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Relevance of High Density Plasma Regimes for Fusion Reactors$*$

F. BOMBARDA, ENEA, B. COPPI, MIT — High density regimes (with peak values around $10^{21}\mathrm{m}^{-3}$) in magnetically confined plasmas have been observed and investigated within the Alcator program at first, and later within the Frascati Torus program. In particular, record low values of the ion thermal conductivity and high degrees of purity($Z_{eff} \simeq 1$) were achieved when peaked density profiles were produced either spontaneously or by the ignition of pellets. It was recognized early on that the large $n\tau$ values attainable in these regimes are suitable to achieve ignition conditions in devices such as Ignitor that are feasible with existing technologies. Plasma regimes with similar confinement characteristics have been produced in the LHD machine, characterized by relatively low magnetic fields and a helical configuration, by means of repeated pellet injection techniques. Assuming that the good characteristics of these plasmas can be preserved at the temperatures where ignition can occur, the helical configuration characterizing LHD makes it possible to avoid the need of a steady state current drive system, a problem that remains unsolved for meaningful fusion burn regimes with axisymmetric configurations. Experiments on fusion burning plasmas to be developed in parallel along the high field compact line represented by Ignitor and the helical line represented by LHD are envisioned.
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