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# The evaluation of the central electron poloidal beta values for higher density operation with supersonic gas injection in RELAX RFP

## RELAXにおける高密度領域のプラズマ特性


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Reversed-Field Pinch (RFP) is one of the magnetic confinement systems for high-temperature, high-beta fusion plasmas. In the RFP, as the aspect ratio ($A$) is lowered, the self-induced bootstrap current tends to increase, which may lead to a reduction of the external source for current drive.

RELAX [1] is a low-aspect-ratio RFP whose major radius $R$ is 0.5 m and the minor, $a$, 0.25 m. The objectives include geometrical optimization of the RFP configuration, so, the aspect ratio A was designed as low as 2. The equilibrium analysis [2] showed that we could expect sizable fraction of the bootstrap current with beta of ~30% at $I_p$ ~100kA with $T_e$ of ~100-200 eV in $A$=2 RFP, the details depending on the equilibrium profiles. Figure 1 shows the central electron poloidal beta $\beta_{pe}(0)=n_e(0)T_e(0)/(B_p{}^2(a)/2\mu_0)$ vs. electron density $n_e$ normalized to the Greenwald density $n_G$ achieved in RELAX to data, where the central electron temperature and density were measured with Thomson scattering [3]. We should note that since $B_p$>>$B_t$ in the RFP, the poloidal beta is almost equal to the total beta. Figure1 shows of achieving higher density region to see if higher beta could be realized there.

We have been developing a supersonic gas injection system for higher density operation in RELAX. The system consists of a fast-acting electromagnetic gas valve with a Laval nozzle to produce directed supersonic gas flow with Mach number of up to 5 (M=5). A 140 GHz heterodyne interferometer was also developed to measure $n_e$ in higher regime than before [4].

Figure 2 shows a summary of the initial gas injection experiments without optimization. The central electron poloidal beta values are plotted vs. the normalized electron density, where the line-averaged electron density was measured with the newly developed 140 GHz interferometer.

Details of the supersonic gas fueling in optimized discharge conditions will be discussed.

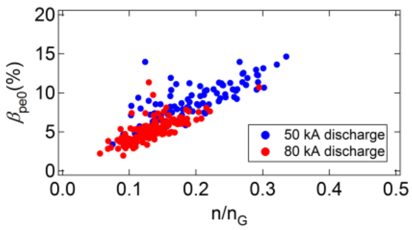


Fig.1 Electron poloidal beta vs. density.

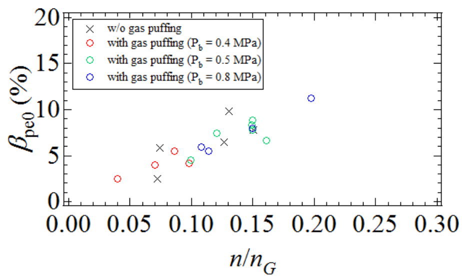


Fig.2 Electron poloidal beta vs. density in gas-puff fueled plasmas. The line-averaged interferometer density was used in the ordinate.

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