Supplementary Materials for

Two-fold symmetric superconductivity in the thin-film kagome superconductor RbV_3Sb_5

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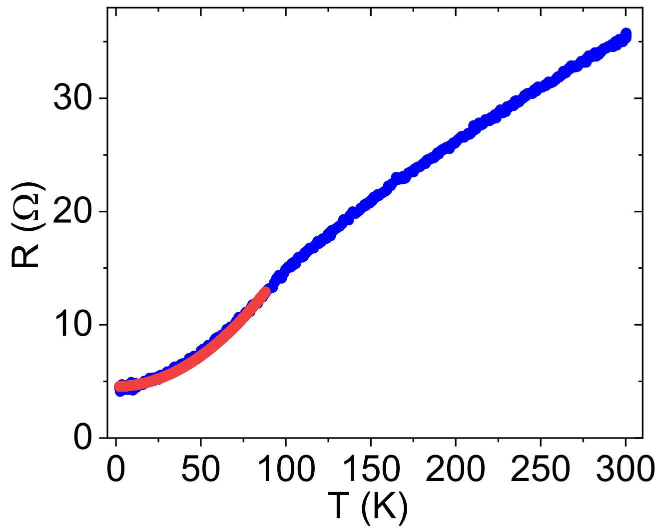

Fig. S1 The temperature dependence of the resistance of a typical RbV_3Sb_5 device (S3). At low temperatures, the resistance can be fitted (red line) according to the Fermi liquid model $R=R_0+AT^2$, where T is the temperature, R_0 and A are constants, indicating the electron-electron scattering dominates over the electron-phonon scattering. The hump is around 100 K, which is consistent with the critical temperature of the CDW transition.

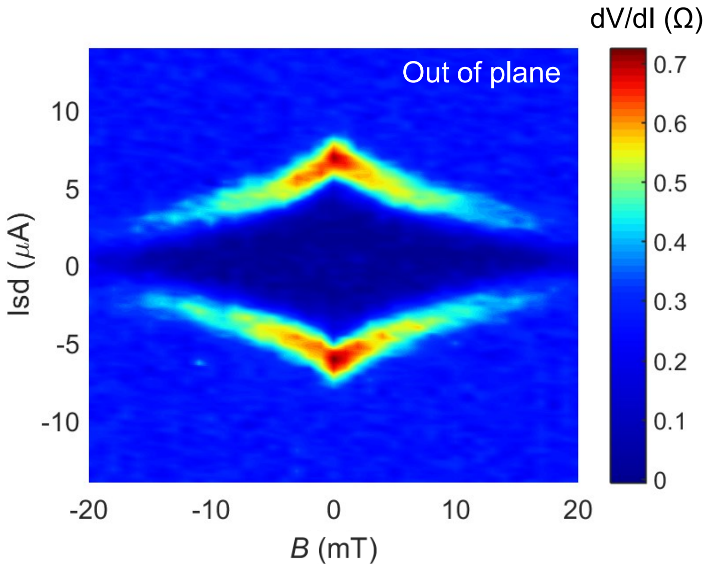

Fig. S2 Differential resistance versus bias current and out-of-plane magnetic fields. The out-of-plane anisotropic superconducting behavior is common in thin-film superconductors.

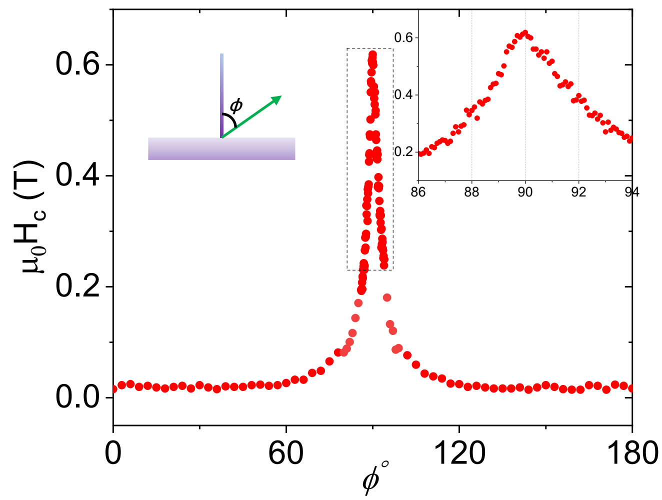

Fig. S3 The out-of-plane angle dependence of the critical magnetic field. Here the angle ϕ denotes the deviation from the normal direction perpendicular to the sample plane as shown in the inset. The green arrow represents the magnetic field direction. The critical magnetic field peaks at 90°, namely the in-plane direction. Such measurements rule out the possible out-of-plane contribution with an accuracy of ~ 0.1°.

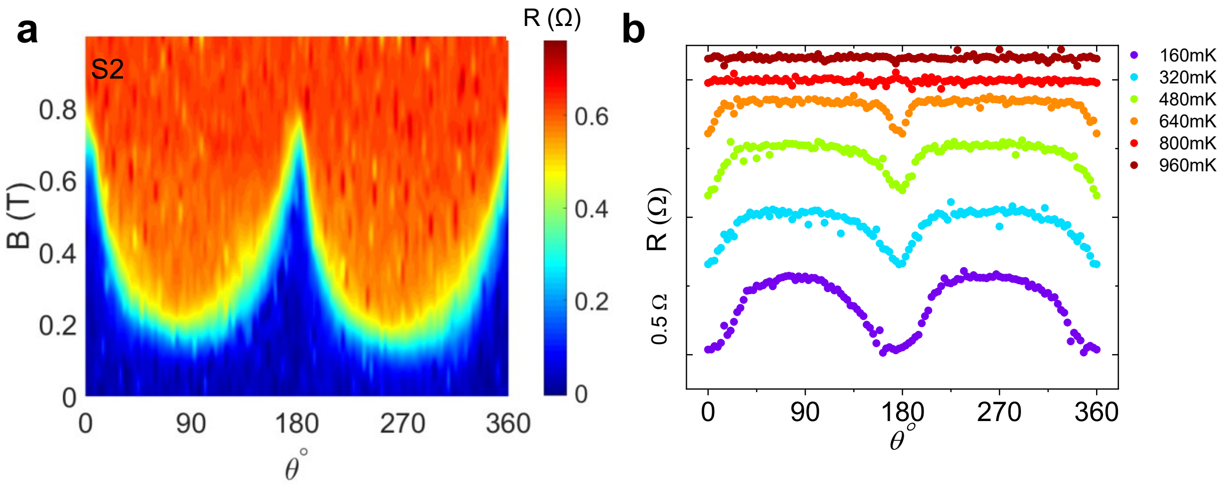

Fig. S4 Another sample S2 showing a similar two-fold symmetric behavior. a The in-plane angle dependence of the magneto-resistance was measured. The two-fold anisotropy is only observed when the sample is in the superconducting state. **b** The temperature dependence of the two-fold symmetric magnetoresistance at 300 mT. When the sample is in the normal state at high temperatures, the two-fold symmetry disappears. The curves were shifted for clarity.

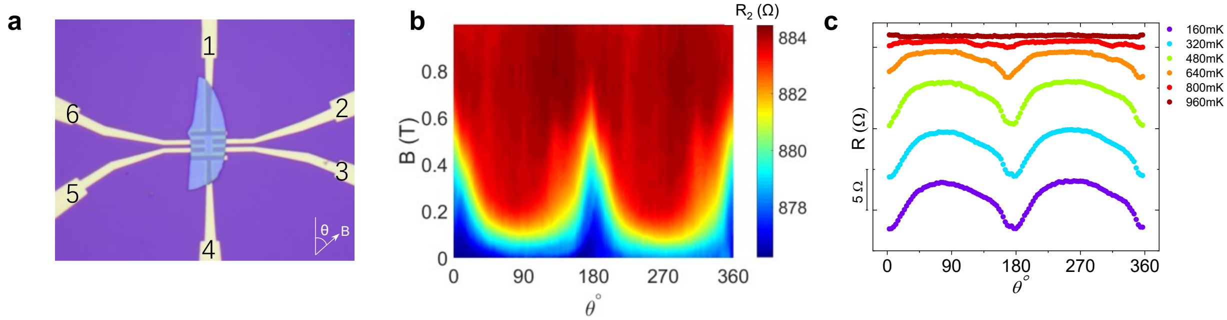

Fig. S5 The two-fold superconducting behavior with the current along θ = 90°. a The optical image of device S1 with the number labeling the measurement terminals. **b** The current was applied along terminals 3,5 (perpendicular to the current direction in the main text) and the voltage was simultaneously measured, then we get the two-terminal resistance R_2. The two-fold symmetry of the superconducting behavior was also observed, indicating such two-fold symmetry is independent of the current direction. **c** The temperature dependence of the two-fold modulation of the magnetoresistance at 200 mT. The curves were shifted for clarity.

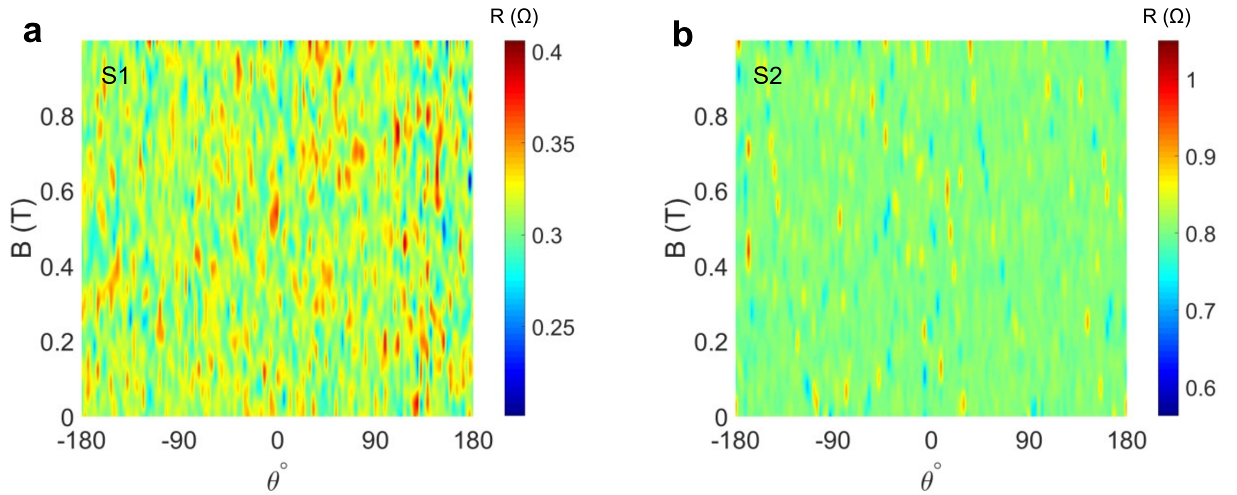

Fig. S6 The in-plane angle dependence of the magneto-resistance of device S1&S2 at a high temperature of 20 K, far above the critical superconducting temperature. No evident symmetric behavior in any form was observed.

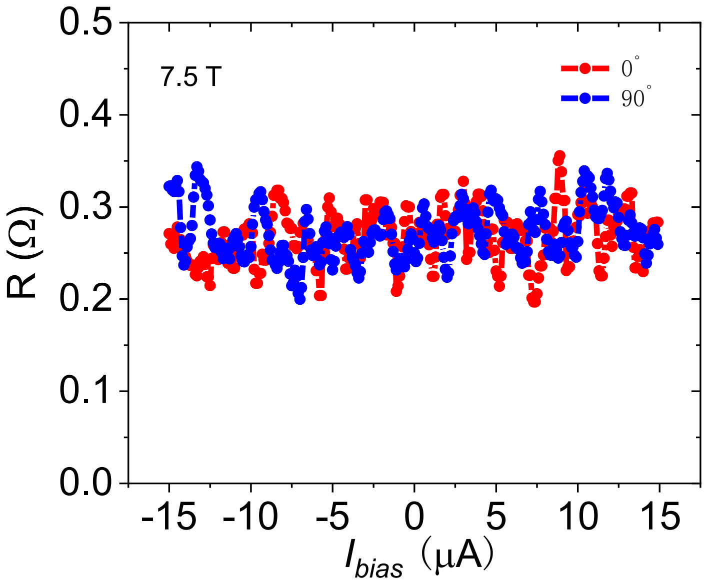

Fig. S7 The in-plane angle dependence of the magnetoresistance of device S1 at a high magnetic field of 7.5 T, far above the critical magnetic field. No evident anisotropy was observed.

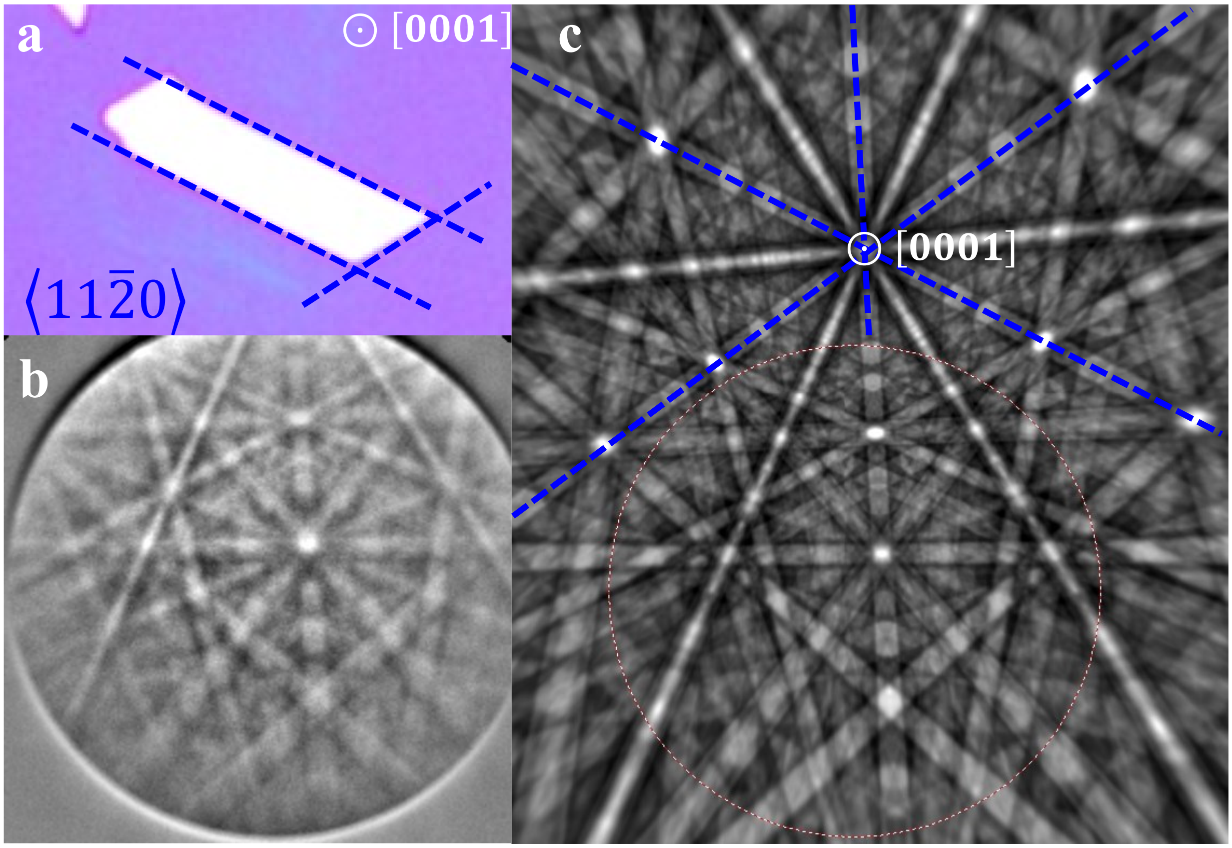

Fig. S8 The electron backscatter diffraction (EBSD) pattern of a typical RbV_3Sb_5 single crystal. **a** The optical image of a typical cleaved sample. **b** The experimental EBSD pattern. **c** The simulated pattern. The simulated pattern in **c** matches the experimental pattern in **b** very well. The blue bands are a family of $\{1\bar{1}00\}$ crystal planes with six-fold rotational symmetry, of which the orientation matches the edges of the RbV_3Sb_5 flakes shown in **a**. The lateral surfaces of the exfoliated RbV_3Sb_5 single crystal are therefore the family of $\{1\bar{1}00\}$ crystal planes. The crack propagation direction is $\langle 11\bar{2}0\rangle$.