Mon-Mo-Po1.09-04 [100]: Analysis to the forced vibration of a high temperature superconducting system with hysteresis

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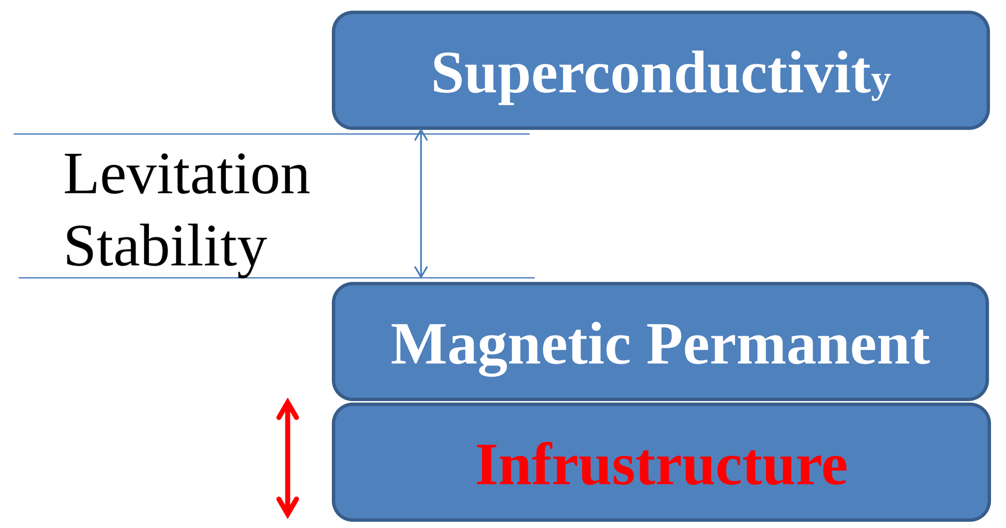
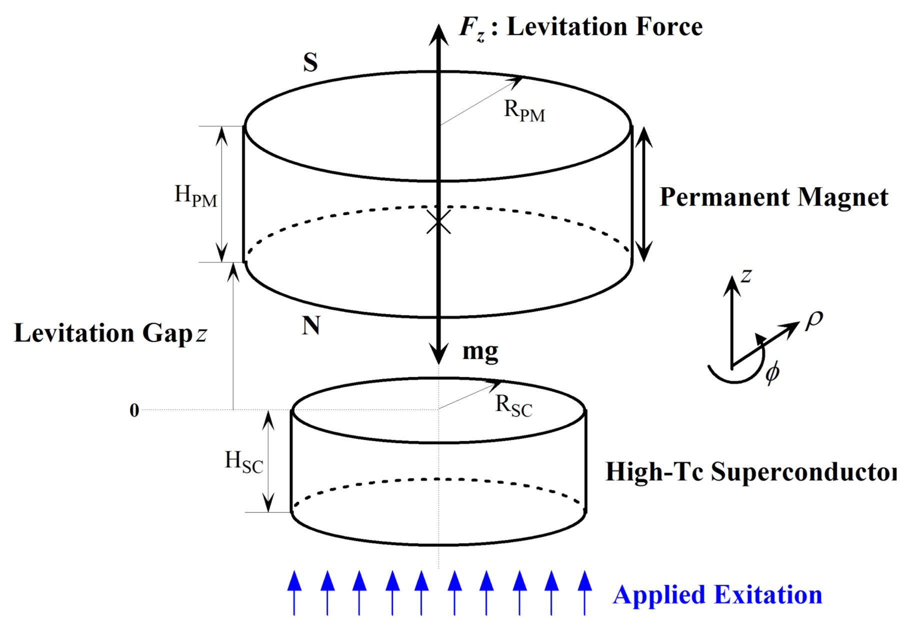
INTRODUCTION





High temperature superconducting levitation structures (bearings, maglev trains) are often excited by applied disturbance. Dynamic behavior with the hysteresis of the levitation force of a PM-HTS system is investigated with application of an alternating magnet field. The irreversible magnetization and hysteresis is considered in simulation..

THEORY

- Amp ère law

$$\nabla \times \boldsymbol{B} = \mu_0 \boldsymbol{J}_c$$

- Boundary condition

$$\mathbf{n} \times (\mathbf{H}_i - \mathbf{H}_{ex}) = 0$$

- Electromagnetic constitutive model

$$\begin{cases} \mathbf{J} = \dfrac{J_{c0} B_0}{B_0 + \boldsymbol{B}_i} \dfrac{\mathbf{E}}{|\mathbf{E}|} & \text{if } |\mathbf{E}| \neq 0 \\ \dfrac{\partial \mathbf{J}}{\partial t} = \mathbf{0} & \text{if } |\mathbf{E}| = 0 \end{cases}$$

- Levitation Force

$$F_z = \int_V \boldsymbol{J}_c \times \boldsymbol{B}_i \, dV$$

- Dynamical differential equation

$$m\ddot{z}_m + c\dot{z}_m - F_z(z_m) + mg = -m\ddot{z}_{sc} - c\dot{z}_{sc}$$

- Controlling equation of penetration depth of shielding currents

$$B_{i0}^2 (R_{SC} - \delta_p) + 2B_0 B_{i0} (R_{SC} - \delta_p) + 2\mu_0 B_0 (\delta_p) J_{c0} (1 - N) - (2B_0 B_{ex} - B_{ex}^2) = 0$$

RESULTS

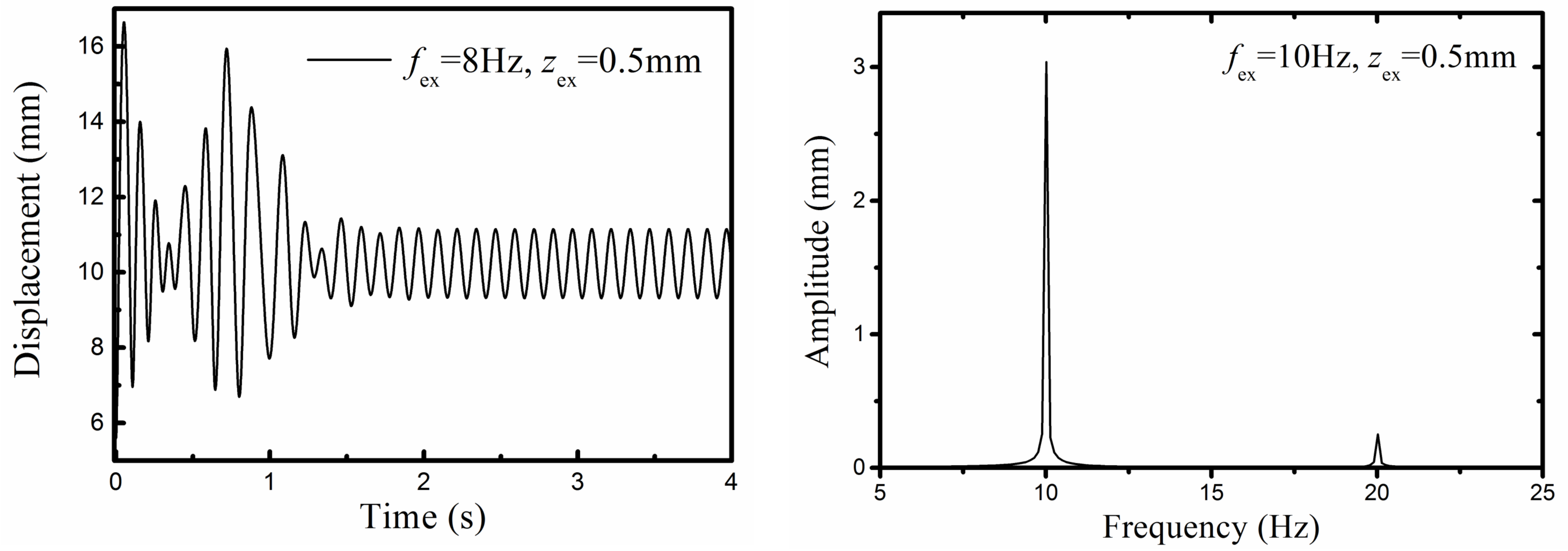


Fig. 1. Resonance swinging of system

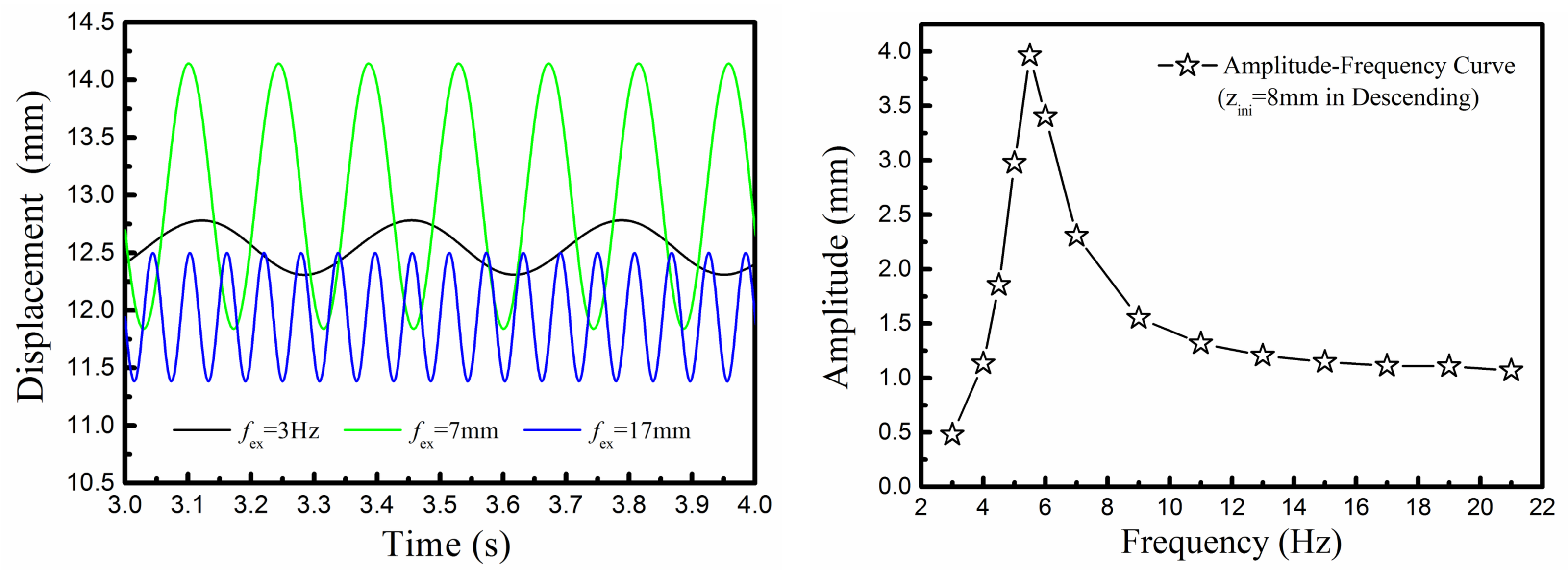


Fig. 2. Effect of applied excited frequency on dynamical response

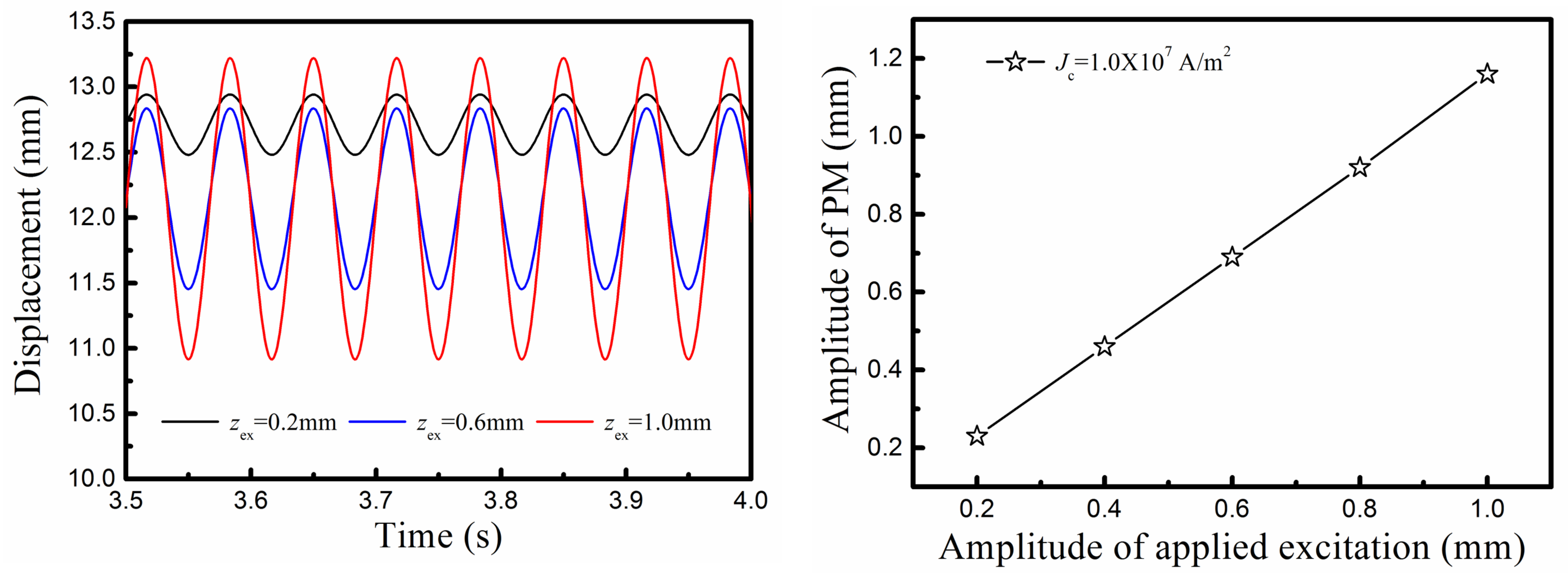


Fig. 3. Effect of applied excited amplitude on dynamical response

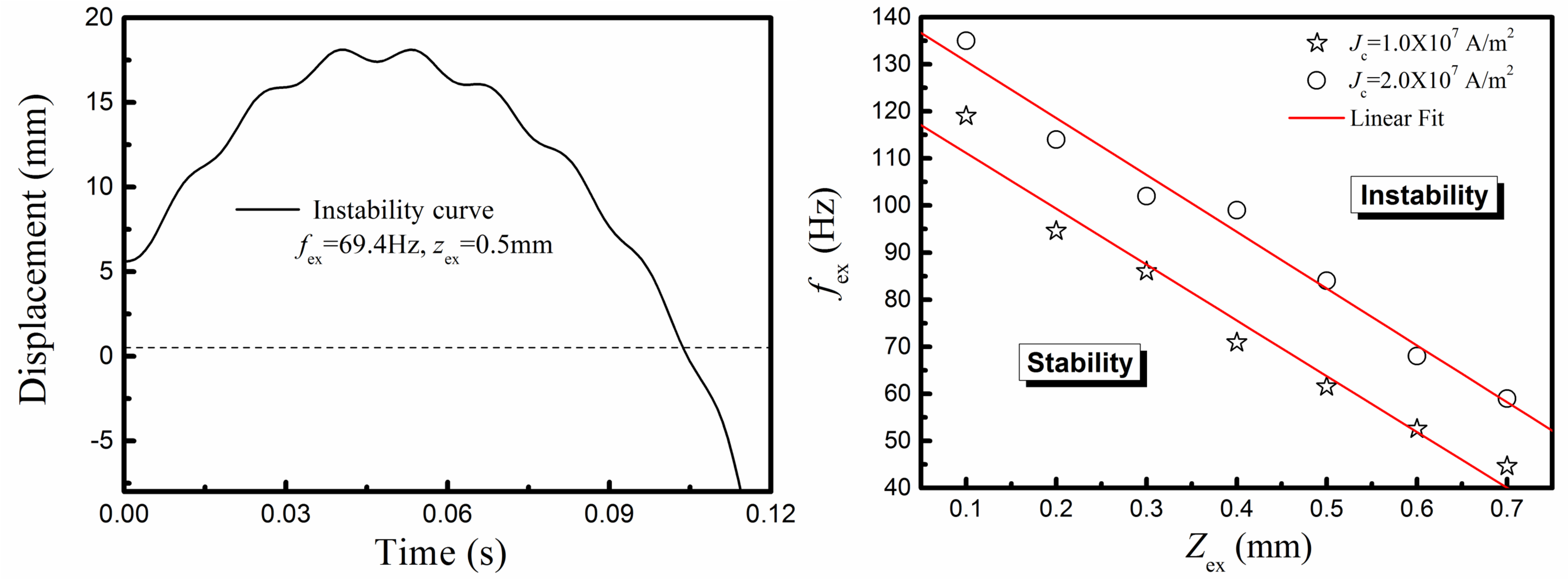


Fig. 4. Critical instability profiles

CONCLUSION

1. The effect of a resonance swinging and break-off of the samples from the levitation level is found. Subharmonic resonance is associated with the nonlinear of levitation dynamics.
2. The critical amplitude vs. the field frequency to the superconductor is presented in this study.
3. It is concluded that levitation is stable most when the sample is exposed to a low-frequency field. In this case large amplitude of the alternating field is needed to break-off of the sample.

I will be here from 10:15 to 11:15, and from 9:15 to 10:15 welcome to Mon-Mo-Po1.10-09 [117]