Enabling QUAntum Information by Scalability of Engineered quantum materials

EQUAISE

QUANTERA Applied Quantum Science

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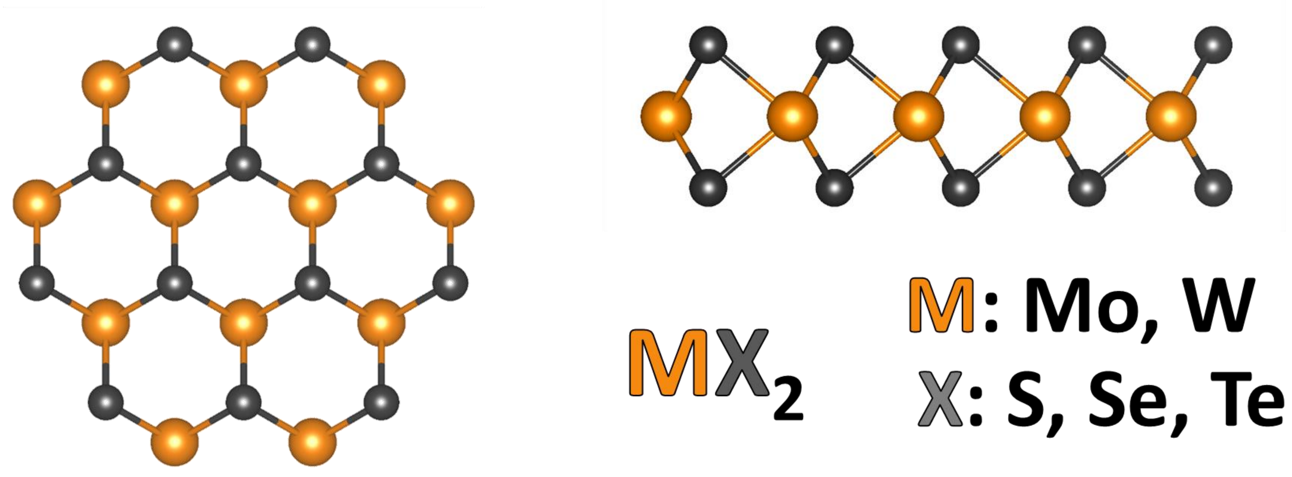
SCOPE: Future quantum applications require non-classical light sources that can be fabricated via simple and cost-effective methods and, at the same time, be compatible with current photonic integration technologies.

We propose a novel approach to fabricate arrays of near ideal single photon sources based on two-dimensional (2D) materials made of transition metal dichalcogenides (TMDs).

A single chip hosting several non-classical light sources will be fabricated in scalable manner with each source being independently addressable by external bias.

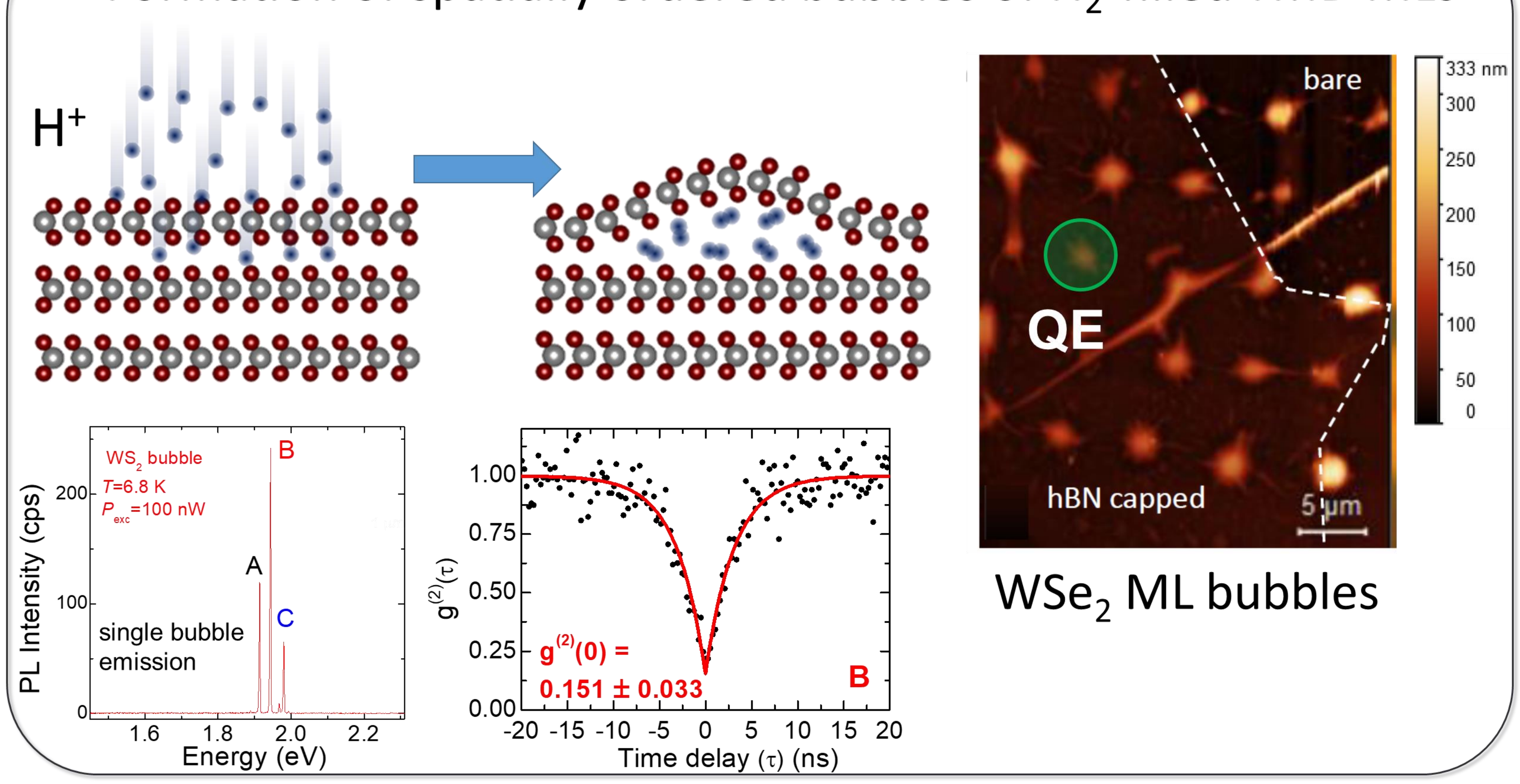
CONCEPT AND METHODOLOGY: We exploit 2D crystals as reliable, cost-effective, and scalable solid-state quantum emitters (QEs) that can be seamlessly integrated on photonic crystal structures.



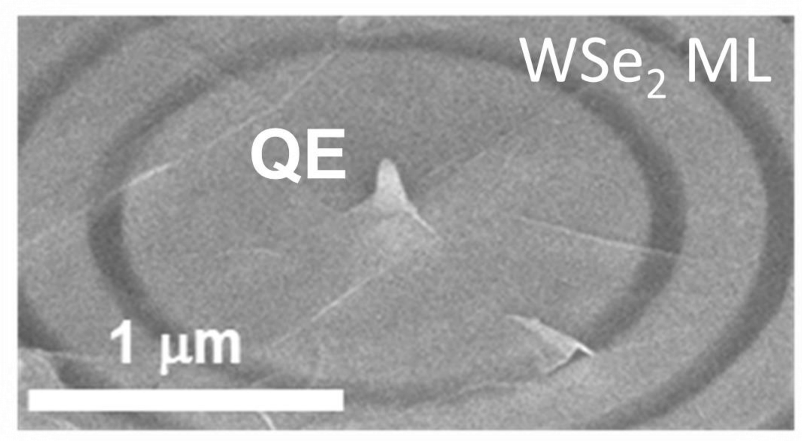
Transition metal dichalcogenides (TMDs, MX_2) can be exfoliated down to the monolayer (ML) limit (0.6 nm thickness). Their all-surface nature makes TMD monolayers extremely resilient to strain and hence their electronic properties can be engineered by suitable mechanical deformations.

Two methods will be used to create spatially controlled QEs

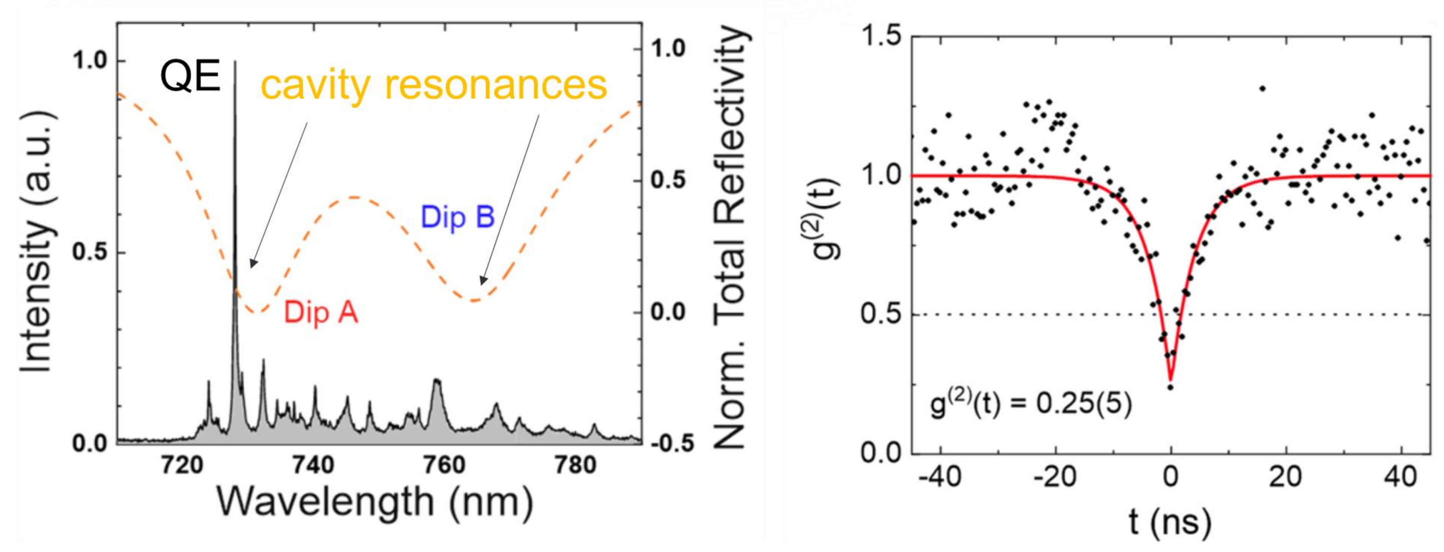
Formation of spatially ordered bubbles of H_2-filled TMD MLs



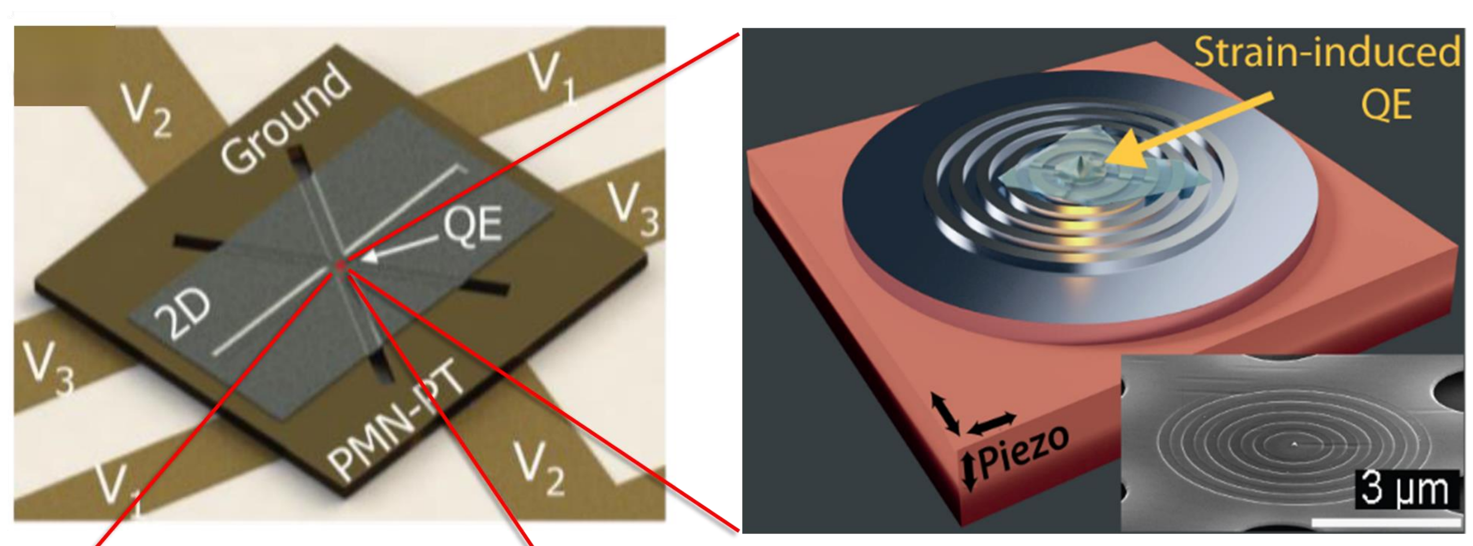
WSe$_2$ ML bubbles

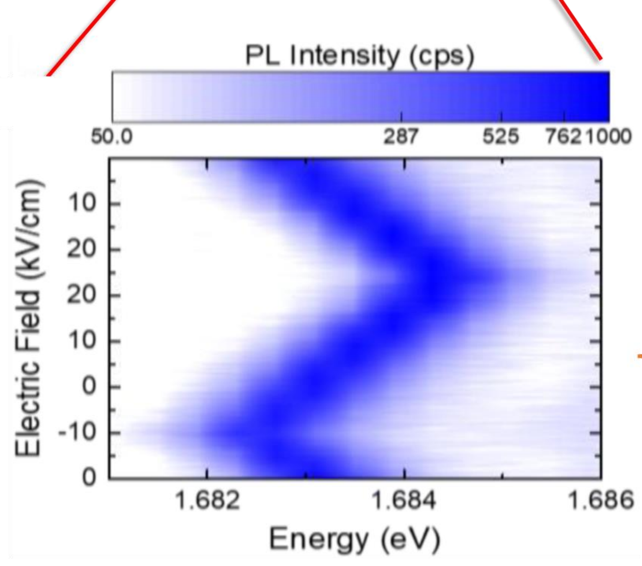


Deposition of ML on dielectric pillars to achieve spatially controlled carrier confinement



Dynamic control of QE emission and cavity resonance wavelengths by strain using piezoelectric actuators

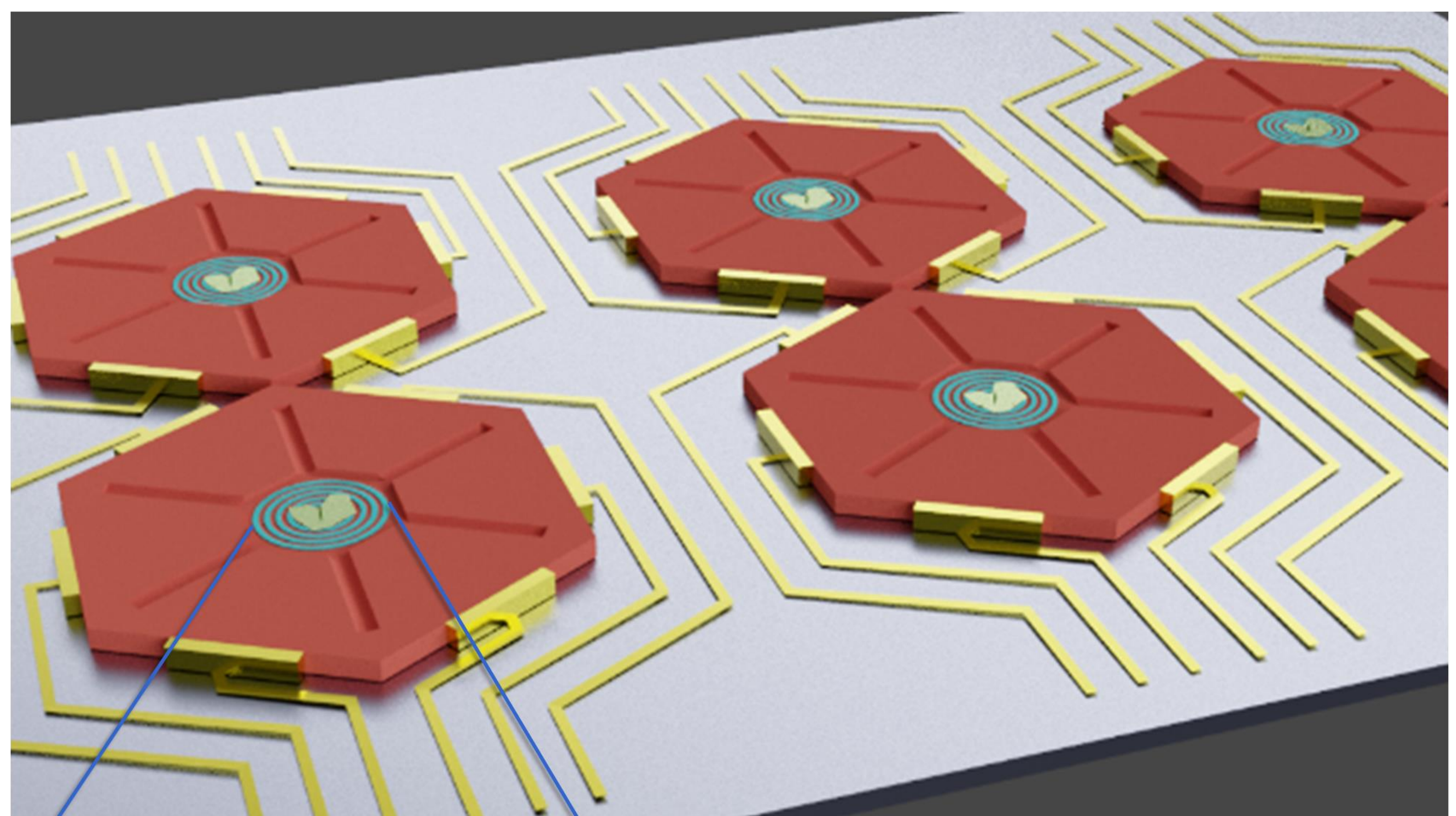


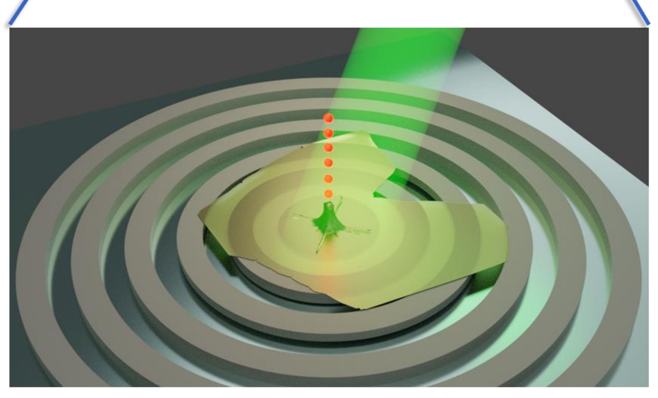


The QE emission efficiency can be enhanced by the Purcell effect.

The QE emission energy can be tuned by deposition of the QE on piezoelectric devices.

Our vision





We aim at photon processing involving many QEs integrated in a single device enhancing the opportunities to test complex arrangements within quantum communications and simulation.