High power, broadly tunable all-solid-state synchronously-pumped lithium triborate optical parametric oscillator.

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The past few years have seen major advances in optical parametric oscillators (OPO's), based on new nonlinear materials, such as lithium triborate (LBO) and capitalising on the availability of improved pump sources having high power and high spatial and spectral coherence. An area of particularly rapid development has been that of synchronously-pumped OPO's, exploiting the wide gain-bandwidth, which allows efficient pumping with short (picosecond or less) pump pulses.

In this presentation we describe the performance of an optimised singly-resonant LBO OPO in which a number of significant improvements have been made over previously reported results [1],[2]. These improvements include greater available pump powers, by making use of a diode-pumped Nd:YLF amplifier stage, a fully optimised resonant frequency doubler, also based on lithium triborate as well as the introduction of cavity length (and hence oscillation wavelength) stabilisation of the OPO and the addition of chirp compensation in the OPO. The full tuning range available from 0.65 to 2.65μm is realised in this device. With the increased available pump power we can routinely obtain >180mW (>90mW) average output power for the signal (idler) waves respectively. These increases in average output power have meant a consequent increase in intracavity peak power. This has led to the observation of significant chirp on the emitted picosecond pulses due to the combined effects of self-phase modulation (SPM) and group velocity dispersion (GVD). Emphasis in this presentation will be given to the results achieved through compensation of the chirp via the inclusion of negative GVD through an SF10 prism pair. We will also describe an active cavity length stabilisation system introduced in order to improve the long term stability both in amplitude and wavelength which has proved both very easy to implement and extremely reliable. Typical values of stability are now ~3% rms. amplitude noise, mainly from the resonant frequency doubler, and ~10-20 GHz linecentre variance.

References:

1. S.D. Butterworth, M.J.McCarthy and D.C.Hanna, Optics Letters, **18**, p.1429-1431 (1993)

2. M.J.McCarthy, S.D.Butterworth and D.C.Hanna, Optics Communications, **102**, 297-303 (1993)