

SWIFT: Electric Field Controlled Integrated Multiferroic Radio Frequency Devices for Interference Immune Broadband Wireless Systems

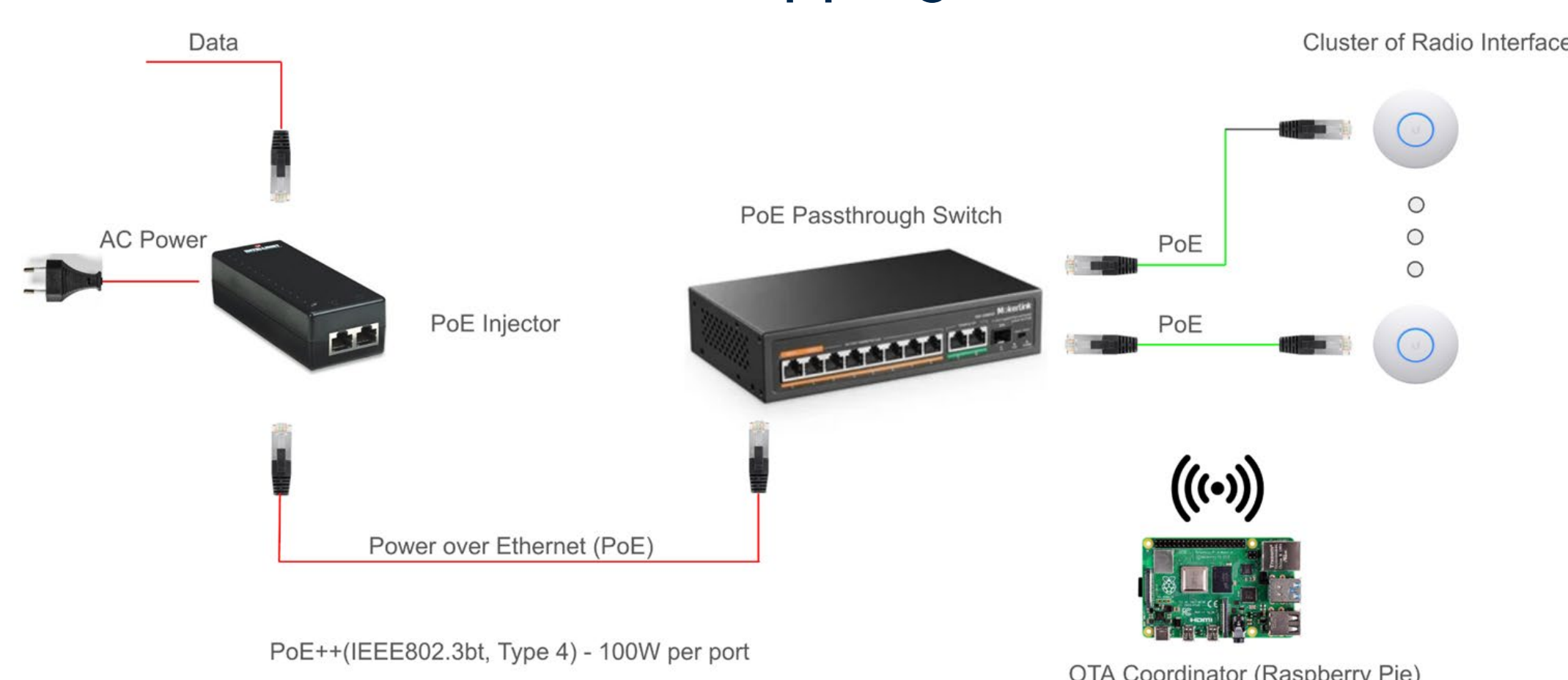
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Motivation

Machine Learning-Driven Solution for Dynamic Spectrum Optimization

- **Motivation:** Enhance Wi-Fi 6 goodput through a system-level solution compatible with legacy devices
- **Design Target:** Enable real-time analysis of spectrum availability versus traffic demand, and implement dynamic access point and station-level control
- **Method:** Fuse real-time traffic demands prediction and spectrum utilization data to intelligently allocate APs hosted channels and AP-Station mapping.

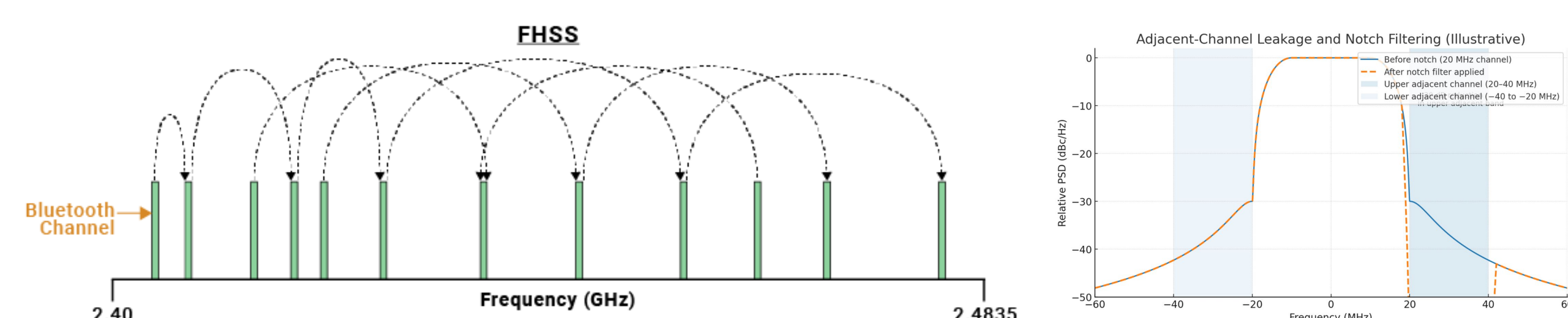


System Design for Heterogeneous WLANs

- **Network Sensing System:** Monitors real-time spectrum usage and station (STA) goodput demands.
- **Optimization Algorithm:** Calculates optimal channel assignments and STA-to-AP associations.
- **Infrastructure Control:** Dynamically re-configures APs and steers STAs to target APs for improved communication quality.

Ferroelectric Material Based Notch Filter

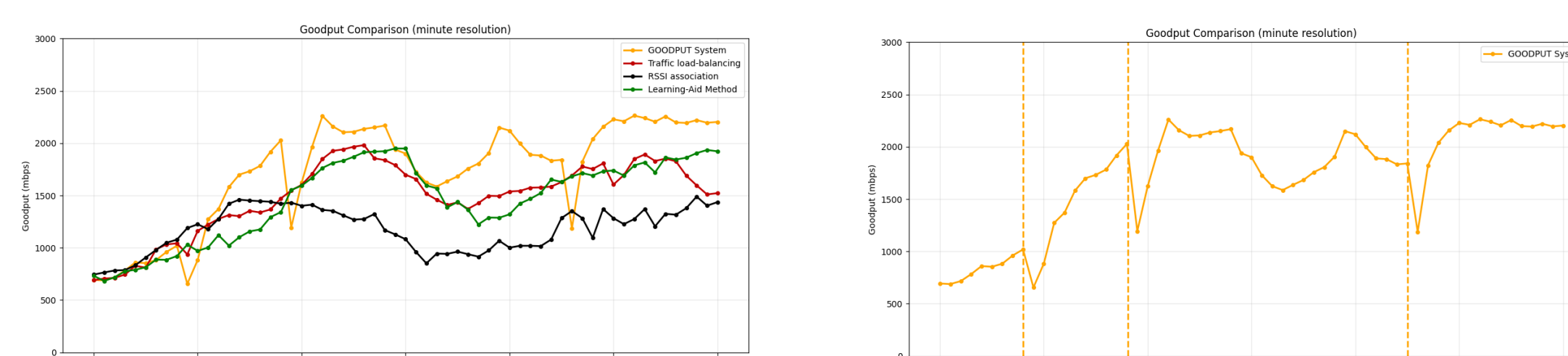
- GOODPUT systems avoid overlapped channels, but a fast reconfigurable notch filter reclaims these channels.
- Integrating rapid notch control allows interference suppression without channel reassignment, improving spectral efficiency and aggregate goodput



Fundamental Studies

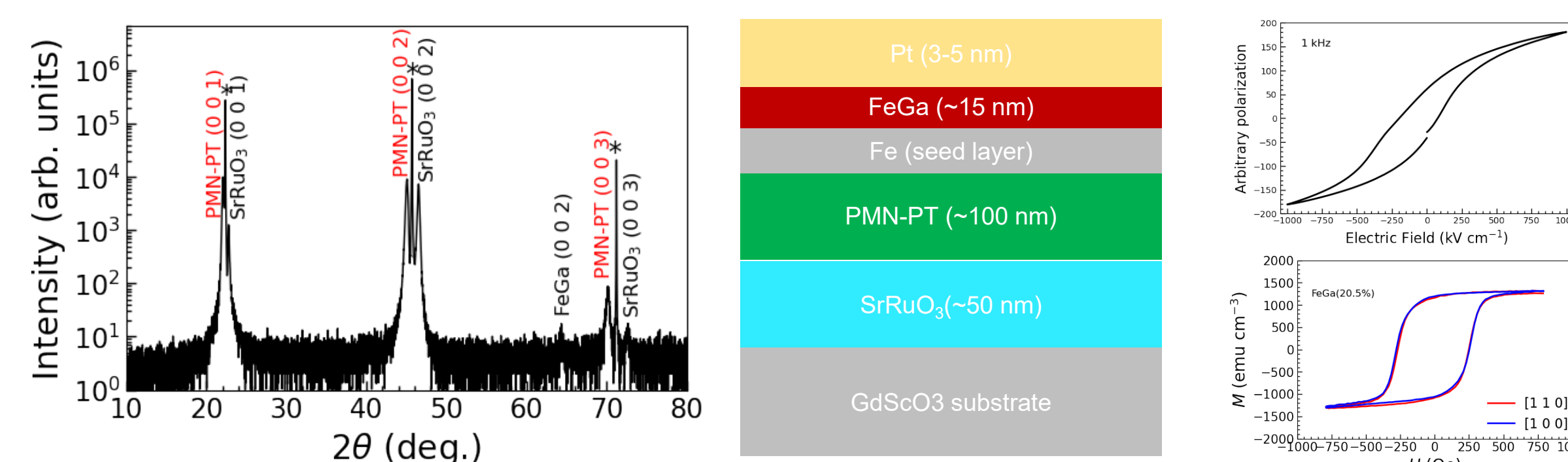
Goodput Improvement Over Related Work

- Improvement over RSSI-based technique = 46.6%
- Improvement over load balancing = 16.2%
- Improvement over deep neural network method = 18.2%



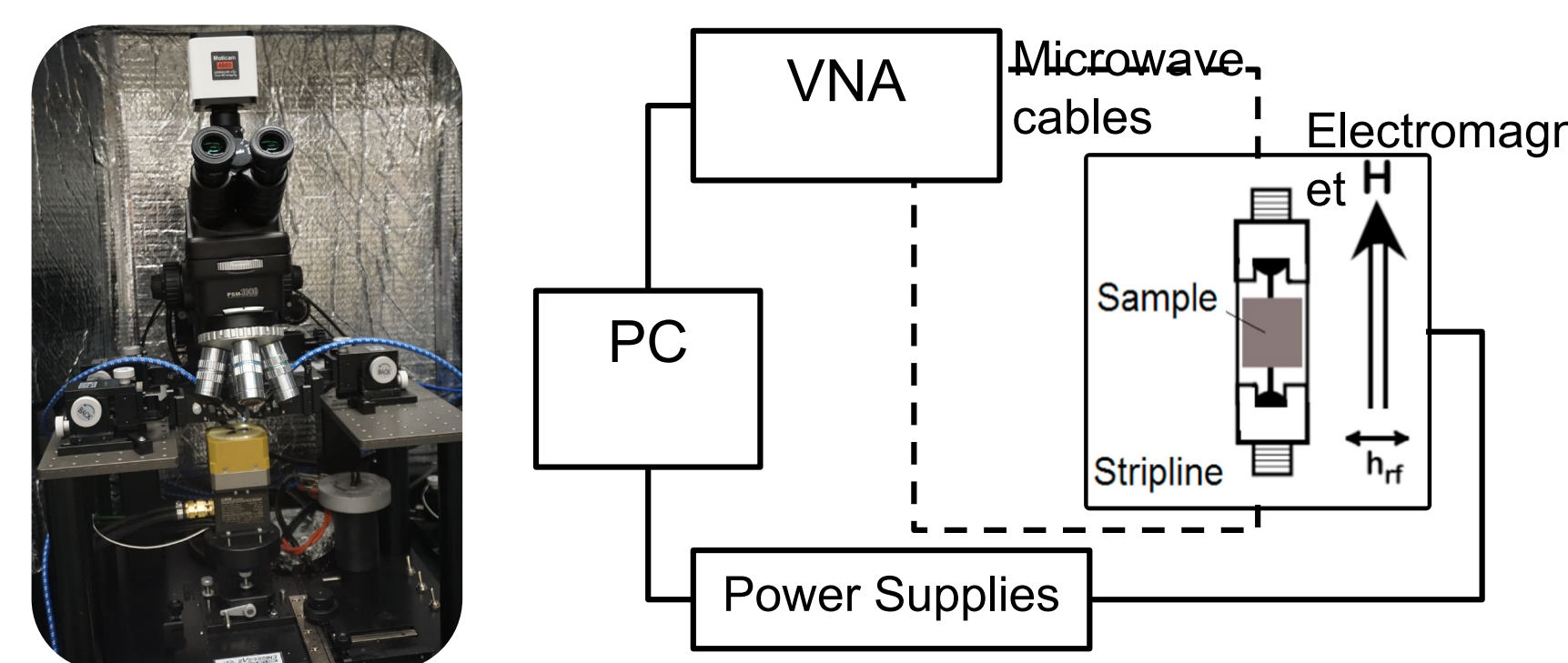
PMN-PT/FeGa Stacks for Tunable FMR

- Bilayer stacks to validate synthesis and properties
- XRD reveals full stack is single crystalline for all Ga%
- Magnetic and ferroelectric properties confirmed

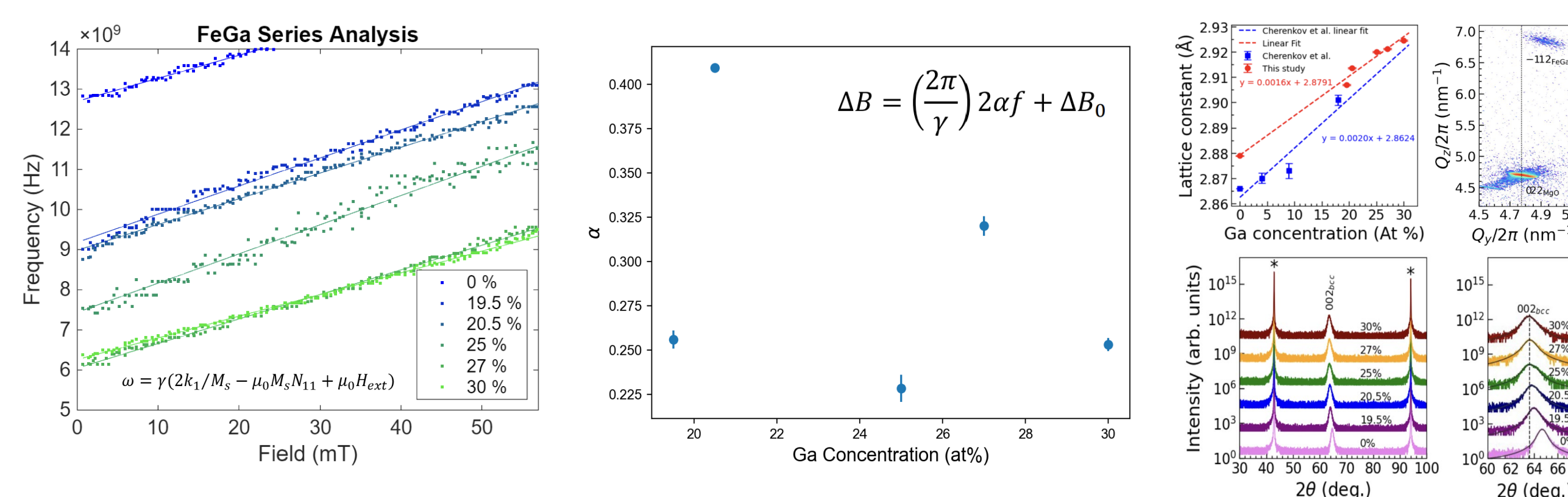


Iron Gallium Ferromagnetic Resonance

- 3D variable field flip chip FMR measurement approach
- Gilbert damping parameter (α) calculated from FMR line width



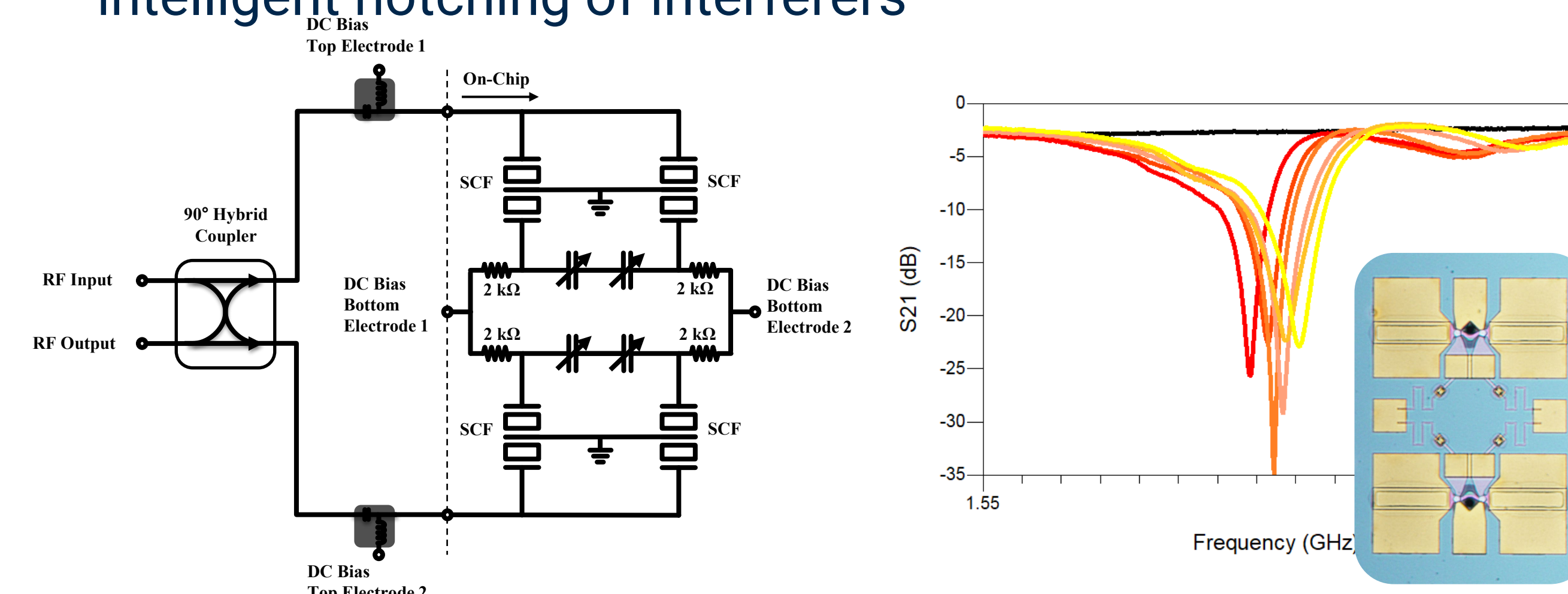
- Deposition of Fe1-xGax layers shows single-crystal growth
- Self bias decreases with increasing Ga %.
- The full width half max roughly reduces with increasing Ga%



Applications

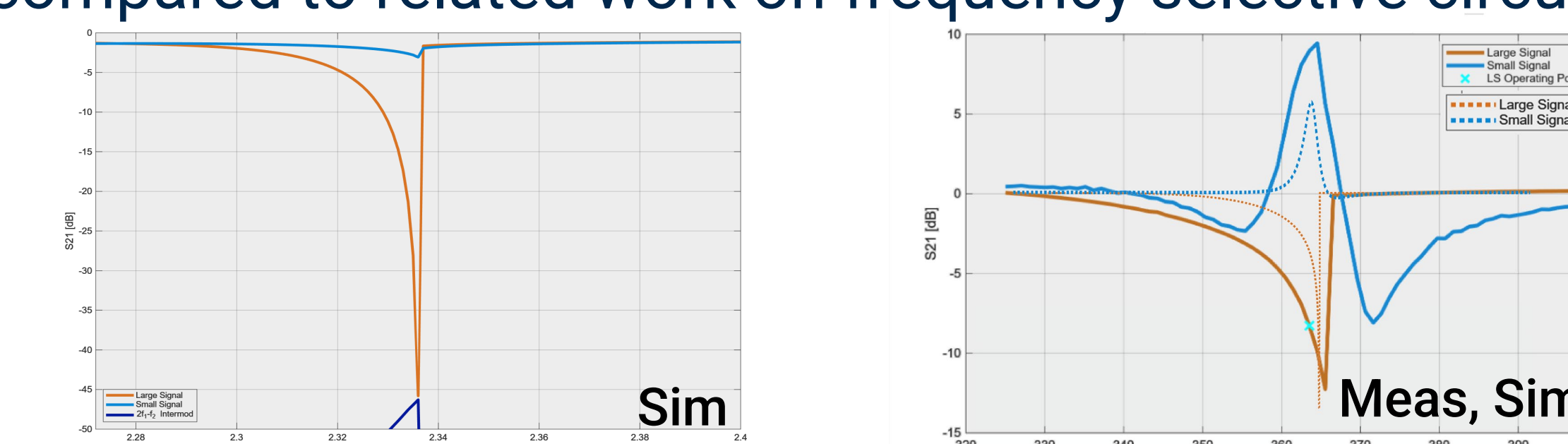
Ferroelectric Acoustic Wave Notch Filter

- Electric field controlled ferroelectric notch filters with frequency tunability and nano second tuning speed
- On chip multilayer ferroelectric microwave circuits allow for intelligent notching of interferers



Self-Latching Notch Filter

- Self-latching notch filter that attenuates an interfering large signal while simultaneously passing a small signal
- Large signal rejection, small signal insertion loss and distortion intermodulation products are all improved compared to related work on frequency selective circuitry



Acknowledgement

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References

- [1] H. Desai and A. Mortazawi, "A Microwave Acoustic QPSK Modulator Leveraging Poled Ferroelectrics," in *2025 IEEE/MTT-S International Microwave Symposium - IMS 2025*, June 2025, pp. 686–689. doi: [10.1109/IMS40360.2025.11103988](https://doi.org/10.1109/IMS40360.2025.11103988).
- [2] H. Desai, M. Z. Koohi, and A. Mortazawi, "SPST Acoustic Switch Based on Poled Ferroelectrics," in *2024 IEEE/MTT-S International Microwave Symposium - IMS 2024*, June 2024, pp. 38–41. doi: [10.1109/IMS40175.2024.10600205](https://doi.org/10.1109/IMS40175.2024.10600205).
- [3] H. Desai, W. Peng, and A. Mortazawi, "Single-Pole Single-Throw RF Acoustic Phase Inversion Switch Leveraging Poled Ferroelectrics," *IEEE Transactions on Microwave Theory and Techniques*, vol. 73, no. 1, pp. 6–13, Jan. 2025, doi: [10.1109/TMTT.2024.3496665](https://doi.org/10.1109/TMTT.2024.3496665).