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Elliptical Flux Vortices in Polycrystalline $YBa_2Cu_3O_7$

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The formation of an Abrikosov flux vortex with its core axis perpendicular to an anisotropic ($a-c$ or $b-c$) plane in $YBa_2Cu_3O_7$ requires only 1/10 of the energy required by the formation of a vortex with its core axis perpendicular to an isotropic ($a-b$) plane. It is not unusual for 18 to 35 % of "shake and bake" bulk $YBa_2Cu_3O_7$ to consist of empty pockets or voids inside the material. Studies estimate that 75 % of the internal grain boundaries contain $a-b$ planes. If many of the $a-b$ planes are incident upon other grains, then many of the $a-c$ and/or $b-c$ planes must be incident on the voids. Evidently there are a large number of exposed anisotropic planes inside the bulk material. This condition is conducive to the formation of vortices that are perpendicular to the anisotropic planes. The magnetic flux density around such a vortex is constant along contour lines that are elliptical in shape, while the circulating supercurrent density must vary in magnitude along the same contour lines. The impact of this elliptical structure on the possibility of a Kosterlitz-Thouless type phase transition as the bulk material goes from superconducting to normal conducting is discussed. Implications with regard to the excess low frequency electrical noise that occurs at the temperature induced transition are also examined.