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Electronic structure of the metal-to-insulator transition in VO2: the chicken-and-egg dilemma of condensed matter

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The strongly correlated material VO_2 displays a metal-to-insulator (MIT) transition when going below $T_{MIT} = 280K$. Alongside this electronic transition, the material undergoes a structural transition from a rutile structure in the metallic phase to a monoclinic structure in the insulating phase. These simultaneous transitions have created a long-lasting debate within the community: is the electronic transition induced by the structural changes (Peierls transition) or is it happening alongside it (Mott transition) [1]? This question has been nicknamed the chicken-and-egg dilemma [2] of condensed matter.

Recent ARPES studies addressed the changes of the electronic structure of VO_2 across the transition [3]. However, a detailed imaging of the evolution of the conduction band spectral function in the transition regime is still lacking.

I will present our ongoing ARPES studies on VO_2 where we were able to observe a progressive transfer of spectral weight between two distinct states composing the conduction band.

References:

[1] Dynamical Singlets and Correlation-Assisted Peierls Transition in VO2, Silke Biermann *et al.*, Physical Review Letters (2005)
[2] Resolving the VO2 controversy: Mott mechanism dominates the insulator-to-metal transition, O. Nájera *et al.*, Physical Review B. (2017)
[3] Photoelectron dispersion in metallic and insulating VO2 thin films, Viktor Jonsson *et al.*, Physical Review Research (2021)

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