# $LiNbO_3$ Bulk Acoustic Resonator characterization at liquid helium temperature.

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Bulk Acoustic Wave (BAW) resonators utilizes the piezoelectric effect in materials like quartz or lithium niobate to generate and detect acoustic waves within a solid medium [1,2]. These devices find applications in filtering and stabilizing radio frequency (RF) signals in communication systems [3,4]. The objective of this research project is to investigate the properties of $LiNbO_3$-BAW resonator materials at both room temperature (RT) and liquid helium temperature (4K). The initial characterization of the crystal has already been conducted at room temperature within the frequency range of 4-25MHz. This characterization is being re-verified at the temperature of 4K. The results show several high-quality modes, having Q-factors on the order of $10^6$ for both longitudinal and shear modes. Crystal modes are studied using finite element method (FEM) modelling tool COMSOL. It has been observed that there are two type of modes which are longitudinal(A-type) and shear modes present inside the crystal [5,6]. $LiNbO_3$ crystal is of macroscopic dimension. 3A,5A,7A,9A,11A longitudinal modes and 3,5,7,9 shear modes are identified using COMSOL modelling. Q-factor for the identified longitudinal and shear modes are measured at 4K with a high Q-factor of $\sim 10^6$. Re-entrant cavity with split post of frequency~5Ghz operating at TM010 mode is designed in COMSOL to further investigate BAW_MWC coupling rates for $LiNbO_3$.[7]

## References

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