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The Isotope Effect in the RFX-Mod Experiment

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The isotope effect, namely the dependence of plasma confinement on the mass Mi of majority ion, is a well known property of tokamak configuration. Increasing Mi leads to an improvement of energy, particle and momentum confinement in all regimes of tokamak plasmas. Besides, Mi influences also many MHD roperties, e.g. increasing the period of plasma instabilities. However in stellarators the confinement properties are independent on Mi.

Despite a strong research effort an explanation of the isotope effect in tokamaks is still lacking.

During the past year the Reversed Field Pinch (RFP) device RFX-mod started to operate using Deuterium (D), besides Hydrogen (H), as filling gas.

In this paper we present first results onthe comparison among Hydrogen and Deuterium plasmas of RFX-mod, offering the opportunity of studying the isotope effect physics from a new perspective

First analyses of Deuterium plasmas show clearly the presence of an isotope effect also in RFP configuration. The plasma properties change with Mi in a way which reminds what happens in tokamaks.

The electron temperature in D plasmas is about 20% higher than in H ones. This increase is essentially due to the steepening of Te gradient in the external region of plasma (r/a > 0.7), while gradients in the plasma core does not undergo a significant modification.

Discharges with similar plasma parameters are characterized by influxes of majority ion 30% lower in D plasmas than in H ones. Interestingly no significant difference is seen in the impurity influxes.

The mass Mi influences also the MHD properties of plasmas. At high current (Ip > 1 MA) the plasma is in the Quasi Single Helicity (QSH) state where a single MHD instability, the dominant one, overcomes the others, the so-called 'secondary' modes. The QSH phases are transiently interrupted by burst of MHD activity, the Dynamo Relaxation Events (DRE). The duration of QSH phases increases by a factor ~1.5 changing the main gas from H to D, resulting in a longer time interval among DREs responsible of QSH collapse. The energy of secondary modes during QSH is about 20% lower in D. Since the amplitude of dominant mode does not exhibit a significant variation, QSH are purer in D than in H. Furthermore the comparison among D and H plasmas shows that the current profile in D plasmas is more peaked than in H.

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