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Orbit-space sensitivity for neutron and gamma-ray detectors in tokamaks

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Neutron and gamma-ray diagnostics will play a fundamental role in fast-ion detection in burning fusion plasmas. As the fast ion undergoes a fusion reaction, the generated neutron or gamma-ray will carry away some of its energy, which can be detected. In the context of axisymmetric machines with high aspect ratio, it is possible to represent the fast-ion phase space in the reduced three-dimensional orbit space, combining position and velocity. In this work, we show the link between position space and fast-ion orbit space for two different choices of coordinates, i.e. the energy, maximum major radius and pitch at maximum major radius (E,R_m,p_m) and the energy, magnetic moment and toroidal canonical angular momentum (E,μ,P_ϕ). We do so by calculating the sensitivity of hypothetical diagnostics in the magnetic equilibrium of ITER for a set of different line-of-sight geometries. This information is encoded in the so-called orbit-space weight functions.

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