Intensity dependent thresholding and switching in the Bridge mutually pumped phase conjugator

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The large electro-optic coefficient of photorefractive materials such as $BaTiO_3$ has allowed the observation of several exotic phase conjugators, such as the Self-Pumped Phase Conjugator (SPPC)[1] and, more recently, the Mutually Pumped Phase Conjugator (MPPC), in which two simultaneous phase conjugate (PC) outputs are produced via the interaction of two mutually incoherent beams within a photorefractive material. Several generic configurations of MPPC have been observed, such as the Double Phase Conjugate Mirror (DPCM)[2], the Mutually incoherent beam coupler (MIBC)[3] and the Bridge MPPC[4,5].

Wave mixing configurations in photorefractive materials generally show input beam intensity *ratio* dependent effects (both the MIBC and DPCM have been shown to posses beam ratio dependent reflectivities and thresholds for example[6,7]), but the only total input intensity dependent effect usually observed is the I^x rise time dependence of the refractive index gratings. Here we report the observation of total intensity dependent PC reflectivity in the Bridge MPPC, which has allowed the investigation of optical thresholding and bistability/hysteresis.

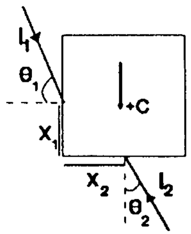

Figure 1: Schematic diagram of the Bridge MPPC

An example of the effects observed is shown in figure 2, in which the PC reflectivities of both beams (the beam ratio kept constant) are plotted against the total input intensity. On the downward cycle a threshold of 18 mW was reached below which the Bridge conjugator was destroyed by the onset of Self Pumped Phase Conjugation from beam 1. On the upward cycle SPPC persisted until the power reached 42 mW before the original bridge configuration was restored, the reflectivity being the same as that obtained on the downward cycle. Thus we have a device which allows the switching of the PC output of beam 2 in a bistable/hysteretic fashion, and, perhaps more interestingly, a method for changing the source of the light for the PC of beam 1, from beam 2 in the bridge configuration, to beam 1 itself in the SPPC geometry, which due to the difference in the pump beam path lengths for these two options, provides a "coherence switch" for subsequent wave mixing processes involving the PC output of beam 1.

It is likely that the effects observed are a result of competition between the Bridge conjugator and SPPC, arising from the difference in the intensity dependent response times of these two processes.

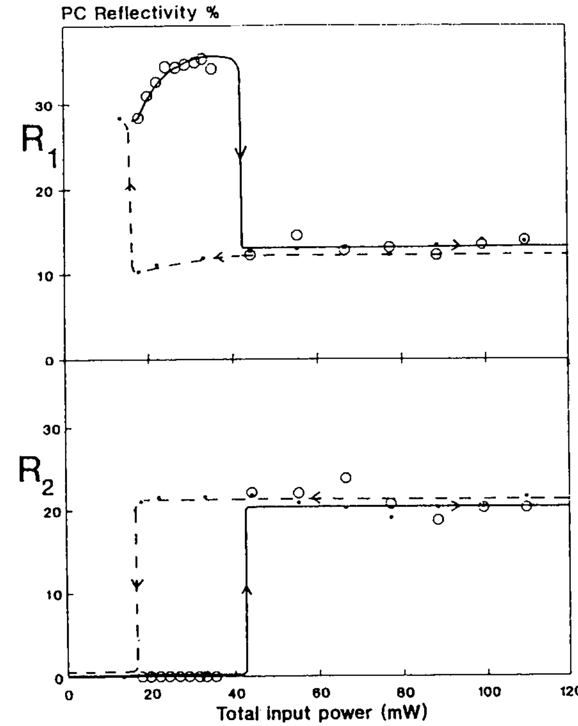

Figure 2: PC reflectivity, R, obtained from the Bridge MPPC as a function of the total input power, with $\theta_1=60°$, $\theta_2=20°$, $x_1=4mm$, $x_2=4mm$. ▪,downward cycle, O, upward cycle.

References

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