Liquid crystal's chaotic inner dynamics

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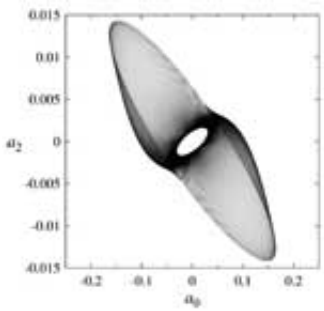

Scientists have unearthed a new dynamic process induced by strong electric fields in thin liquid crystal cells.

Liquid crystal displays are ubiquitous. Now, Polish physicists have demonstrated that the application of a very strong alternating electric field to thin liquid crystal cells leads to a new distinct dynamic effect in the response of the cells. The theory of spatio-temporal chaos explains this effect. It was elucidated by Wojciech Jeżewski and colleagues from the Institute of Molecular Physics, Polish Academy of Sciences, in Poznań, Poland, and is about to be published in *EPJ E*. This effect has implications for the operation of liquid-crystal devices because their operation is based on the electro-optic switching phenomenon, subject to the newly discovered effect.

The authors first applied an alternating electric field to semi-transparent,

conducting plates of cells containing a liquid crystal substance. Such systems are characterised by a spontaneous electric polarisation that can be reversed by the application of an external electric field.

The Jeżewski team then registered the resulting molecular reorientations by recording changes in the intensity of light transmitted by the liquid crystal sample, or spectra. In particular, the authors experimentally identified a distinct high-frequency band in the response, reflecting the activation of a specific dynamic process inside the sample.

Theoretical studies of the complex molecular reorientation dynamics confirmed experimental observations. The team explained the response of the sample by numerically solving the equation describing the motion of molecules subjected to very strong alternating fields. Unlike previous approaches, these simulations did not make any assumption about the sample dynamics.

The effect they showed was associated with a chaotic molecular reorientation induced by a strong field of sufficiently high frequency. Furthermore, a unique experimental setup led to signals, due to strong excitations of liquid crystals at frequencies less than the frequency of the external electric field, being registered.

More information: W. Jeżewski, I. Śliwa, and W. Kuczyński (2013), Strongly nonlinear dynamics of ferroelectric liquid crystals, *European Physical Journal E*, DOI 10.1140/epje/i2013-13002-7 . link.springer.com/article/10.1 … 0/epje/i2013-13002-7

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