ON FAST VERTICAL PLASMA POSITION FEEDBACK SYSTEM FOR COMPASS TOKAMAK

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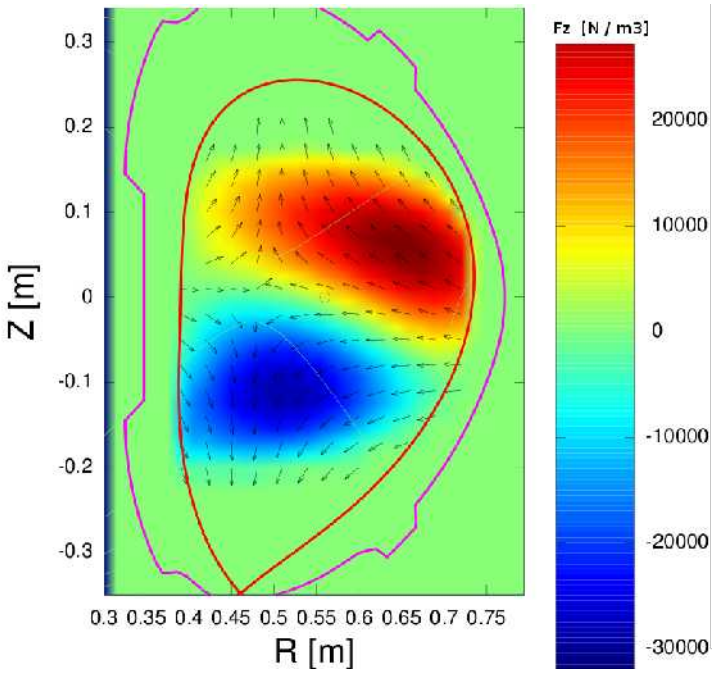
The COMPASS tokamak at IPP Prague is proceeding towards H-mode, requiring vertically elongated plasma which becomes vertically unstable (with time constant of ~0.5ms), calling for need of active feedback control of plasma position. In this contribution, a bridge between electromagnetism (physics) and plasma position control (engineering) is provided by quantitative modeling of specific magnetic forces (shown in the figure) acting on the COMPASS plasma, yielding the equation for force equilibrium as the main result. Within the control loop (running at 20kHz rate), this information is used in the algorithm performed by a digital PID controller which sets up the reference value for the fast current supplies driving current in the poloidal coils, thus stabilizing the plasma vertical position.



Poloidal cross-section of plasma in the COMPASS tokamak shows how the volumetric magnetic force (red upwards, blue downwards) stretches the plasma vertically, as desired, but also yielding vertical instability. For typical conditions, the force is a product of toroidal plasma current density and poloidal magnetic field.