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MHD stability control in alternate confinement concept experiments[1]

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High-quality plasma operation and good energy confinement in the alternate confinement experiments require control of ideal and resistive MHD instabilities. New experiments in the revitalized ICC program, supported by modern MHD computational capabilities, are demonstrating progress in this control which significantly extends previous work. Results from the classical tokamak are thereby extended into new parameter regimes, generating insight into the physics. We consider both toroidal and open concepts and, where appropriate, highlight comparisons with the tokamak, ST, and stellarator. The driving forces for ideal MHD modes are characterized using the Frieman-Rotenberg condition,[2] which generalizes the stability analysis by including plasma flow. Stabilizing mechanisms include conducting walls (RFP, spheromak, FRC); plasma shaping as characterized by the magnetic dipole moment (spheromak, FRC); current-profile control (RFP, spheromak); sheared, super-Alfvénic flows (Z-pinch, centrifugal mirror); quadrupole magnetic wells (FRC, mirror); and high kinetic-energy density flow in good curvature regions (gas-dynamic trap). Resistive tearing is stabilized or limited by current profile control, primarily in the RFP and spheromak. Non-MHD mechanisms such as FLR can also be stabilizing and will be most effective if the MHD growth rate is minimized. Most of the experimental work to date has focused on global or large-scale modes; the possible consequences of short-wavelength or local modes will be explored.

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[2]E. Frieman and M. Rotenberg, Rev. Mod. Phys. **32**, 898 (1960).