The current I_{NS} as a function of the bias voltage V through a N/S point contact interface can be described by the BTK theory [13] in which the interfacial barrier is represented by a δ function with a dimensionless strength factor Z:

$$I_{NS}(V) = C\int_{-\infty}^{\infty}[f(E-eV) - f(E)][1 + A(E) - B(E)]dE\,,$$

where *A(E)* and *B(E)* are the probability of Andreev reflection and normal reflection and can be calculated from the coherence factors u_0 and v_0 described below, $f(E)$ is the Fermi distribution function, and C is a constant depending on the contact area, density of states and Fermi velocity. In reality, the quarsiparticle lifetime is shortened by inelastic scattering near the N/S interface, leading to a smearing effect on the conductance. The inelastic effects can be included in the BTK theory by introducing an imaginary component Γ into the energy thus the coherence factors are [14]

$$\begin{aligned}\tilde{u}_0^2 &= \frac{1}{2}\left[1 + \frac{\sqrt{(E+i\Gamma)^2 - \Delta^2}}{E+i\Gamma}\right]\\ \tilde{v}_0^2 &= \frac{1}{2}\left[1 - \frac{\sqrt{(E+i\Gamma)^2 - \Delta^2}}{E+i\Gamma}\right]\end{aligned},$$

where Δ is the superconducting gap. The probability *A(E)* and *B(E)* are calculated as follows,

$$\begin{aligned}A(E) &= a\cdot a^*\\ B(E) &= b\cdot b^*\\ a &= \tilde{u}_0\tilde{v}_0/\gamma\\ b &= -(\tilde{u}_0^2 - \tilde{v}_0^2)(Z^2 + iZ)/\gamma\\ \gamma &= \tilde{u}_0^2 + (\tilde{u}_0^2 - \tilde{v}_0^2)Z^2\end{aligned}.$$

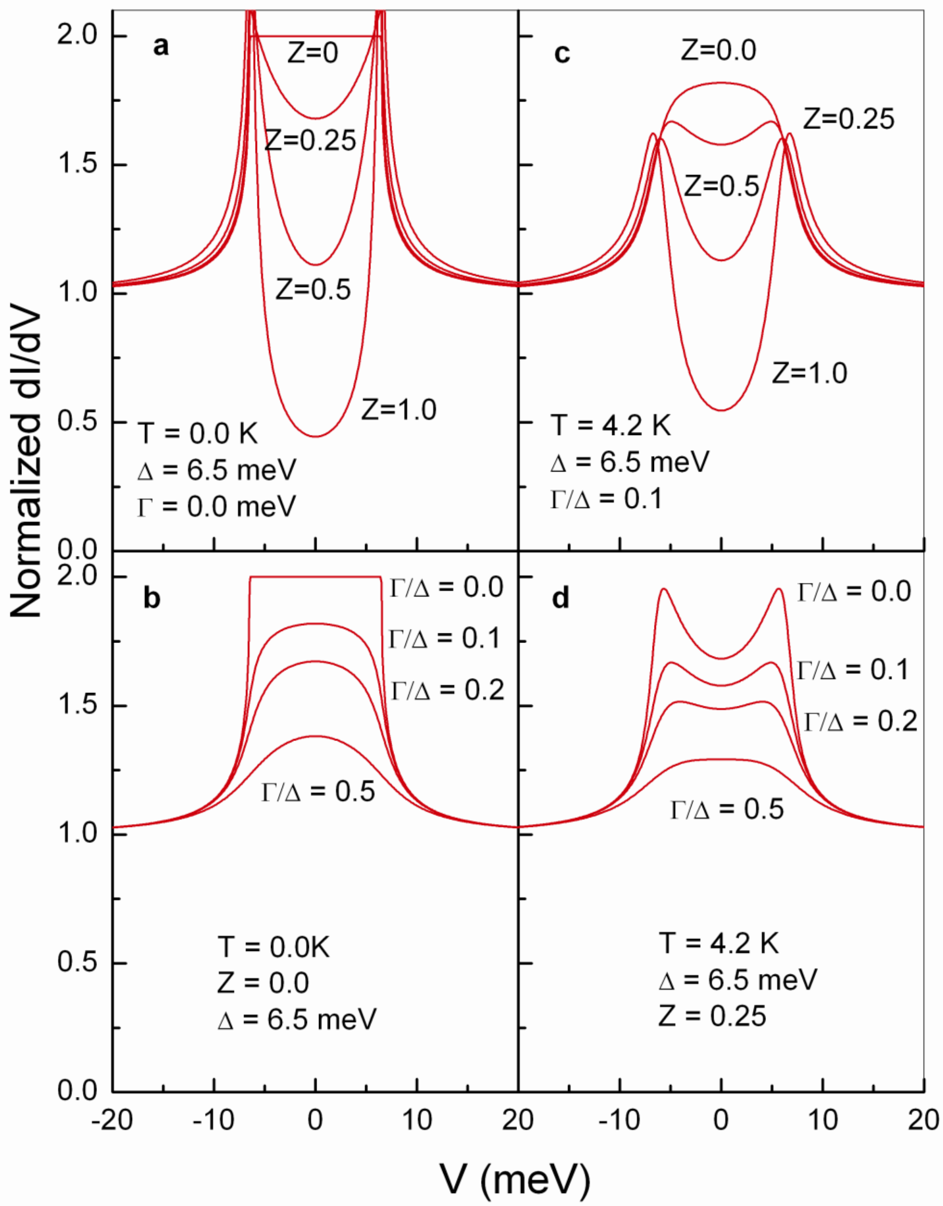
When Γ is zero, this model becomes the original BTK model. It is worthwhile to note that the model turns into the Dynes's model [22] accounting for the inelastic effects for tunneling when $Z \rightarrow \infty$, which is often utilized in analyzing spectra of scanning tunneling microscopy for superconductors.

Supplementary Figure 1 illustrates the effect of Z and Γ on the normalized conductance curve $G(V)/G_n$ with the method outlined above. Four conductance curves have been calculated for Z = 0, 0.25, 0.5, and 1.0, with the other parameters fixed at T = 0, Δ = 6.5 meV, and Γ = 0, as shown in Supplementary Figure 1**a**. At Z = 0, the conductance is a bell-shape curve in which $G(V)/G_n = 2$ for $|V|<\Delta$ and $G(V)/G_n = 1$ for $|V|>>\Delta$. As Z increases, the Andreev reflection at low voltages is suppressed, and peaks appear at $\pm\Delta$. The effect of Γ, however, is very different. Andreev reflection is suppressed at low V but also smeared around $\pm\Delta$ when Γ increases, as shown in Supplementary Figure 1**b** where four conductance curves for Γ/Δ=0, 0.1, 0.2 , and 0.5 are calculated with the other parameters fixed at T = 0, Δ = 6.5 meV, and Z = 0. When effect of both Z and Γ are included, and at finite temperatures, two conductance peaks generally appear in $G(V)/G_n$ around $\pm\Delta$, as illustrated by some calculated examples in Supplementary Figure 1**c-d** with the parameters used listed in the figure.

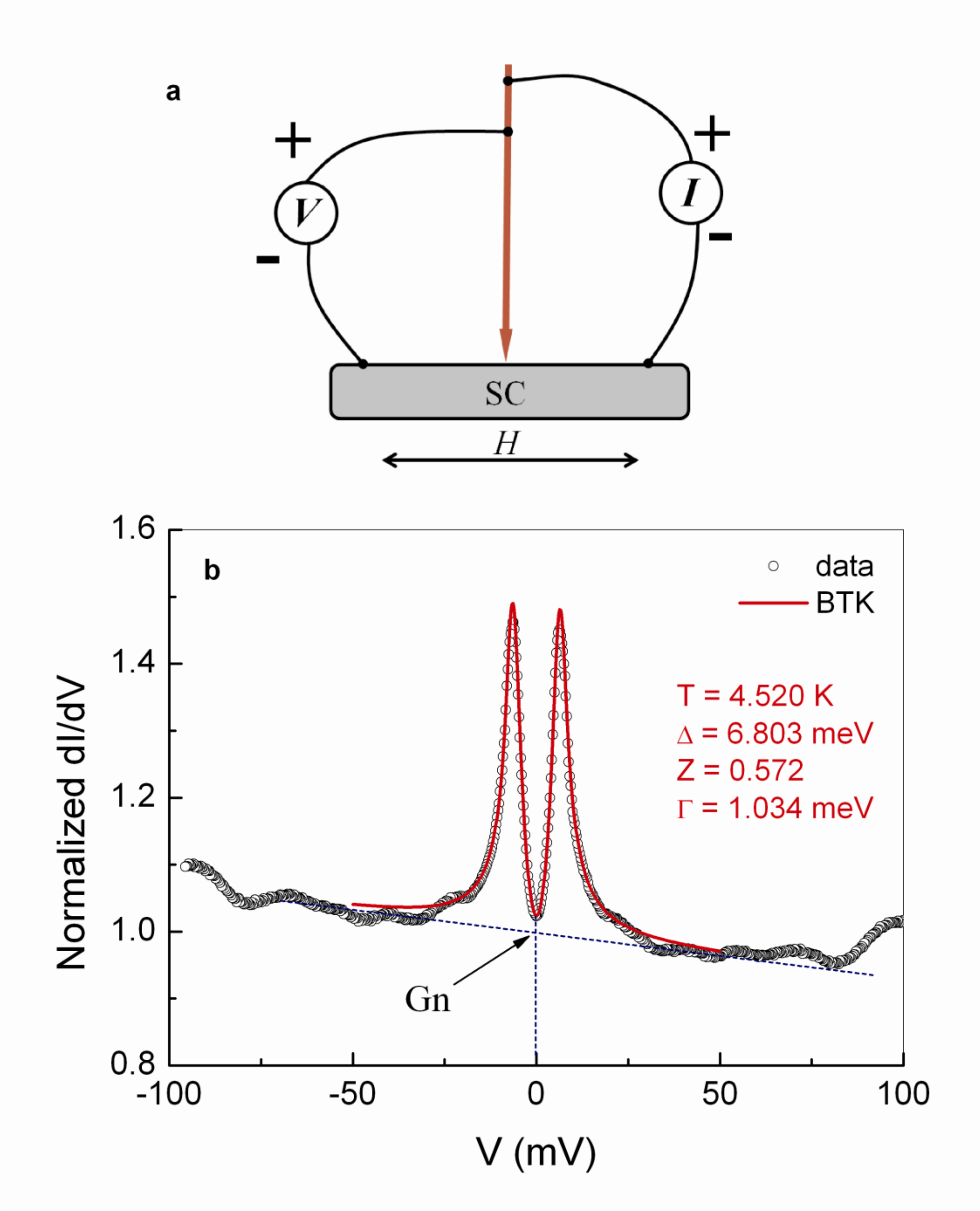
The Andreev spectroscopy was performed using a normal metal tip in contact with the superconductor. Our experimental setup is schematically shown in Supplementary Figure 2**a**. Two electrodes are attached to the tip and the sample. The tip and the sample were enclosed in a vacuum jacket inserted in a cryostat with controllable temperature and magnetic field up to 9 T. The measurements of I and dI/dV versus V curves were made using a four-probe method and a lock-in technique. Because of the asymmetric background, G_n cannot be determined by simply increasing V. Supplementary Figure 2**b** illustrates the process of determining G_n. We linearly fit the data between 25 mV <|V| < 50 mV and choose the point at V=0 as G_n. Then the normalized data is analyzed using the above model with an extra linear background.

Some representative data at different temperatures for Figure 3 in the manuscript are shown in Supplementary Figure 3. The open circles are experimental data and solid curves are best-fit using the modified BTK model. One notes the fine vertical scale of the plots, showing that the data can be well described by the model even at 40K when the conductance change is only a few percent. All the conductance curves share a similar background.

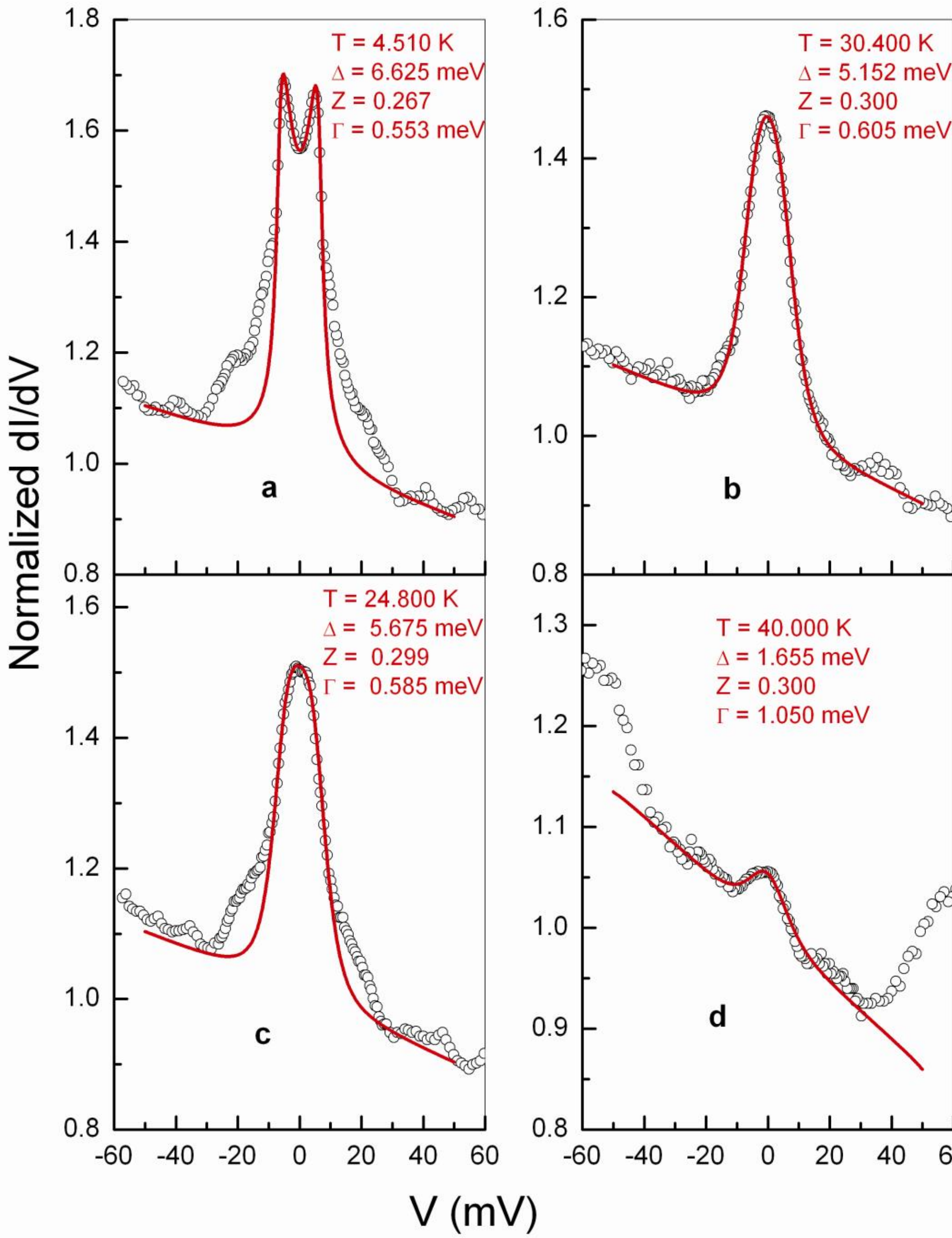
[22]. Dynes, R. C., Narayanamurti, V., and Garno, J. P., Direct measurement of quarsiparticle-lifetime broadening in a strong-coupled superconductor. Phys. Rev. Lett. **41**, 1509-1512 (1978).



Supplementary Figure 1 | Calculated conductance curves using the modified BTK model: **a** for Z = 0, 0.25, 0.5, 1.0 with T, Δ and Γ fixed at 0, 6.5 meV, and 0, **b** for Γ/Δ =0, 0.1, 0.2, 0.5 with T, Δ and Z fixed at 0, 6.5 meV, and 0, **c** for Z = 0, 0.25, 0.5, 1.0 with T, Δ and Γ/Δ fixed at 4.2 K, 6.5 meV, and 0.1, and **d** for Γ/Δ =0, 0.1, 0.2, 0.5 with T, Δ and Z fixed at 4.2 K, 6.5 meV, and 0.25.



Supplementary Figure 2 | **a** Schematics of experimental setup of a gold tip in contact with a superconductor (SC) with the electrical leads attached, and **b** determination of the normalization conductance G_n (Open circles are the data and solid line is the best fit to the modified BTK model with parameters listed in the figure).



Supplementary Figure 3 | Representative best fits to the data at different temperatures with the parameters listed in each panel.