4:00pm - 4:15pm
GSWL4.2

Room 209

Generation and Amplification of Short Pulse Radiation at 193 nm

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Currently, there exists considerable interest in the development of high power ArF excimer systems. Intense coherent radiation at 193 nm is useful in various potential applications, such as photochemistry, lithography and the generation of soft x-ray radiation by nonlinear interactions.
We report on the design of a high power ArF excimer system, based on an electron-beam pumped ArF excimer amplifier. For the generation of subpicosecond injection pulses at 193 nm a modified sum-frequency mixing process in a β–barium borate (BBO) crystal is utilized. The experimental set-up for the sum-frequency mixing scheme is shown in figure 1. A narrow linewidth UV input pulse at 266 nm and broadband laser radiation at 707 nm are used as input wavelenghts for the BBO mixing crystal. The red laser beam is angularly dispersed by means of a grating-lens combination in such a way that every spectral component enters the BBO crystal at the corresponding phase-matching angle. Two nanosecond dye lasers, one operating at 707 nm and the other at 532 nm with subsequent frequency doubling have been used in initial experiments. The spectral acceptance of the mixing set-up has been determined by tuning of the red dye laser. The calculated bandwidths for a 1 mm crystal for both conventional and dispersively compensated sum-frequency mixing are depicted in figure 2 together with the corresponding experimental results. With dispersively compensated sum-frequency mixing in BBO it is possible to generate broadband and therefore subpicosecond radiation at 193 nm [1]. Furthermore, such a mixing process allows the use of long nonlinear optical crystals with a corresponding increase in conversion efficiency. For the generation of subpicosecond pulses at 193 nm, the input signals to the sum-frequency mixer are provided by an amplified mode-locked dye laser at 707 nm and by the fourth harmonic radiation of an Nd:YAG regenerative amplifier.
This injection source has been used to study the small-signal gain and the saturation energy density of an electron-beam pumped ArF excimer amplifier module. A double-pass amplifier arrangement and a large amplifier aperture of 15 cm^2 is expected to yield output energies of 50 mJ for subpicosecond pulses.

1. G. Szabó and Zs. Bor, Appl. Phys. B 50, 51(1990)

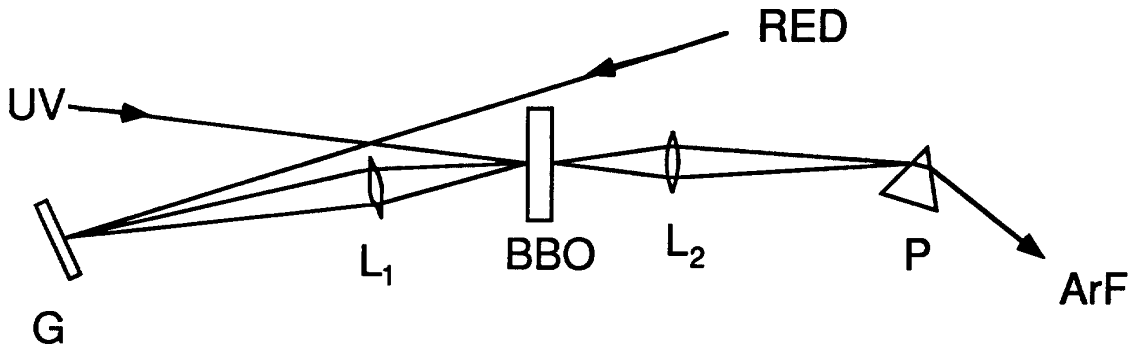

Fig.1 Experimental arrangement for dispersively compensated sum-frequency mixing (G=grating).

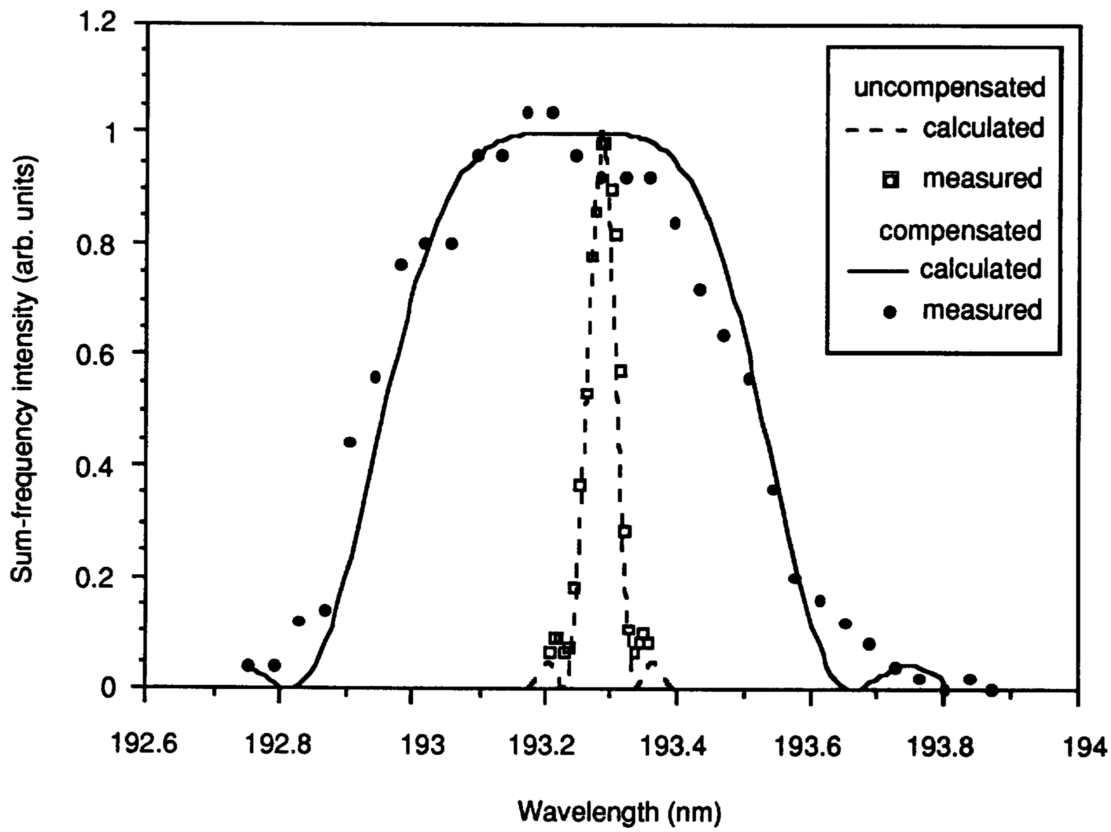

Fig.2 Calculated and measured spectral acceptance of a 1 mm BBO crystal. The conventional and dispersively compensated arrangements are compared.