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Direct modulation of lanthanide emission at sub-lifetime scales using electric and magnetic dipole transition
SINAN KARAVELI, AARON J. WEINSTEIN, RASHID ZIA, Brown University — Lanthanide ions, such as trivalent Europium (Eu^{3+}) and Erbium (Er^{3+}) are technologically important, high quantum yield light emitters that exhibit both magnetic dipole (MD) and electric dipole (ED) transitions. It is well known that the transition rate of an emitter in an inhomogeneous optical environment, e.g. an emitter near a mirror, is modified due to self-interference effects, leading to either enhancement or inhibition of spontaneous emission. However, due to the opposite symmetry of their emitted fields, ED and MD transitions exhibit differing self-interference. Here, we leverage this difference to show large spectral tuning and sub-lifetime dynamic modulation of Eu^{3+} emission. Specifically, we use a moving gold mirror to selectively enhance the ED and MD transitions in Eu^{3+} doped Y_2O_3 . Controlling the emitter-mirror distance allows us to tune the emission spectra from 580 nm to 715 nm. Modulating the mirror position with a piezoelectric crystal allows us to dynamically tune the Eu^{3+} emission at speeds faster than the excited state lifetime.

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