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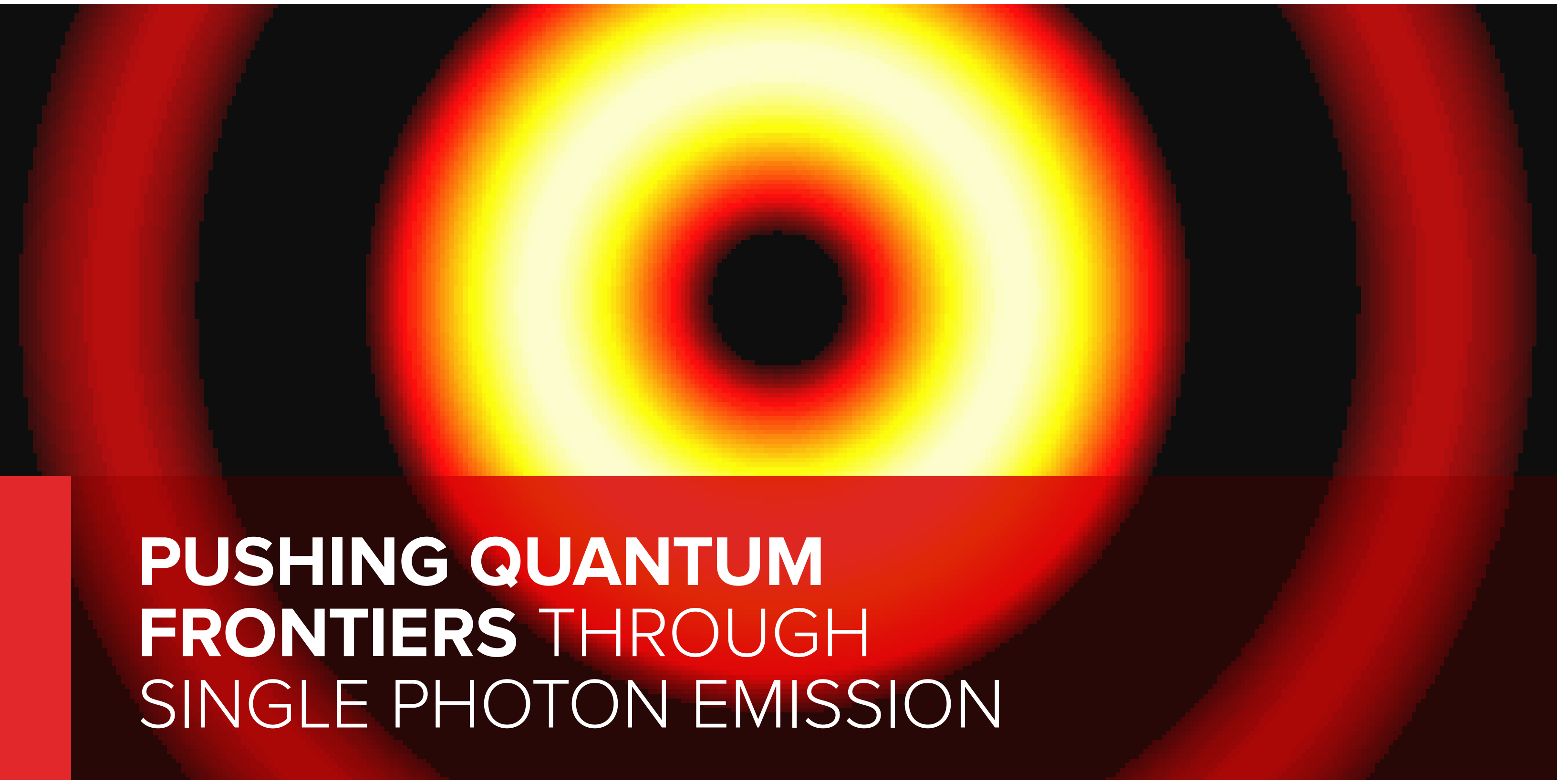

PUSHING QUANTUM FRONTIERS THROUGH SINGLE PHOTON EMISSION

THE IMPETUS

Scientists at the Center for Nanoscale Materials, a U.S. Department of Energy Office of Science user facility located at Argonne National Laboratory, with collaborators from the University of Chicago and Northwestern University have shown how polarized single photon emission from semiconductor nanoparticles can be achieved despite their two-dimensional isotropic emission dipoles.

Quasi-two-dimensional nanoplatelets (NPLs) possess extremely narrow spectral features due to their near-perfect monodispersity in the quantum-confined thickness dimension. NPL-based optoelectronic devices are promising for highly efficient dipole coupling and energy transfer processes. NPLs are also potentially interesting candidates for single photon sources in quantum information processing.

To leverage these exceptional properties of NPLs for high-performance optoelectronic and quantum photonic applications, knowledge of their transition dipole moment is essential for efficient dipole-dipole and dipole-cavity mode coupling.

THE WORK

The research team investigated individual quasi-two-dimensional NPLs using higher-order laser scanning microscopy and found that absorption dipoles in NPLs are isotropic in three dimensions at the excitation wavelength. Correlated polarization studies of the NPLs reveal that their emission polarization is strongly dependent on the aspect ratio of the lateral dimensions.

The research team concluded that emission dipoles in NPLs are isotropic in the plane of the NPLs. The study presents an approach for disentangling the effects of dipole degeneracy and electric field renormalization on emission anisotropy and can be adapted for studying the intrinsic optical transition dipoles of various nanostructures.

THE IMPACT

The study will further enable quantum optics and quantum network opportunities utilizing nanoscale single photon emitters by manipulating their emission polarization and directionality.

CONTACT

Argonne National Laboratory
9700 South Cass Avenue
Lemont, Illinois 60439
Phone: 630-252-2000
www.anl.gov/partners

September 2022