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A Tunable Vacuum Ultraviolet Light Source and High Intensity Saturation of the Nonlinear Medium

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Abstract content
   (Max 300 words)
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A wavelength tunable vacuum ultraviolet (VUV) light source of high peak power and narrow spectral bandwidth has been developed at the Laser Research Institute of Stellenbosch University.

Two-photon resonant four wave sum-frequency mixing in phase matched magnesium vapour-krypton gas was used to produce wavelengths in the range 143 nm to 146 nm. The maximum VUV peak power obtained was 4.4 watts at 144.7 nm and a total laser input intensity of 420 MW.cm⁻¹. A quantum efficiency of 1.7 x 10⁻⁷ was obtained. Applications of this source include absorption and fluorescence spectroscopy of molecular gases and crystals.

Saturation effects in the nonlinear medium leading to a decrease in VUV generation efficiency near the two-photon resonance are investigated and compared to existing theoretical models. It is shown that two-photon absorption dominates in a narrow wavelength region around resonance, leading to significant population of the excited state, resulting in a change of the effective refractive index which in turn causes destruction of the phase matching conditions. The intensity dependent change of index of refraction causes the VUV generation efficiency to the blue and red of the resonance to differ. Failure to account for these changes can lead to a reduction of the VUV peak power obtained by 20 % or more.

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Main supervisor (name and email)
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