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GALVANIC CHAOS IN CO₂ LASER DISCHARGES

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Low-frequency instabilities (~ 5 kHz) have been observed on the output power of a dc-excited CO₂ laser. By changing the gas mixture or the discharge current, they show up first as a sinewave and then as a chaotic modulation of the laser intensity. When the modulation amplitude reaches 100%, fast damped oscillations at the relaxation frequency of the laser are superimposed on them.

The low frequency oscillations are due to galvanic processes similar to the striation waves which were observed in electric discharges in low pressure gases. They can also be detected on other discharge variables such as the visible fluorescence intensity or the electric field in the vicinity of the positive column. The evolution of these oscillations versus the various possible control parameters show that they evolve towards chaos following a period-doubling cascade. The coexistence of several oscillation modes leads to "generalized bistability" as the discharge oscillates on one or the other mode (or its subharmonics) depending on the previous evolution of the control parameters.

Such instabilities have been known for a long time in the framework of studies of gaseous dc-discharges but the development of non linear physics brought in new tools which allow to assign to deterministic phenomena, what was previously considered as "discharge noise".