# INITIAL COMPARATIVE PERFORMANCES OF CONVENTIONAL "SURFACE"- AND "VOLUME"- TYPE, MINIMUM-*B* ALL PERMANENT MAGNET ELECTRON CYCLOTRON RESONANCE (ECR) ION SOURCES

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It has been postulated[2,3] and subsequently experimentally verified[4-7] that the physical sizes and numbers of ECR zones in an ECR ion source play fundamentally important roles in the ability of the plasma to adsorb microwave radiation and consequently, to accelerate large populations of electrons to high energies, resulting in higher degrees of ionization, lower rates of charge-exchange and higher charge-state heavy ion populations within such plasmas. The physical sizes of the ECR zones can be enlarged in the spatial domain by configuring the central magnetic field so that it is uniformly distributed with magnitude in resonance with single frequency microwave radiation[2-4]. Additional zones can be added or physically enlarged in conventional ECR ion sources in the frequency domain by injecting multiple discrete[3,6,7], rapidly varying[3] or broadband frequency microwave radiation[3]. However, to date, no comparative measurements have been made that convincingly elucidate the advantages or disadvantages of single frequency "volume" ECR sources over their more conventional single frequency "surface" counterparts, as proposed in the original paper on the subject[2]. In this report, we seek to provide such information to help clarify the controversy of which design is superior. An all permanent magnet (6 GHz) ECR source, equipped with provisions for conversion into either magnetic field geometry was designed at the Oak Ridge National Laboratory for this purpose[8]. Details of the source design and operational parameters will be described, and charge-state and intensity distribution, along with companion *X*-ray spectral data, derived by operation of "volume" and "surface" forms of the source with selected noble gases without the use of gas mixing or biased probes, will be provided in this report. The present studies clearly show that, the "volume" configuration is superior to the "surface" configuration in terms of charge-state-distribution and intensity within a particular charge-state, under the same operating conditions[9].

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