Contribution ID: **16** Type: **Oral Talk 口头报告**

Kinetic Energy Driven Ferromagnetic Insulator

We construct a minimal model of interacting fermions establishing a ferromagnetic insulating phase. It is based on the Hubbard model on a trimerized triangular lattice in the regime of $U \gg t \gg |t'|$ with $t > 0$ and t', the intra- and inter-trimer hopping amplitudes respectively. At the $\frac{1}{3}$-filling, each trimer becomes a triplet spin-1 moment, and the inter-trimer superexchange is ferromagnetic with
$J = -\frac{2}{27}\frac{t'^2}{t}$ in the limit of $U/t = +\infty$.
As U/t becomes finite, the antiferromagnetic superexchange competes with the ferromagnetic one. The system enters into a frustrated antiferromagnetic insulator when $\lambda > U/t \gg 1$ where $\lambda \sim 10$. In contrast, a similar analysis performed on the trimerized Kagome lattice shows that only antiferromagnetic superchange exits at 1/3-filling. The effect of threading flux is also studied.

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