

Highly displacement sensitive higher order modes in a cylindrical reentrant-ring cavity resonator

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A microwave reentrant cavity transducer is a highly sensitive transducer, which has been developed in the past for many precision applications, including gravitational wave detection, high sensitivity opto-mechanics and investigating the dynamic Casimir effect [1]. Such systems may be used for displacement measurements, sideband cooling, amplification of mechanical motion and investigating quantum behavior of mechanical resonators. The key component of the reentrant transducer is a narrow-gap superconducting reentrant cavity, which has achieved high displacement sensitivity and electrical Q-factor at low temperatures. Rigorous analysis of the properties of resonant modes in such a structure comprising of a post and ring is undertaken and verified experimentally. For the first time we show the existence of higher order reentrant cavity modes, with a significantly better displacement sensitivity compared to the common fundamental mode in a reentrant cylindrical cavity with just a single post. Thus, this type of cavity has the potential to operate as a highly sensitive transducer for a variety of precision measurement applications, which will be discussed at the conference.

[1] J-M Le Floch, Y Fan, M Aubourg, D Cros, NC Carvahlo, Q Shan, J Bourhill, EN Ivanov, G Humbert, V Mdrangeas, ME Tobar. "Rigorous analysis of highly tunable cylindrical Transverse Magnetic mode re-entrant cavities," Rev. Sci. Instrum., vol. 84, 125114, 2013.