NMR study of CDW order in YBa$_2$Cu$_3$O$_y$ under hydrostatic pressure

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We address the question whether the enhancement of the superconducting $T_c$ in YBa$_2$Cu$_3$O$_y$ with the application of hydrostatic pressure is due to the suppression of a competing charge-density-wave ordered (CDW) phase as proposed by Cyr-Choinière et al. [1]. Using a BeCu clamp cell and Daphne oil as the pressure medium we apply 1.9 GPa (19 kbar) to a very clean YBa$_2$Cu$_3$O$_y$ single crystal with an oxygen concentration $y = 6.56$ ($p = 0.109$) and increase its $T_c$ from 60.5 K at 0 GPa to 66.5 K.

We have performed $^{17}$O-NMR measurements under hydrostatic pressure and studied its effect on the 2D short-ranged CDW as well as the 3D long-ranged CDW in high magnetic fields. Since hydrostatic pressure enhances $T_c$ and the critical field $H_{c2}$ the main effect is a higher onset field towards the long-range CDW order which emerges when CDW patches inside and around vortex cores start to overlap [2]. Neither CDW phase appears to be strongly affected by the applied pressure. This is confirmed by the fact that a negative sign of the Hall effect in YBa$_2$Cu$_3$O$_y$ ($p=0.11$) [3] as well as slow quantum oscillations in YBa$_2$CuO$_6$ [4] persist under moderate pressures. On the other hand these results are in conflict with two recent X-ray diffraction studies that find a complete suppression of charge order at 10 to 15 kbar [5-6].


