

FMR analysis by machine learning leads to remarkable insights into the magnetic anisotropy of $\text{Co}_{25}\text{Fe}_{75}$ thin films

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The traditional approach to analyzing ferromagnetic resonance spectroscopy data can produce inconsistent material parameters when measurements are done at both broadband and fixed-frequency conditions [Nat. Comm. 8, 234 (2017)]. Machine learning-based global optimization addresses this issue by simultaneously analyzing all FMR data, independent of frequency. Through a comprehensive reanalysis of published data and analysis of independent measurements on epitaxial $\text{Co}_{25}\text{Fe}_{75}$ thin films, we demonstrate that this method yields identical magnetic anisotropy parameters at both broadband and fixed-frequency conditions. In contrast, traditional fitting methods reproduce discrepancies up to 6% when used at both broadband and fixed-frequency measurements. Evaluation of four phenomenological models indicates that the model with cubic symmetry provides the most accurate description of the CoFe system. This methodology enables direct extraction of fundamental parameters, such as the g -factor and saturation magnetization, from FMR data alone, with results consistent with independent measurements. By leveraging measurements for all frequencies, the machine learning approach facilitates self-consistent and frequency-independent material evaluation and effectively distinguishes intrinsic properties from measurement artifacts.