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# [Invited] Giant Field Leap in Bulk HTS –A Systematic Failure of the Critical State Model

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Pulsed activation studies previously done on zero-field-cooled high Jc YBCO bulks have exhibited giant field leaps (GFL), among other anomalies.[1] Additional experiments, with varying Jc, have now been performed, searching for regularities to illuminate the underlying physics. Thirty single-grain melt-textured YBCO samples with varying Jc ($6{,}700 \le Jc \le 60{,}000$ A/cm2 at 77 K) were prepared. These had dominant pinning centers (PCs) of either broken-columnar or point geometry. GFL was observed for all samples with $Jc \ge 15{,}000$ A/cm2. Results showed that PC geometry does not modify GFL magnitude or systematics, at least to first order. The threshold of the field leap, measured 2 minutes after the pulse, was found to decrease monotonically with increasing Jc. The magnitude of the field leap was found to increase monotonically from zero at $Jc \approx 15{,}000$ A/cm2 to ˜3 Tesla at highest Jc. The Bean model rule that the ratio of applied field, BA, required to activate maximum trapped field, BT,max, is $BA/BT,max \ge 2$. We find this rule holds only for $Jc < 10{,}000$ A/cm2. BA/BT,max decreases sharply at about the same value of Jc which initiates GFL, and has a value of ˜1.2 at the highest value of Jc. It is difficult to reconcile results with the critical state model (CSM). We suggest that two dominant GFL modifications are needed. Creep, at short times is a "cascade"not a "creep,"and the very large Lorentz force, $FL \propto Jc \times B$, enhances the fluxoid cascade. These effects combine to cause large internal flux transfers whereas the CSM assumes no internal flux transfer.

[1] R. Weinstein, Drew Parks, Ravi-Persad Sawh, Kent Davey, Keith Carpenter, "Observation of a Bean Model Limit –A Large Decrease in Required Applied Activation Field for TFMs,"IEEE Trans. Appl. Supercond., 25, Article 6601106, 2015.

**Primary author:** WEINSTEIN, Roy (University of Houston)

**Co-authors:** PARKS, Drew (University of Houston); CARPENTER, Keith (University of Houston); DAVEY, Kent (University of Houston); SAWH, Ravi-Persad (University of Houston)

**Presenter:** WEINSTEIN, Roy (University of Houston)

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