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Intraexcitonic Autler-Townes effect in terahertz-driven semiconductor quantum wells M. WAGNER, D. STEHR, H. SCHNEIDER, S. WINNERL, Helmholtz-Zentrum Dresden-Rossendorf HZDR, Dresden, Germany, A. ANDREWS, S. SCHARTNER, G. STRASSER, TU Vienna, Austria, M. HELM, HZDR — When a two-level system is resonantly driven by intense light non-perturbative phenomena such as Rabi oscillations and their frequency equivalent, the AC Stark or Autler-Townes effect, can be observed. The latter one manifests itself in an absorption line splitting where the magnitude is linear in the light field strength and where the symmetry of the splitting is determined by the detuning from resonance. Known from molecular spectroscopy [1], the effect has also been observed in solid state structures with its much broader line widths, e.g. for intersubband transitions [2]. Here, we present the first unambigous evidence of this effect in undoped GaAs/AlGaAs quantum wells using the hydrogen atom like intraexcitonic 1s and 2p states of the heavy-hole exciton. These states with a transition energy of 9 meV are resonantly coupled by strong terahertz light from a free-electron laser. For low fields our findings are qualitatively explained by a simple two-level model whereas deviations occur in the 10 kV/cm field range where the rotating-wave approximation of the simplified model breaks down and exciton ionization occurs. Due to the small Rydberg energy we can easily reach a highly non-trivial regime where the Rabi energy and the transition energy become comparable to the photon energy.

[1] S. H. Autler and C. H. Townes, Phys. Rev. 100, 703 (1955).
[2] S. G. Carter et al., Science 310, 651 (2005).
[3] M. Wagner et al., Phys. Rev. Lett. 105, 167401 (2010).

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