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Diamagnetic Plasma Confinement in Linear Traps

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A new efficient method of magnetic confinement is suggested for use in linear traps with extremely high plasma pressure. While pressure grows, the equilibrium in a linear trap changes in such a way that the effective mirror ratio increases, and, as a result, the axial particle and energy confinement becomes gas-dynamic and improves linearly with mirror ratio. This effect is due to diamagnetic expulsion of the magnetic field from the plasma volume while beta tends to one. The improved confinement could lead to construction of a compact fusion reactor based on a linear trap, if one could ensure suppression of pressure-driven instabilities, in particular, the ballooning instability. This paper shows how it can be done: one should use magnetic configuration with a stretch of uniform field at its minimum, and place external stabilizers near ends of that stretch. Equilibrium with anisotropic pressure, MHD stability, fast-ion confinement, startup, and the energy balance issues are considered for a linear trap in the diamagnetic-bubble regime. Such type of confinement is shown to be very promising for reactor perspectives.

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