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Optimization of RFX-mod2 gap configuration by estimating the magnetic error fields due to the passive structure currents

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The design of a major refurbishment of the toroidal complex of the RFX-mod experiment is going to be finalized before starting the realization phase. The Inconel vacuum vessel will be removed and the stainless steel supporting structure will be modified so as to become vacuum tight. The plasma facing graphite tiles will be mounted onto the inner surface of the copper shell, allowing an increase of the plasma proximity factor. This could allow different operation regimes expected to provide a significant reduction of the amplitude of RFP tearing modes. This reduction would lead to magnetic chaos mitigation with confinement improvement, better mode control capability and reduced plasma wall interaction. On the other hand, due to the shorter distance from the passive structures, the plasma will be even more sensitive to magnetic field errors produced by the induced currents at the cuts of the same structures. A careful assessment of different gap configuration is mandatory to optimize the final design of the machine modifications. Numerical analyses confirmed by the following experimental results showed that overlapping layers at the shell poloidal gap were an effective solution to minimize error fields in RFX-mod. This suggested analysing the possibility of a similar configuration at the shell inner equatorial gap, too. The direct reproduction is not straight-forward due to strict dimensional constraints and the required compatibility with a much more complex assembly procedure necessary to make the support structure vacuum tight. Parametric analyses of different constructive solutions have been made possible by a computational tool specialized to estimate the induced currents in thin conducting structures with complex geometry and the associated magnetic fields. The magnetic error fields due to other new features of the design such as the conducting cage introduced to assure the electrical equipotentiality of the graphite tiles have also been investigated.

Co-authors: Dr MARCHIORI, Giuseppe (Consorzio RFX); Dr BETTINI, Paolo (Consorzio RFX); Dr CAVAZZANA, Roberto (Consorzio RFX); Dr MARCONATO, Nicolò (Consorzio RFX); Dr MARRELLI, Lionello (Consorzio RFX); Dr KAPIDANI, Bernard (Dipartimento Politecnico di Ingegneria e Architettura, Università di Udine); Dr SPECOGNA, Ruben (Dipartimento Politecnico di Ingegneria e Architettura, Università di Udine)

Presenter: Dr MARCHIORI, Giuseppe (Consorzio RFX)

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