Dynamical response of magnetized spin liquids

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We discuss dynamical response of the $U(1)$ spin liquids in a small applied Zeeman field. We show that both generic short-range interactions, as well as gauge fluctuations characteristic of the $U(1)$ spin liquid, qualitatively change the result based on the frequently assumed non-interacting spinon approximation. Differences between interacting spinon liquid and non-interacting spinon gas are most pronounced at small momenta.

Short-range interaction leads to a new collective mode: a"spinon spin wave" which splits off from the two-spinon continuum at small momentum and disperses downward. Gauge fluctuations renormalize the susceptibility, providing non-zero power law weight in the region outside the spinon continuum and giving the spin wave a finite lifetime [1].

With this picture in mind, we revisit dynamical response of the extensively studied spin-1/2 Heisenberg chain where a direct comparison of the approximate analytical description with numerically accurate and unbiased matrix-product-state techniques is possible [2].

We also sketch an ongoing investigation of the dynamic response functions of the magnetized two-dimensional Dirac spin liquid and describe dynamic spin susceptibility of a graphene-like model with short-ranged interactions between fermions.

[1] Leon Balents, Oleg A. Starykh, Phys. Rev. B **101**, 020401 (2020).
[2] Anna Keselman, Leon Balents, Oleg A. Starykh, Phys. Rev. Lett. **125**, 187201 (2020).