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A theoretical model of the "Transverse Optical Magnetism" phenomenon[1] CHITRA RANGAN, CHRISTOPHER DILORETO, University of Windsor — In famous scattering experiments [1,2], high-intensity, short-duration, electromagnetic pulses were scattered off dielectric liquids such as water and carbon tetrachloride. The observed pattern of the scattered light led the authors to propose that there was magnetic dipole radiation generated. They called this phenomenon "transverse optical magnetism". There has been no satisfactory theoretical explanation for this phenomenon. We have recently demonstrated that a dense ensemble of two-level atoms driven by an electromagnetic field can be modelled by an effective single quantum system that has a time-varying decoherence rate [3]. We use this model to provide an elegant theoretical explanation for the experiments. We show that the radiation pattern suggestive of magnetic dipole scattering occurs naturally when the inter-particle interactions caused due to spontaneous emission from individual atoms are taken into account in 3-dimensions. Our effective single particle model's predictions match very well with experimental data. [1] S.L. Oliveira and S. C. Rand, Phys. Rev. Lett. 98:093901, 2007. [2] S. C. Rand, W.M. Fisher, and S. L. Oliveira, J. Opt. Soc. Am B 25:1106, 2008. [3] C. S. DiLoreto and C. Rangan, Phys. Rev. A 97: 013812, 2018.

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Chitra Rangan
University of Windsor

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