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Reference Magnetic Coordinates (RMC) for toroidal confinement systems[1] LEONID ZAKHAROV, EGEMEN KOLEMEN, SAMUEL LAZERSON, Princeton University, PPPL — Because of intrinsic anisotropy of high temperature plasma with respect to magnetic field, use of proper coordinates is of high priority for both theory and numerical methods. While in axisymmetric case, the poloidal flux function $Y(r,z) = const$ determines proper flux coordinates, in 3-D, such a function does not exist. The destruction of nested magnetic surfaces even by small 3-D perturbations leads to a sudden change of topology of magnetic field. As a result, the coordinate systems can no longer be based on tracing the magnetic field lines resulting in difficulties for theory and 3-D numerical simulations. The RMC coordinates $\hat{a}, \hat{\theta}, \hat{\zeta}$ presented here (introduced in 1998 but not really used) are nested toroidal coordinates, which are best aligned with an ergodic confinement fields. In particular, in RMC the vector potential of the magnetic field has an irreducible form

$$\mathbf{A} = \bar{\Phi}_{00}(\hat{a})\nabla\hat{\theta} + \left[Y_{00}(\hat{a}) + \bar{\psi}^*(\hat{a},\hat{\theta},\hat{\zeta})\right]\nabla\hat{\zeta},$$

where 3-D function $\bar{\psi}^*$ contains only resonant Fourier harmonics of angle coordinates. RMC can be generated and advanced using a fast (Newton) algorithm not involving the field line tracing.

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