

GaN/InGaN-diode-pumped AlGaInP-based VECSELS with high spectral purity for quantum technology systems

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Abstract: The development of compact laser systems, especially those with emission at visible wavelengths, is key for the advancement of quantum technology systems, often required to have high performance in terms of stability, noise and linewidth. In this scenario, optically pumped vertical-external-cavity surface-emitting laser (VECSEL) technology has demonstrated great potential due to its higher brightness, lower noise, and narrower intrinsic linewidth operation when compared to other semiconductor laser technologies. Recently, we demonstrated sub-200 Hz operation of an AlGaInP-based VECSEL with emission at 689 nm with output power exceeding 150 mW, targeting the narrow red cooling transition of neutral strontium. Similar narrow linewidth performance was achieved when a high-power InGaN-GaN laser diode (LD) was implemented as the optical pump source for the VECSEL [2]. These blue/green-emitting LDs are key not only for the achievement of robust low noise operation via active pump control but also for the miniaturization of the visible VECSEL systems via pump laser integration to the overall packaging. In this talk, we review and outline the next steps for our research work on the development of compact, narrow linewidth diode-pumped AlGaInP-based VECSELS for application in neutral strontium optical clocks.

References

- [1] P.H. Moriya et al., "Sub-kHz linewidth VECSELS for cold atoms experiments," *Opt. Express* 28, 15943-15953 (2020).
- [2] P.H. Moriya et al., "InGaN-diode-pumped AlGaInP VECSEL with sub-kHz linewidth at 689 nm," *Opt. Express* 29, 3258-3268 (2021).