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## Quantum information processing with VOI-based valleytronics

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Graphene electrons possess the interesting degree of freedom known as valley pseudospin, due to the double valley degeneracy at Dirac valleys (K and K') in the band structure. Such pseudospin is an analog of electron spin and opens up a new type of electronics known as valleytronics. For example, the valley pseudospin can serve as an information carrier for quantum information processing. In this presentation, we will discuss the implementation of valley based qubits - valley pair qubits formed of two quantum dot-confined valley pseudospins, with logic 0 and 1 represented in terms of "valley singlet and triplet states", respectively. Their manipulation can be electrically achieved with the unique valley-orbit interaction (VOI) in graphene. We will also present a recent expansion in the valley qubit research, namely, the valley-photon quantum state transfer enabled by the electron valley - photon polarization correspondence. As a result, quantum information can flow back and forth between valley and photon qubits, with a possible application in quantum communications.

### Biography

Yu-Shu Wu has completed his PhD at the age of 29 years from Caltech and postdoctoral studies from Harvard University Division of Applied Sciences. He is a professor of Department of Electrical Engineering, National Tsing-Hua University, Hsinchu, Taiwan.

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