Modulation and trapping of 2D excitons using surface acoustic wave resonators

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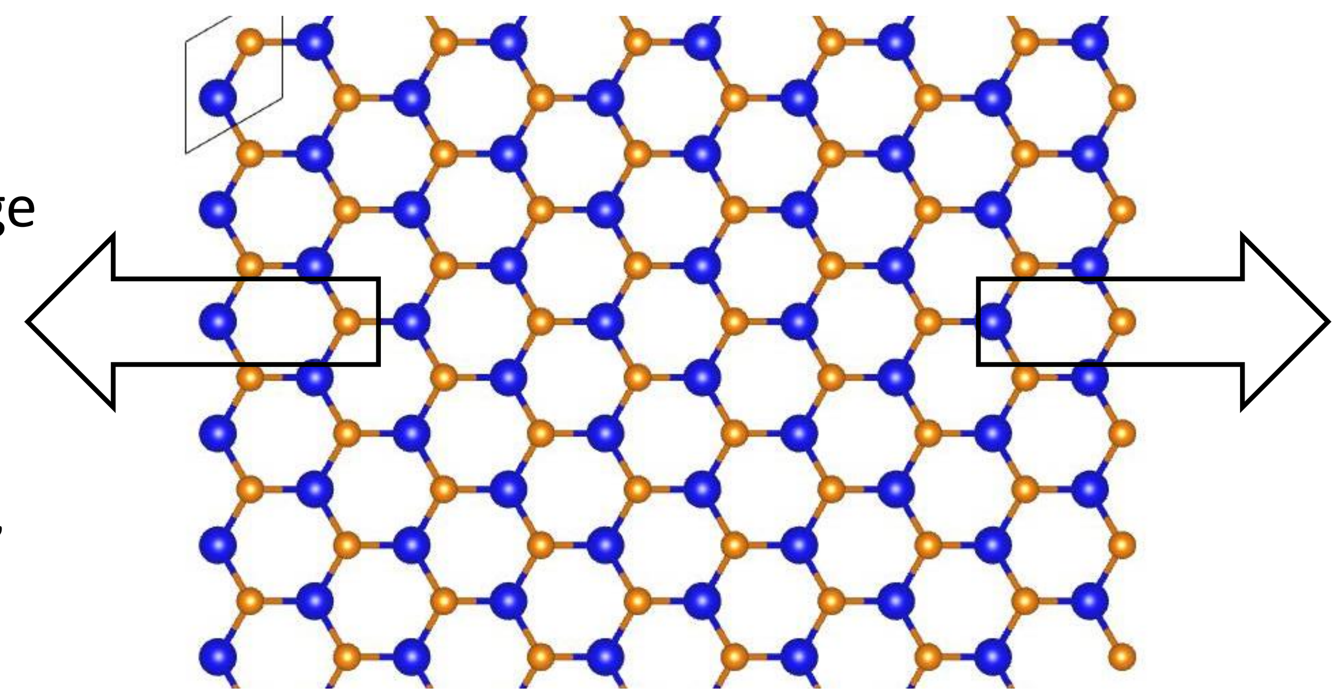
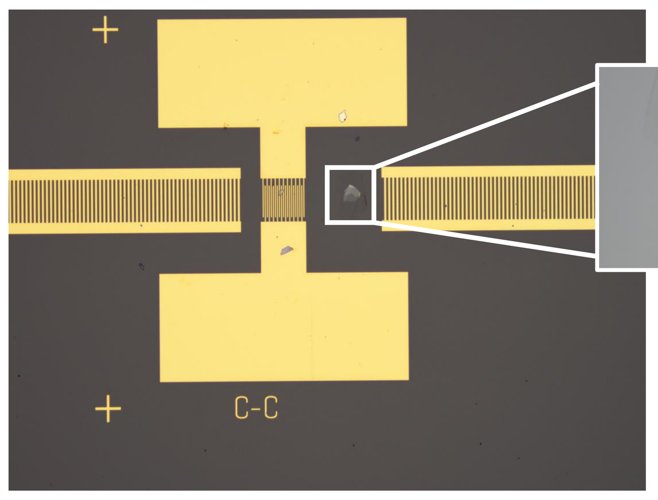
Transition metal dichalcogenides (TMDs) are very sensitive to their hexagonal lattice, so small amounts of strain can drastically change material properties such as exciton energy, carrier mobility, and Raman modes. By spatially varying the strain applied to the TMD with a surface acoustic wave resonator, we attempt to spatially control the various material properties.

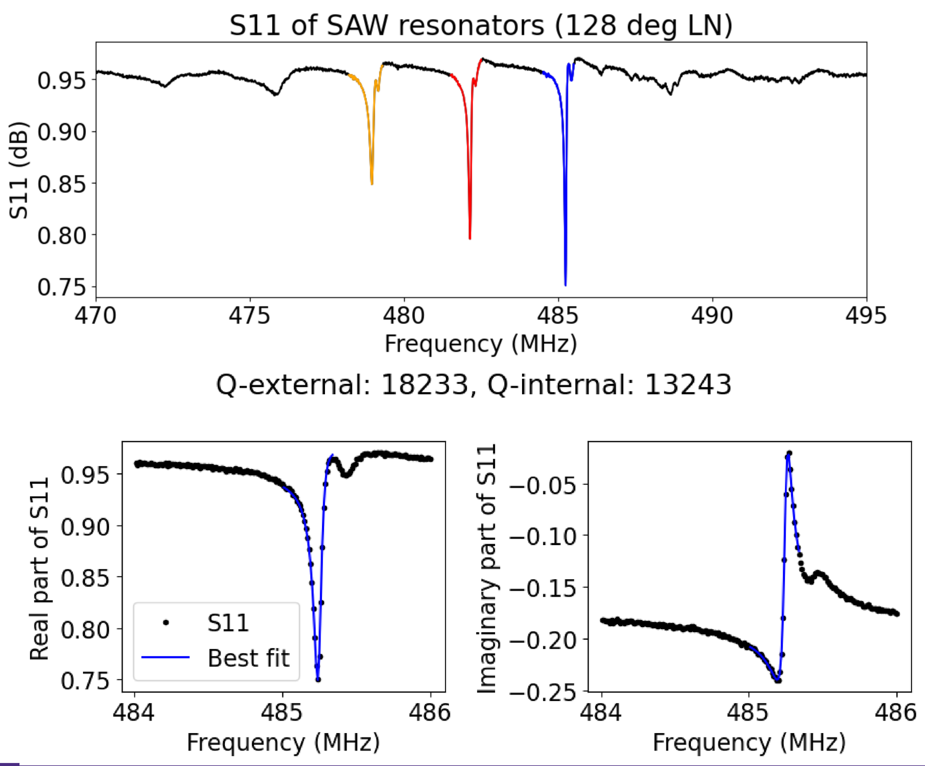


Using standing waves, we can vary the spatial profile of the strain and electric fields the excitons experience. With precise control over these fields, we can tune excitonic properties selectively. This work has applications towards information storage, programmable optical properties, excitonic trapping at antinodes, and control and modulation of quantum emitter arrays.

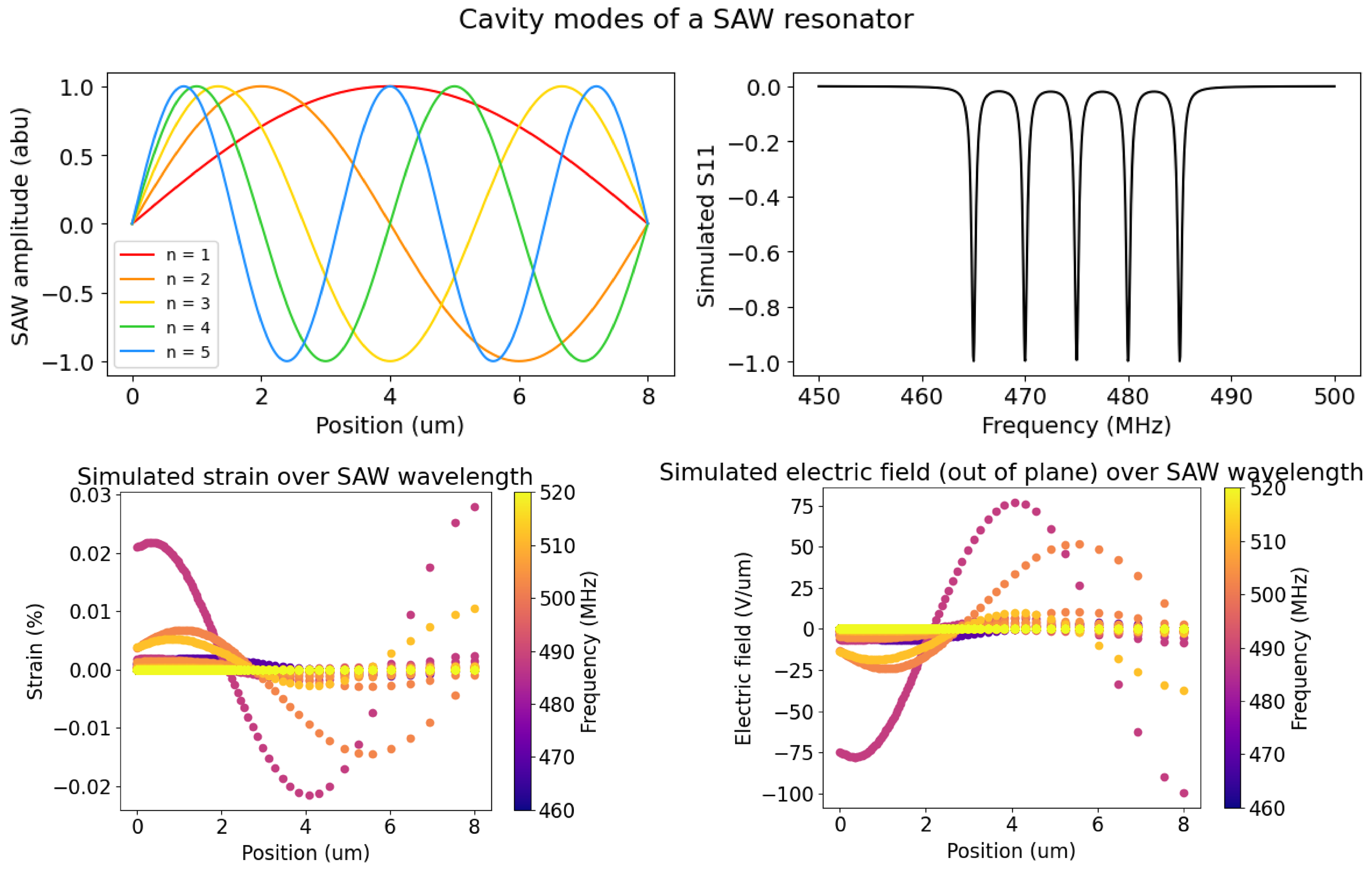
Device layout



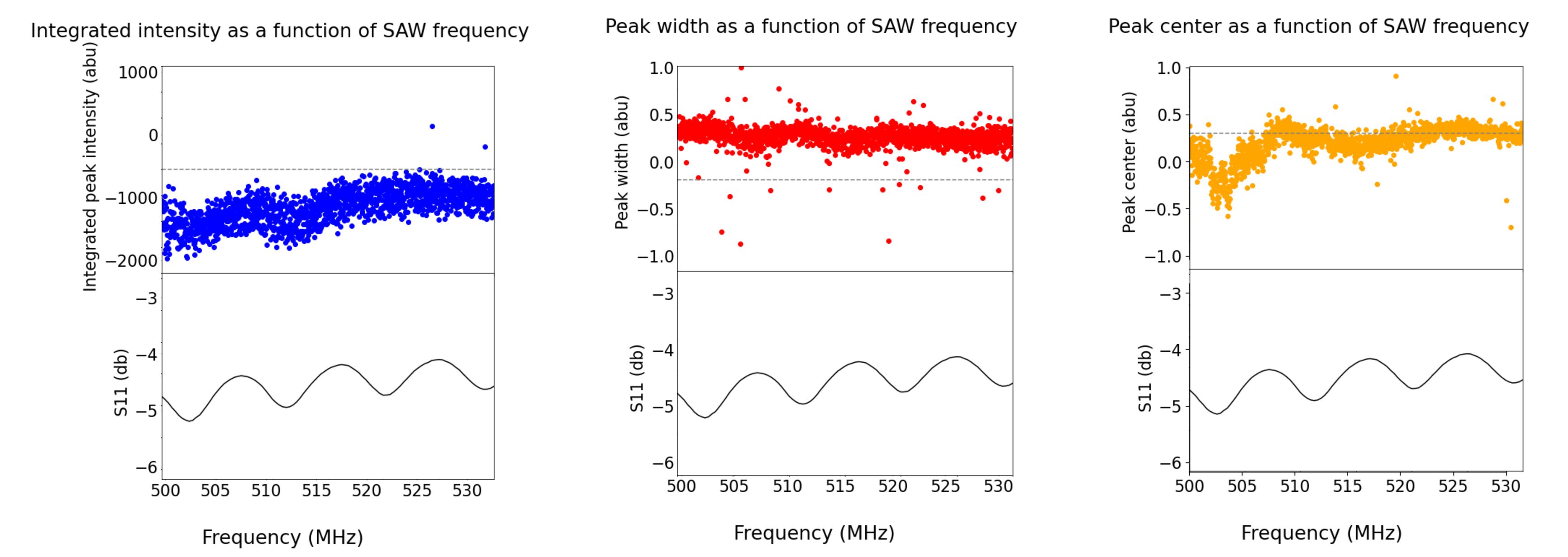
Above: A surface acoustic wave resonator (Au) with hBN encapsulated WSe2 inside the cavity. *Right*: S11 and quality factor fitting of resonator.



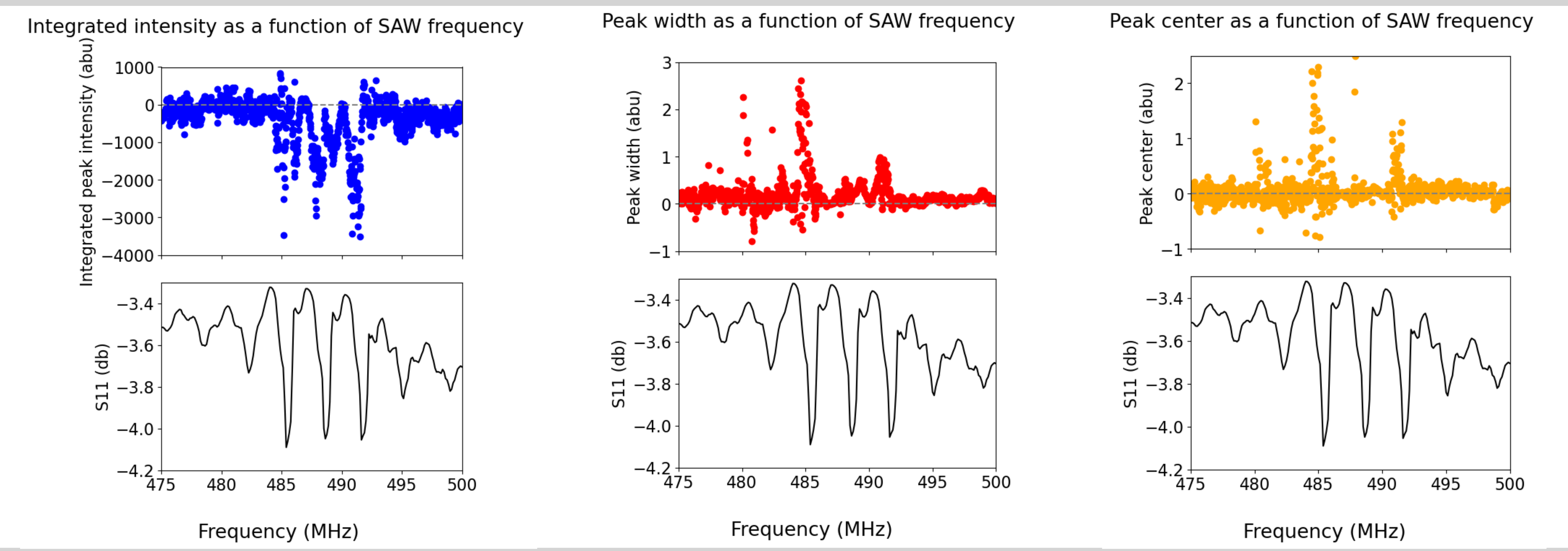
SAW resonator simulation results



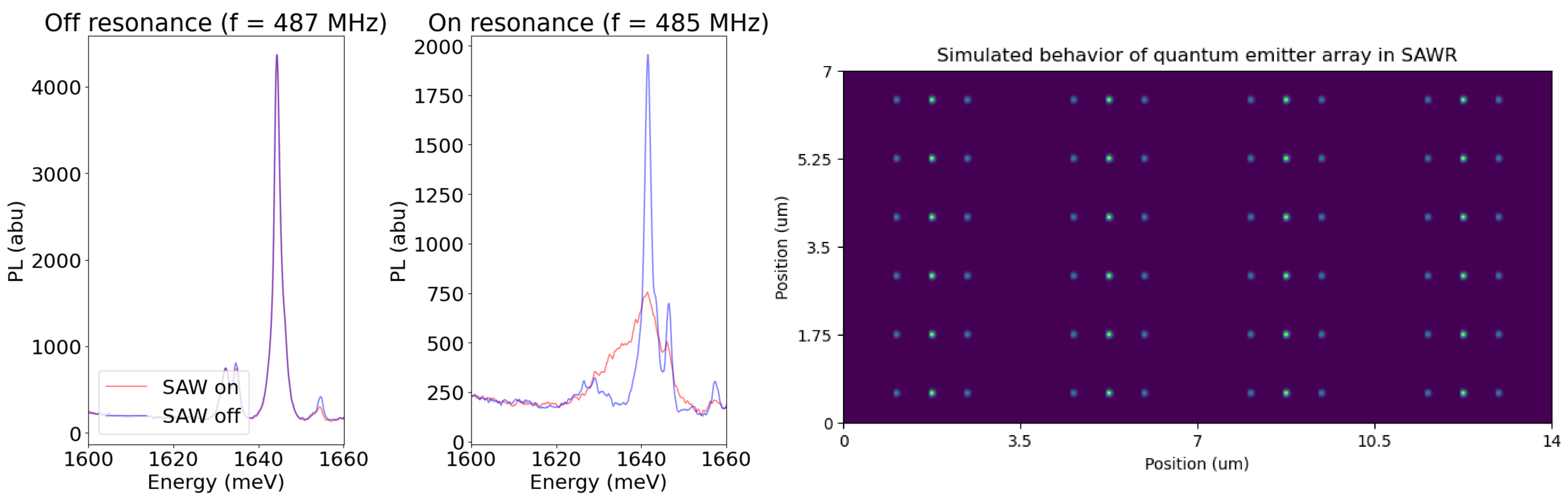
Modulation of free excitons



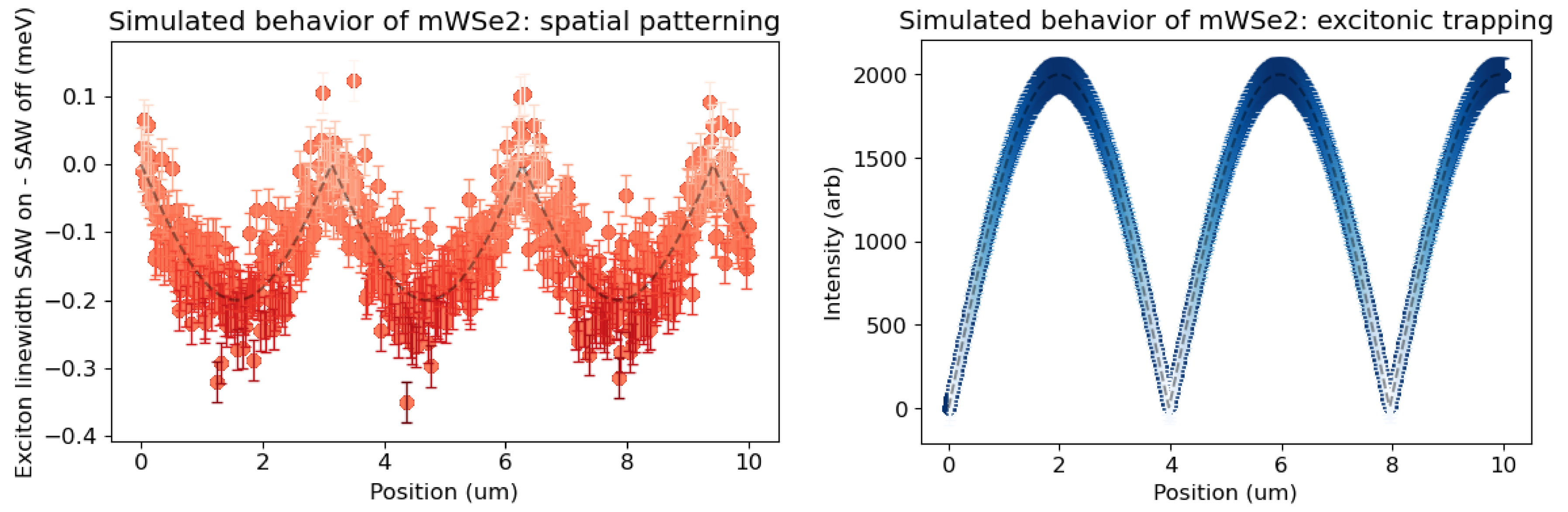
Modulation of quantum emitters



Switching quantum emitter on/off



Applications of spatially modulation excitons



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