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## Superconductivity nearby quantum critical point in hole-doped organic strange metal $\kappa$ -(ET)<sub>4</sub>Hg<sub>3- $\delta$</sub> Br<sub>8</sub>

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The hole-doped organic superconductor  $\kappa$ -(ET)<sub>4</sub>Hg<sub>3- $\delta$</sub> Br<sub>8</sub>, ( $\kappa$ -HgBr), where  $\delta=11\%$  and ET=bis(ethylenedithio)tetrathiafulvalene, has been the key to bridge the knowledge gap between half-filled organics and doped cuprate systems. Nonetheless, the isotropic triangular lattice of ET dimers of  $\kappa$ -HgBr, unlike the square lattice in cuprates, is suspected responsible for its susceptibility which is well scaled with the organic spin liquid insulator  $\kappa$ -(ET)<sub>2</sub>Cu<sub>2</sub>(CN)<sub>3</sub>. However, both  $\kappa$ -HgBr and cuprate have a region at high temperature and high-pressure corresponding to the *strange metallic* state where resistivity exhibits a linear temperature dependence which is non-Fermi-liquid (non-FL) behavior. In  $\kappa$ -HgBr this non-FL region gradually changed to an FL state by pressure [1], like the change of metallic state from optimal to overdoped cuprates. The <sup>13</sup>C-NMR concluded that the antiferromagnetic fluctuations contribute to the origin of the non-FL in  $\kappa$ -HgBr [3]. This evidence may locate superconducting  $\kappa$ -HgBr nearby quantum critical point (QCP) in between FL and localized states, where in its non-FL state the incoherent conductivity was observed [1,3].

Our zero-field  $\mu^+$ SR experiment showed the relaxation rate from around 10 K down to 0.3 K is temperature-independent. This is a high possibility of the superconducting state that preserved time-reversal symmetry. There was almost no change in the 120 Oe of transverse-field- $\mu^+$ SR time spectra, at 0.3 K and above the superconducting temperature  $T_c = 4.6$  K, indicating that the London penetration depth is longer than a  $\mu\text{m}$  order, while we estimate the lower critical field,  $H_{c1} = 25(5)$  Oe. These could be an indication of a strong-coupling superconductor. We will discuss a possible mechanism of preserved time-reversal Cooper pairing formation from strong-coupling non-FL metal with geometrical frustration.

[1] H. Taniguchi, et al., J. Phys. Soc. Jpn. 11, 113709 (2007)

[2] Y. Eto, et al., Phys. Rev. B 81, 212503 (2010)

[3] H. Oike, et al., Nat. Commun. 8, 756 (2017)

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