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Generation of photon pairs at different frequencies: route toward quantum microwave source DANIEL ESTEVE, OLIVIER PARLAVECCHIO, CARLES ALTIMIRAS, PHILIPPE JOYEZ, DENIS VION, PATRICE ROCHE, FABIEN PORTIER, Service de Physique de l'Etat Condensé (CNRS URA 2464), IRAMIS, CEA Saclay, 91191 Gif-sur-Yvette, France, NANOELECTRONICS-QUANTRONICS GROUPS COLLABORATION — The dynamical Coulomb blockade (DCB) is a quantum phenomenon where the tunneling of charge through a tunnel junction is modified by its electromagnetic environment. The sudden charge transfer generates photons in the electromagnetic modes. We coupled a Josephson junction to two resonators at frequencies $\nu_1 \neq \nu_2$; when voltage-biased at $2eV = h\nu_1 + h\nu_2$, Cooper pairs can tunnel only if two photons, one at each frequency, are simultaneously emitted. We measured the cross-correlations between the emission rates and showed that a Cauchy-Schwarz inequality is violated. This result, in agreement with theoretical prediction made by Leppakangas and coworkers[1], reveals the amplitude two-mode squeezing. Our setup is a easy way to produce non-classical microwave radiation from a battery. We believe that this source is a good candidate for producing pairs of entangled photons with high rate (few hundreds of MHz).

[1]J. Leppäkangas, G. Johansson, M. Marthaler, and M. Fogelstrom, "Nonclassical Photon Pair production in a Voltage-Biased Josephson Junction," Phys. Rev. Lett. **110**, 267004-5 (2013).

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