Defining $B_\text{c}$, $B^*$ and $B_{\phi}$ for YBCO Thin Films

The accommodation field, $B^*$, is generally defined to be the field at which the cross over from single vortex pinning to collective pinning occurs. It is determined from magnetization curves as the point where the $J_c$ plateau ends and it is used as a convenient way of comparing the pinning properties of superconducting films. Similarly, the characteristic field, $B_\text{c}$, can be obtained from magneto-optical (MO) images from when the flux fronts meet in the middle of the film. The matching field, $B_{\phi}$, at which there is one vortex line per pinning site, is sometimes thought to be the same as $B^*$, but in BaZrO$_3$-doped YBa$_2$Cu$_3$O$_7$ films the calculated $B_{\phi}$ is much higher than the observed $B^*$. $B_{\phi}$ can be determined from angular dependent transport measurements. All of the field values correspond to some special case in the flux pinning in the film and relate to $J_c$. In this work we have determined $B_\text{c}$, $B^*$ and $B_{\phi}$ for different kinds of YBCO films using MO, magnetization and transport measurements to reveal the deeper meaning of the special fields.