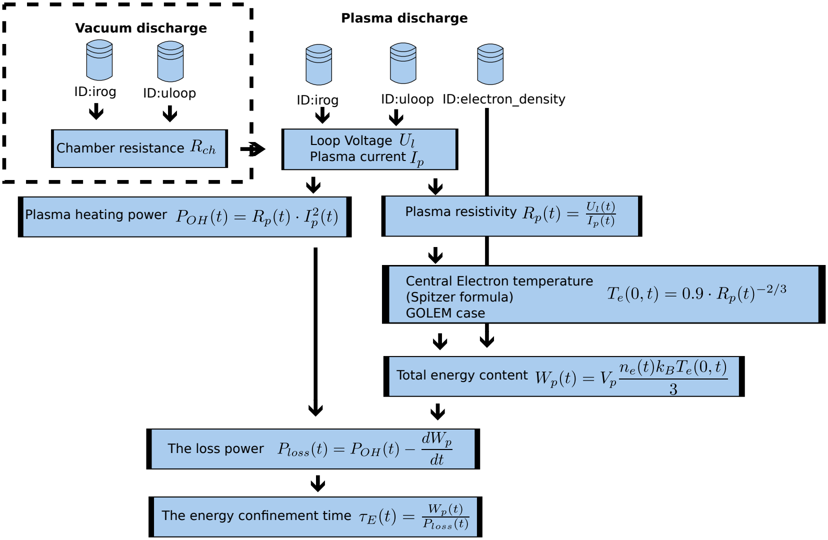
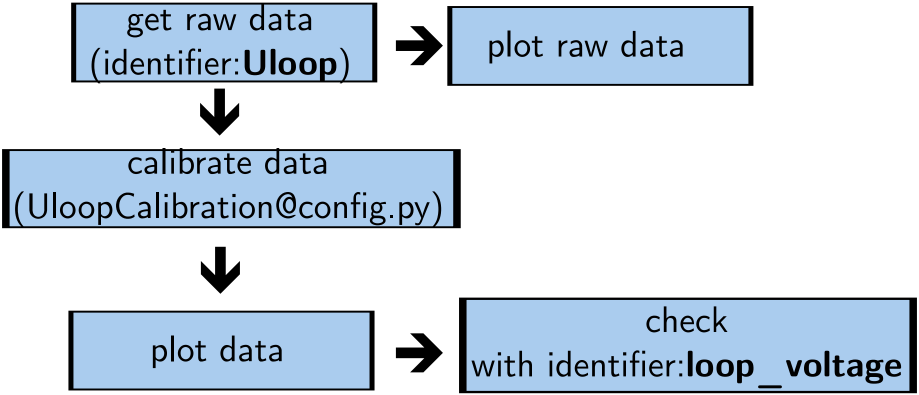
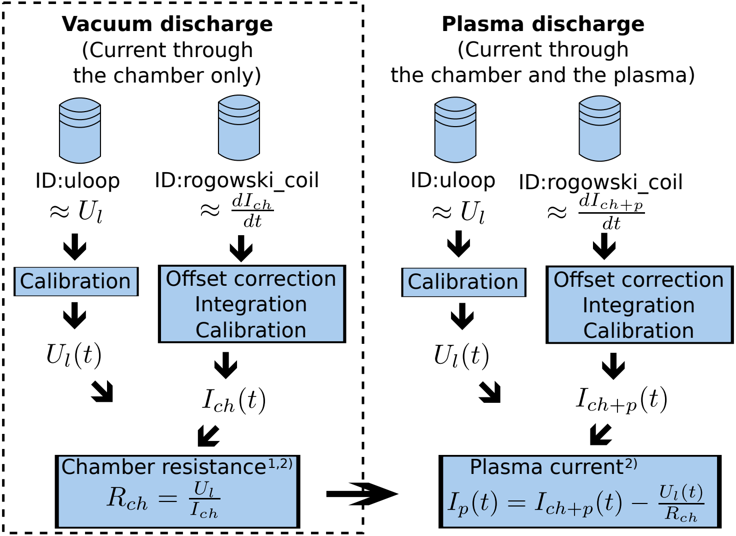
Towards Energy confinement time τ_E



Flowchart for U_l generation



Towards Plasma current I_p



1) With some statistical effort.

2) Do it in the stationary phase, i.e. current constant, to avoid inductive phenomena.

Plasma current

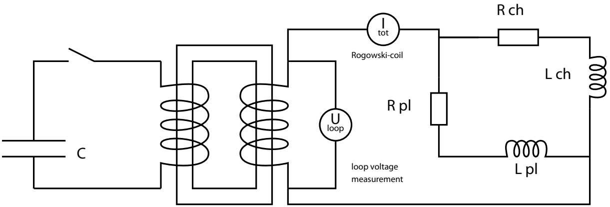


Figure: Model of the inductive current drive circuit

The basic circuit equations is:

$$I_{tot}(t) = I_{pl}(t) + I_{ch}(t) \quad (1)$$

- Magnetic diagnostics $\rightarrow$ Numerical Integration (with 1 μs step)
- Rogowski Coil calibration constant $= 5.3 \cdot 10^6$ (see config.py)

Central Electron Temperature estimation (Spitzer Formula)

The time evolution of the central electron temperature $T_e(0,t)$ is calculated from equation based on Spitzer's resistivity formula (see eg. [**?**],[**?**]):

$$T_e(0,t) = \left(\frac{R_0}{a^2} \frac{8Z_{eff.}}{1544} \frac{1}{R_{pl}(t)} \right)^{2/3}, [eV; m, \Omega] \quad (2)$$

For particular case of the GOLEM tokamak it says:

$$T_e(0,t) = \left(0.7 \cdot \frac{I_p(t)}{U_l(t)} \right)^{2/3}, [eV; A, V] \quad (3)$$

Plasma heating power

On the GOLEM tokamak the only heating mechanism of the plasma is ohmic heating resulting from current flowing in a conductor with finite resistivity. The ohmic heating power can be calculated as:

$$P_{OH}(t) = R_p(t) \cdot I_p^2(t) \tag{4}$$

Plasma Energy

The total energy content can be simply calculated from the temperature, density and volume (V), based on the ideal gas law, taking into account the assumed $T_e(r,t) = T_{e0}(t)\left(1 - \frac{r^2}{a^2}\right)^2$ temperature profile:

$$W_p(t) = V\frac{n_{avr} k_B T_{e0}(t)}{3}. \tag{5}$$

The information that the magnetic field reduces the degrees of freedom of the particles to two has been used to derive this formula.

- $V = 80$ l