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New DC low temperature plasma source in a multidipole device with magnetic X-point configuration

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We present a new DC low temperature plasma source[1] in a cylindrical (60cm diameter and 2m long) multidipole vacuum chamber. The chamber has magnetic X-point configuration which is generated by a pair of axially flowing current sources. DC plasmas are generated by three types of sources, that are 1) end-plate tungsten filaments, 2) core tungsten filaments and 3) LaB_6 disk. Depending on the types of sources, a wide range of plasma densities from 10^8 to 10^{12} cm^{-3} and electron temperatures from 0.4 to 3 eV can be produced. It is found that the spatial structures of the DC plasmas are highly correlated with the magnetic X-point configuration. Furthermore, owing to the magnetic X-point configuration, magnetized electrons drift axially due to the gradient and curvature of the magnetic fields, i.e., grad-B and curvature drifts. Such drifts allow us to control, in some degree, the skewness and kurtosis of the electron velocity distribution function providing us opportunities to investigate effects of non-Maxwellian electron distributions on many physical phenomena such as cross-field diffusion, plasma waves and instabilities.

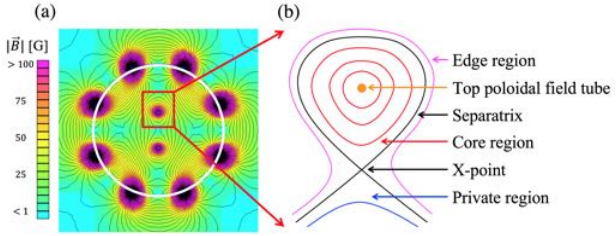

Fig. 1. Poloidal cross-section of magnetic field structure

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References

[1] Yegon Lim *et al*, Plasma Sources Sci. Technol. **29**, 115012 (2020)

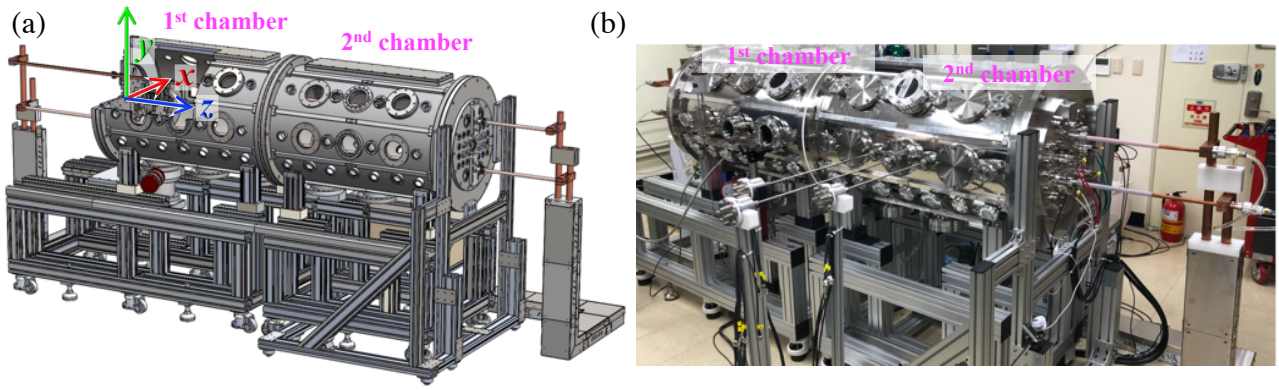

Fig. 2. Schematic diagram (a) and a picture (b) of the DC plasma source with magnetic X-point configuration