# Canted Topological Spin Transport in Low-symmetry Quantum Materials

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In this talk, I will present theoretical spin transport features in $MoTe_2$ and $WTe_2$-based materials which have recently been the subject of great attention within the broad context of Quantum Materials [1]. By focusing on the monolayer limit, using DFT-derived tight-binding models and using both efficient bulk and multi-terminal formalisms and techniques [2,3], I will first discuss the emergence of new forms of *intrinsic spin Hall effect (SHE)* that produce large and robust in-plane spin polarizations. Quantum transport calculations on realistic device geometries with disorder demonstrate large charge-to-spin interconversion efficiency with gate tunable spin Hall angle as large as $\theta_{xy}\approx80\%$, and SHE figure of merit $\lambda_s.\theta_{xy}\sim 8$-10 nm, largely superior to any known SHE material [4]. Besides, I will present our theoretical prediction of an *unconventional canted quantum spin Hall phase* in the monolayer $T_d$-$WTe_2$, which exhibits hitherto unknown features in other topological materials [5]. The low-symmetry of the structure induces a canted spin texture in the yz plane, dictating the spin polarization of topologically protected boundary states. Additionally, the spin Hall conductivity gets quantized ($2e^2/h$) with a spin quantization axis parallel to the canting direction. Our theoretical predictions for the canted QSHE findings have just been confirmed experimentally [6].

## REFERENCES

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## FIGURES

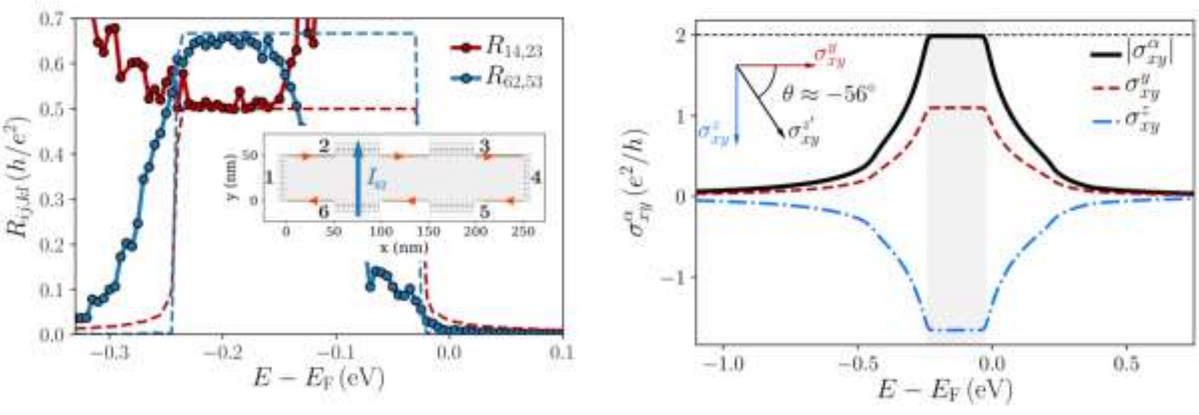


**Figure 1:** Right: Multiple components of the spin Hall conductivities computed for monolayer $WTe_2$
Left: Nonlocal resistances (6-terminals device), evidencing topological edge transport quantization