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Magnetic Light Emitters: Plasmon-enhanced Magnetic Dipole Transitions

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Over the past decade, advances in both negative index metamaterials and resonant optical antennas have challenged traditional assumptions about light-matter interactions. While metamaterials research has shown that metallic structures can be engineered to support strong optical frequency magnetic resonances, resonant optical antennas have been designed to amplify and re-direct the emission from electric dipole emitters. In this talk, we explore the intersection of these distinct fields and investigate how resonant optical effects may be used to challenge the electric dipole approximation. Specifically, we will show how Purcell effects may be used to enhance the natural optical frequency magnetic dipole transitions in Lanthanide ions. We will present experimental and numerical results that demonstrate enhanced magnetic dipole emission from trivalent Europium ions near metallic films and nanoparticle composites. We will explore how the varying symmetries of electric and magnetic dipoles can be used to characterize and optimize magnetic light emission. Finally, we will discuss the implications of enhancing and controlling higher-order optical transitions for optical spectroscopy and photonic devices.