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Broadband frequency conversion

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We demonstrate a method for frequency conversion of broadly tunable or broad bandwidth light in a static, passive setup. Using simple optical components like lenses, mirrors and gratings and a BiBO crystal as the nonlinear material, we are able to frequency double a single-frequency, tunable, external cavity diode laser in the 1020-1090 nm range into the 510-545 nm range with almost equal efficiency for all wavelengths. Phase matching is obtained as follows; a diffraction grating is used to disperse light at different wavelengths into different angles, followed by an appropriately selected lens that ensures phase matching over a broad spectral range in the BBO crystal. Since the tuning mechanism relies on all-passive components with extremely short response times the proposed method is well suited for short pulse, broad bandwidth laser sources like mode-locked lasers or super-continuum sources. The method is generic and can be extended to cover other wavelength ranges with a suitable choice of lenses, gratings and nonlinear material.