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**Simultaneous Oscillation of Annular Solid $^4$He Samples at Two Mode Frequencies in Compound Torsion Pendulum**[1] MICHAEL C. KEIDERLING, HARRY KOJIMA, Rutgers University — We have extended our studies on the non-classical behavior of solid $^4$He contained in compound torsional oscillator (TO) cell below 1 K. Our unique TO design allows observations on the identical sample at two distinct frequencies($f_1$=493 and $f_2$=1165 Hz). The sample was grown by blocked capillary method in an annular cell(id = 8.0 mm, od = 10.0 mm, height = 9.0 mm). We focus here on experiments in which the two modes are excited simultaneously. While keeping the drive of $f_2$ mode at a very low level, the drive of $f_1$ mode was varied from high to low levels to produce substantial variations in the non-classical rotation inertia fraction (NCRIf). When the NCRIf seen by $f_1$ mode is reduced by 89, 91 and 94 % at 9.7, 23.5 and 56.5 mK, respectively, the NCRIf seen by $f_2$ mode (driven at low level) is reduced by 62, 68 and 80 %. The discrepancies and their temperature dependence in the observed reductions in NCRIf are not yet understood. Similar Measurements with the roles of the drive levels of the modes reversed as well as the changes in the dissipation of the torsional oscillator during the simultaneous drive will be reported.

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