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Defects in low dimensional quantum magnets[1]

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Quantum systems are known to be extremely susceptible to defects when confined in one dimension. Spin chains and ladders are no exception to this rule. In this talk I will demonstrate the dramatic effect that a depletion with nonmagnetic impurities has on several such compounds. Due to fundamentally different low-energy degrees of freedom, impurities in spin chains and spin ladders play very different roles. In spin chains, scattering by defects leads to a confinement of low energy quasiparticles already present in the unperturbed system. As a result, a magnetic excitation spectrum acquires a concentration-dependent "pseudogap" which bears a universal description [1]. In contrast, the unperturbed spin ladder has no low-energy excitations of its own. Instead, new local degrees of freedom are released upon the introduction of defects. Strong antiferromagnetic correlations shape them as spatially extended "spin islands". Although these spin islands are localized, they strongly interact and thereby give rise to unusual thermodynamic properties and novel collective modes [2]. In both cases, inelastic neutron scattering allows to see the corresponding defect-induced transformations of the spin excitation spectra *directly*. Good understanding of the clean ground states makes it possible to describe these metamorphoses of gapped and gapless behavior in quantitative ways.

[1] G. Simutis, S. Gvasaliya *et al.*; Phys. Rev. Lett. **111**, 067204 (2013)
[2] D. Schmidiger, K. Yu. Povarov *et al.*; Phys. Rev. Lett. **116**, 257203 (2016)

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