Mon-Mo-Po1.10-09 [117]: Quadratic Approximation Method for the Limit Value of Magnetic Stiffness in a High Temperature Superconducting Levitation System

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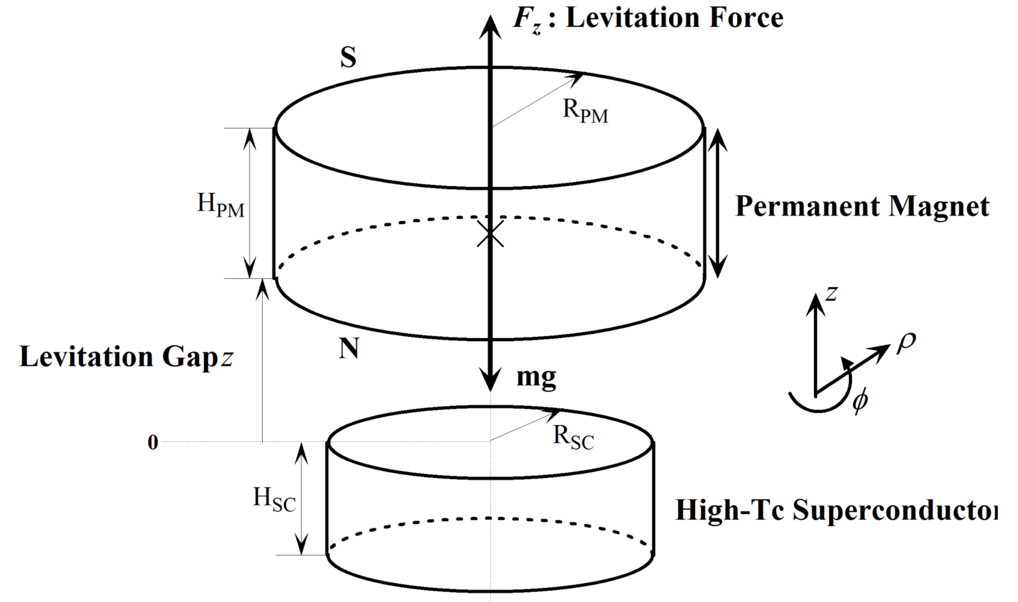
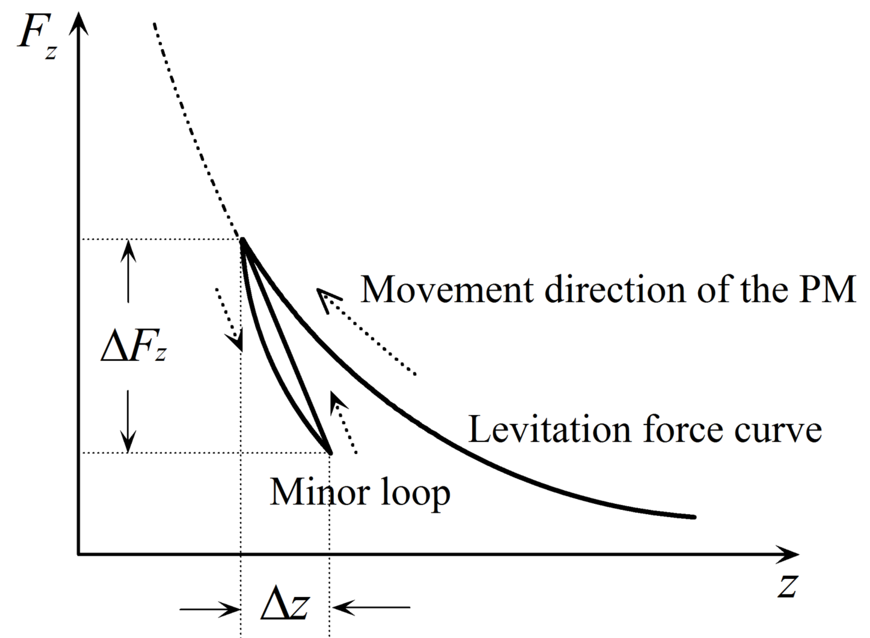
INTRODUCTION





- **The PM can be stably levitated over the HTS.**
- ***Nonlinearity* and *hysteresis* is important to evaluate the magnetic stiffness the system.**
- **the slope of a minor hysteresis loop in large force-distance curves is often employed in experiments and analysis. Up to now, there is no accepted value for small hysteresis distance and unified judgment standard for the accuracy of magnetic stiffness results.**

THEORY

$$\nabla \times \boldsymbol{B} = \mu_0 \boldsymbol{J}_c \Longrightarrow J_c(|\boldsymbol{B}_i|) = \frac{J_{c0}B_0}{B_0 + |\boldsymbol{B}_i|}$$

Frozen condition: $B_{i0}(\rho, z) = B_{tr}(\rho, z)$

Levitation Force: $\boldsymbol{F}_z = \int_V \boldsymbol{J}_c \times \boldsymbol{B}_i dV$

$$k_z = \lim_{\Delta z \to 0} \frac{\Delta F_z}{\Delta z} \neq \frac{dF_z}{dz}$$

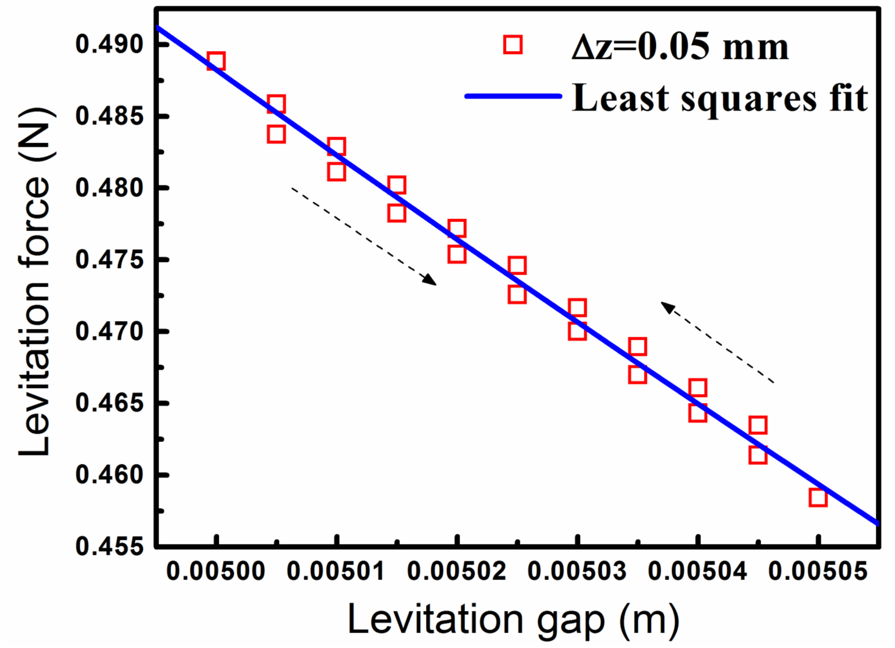
For an irreversible system

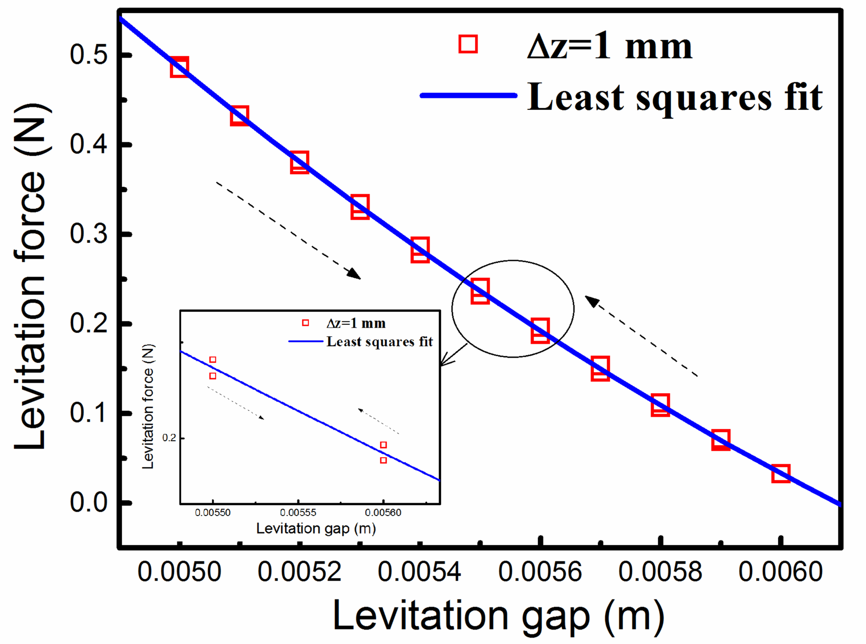
An implicit equation to solute penetration depth of shielding currents in HTS:

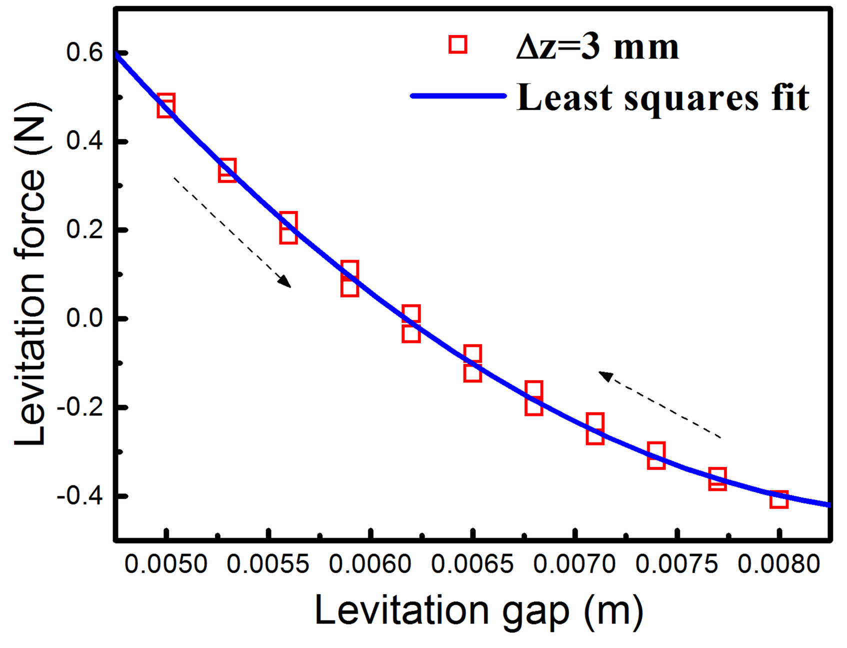
$$B_{i0}^2(\rho_P) + 2B_0B_{i0}(\rho_P) + sign(\boldsymbol{J}_c)2\mu_0 B_0 J_{c0}(R_{SC} - \rho_P)(1 - N) - (2B_0B_{R_{SC}} - B_{R_{SC}}^2) = 0$$

RESULTS AND DISCUSSIONS

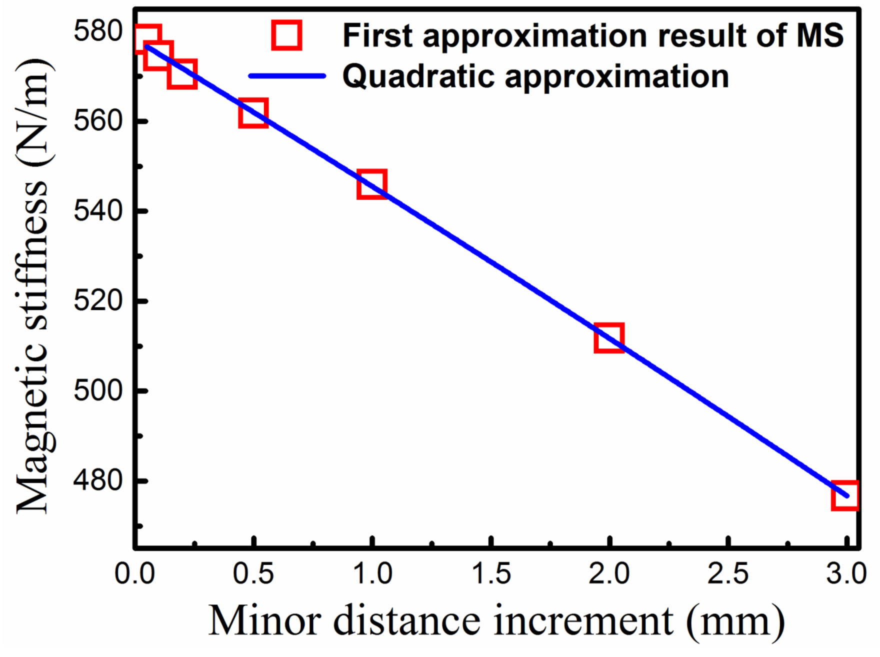
- First approximation to the distance increments of seven minor loops from 0.05 mm to 3 mm at levitation height 5 mm ↓







- Quadratic approximation to above results corresponding to difference distance increments



Category	Unit	The limit value of MS	First approximation result to distance increment Δz						
			0.05mm	0.1mm	0.2mm	0.5mm	1mm	2mm	3mm
Vaule	N/m	578.2	578.1	574.6	570.4	561.8	545.9	511.8	476.6
Deviation	%	/	0.02	0.63	1.35	2.84	5.59	11.49	17.57
			Good results				Bad results		

I will be here from 9:15 to 10:15, and from 10:15 to 11:15 welcome to Mon-Mo-Po1.09-04 [100]