Quantum optics in the hyperfine Paschen-Back regime

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The study of light propagation through thermal atomic vapours subject to external magnetic fields is a flourishing area of research [1]. At Durham we have used our electric susceptibility code ElecSus [2, 3] to investigate nondegenerate three-level ladder and four-level diamond schemes. Application of a large magnetic field (where the Zeeman splittings exceed the Doppler width) allows us to gain access to the hyperfine Paschen-Back (HPB) regime [4, 5]. In hot alkali-metal vapors we have demonstrated that it is possible to realise electromagnetically induced transparency (EIT) [6], absorption (EIA) [7] and four-wave mixing [8] in nondegenerate three and four-level systems. Applications range from devices (a compact optical isolator [9], narrow-line filters [10], Faraday laser [11]) to fundamental physics such as single-photon interference due to motion in a collective excitation [12].

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