Over the past few years, the exploration of quantum matter’s unique properties has seen remarkable strides, especially within the low-dimensional realms. Among them, two-dimensional (2D) materials like topological superconductors and van der Waals (vdW) magnets have emerged as significant focal points. Their potential to reshape the landscape of next-generation computing technologies, including avenues like quantum computing and spintronics, is immense. In this colloquium, I will present our latest experimental observations surrounding the intriguing electronic and magnetic states of two types of such 2D materials: the topological superconductor candidate 2M-WS₂ and the vdW magnet CrI₃. In the first part, I will discuss the unconventional superconductivity and controllable phase transitions in 2M-WS₂ atomic layers, offering insights into the essence of "topological qubits" for quantum computing. In the second part, I will talk about our advancements in manipulating magnetic and electronic states of CrI₃-based magnetic tunnel junctions, emphasizing their potential in probabilistic computing and non-volatile memory applications.