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Excitation of a Microwave Cavity Resonators using an Interferometric Dipole Probe

We present a new way to excite a sapphire-loaded cavity resonator based on a balanced microwave dipole probe in a Mach Zehnder interferometric configuration. The probe is constructed from two separate coaxial electric field probes inserted into a cylindrical cavity resonator from opposite sides with a small gap between them, so they act as an active wire dipole antenna. The power into the resonator from the probes is matched with a variable attenuator in one of the arms of the interferometer. To change the phase between the two electric field probes a variable phase shifter is implemented. Following this we show that the probe couples to high-Q cavity modes as well as low-Q background modes associated with the probe, which can be made resonant or anti-resonant with the cavity modes. We show that when the probe modes are in anti-resonance the line shape of the cavity mode can be made symmetric which also optimizes the cavity mode resonant Q-factor. This is a condition required to optimize the phase noise performance of a resonator-oscillator [1].

[1] EN Ivanov, ME Tobar, "Noise Suppression with Cryogenic Resonators," IEEE Microwave and Wireless Components Letters, vol. 31, no. 4, pp. 405-408, 2021.

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