

## Emergent magnetism in NbSe<sub>2</sub> thin films

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NbSe<sub>2</sub> is a transition metal dichalcogenide (TMDC) well known for having the highest superconducting transition temperature among all pristine TMDCs. While bulk NbSe<sub>2</sub> is only found in its 2H superconducting phase, it has been shown that 1T-NbSe<sub>2</sub> can be stabilized on a substrate through molecular beam epitaxy growth<sup>1</sup>, with extremely different properties from the 2H phase. 1T-NbSe<sub>2</sub> is not superconducting, but a Mott insulator that exhibits localized magnetic moments as seen through Kondo resonances<sup>2</sup>, and has recently been characterized as a spin liquid<sup>3</sup>. However, no evidence of long-range magnetic order has been shown to date. In this work, we grown mixed phase 2H/1T-NbSe<sub>2</sub> thin films on YAlO<sub>3</sub> substrates using molecular beam epitaxy. New Raman modes are found to be present, particularly at the edge of the films, distinguishing it from the pure 2H phase. We observe the onset of a sizeable magnetoresistance around 75 K, and a pronounced magnetic hysteresis at low temperatures, implying the existence of a long-range magnetic order. However, muon spin rotation experiments showed no presence of a strong magnetic transition, limiting the possible magnetic volume fraction of the film to be less than 5%.

[1] Nakata, Y., Sugawara, K., Shimizu, R. et al. Monolayer 1T-NbSe<sub>2</sub> as a Mott insulator. *NPG Asia Mater* 8, e321 (2016). <https://doi.org/10.1038/am.2016.157>.

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[3] Zhang, Q., He, WY., Zhang, Y. et al. Quantum spin liquid signatures in monolayer 1T-NbSe<sub>2</sub>. *Nat Commun* 15, 2336 (2024). <https://doi.org/10.1038/s41467-024-46612-1>.