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g-factor physics in 2D materials and van der Waals heterostructures

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Abstract

The interplay of the spin and the orbital angular momenta of electrons in semiconductors governs the Zeeman splitting, often described by the g-factors. In this talk, I will cover the basic physics behind the Zeeman splitting and g-factors, with recent examples involving two-
dimensional materials and related van der Waals heterostructures. Particularly, I will show that in monolayer phosphorene[1], the g-factors are driven by spin-orbit coupling, thus acquiring small corrections. In transition metal dichalcogenides (TMDCs) monolayers, I will discuss a full ab initio approach for the g-factors[2] that nicely reproduces the experimental values, demystifying the so-called valley-Zeeman physics in TMDCs and connecting it to the longstanding knowledge of g-factors in III-V materials. Using this full ab initio approach, I will discuss the effect of mechanical strain in the g-factors of monolayer TMDCs in close connection to experiments[3,4].
Beyond monolayers, I will discuss TMDC-based van der Waals heterostructures, particularly MoSe 2/WSe2 [2]and WS2/graphene systems, in which the spin-valley physics and g-factors encode valuable information about the interlayer coupling. Reaching the bulk limit of TMDCs, I will address the origin of ultrafast oscillations for in-plane magnetic fields in bulk MoSe2 and WSe2[5].

References

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