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Validation of Miyamoto's formula (for the total force on the vessel following disruption) with ASDEX Upgrade measurements

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Abstract

The magnitude of the electromagnetic forces expected during and after a vertical displacement event (VDE) of a tokamak plasma is a necessary design parameter for the structural design of the many components of the tokamak device. During and after a VDE, the plasma current moves, changes in time and induces currents in the conductors around the plasma. The total vertical force
on the device is then the integral over all the conductors of the vertical component of the acting force. The total vertical force (and its spatial and temporal evolution) can be found by simulating the VDE with a 2D or 3D MHD code.

S. Miyamoto [1] found an approximate way of deriving the total maximum vertical force due to a VDE in a tokamak device without modeling the whole phenomenon. This formula is of interest because it allows to dimension the vessel and its supports during the conceptual design of a new device without having to use numerical codes for detailed simulations.

In this contribution, the formula is validated against ASDEX Upgrade measurements. Since the validation is not successful, possible errors in the derivation of Miyamoto's formula are discussed and a correction is suggested.

[1] S Miyamoto 2011 Plasma Phys. Control. Fusion 53 082001

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