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External vs. "internal" pressure effect on the anti-ferromagnetic superexchange energy, J, in $LnBa_2Cu_3O_6$ (Ln=La,Nd,...,Lu) BEN MALLETT, The MacDiarmid Institute, Victoria University of Wellington, JEFFERY TALLON, The MacDiarmid Institute, Industrial Research Limited, GRANT WILLIAMS, The MacDiarmid Institute, Victoria University of Wellington, THOMAS WOLF, Karlsruhe Institute of Technology, Institute of Solid State Physics — What causes the difference between the effect of "internal" pressure, as caused by ionic substitution, and external pressure on T_c^{max} in the cuprates [1]? Is it the density of states, the pairing boson energy scale (ω_B), condensation energy (which governs fluctuations), or ...? Many models of high temperature superconductivity put the energy scale of ω_B as the anti-ferromagnetic super-exchange energy, J, between adjacent Cu(2) ions in the CuO_2 plane. We therefore investigated Raman B_{1g} two-magnon scattering in high quality $LnBa_2Cu_3O_6$ (Ln123) single crystals, Ln(=La, Nd, Sm, Eu, Gd, Dy, Yb, Lu), at ambient pressure to determine the effect of internal pressure on J. Comparing with measurements of J under external pressure reveals that internal and external pressure have *quantitatively* the same effect on J. However, and most surprisingly, we find an anticorrelation between J and T_c^{max} when ion size or internal pressure is the implicit variable. Given the opposite effects of internal and external pressure on T_c^{max}, this result suggests that some energy scale other than short range anti-ferromagnetic interactions has a more dominant effect on T_c^{max}.

[1] e.g. M. Marezio, Physica C, 341-348, 375 (2000)

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