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A Kinetic Plasma-Pumped Rare Gas Laser[1] GUY PARSEY, Michigan State University, YAMAN GÜÇLÜ, Max Planck Institute, JOHN VERBONCOEUR, ANDREW CHRISTLIEB, Michigan State University — Extending from diode-pumped alkali vapor lasers (DPAL), Han and Heaven [*Opt. Lett.* **37** 2157-9] have shown that rare gas metastable states, $np^5(n+1)s[3/2]_2$, can operate as the base of a three-level laser with excition of the $(n+1)s \rightarrow (n+1)p$ transitions. Though both the rare gas lasers (RGL) and DPALs can be excited with incoherent optical pumping, RGLs do not suffer from the highly reactive behavior of alkali metals. Since metastable populations are maintained via electric discharge, we propose using a tuned electron energy distribution function (EEDF) to modify RGL efficiencies and drive the population inversion. The EEDF is maintained by the discharge along with the introduction of electron sources. Using our kinetic global modeling framework (KGMf) and three gas systems (helium buffered argon and krypton along with pure argon), we first validate the intracavity intensity laser model and then generate gain and energy efficiency baselines for each system. Parameter scanning methods are then used to find optimized EEDFs and system parameters for metastable production, generation of a lasing population inversion, and increasing RGL operation efficiencies. Finally, we determine if an RGL can operate without optical pumping.

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Guy Parsey
Michigan State University

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