# Plasma magnetic phase transitions and confinement regimes

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A model of the plasma as a magnetised substance is presented. It is shown that magnetic phase transitions can take place in the plasma, and that transport barriers can form at the boundary between magnetic phases [1].

In this model, plasma blobs with pressure excess or defect are dia- or para-magnets and move radially under the influence of the background plasma magnetisation. The movement is such that al plasma with low pressure gradient (paramagnetic) would attract low pressure plasma blobs and repel high pressure (diamagnetic) ones, producing a simple model for L-mode. In a plasma with higher pressure gradient and high beta poloidal (diamagnetic) hot blobs are attracted, cold ones expelled, as in H-mode.

When blob convective motion is accounted for, profile evolution naturally enhances magnetic phase separation into low and high pressure gradient regions. We propose that magnetic phase separation is the underlying mechanism of L to H transition, driving transport barrier formation.

Magnetic phase separation and associated pedestal build up, as described here, can be explained by the well known interchange mechanism, now reinterpreted as a magnetisation interchange which remains relevant even when stable or saturated. A testable necessary criterion for the L to H transition is presented.

Experimental evidence for the magnetic character of confinement transitions in tokamaks will be presented.

[1] E. R. Solano, R. D. Hazeltine, Nucl. Fusion 52 114017 (October 2012)