« Atelier sur les méthodes mathématiques et informatiques pour les systèmes quantiques »
11 au 14 décembre 2018

"Workshop on Mathematical and Computational Methods for Quantum Systems"
December 11-14, 2018

Numerical modeling of rotational effects in $N_2{}^+$ lasing

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We simulate the pump-probe experiments of lasing in nitrogen ions with particular interest on the effects of rotational wave-packet dynamics. Our computations demonstrate that pumping of the higher rotational levels by an intense short non-resonant pulse results in a modulation of the subsequent emission from $B \to X$ transitions induced by a resonant probe pulse. Starting with the system in an incoherent superposition of the thermally equilibrium states, we model within the density matrix theory the dynamics of such pumping and emission, and show the time dependence on the pump-probe delay which is seen to be modulated by the rotational dynamics of the nitrogen ions.

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