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On the mode based regime apdatiation for quench propagation model in CICC

Bringing back the substantial idea of hybrid contact discontinuity (A. Shajii and J. P. Freidberg, 1996), thermally coupled 1-d fuild-solid system is carefully repriced on the fundamental question what is the best approach to the quench propagation model of superconducting CICC (cable-in-conduit conductor). By means of a mode analysis with the exact dispersion relation, the simple equations of temperature flow just reveals the regimes of flow speed to discern when the fluid is coupled enough under heat transfer with the conductive solid in parallel. Therefore, broken equilibriation from the unstable mode 2 is interpreted as the upper limit of hybrid contact by a dimesionless quantity of thermal Péclet number. In consequence, the analysis just explains the regimes of normal zone propagation as a possible rationale on THQB (thermal hydraulic quench back) too. Thus, a hybrid approach of numerical scheme emerges according to the discriminated regimes, i.e., of Joule-heat driven reaction-diffusion (Regime 0), equilibriated propagation in hybrid contact (Regime A) and decoupled hot front of advective flow (Regime B). To support the idea to design an effective numerical scheme, further investigation is carried out with numerical experiments not only to check the behavior of the predicted limit, but also to justify the non-conservative form in temperature with which the numerical solution is sound enough in terms of front tracking as well as conservation laws. As a result, we suggest a hybrid numerical model of quench propagation, and discuss our idea, comparing with the existing codes of implicit FEM in non-conservative form (Gandalf, Mitrandir and THEA) and the recent alternatives based on Riemann solvers of the conservative equations (S. Mao's discontinuous Galerkin code and REIMS).

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