. thermal velocity