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Spin and Valley Noise in Two-dimensional Transition Metal Dichalcogenides[1] WANG-KONG TSE, D.L. SMITH, N.A. SINITSYN, Los Alamos National Laboratory — We develop a theory for the spin dynamics and optical spin noise spectroscopy in two-dimensional transition metal dichalcogenides. Different from spin noise in conventional semiconductors, we find that the Faraday rotation fluctuations consist of intrinsic noise not only from spins but also the valley degrees of freedom in the presence of inter-valley scattering processes. When inter-valley scattering is fast compared to spin flip scattering, we find that the spin relaxation time is renormalized by spin-orbit coupling and the valley relaxation time. When spin flip scattering is, on the other hand, fast compared to inter-valley scattering, spin relaxation and valley relaxation processes decouple. The Faraday rotation noise power spectrum displays distinctive signatures in both cases. We propose optical spin noise spectroscopy as a useful nonperturbative technique for probing the spin and valley relaxation processes in transition metal dichalcogenides.

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