

Effective-medium theory for multilayer metamaterials: Role of near-field corrections

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Backgrounds & Motivations

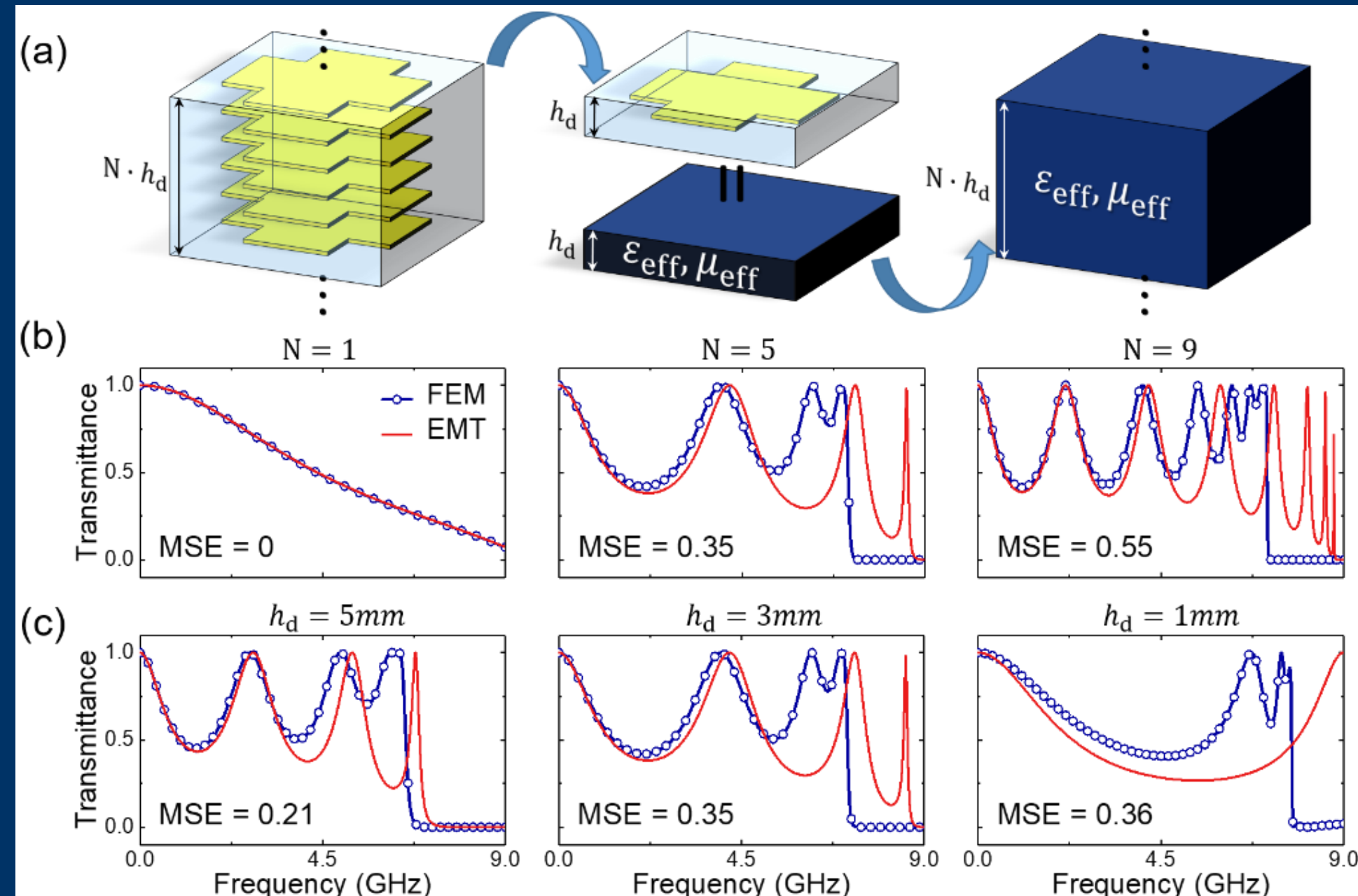


Fig. 1 Problems left by conventional EMT

- Such conventional definition of sub-system makes single layer's properties failing in describing multilayer MTMs in many cases.
- How to understand NF coupling physically and develop a new EMT with NF coupling effect fully taken into account?

NF corrected EMT and discussions

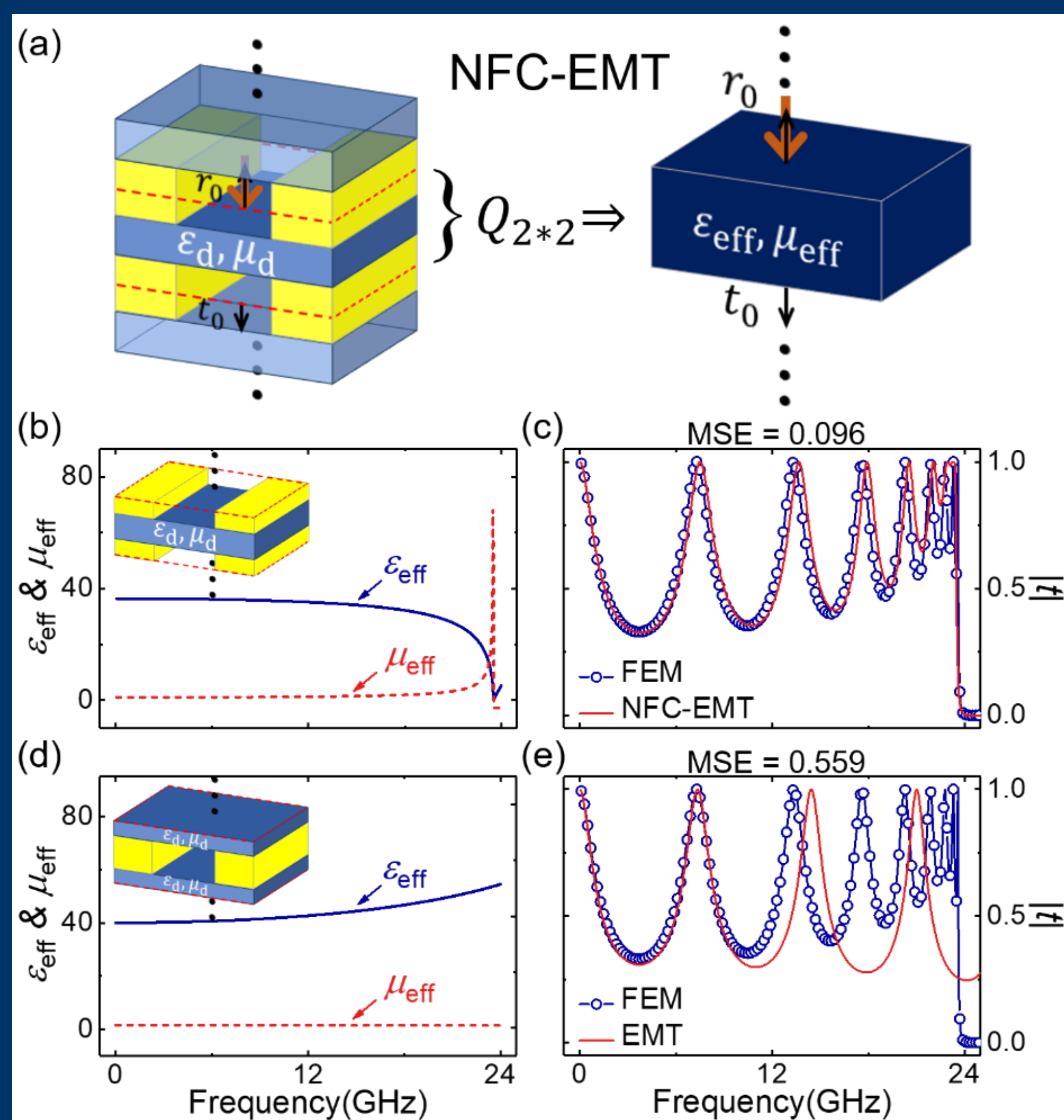


Fig. 3 Schematics of the essential idea of NFC-EMT and a quick test on a 9-layer grating system compared with conventional method

Extension and experiment

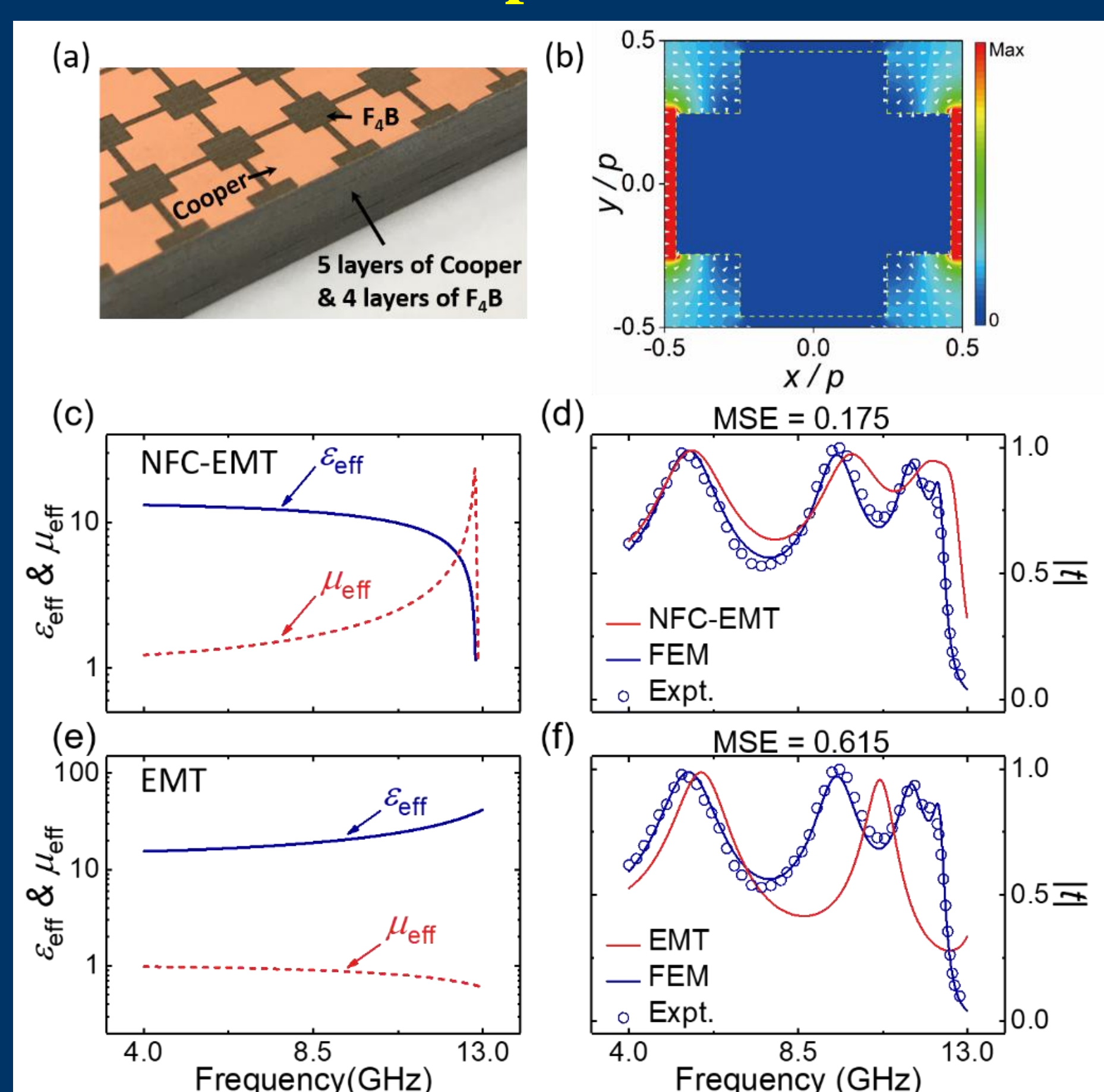


Fig. 6 Extension to general multilayer MTMs with complex microstructures and validation by microwave experiment

An analytical study on a simple system

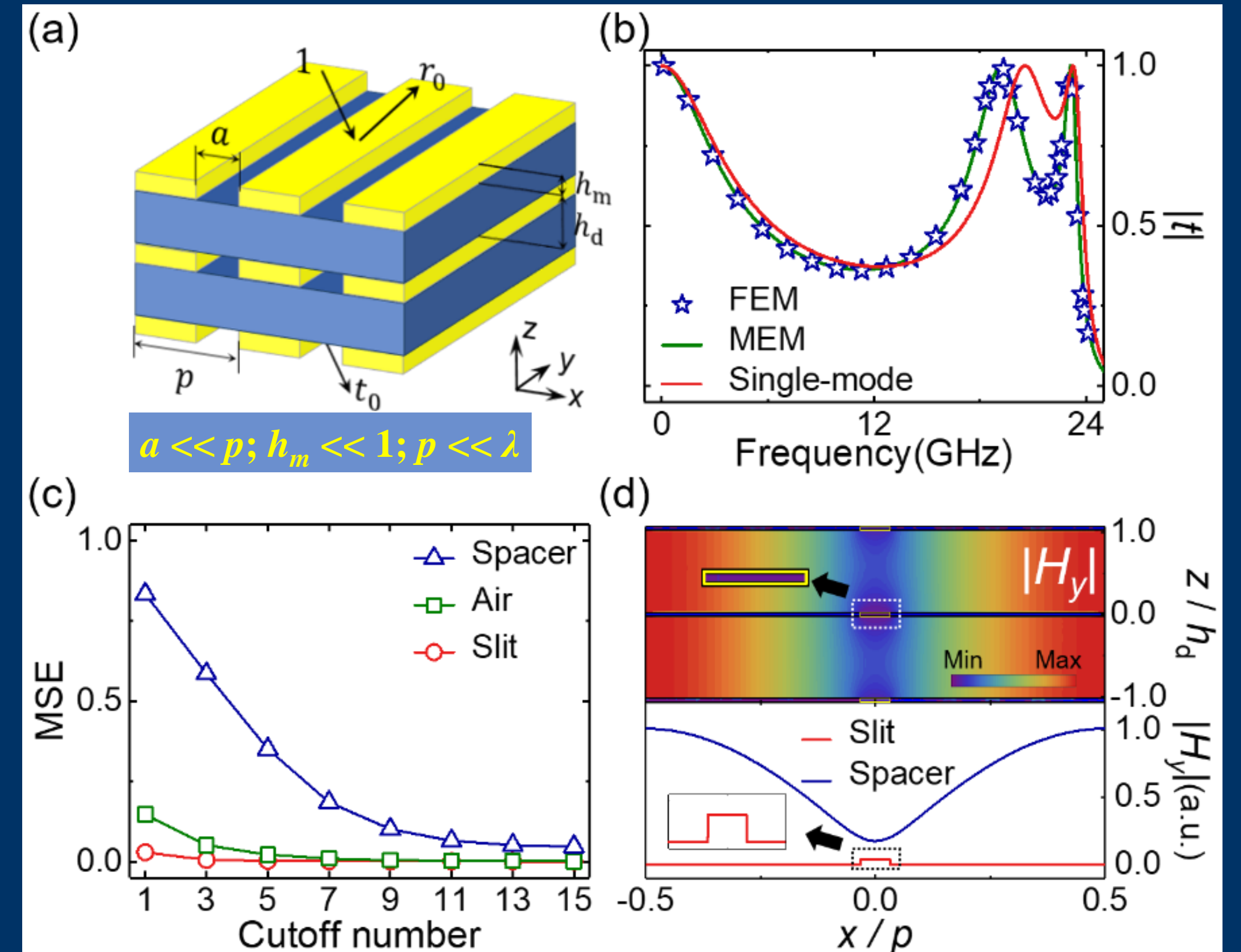


Fig. 2 Higher order modes only matter in spacer

Physical understandings

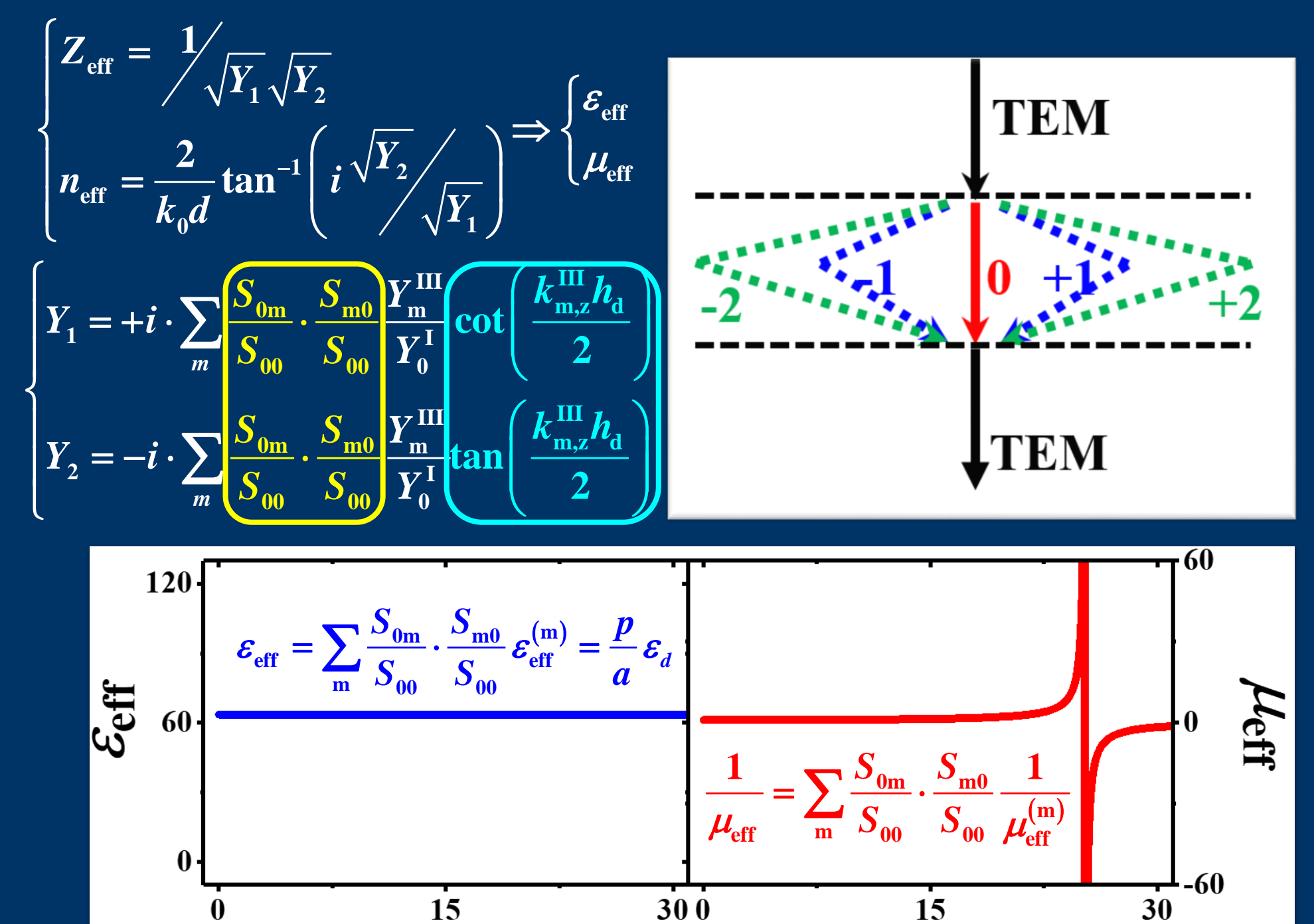


Fig. 4 Intriguing formulae under ultrathin spacer limit

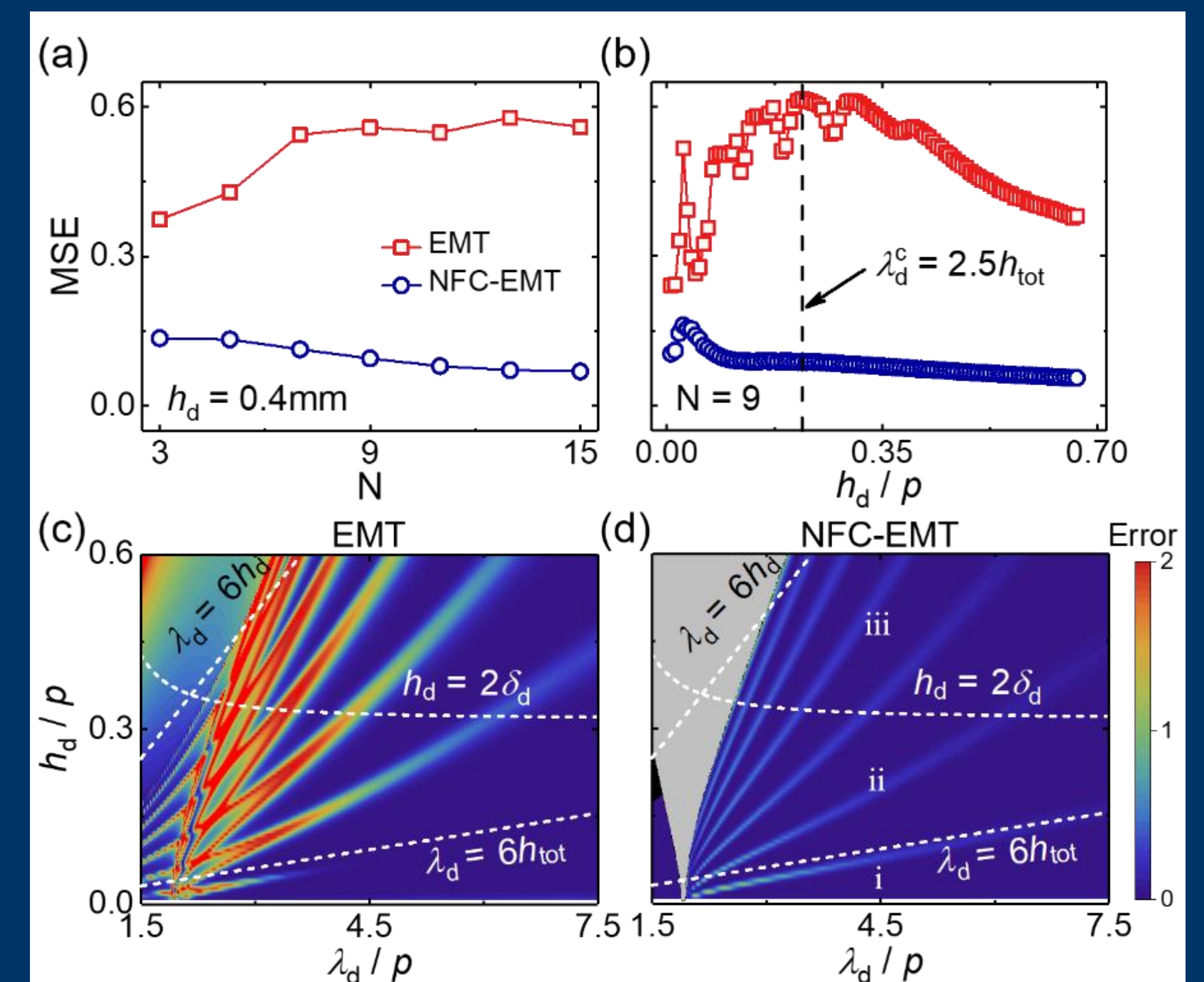


Fig. 5 A systematic comparison between NFC-EMT & EMT

Conclusions

- After identifying that the *interlayer* NF coupling in the spacer dominates in the multilayer MTMs, we have a *better unit cell definition* by cutting off at metallic layer.
- Analytical formulae reveal the physics of NFC.
- Our theory can be extended to general cases.

References

- [1] Wujiong Sun, Qiong He, Shulin Sun, and Lei Zhou, *Light Sci. Appl.* 5, e16003 (2016).
- [2] Shaojie Ma, Shiyi Xiao, and Lei Zhou, *Phys. Rev. B*, 93, 045305 (2016).
- [3] Tong Liu, Shaojie Ma, Shiyi Xiao, and Lei Zhou, manuscript in preparation.