Josephson-vortex-flow-induced THz Emission in Stacks of $Bi_2Sr_2CaCu_2O_{8+x}$ Intrinsic Josephson Junctions

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Collective transverse plasma modes in $Bi_2Sr_2CaCu_2O_{8+x}$ intrinsic Josephson junctions (IJJs) can be excited by moving Josephson vortex lattices. The *c*-axis standing plasma wave eigen-modes amplified by the resonance arrange the Josephson vortex lattice according to the profile of the plasma modes along the *c* axis. This resonance phenomenon accompanies the collectively resonating multiple branches in the Josephson vortex dynamics, which may excites electromagnetic wave emission from edges of a stack of IJJs. In this presentation, we will show the experimental observation of distinct collective resonance modes in the Josephson vortex flow branches. The generic feature of the collective resonance modes is the multiple sub-branching of its current-voltage characteristics round the zero-bias region, which can be explained by the inductive inter-junction coupling combined with the capacitive coupling. For a proper bias in sub-branches, the emission of the electromagnetic waves by the collective vortex resonance motion in a stack of IJJs (the oscillator stack) was examined using another on-chip stack of IJJs (the detector stack), which was placed within a fraction of □m from the oscillator stack. The microwave emission from the oscillator stack and the resulting irradiation onto the detector stack were evidenced by (i) the suppression of the tunneling critical current revealed in the quasiparticle branches, (ii) the increase of Josephson vortex-flow voltages in the detector stack, and (iii) the appearance of the Shapiro steps.

Keywords : collective transverse plasma modes, multiple Josephson vortex-flow branches, microwave emission.