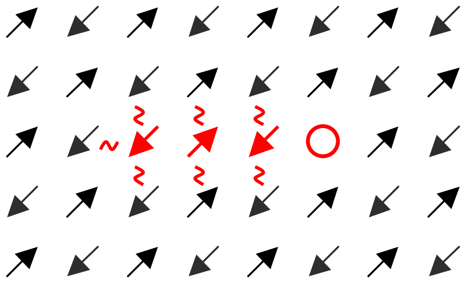

Frustration of a moving hole in the Ising model.

What is a quantum antiferromagnet?

An antiferromagnet is a magnet where spins point alternatingly up and down, as in the picture left. In the classical Ising model the localized spins can only point up or down. The hopping of a single hole in the antiferromagnet causes a 'magnetic string' of overturned spins. Since this costs energy a hole in the Ising model is effectively confined.

In real antiferromagnetic materials, such as undoped cuprates, there will be quantum fluctuations of the spins that will repair the magnetic damage when the hole moves. So there the hole is not completely confined!

DYNAMICAL FRUSTRATION OF INTERLAYER EXCITONS IN QUANTUM ANTIFERROMAGNETS

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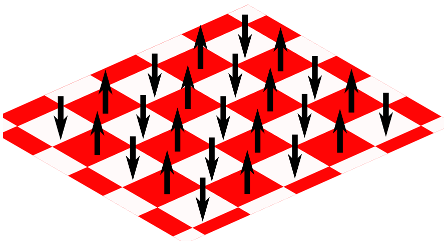
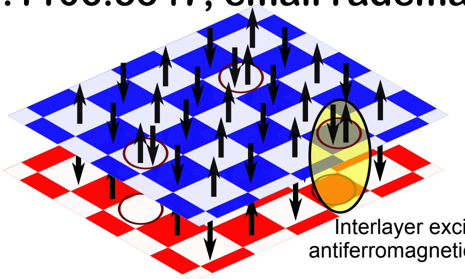
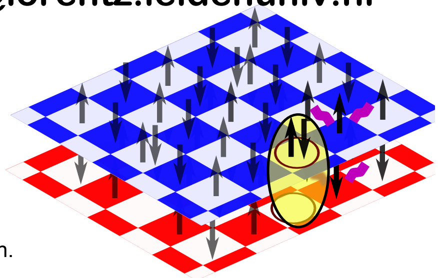




Interlayer exciton in an antiferromagnetic sandwich.



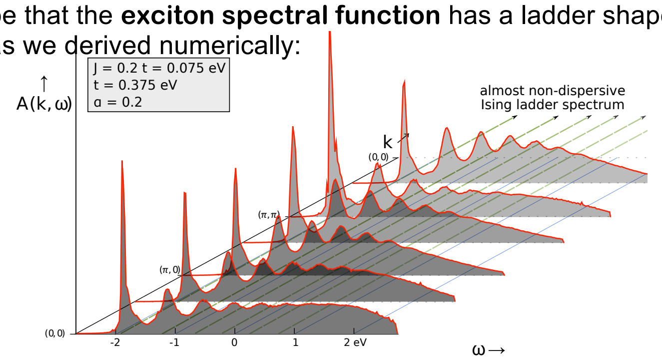
Interlayer excitons

In strongly correlated materials the antiferromagnetism arises from localized electron spins (see first picture above). Relative to the state where each site has exactly one electron, we can create exciton states as a **bound state of a double occupied and a vacant lattice site** (see second picture).

Imagine an interlayer exciton, in which the doubly occupied and vacant site live in two adjacent layers of an antiferromagnetic sandwich. One would expect that such an excitonic state has dynamical properties similar to the hole in the single layer antiferromagnet (see third picture): frustration repaired by quantum fluctuations.

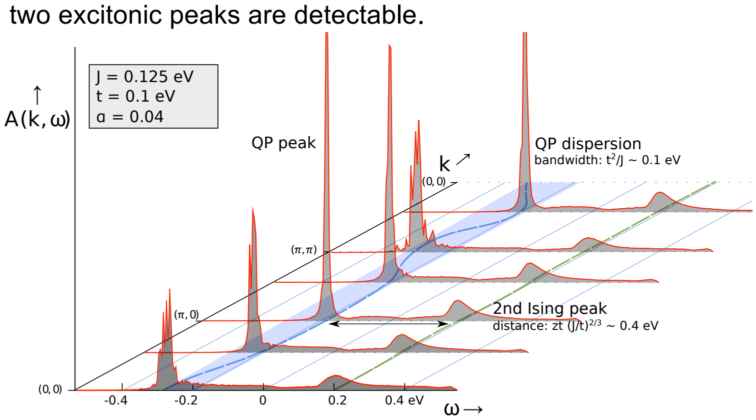
NEW: Dynamical frustration!

We developed new theoretical model for interlayer excitons in a quantum antiferromagnet. Surprisingly enough, we found that for small magnetic interlayer interactions, the confinement of the exciton is enhanced relative to the single layer case. A signal of such dynamical frustration will be that the **exciton spectral function** has a ladder shape, as we derived numerically:



Future research: We anticipate that the real significance of this discovery lies in the potential of creating exciton systems of this kind at a finite density. Rich new physics and possible novel kinds of exciton condensates are expected!

Consequently, we predict that in the *c*-axis optical absorption spectrum of **undoped YBCO bilayers** not one but at least two excitonic peaks are detectable.



In order to derive these exciton spectral functions, we developed an *exciton t-J model* that we solved numerically with the self-consistent Born approximation. **Want to know more? Please ask any question or take a copy of our arXiv paper.**