# Effects of deep superconducting gap minima on impurity induced residual thermal transport in $Sr_2RuO_4$

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The recent thermal conductivity measurement on $Sr_2RuO_4$ [E. Hassinger *et al.*, Phys. Rev. X **7**,011032(2017)] was suggested to favor a pairing gap function with symmetry enforced line nodes while conflicting with the scenario of a chiral $p$-wave pairing gap function with deep gap minima. Motivated by this work we revisit the effects of deep superconducting gap minima on impurity induced quasiparticle thermal transport in $Sr_2RuO_4$. Combining a self-consistent T-matrix analysis and self-consistent Bogoliubov-de-Gennes calculation, we show that when the superconducting gap has very deep minima, even small amounts of disorder can induce considerable residual quasiparticle thermal transport at zero temperature and frequency. Moreover, we find that the dependence of the residual thermal conductivity on the normal state impurity scattering rate can be quite similar to the $d$-wave pairing state, provided the normal state impurity scattering rate is large compared with the deep gap minima. Our work shows that the thermal conductivity measurement by E. Hassinger *et al.* can be reconciled with a chiral $p$-wave pairing state with deep gap minima.

## References

[1] E. Hassinger, P. Bourgeois-Hope, H. Taniguchi, S. Ren de Cotret, G. Grissonnanche, M.S. Anwar, Y. Maeno, N. Doiron-Leyraud, and Louis Taillefer, Phys. Rev. X **7**, 011032 (2017)