CHARACTERIZATION OF A THZ ELECTRIC FIELD BY MOLECULAR ION SPECTROSCOPY

FLORIN LUCIAN CONSTANTIN, *UMR 8523 CNRS, Laboratoire PHLAM, Villeneuve d'Ascq, France*.

The Rydberg atom spectroscopy, exploited for SI-traceable electrometry, allowed to measure weak microwave electric fields at the μV/cm level. The Doppler-free spectroscopy methods allowed recently significant improvements of the resolution and precision of the measurements with cold trapped HD^+ molecular ions. The ab-initio molecular ion theory provided accurate predictions of the HD^+ energy levels and their shifts in external fields. This contribution proposes a new method to characterize a THz electric field that is off-resonantly coupled to the HD^+ energy levels based on the comparison of the measurements of the lighshifts induced on a two-photon rovibrational transition with the theoretical ab-initio predictions. Precisely, a THz-wave slightly detuned to the Zeeman subcomponents of the (v,L)=(0,0)-(0,1) transition may be characterized by measuring the lightshift of a Zeeman subcomponent of the (v,L)=(0,0)-(2,0) two-photon transition with potential Hz-level uncertainty limited by the molecular ion quantum projection noise. This method allows detecting a THz electric field at the μV/m level from a THz-wave optimally detuned to a hyperfine transition of HD^+. An algorithm is proposed to retrieve the amplitudes and the phases of a THz electric field in a Cartesian reference frame from six lightshift measurements using two orientations and three values of the static magnetic field in the ion trap. The Cartesian components of the electric field of a THz-wave, with an intensity of 1 W/m^2, circularly polarized, and detuned to a hyperfine transition of HD^+, may be characterized with mV/m-level uncertainties for the amplitudes, and 0.1 rad-level for the phases.