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High-power short-pulsed microwave impingement on a high-pressure plasma ball in acoustic spherical resonance

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In a project on the development of a pulsed microwave sulfur lamp prototype of 1 kW, we discovered a phenomenon in which the plasma forms a ball at the center of the electrodeless spherical bulb despite gravity. In a preceding publication, we then reported measurements performed with a photodiode that show the high-pressure plasma response to short pulses and showed by modelization that the ball formation results from an acoustic resonance in a spherical mode. With our setup, so using a bulb with 15.6 cm³ volume, this phenomenon appears mostly at a pulse repetition frequency a little below 30 kHz. In this paper, we present complementary results obtained with a second photodiode placed opposite to the first, targeting the side of the ball where the high-power pulse microwaves impinge on the plasma. The second signal is similar to the preceding in the main characteristics: when the resonance occurs, its modulation passes from quasi-triangular to sinusoidal form with a frequency decrease of a few percent, as the oscillation slows down a little below the pulse repetition frequency. The resulting beat also shows up at a frequency equal to the frequency shift. However, the second signal shows an additional rectangular modulation that matches the pulses. The present work focuses on this new revelation and its interpretation.

Biography

Gilles Courret has completed his PhD at the Swiss Federal Institute of Technology (EPFL) in 1999. Since 2013, he is Professor of Physics in the Department of Industrial Technologies of the University of Applied Sciences and Arts Western Switzerland (HES-SO). His research interests include microwave-plasma interaction, plasma chemistry, light sources and illumination engineering, with emphasis on the improvement of energy efficiency. He has published more than 20 papers in reputed journals.

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