Cavity light-matter coupling in solid state systems has been recently approaching the ultrastrong coupling regime [1-4], where the Rabi frequency $\Omega$ is comparable to the bare excitation frequency $\omega$. We recently demonstrated a new platform to investigate ultrastrong coupling physics: the cyclotron transition of a 2DEG is coupled to an Au metasurface of THz split-ring resonators reaching the ultrastrong coupling regime and showing record high values of the light-matter coupling ratio $\Omega / \omega = 0.58$ [5]. I will present our recent advances in this polaritonic system. We employ Nb-based superconducting complementary metasurfaces [6] achieving adiabatic modulation of the polaritonic states through temperature tuning. With the same kind of cavities and a sample with $n=4$ quantum wells we observe a record-high normalized coupling ratio of $\Omega / \omega = 0.89$ [7] at a frequency of 300 GHz. For such value the polaritonic dispersion clearly deviates from the linear regime. I will discuss also an high quality factor complementary THz metasurface based on Niobium thin film [8], which displays narrow resonance and Q factor higher than 50 at $T=3$ K in a strongly subwavelength volume ($V_{\text{cav}}/\lambda^3$ of the order of $10^{-6}$). I will present new experimental results obtained measuring these metasurfaces at temperatures as low as 20 mK, where Q factors as high as 120 are measured. Our measurements highlight the role of the residual normal state electrons at temperatures well below the critical temperature $T_C$.

[6] G. Scalari, C. Maissen, S. Cibella, R. Leoni, P. Carelli, F. Valmorra, M. Beck, and J. Faist,
