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Competing quantum phases in Ising superconducting dome of monolayer WS₂ JIANMING LU, OLEKSANDR ZHELIUK, QIHONG CHEN, Univ of Groningen, INGE LEERMAKERS, NIGEL HUSSEY, ULI ZEITLER, High Field Magnet Laboratory (HFML-EMFL), Radboud University, JIANTING YE, Univ of Groningen — A fascinating phenomenon in two dimensional electronic systems (2DES) is the quantum phase transition between an insulating, metallic and superconducting. Recent advances in crystalline 2D materials now make it possible to address quantum phase transitions in a truly 2DES. Here, we present a complete set of competing quantum phases from band insulator, superconductor, to an unexpected re-entrant insulator in a truly 2DES – a monolayer of WS₂ – where we can control field effect without altering the chemical structure over a large range. In the phase diagram we observe an Ising superconducting dome with dual quantum critical points (QCP). Over the entire dome, the spin of Cooper pairs is pinned by a strong internal spin orbit interaction (~ 30 meV). In the strong gating limit, the weak screening in monolayer causes reentrance to a highly insulating state, providing the key insight into many dome-like superconducting phases observed in field induced quasi-2D superconductors.

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