# Giant Resistance Switch in Twisted Transition Metal Dichalcogenide Tunnel Junctions


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Resistance switching in multilayer structures are typically based on materials possessing ferroic orders. Here we predict an extremely large resistance switching based on the relative spin-orbit splitting in twisted transition metal dichalcogenide (TMD) monolayers tunnel junctions. Because of the valence band spin splitting which depends on the valley index in the Brillouin zone, the perpendicular electronic transport through the junction depends on the relative reciprocal space overlap of the spin-dependent Fermi surfaces of both layers, which can be tuned by twisting one layer. Our quantum transport calculations reveal a switching resistance of up to $10^6$ % when the relative alignment of TMDs goes from 0° to 60° and when the angle is kept fixed at 60° and the Fermi level is varied. By creating vacancies, we evaluate how inter-valley scattering affects the efficiency and find that the resistance switching remains large ($10^4$ %) for typical values of vacancy concentration. Not only should this resistance switching be observed at room temperature due to the large spin splitting, but our results also show how twist angle engineering and control of van der Waals heterostructures could be used for next-generation memory and electronic applications.


## References


[1] Marc Vila, arXiv:2311.08397 (2023)


## Figures

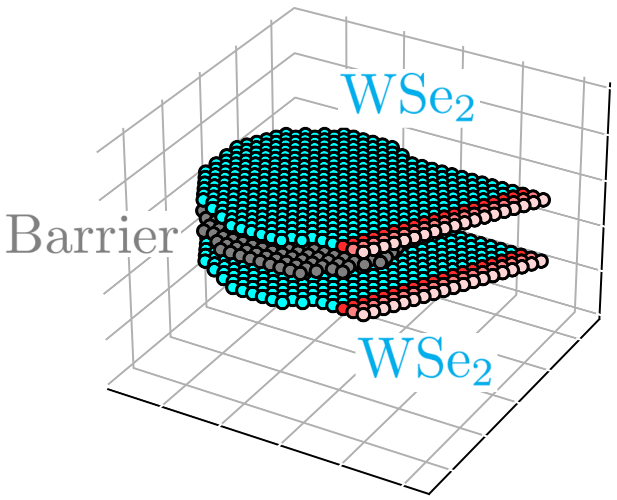


**Figure 1:** Schematic of the tunnel junction comprised of a TMD monolayer, a barrier and another TMD monolayer that can be rotated. Red sites correspond to the semi-infinite leads.

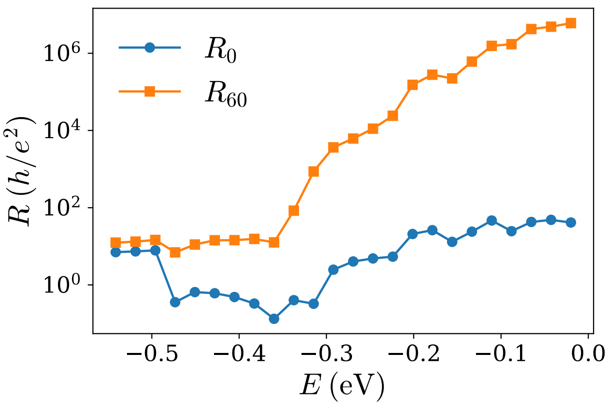


**Figure 2:** Tunneling resistance for twist angle of 0° (blue) and 60° (orange).