Z208b Self-consistent model of helicon discharge

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Helicon plasma is a high-density and low-temperature plasma generated by the helicon wave, i.e., electromagnetic whistler wave bounded typically in the cylindrical geometry. Since helicon plasma can be generated under a wide range of external parameters, it is expected to be useful for various applications. The mechanism of helicon plasma production has been studied by many authors with theoretical and experimental investigations. On the other hand, there remains a central problem that has not been fully answered: How does the helicon discharge grow? The mechanism of the helicon discharge includes the wave propagation in the plasma (dispersion relation), collisional or non-collisional wave damping and plasma heating, and ionization/recombination of neutral particles which causes time evolution of the dispersion relation.

In this study, we construct a fluid model of the helicon discharge including all the physics mentioned above self-consistently. By numerically solving the model, we show the time evolution of the helicon discharge in the cylindrical model and discuss how the waves influence the plasma density, electron temperature and their profiles. Furthermore, we make some comparisons with experimental results.