

PULSE BROADENING IN TE CO<sub>2</sub> REGENERATIVE  
LASER AMPLIFIERS

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Regenerative amplification above threshold<sup>1</sup> of ultra-short infra-red laser pulses, also called injection modelocking<sup>2,3</sup>, with potential applications in bond selective laser chemistry and laser fusion research, is of considerable current interest. An important consequence of such multi-pass operation is the high energy extraction efficiency<sup>2</sup> unlike in conventional amplifications, where the energy extraction efficiency of short pulses is limited by the finite collisional relaxation time of rotational sub-levels.

A simplified theoretical model is presented to evaluate the degree of pulse broadening of an injected short pulse, due to repeated amplification in the finite bandwidth gain medium of a CO<sub>2</sub> laser. Theoretical considerations suggest that intense pulse broadening results when line width limited pulses are injected, agreeing reasonably well with experimental results. This pulse broadening mechanism holds true even in multi-atmosphere laser amplifiers<sup>3</sup>

where significant line overlap is caused due to broadening of regular and hot bands of the CO<sub>2</sub> molecule. The only limitation of this model was observed when the gain bandwidth of the amplifier was comparable to the spectral width of the injected pulse.

### References

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