

14 March, 2016

Andrew M. Weiner
Editor-in-Chief
Optics Express



Re: *Sub-kilohertz laser linewidth narrowing using polarization spectroscopy*,
J. S. Torrance, B. M. Sparkes, L. D. Turner and R. E. Scholten

Dear Prof. Weiner and colleagues,

We would appreciate your consideration of the attached manuscript for publication in *Optics Express*.

Our submission describes narrowing the linewidth of tunable external cavity diode lasers to well below 1 kHz, while retaining absolute frequency stabilization to an atomic reference. Narrow linewidth lasers are an essential component of numerous laser-based applications such as the cooling and trapping of atoms, atomic clocks, high resolution spectroscopy and metrology. Typical external cavity diode laser linewidths are of order a few hundred kHz, and reducing the linewidth below a kilohertz has traditionally required locking to a high finesse optical cavity using RF modulation and demodulation.

We have demonstrated that polarization spectroscopy is capable of producing sub-kilohertz laser linewidths, two orders of magnitude improvement compared to the best previous results [1], without the complexity of RF electronics, modulators, and high finesse cavity, while remaining inherently referenced to an atomic transition. We explain the characteristics of polarization spectroscopy that enable such linewidth narrowing, and show that long term frequency drift, a common concern of DC techniques, can be mitigated.

Optics Express is an important resource when investigating laser frequency stabilization. We counted 136 articles in the 'laser stabilization' category, many of which discuss new techniques for laser frequency narrowing and pushing the boundaries of existing techniques (see for example Refs.[4, 25] of our manuscript, and 2 – 4 below). We believe our manuscript would make a significant contribution in this area, and hope that the *Optics Express* editorial team and assessors will find the manuscript suitable.

Please don't hesitate to contact us if there is anything we can do to assist in the review process.

Sincerely,

Robert Scholten on behalf of all authors.

- [1] Y. Torii, H. Tashiro, N. Ohtsubo, and T. Aoki, "Laser-phase and frequency stabilization using atomic coherence", *Phys. Rev. A*, vol. 86, no. 3, p. 033805 (2012).
- [2] T. Führer, D. Stang and T. Walther, "Actively controlled tuning of an external cavity diode laser by polarization spectroscopy", *Optics Express*, vol. 17, no. 7 p. 4991 (2009).
- [3] M. W. Lee, M. C. Jarratt, C. Marciniak and M. J. Biercuk, "Frequency stabilization of a 369 nm diode laser by nonlinear spectroscopy of Ytterbium ions in a discharge", *Optics Express*, vol. 22, no. 6, p. 7210 (2014).
- [4] W. Lewoczko-Adamczyk, C. Pyrlík, J. Häger, S. Schwertfeger, A. Wicht, A. Peters, G. Erbert and G. Tränkle, "Ultra-narrow linewidth DFB-laser with optical feedback from a monolithic confocal Fabry-Perot cavity", *Optics Express*, vol. 23, no. 8, p. 9705 (2015).