ALTERNATIVE PLASMA GENERATION SCHEMES IN RF MULTICUSP H^- ION SOURCES

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Abstract

RF-driven, multicusp, H^- ion sources used for injection of high brightness beams into particle accelerators have traditionally produced inductively coupled plasmas created by the application of many kilowatts of pulsed RF power to a helical antenna immersed in the plasma. In recent years, antenna coating technology has improved dramatically allowing these sources to operate with reasonable lifetimes at the beam currents and duty factors demanded by modern accelerator facilities. In order to insure long source lifetime at the beam currents (~45 mA) and duty factors (6%) which will be required during the operational phase of the US Spallation Neutron Source (SNS) we are exploring alternative plasma generation schemes. This report discusses four alternative plasma generation schemes: an inductively coupled plasma produced using an external, water-immersed antenna; a high-density helicon plasma created using an external antenna; a plasma produced using a circularly polarized wave launched from a spiral antenna; and an over-dense plasma created by microwave excitation coupled through a resonance zone located at the injection surface of the plasma. The physics of each technique is discussed along with main design considerations for each concept. Ion source designs are presented as well as preliminary results of experimental investigations of H^- production for systems that have been tested.