Towards practical applications of powerful and widely-tunable THz sources made of layered superconductors

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Terahertz (THz) emission from intrinsic Josephson junction stacks made of high temperature superconductor Bi$_2$Sr$_2$CaCu$_2$O$_{8+\delta}$ have been obtained both in a low bias and a high bias regime [1, 2]. While at low bias the temperature distribution in the stack is almost homogeneous, at high bias an over-heated part (hot spot area) and a cold part of the sample coexist [2, 3]. Previous resolution-limited measurements indicated that the linewidth $\Delta f$ of THz emission may be below 1 GHz, showing no difference between two regimes. In this talk, we report on measurements of the linewidth of THz radiation using a Nb/AlN/NbN integrated receiver for detection [4]. While at low bias we found $\Delta f$ to be not smaller than $\sim$500 MHz, at high bias $\Delta f$ turned out to be as narrow as a few MHz. We attribute this to the hot spot acting as a synchronizing element. Also thanks to the variable size of the hot spot and the temperature rise due to the self-heating, the emission frequency can be tuned over a wide range of up to 500 GHz. Last but not least, the emission power was measured to be above 25 $\mu$W. All these properties imply that THz sources made of layered cuprate superconductors can be employed for practical applications.
