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Density of metastable atoms in the plume of a low-pressure argon microplasma JAMES COOLEY, JUN XUE, RANDALL URDAHL, Agilent Technologies — Spatially-resolved measurements of the density of metastable excited atoms in the plume of an argon microplasma are presented. The microplasma device is operated at relatively low pressure, on the order of 1 Torr, and is exhausted into a vacuum. Line-integrated densities of excited argon neutrals in the exhaust plume are measured using tunable diode laser absorption spectroscopy. The density of argon metastables in both $1s_5$ and $1s_3$ states are measured. These line-integrated density measurements are converted to three-dimensional density maps using Abel inversion. The density of $1s_5$ argon peaks at a value of approximately 10^{18} m^{-3} near the outlet orifice, while the $1s_3$ density is roughly five times lower everywhere. It is found that, far from the face of the microplasma outlet orifice, metastable density follows an angular distribution consistent with that expected of vacuum gas expansion as predicted by classic rarified flow theory. Metastable flux is found to be conserved as the plume expands through 4 mm, suggesting an absence of de-excitation collisions or other loss processes along with a frozen velocity profile.

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