S4-15: Optically driven Quantum Josephson Voltage standard

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Abstract: Voltage on Josephson junction (JJ) directly depends on frequencies of bias signal. Existing Josephson voltage standards (JVS) usually use irradiation frequencies for biasing JJ arrays in the range from 10 GHz to 100 GHz. In consequence, value of the electric voltage that reproduced on the single JJ in the range from 20 µV to 200 µV. For increasing voltage on JJ it is required to use bias irradiation of higher frequency. The highest possible bias frequency for the Josephson junction is limited for low temperature superconductor (LTS) at about 1 THz, for High temperature superconductor (HTS) JJ order up to 10 THz. It is difficult to develop high stability THz – range generator or synthesizer with enough power and phase locked to quantum time and frequency standard. It would be easier to use the optical range of the frequency for the JJ bias signal, because modern standards of time and frequencies work in optical range, but in fact, them are outside of the limited possible frequencies range of the JJ bias signal. However, if using the irradiation JJ by two optical signal sources, having between themselves a difference on frequency from possible GHz or THz range, on the high nonlinearity of the Josephson junction and its ability to lock the phase, on the junction can appear the signal of difference frequency that sufficient for biasing of the JJ. This characteristic of the JJ can be used for increasing of the voltage on single junction, and development of realization of DC, AC, and Pulse Josephson voltage standards, as well as for development of the new classes of the converters, frequency and phase detectors with carrying from optical effect into the electric voltage signals. As HTS Josephson junction has maximum irradiation bias frequency higher than LTS JJ, it’s possible to produce mV level output voltage on the small several junctions arrays. Liquid Nitrogen cooling level is not required complicated thermal insulation, it’s possible build bi-optically driven JJ converter in greatly short tract and in this way provide a good connecting features with precision level of the reproducible Voltage for calibration oscilloscopes, AD Converters, high-speed voltmeters.