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Design and preliminary tests of an external antenna driven cw ion source at IAP Frankfurt

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A filament driven arc discharge proton ion source has been developed for the FRANZ (Frankfurt Neutron Source at Stern-Gerlach-Zentrum) project for many years [1]. The current and emittance requirements for the FRANZ project were reached successfully. But as a tungsten filament is used, the lifetime of the ion source is limited due to the ion bombardment. For improving the lifetime, a radio frequency driven plasma generator with an antenna outside of the plasma chamber was developed at the Institute for Applied Physics (IAP). The frequency of the ion source was set to 13.56 MHz, and a copper coil antenna was installed in a water-cooled channel to feed an inductive discharge inside the plasma chamber. The plasma was separated from the antenna by an Al_2O_3 cylinder. Eight permanent magnets were arranged around the plasma chamber to generate a multi-cusp filed. Preliminary experiments show that the plasma can be ignited easily with a load power higher than 1 kW in pulsed and cw mode. After the optimization of the RF coupling between RF generator and ion source with a 5.5 turn coil antenna, a coupling efficiency of 95% in pulsed mode and 93% in cw mode with a 10 kW input power could be reached. More details of the ion source and the experiments will be reported in this paper.

References

[1] W. Schweizer, U. Ratzinger, B. Klump, and K. Volk, *Rev. Sci. Instrum.* **85** 02A743, 2014.