Vertical Stability

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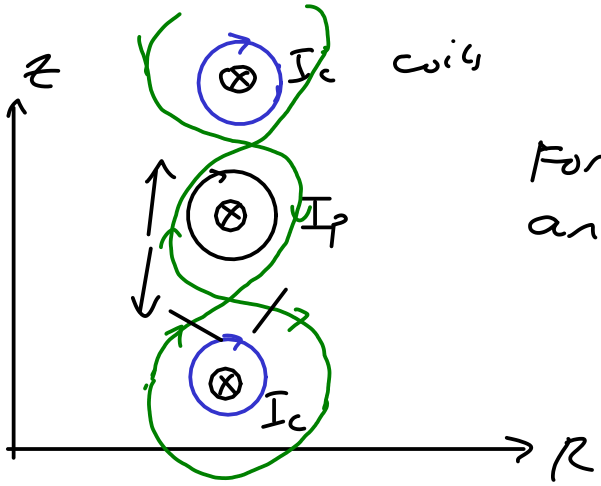
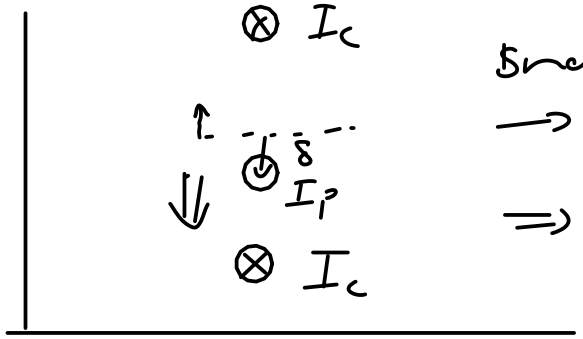


Forces between coils and plasma (attract)

Unstable



Small downward shift
→ Larger downward force
⇒ exponentially growing

$F \sim \pi \times 10^6 A \times 10m \simeq 10^7 N$ Large

Mass $\simeq 100 m^3 \times 10^{20} m^{-3} \times 2 \times 1.67 \times 10^{-27} kg \sim 3 \times 10^{-5} kg$ Small!

Growth rates $\sim 10^6 s^{-1}$

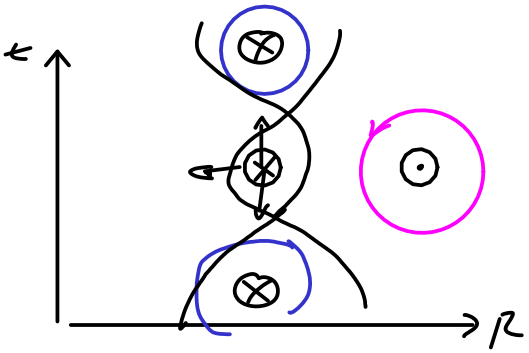
⇒ plasma lifetime $\sim \mu s$

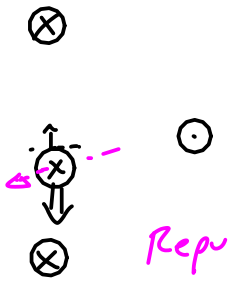
Plasma elongation

In general the stronger the shaping (especially elongation) the more vertically unstable

- Elongation good for confinement
  higher I_p for given q
- Typically limited to about $\kappa \lesssim 1.8$

Effect of elongation

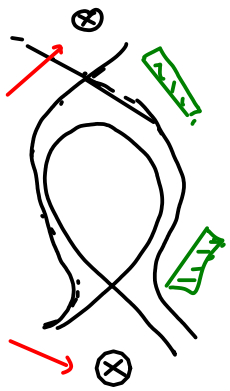




Repulsive force enhance instability

Stabilisation

(1) Passive *
(2) Active *



Metal plates

Currents induced in plates by moving plasma

→ Oppose motion of plasma

→ Slow resistive time τ_w (wall)

~ ms

Change currents in the coils, perhaps dedicated Vertical control coils

Magnetic flux coils used for feedback