Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

High-Q Bulk Acoustic Quartz Resonators and Application to Hybrid Quantum Systems[1] MICHAEL TOBAR, MAXIM GORYACHEV, DANIEL CREEDON, The University of Western Australia, SERGE GALLIOU, Institut FEMTO-ST — Latest results on cryogenically cooled Balk Acoustic Wave quartz resonators will be presented. We demonstrate the ability of such devices to have quality factors approaching 10^{10} and frequencies approaching 1 GHz. The corresponding $Q \times f$ products make these devices several orders of magnitude better than any other mechanical system cooled to near the ground state. Such results are achieved for very-high overtones (up to 227th) of the longitudinally polarized phonons, such high overtones have never been observed previously. We discuss the basic requirements to achieve the extremely high quality factor regimes in acoustic devices by describing the main sources of losses. This includes material (two-level system, thermoelastic, Landau-Rumer losses), surface scattering, acoustic version of Raleigh scattering, clamping (phonon tunneling to the environment) loss mechanisms. Several types of BAW quartz resonators are compared. Finally, we discuss a range of applications of extremely low-loss acoustic cavities and how the very narrow bandwidths of the cavities (of orders of tens of mHz) can be incorporated into hybrid quantum systems.

[1]This work has been supported by the Australian Research Council Grants FL0992016 and CE110001013.

Michael Tobar
The University of Western Australia

Date submitted: 15 Nov 2013 Electronic form version 1.4