High pressure magneto-resistance measurements on Weyl semimetals NbP and NbAs

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Binary Weyl semimetal compounds NbP and NbAs (having inversion symmetry broken lattice) are of tremendous current research interest due to their potential application exploiting extremely large magneto-resistance and ultrahigh carrier mobility stemming from the chiral anomaly [1,2]. In another class of Weyl semi-metal (WTe_2), upon increasing pressure superconductivity emerges as a result of suppression of such large magneto-resistance [3]. Although NbAs displays robustness of its Fermi-surface upon moderate pressure application [2], a dramatic change of temperature dependence of resistivity of NbP and TaP has been noticed under pressure, which has been correlated to the pressure induced shift of Weyl points compared to the Fermi energy [4].

Here we present our detailed high pressure-low temperature resistivity and magneto-resistance results on oriented single crystal NbP and NbAs up to ~10 GPa. Pressure induced conspicuous change in resistivity behavior is observed above ~5 and 7 GPa respectively. At higher pressures observation of resistance plateau features in both cases indicate transition to topological insulating state. The nature of this transition and the carrier details of the high pressure phase have been investigated by longitudinal magneto-resistance and Hall measurements under pressure. The results will be discussed in view of the pressure-induced iso-structural transitions observed in these compounds [5,6] and similar field-induced transition in a centro-symmetric compound LaSb [7].

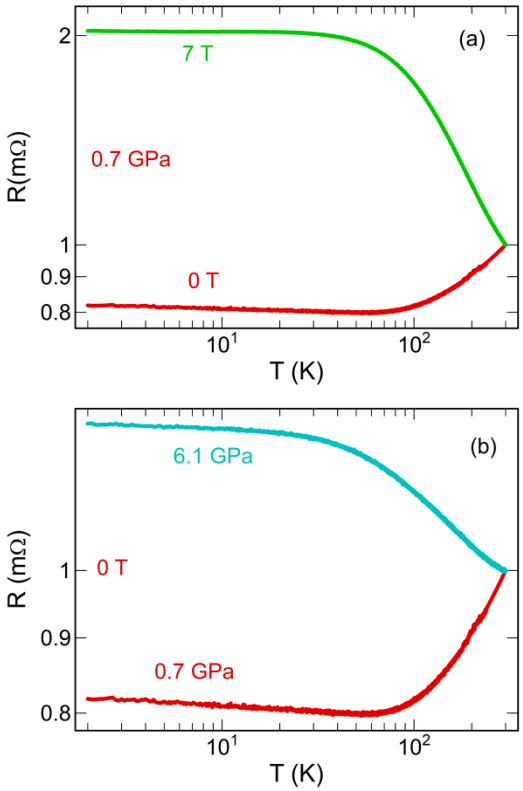

Figure 1. Comparison of the effect of magnetic field and pressure on NbP. (a) At 0.7 GPa, the normalized resistance of NbP is plotted as a function of temperature at zero field (red line) and at a field of 7 T (Green). (b) Temperature dependence normalized resistance at 0.7 (Red) GPa and at 6.1 (Blue) GPa with no applied magnetic field

[1] Chandra Shekhar et. al., Nature Physics 2015, **11**, 645
[2] Y. Luo et. al., J. Phys.: Condens. Matter 2016, **28,** 055502
[3] D. Kang et. al., Nat. Comm. 2015, **6**, 7804
[4] K. Einaga et. al., Phys. Stat. Sol. RRL, 2017, **11**, 1700182
[5] S.N.Gupta et al., J. Phys.: Condens. Matter 2018, **30**,185401
[6] S. N. Gupta et al. Phys.Rev.B. 2018, **97**, 064102.
[7] F. F. Tafti et. al., Nature Physics 2016, **12**, 272