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The sharp-front magnetic diffusion wave of a strong magnetic field diffusing into a solid metal[1] BO XIAO, ZHUO-WEI GU, MING-XIAN KAN, GANG-HUA WANG, JIAN-HENG ZHAO, Institute of Fluid Physics, COMPUTATIONAL PHYSICS TEAM — When a mega-gauss magnetic field diffuses into a solid metal, the Joule heat would rise rapidly the temperature of the metal, and the rise of temperature leads to an increase of the metals resistance, which in turn accelerates the magnetic field diffusion. Those positive feedbacks acting iteratively would lead to an interesting sharp-front magnetic diffusion wave. By assuming that the metals resistance has an abrupt change from a small value η_{S} to larger value η_{L} at some critical temperature T_{c}, the sharp-front magnetic diffusion wave can be solved analytically. The conditions for the emerging of the sharp-front magnetic diffusion wave are $B_0 > B_{\mathrm{c}}$, $\eta_{\mathrm{L}}/\eta_{\mathrm{S}} \gg 1$, and $\frac{\eta_{\mathrm{L}}}{\eta_{\mathrm{S}}}\frac{B_0-B_{\mathrm{c}}}{B_{\mathrm{c}}} \gg 1$, where $B_{\mathrm{c}} = \sqrt{2\mu_0 J_{\mathrm{c}}}$, B_0 is the vacuum magnetic field strength, and J_{c} is the critical Joule heat density. The wave-front velocity of the diffusion wave is $V_{\mathrm{c}} = \frac{\eta_{\mathrm{L}}}{\mu_0}\frac{B_0-B_{\mathrm{c}}}{B_{\mathrm{c}}}\frac{1}{x_{\mathrm{c}}}$, where x_{c} is the depth the wave have propagated in the metal. In this presentation we would like to discuss the derivation of the formulas and its impact to magnetically driven experiments.

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Gang hua Wang
Institute of Fluid Physics

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