



# Secure & Energy Efficient Sub-Terahertz Wireless System for 6G

August 2023

*Changing the World's Energy Future*

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**<http://www.inl.gov>**

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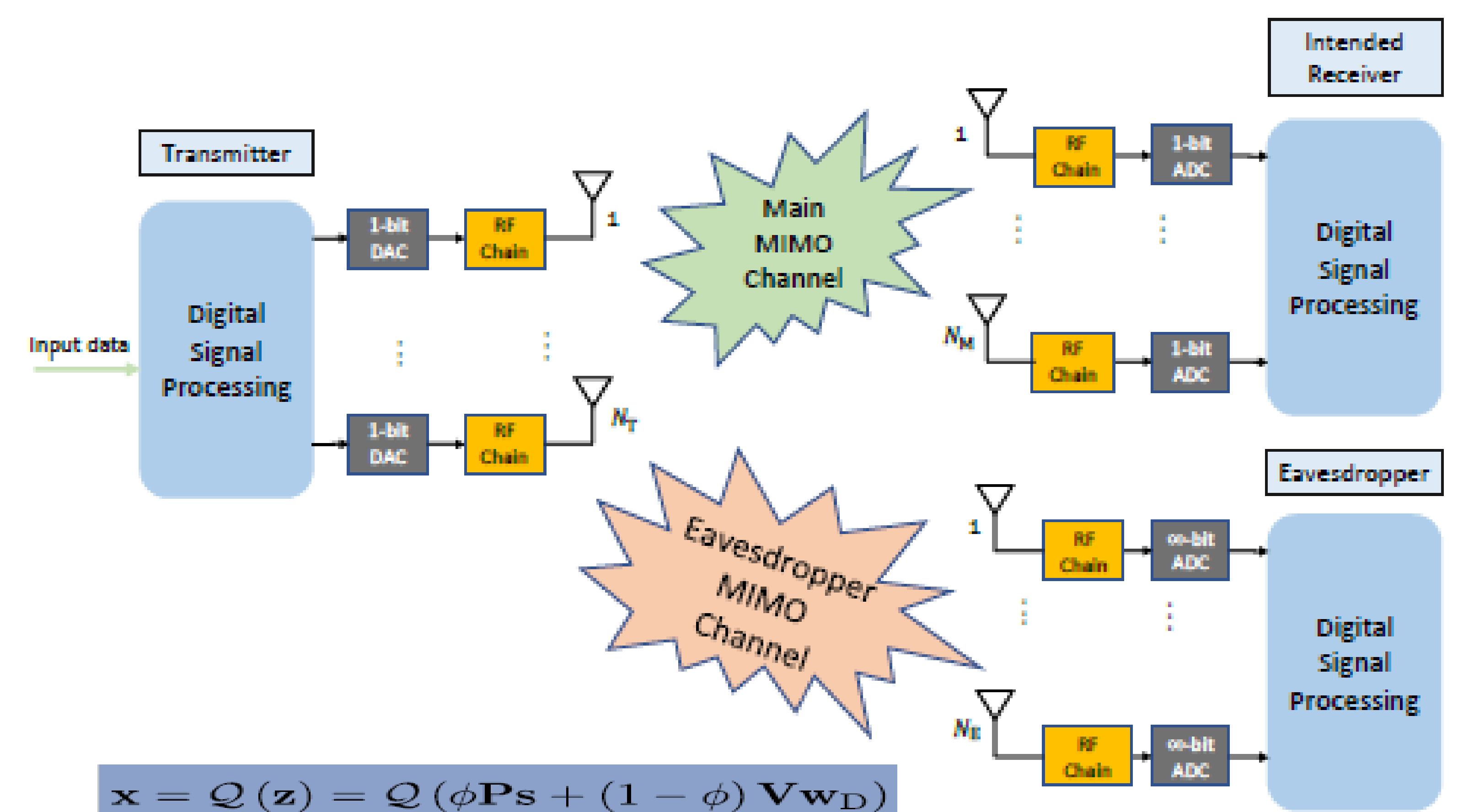


# Secure & Energy Efficient Sub-Terahertz Wireless System for 6G

Arupjyoti (Arup) Bhuyan (INL), Robert Heath (North Carolina State University)

## Need and Significance

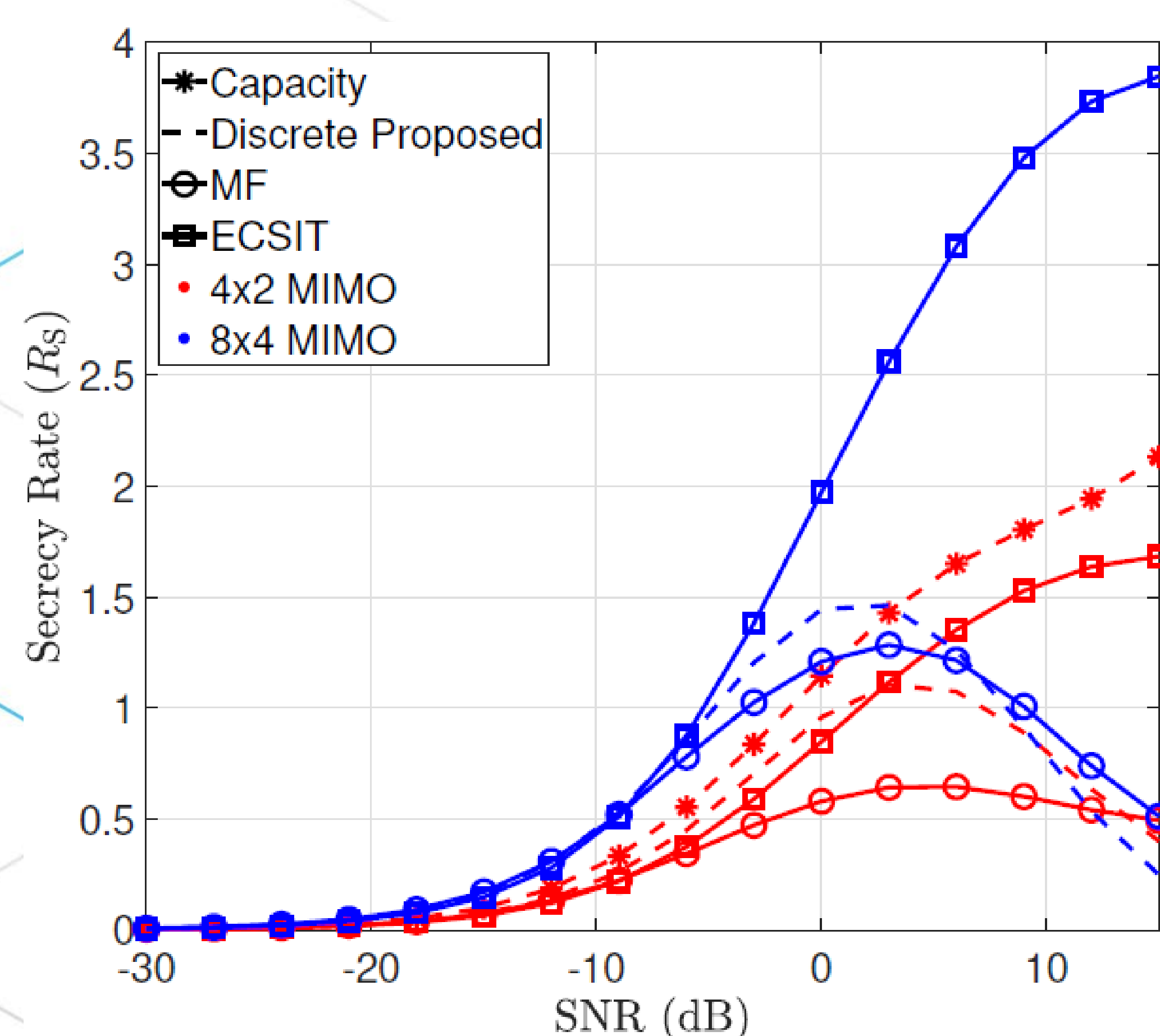
- Required energy efficient 6G **low resolution multiple-input and multiple-output (MIMO) systems degrades security.**
- This research proposes to prove the principle that **security can be designed into low resolution 6G MIMO system** that operates in the sub-Terahertz (100-300 GHz) bands.
- Successful conclusion will lead to **secure next generation cellular systems worldwide.**



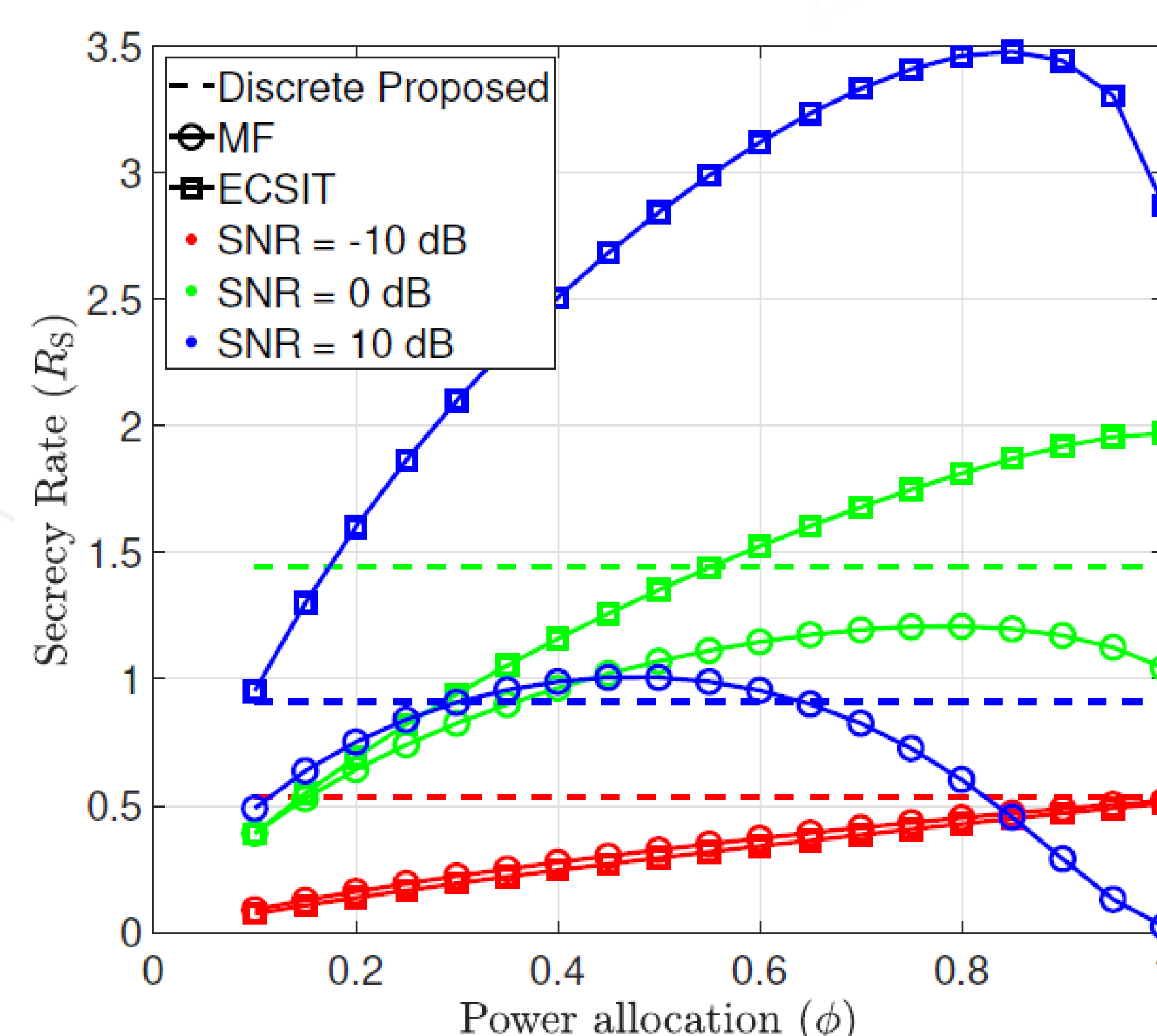
## Approach and Innovative Aspects

- Use directional modulation (DM) in low resolution systems
- Transmit artificial noise and symbols to increase secrecy rate/capacity

## Summary of Results



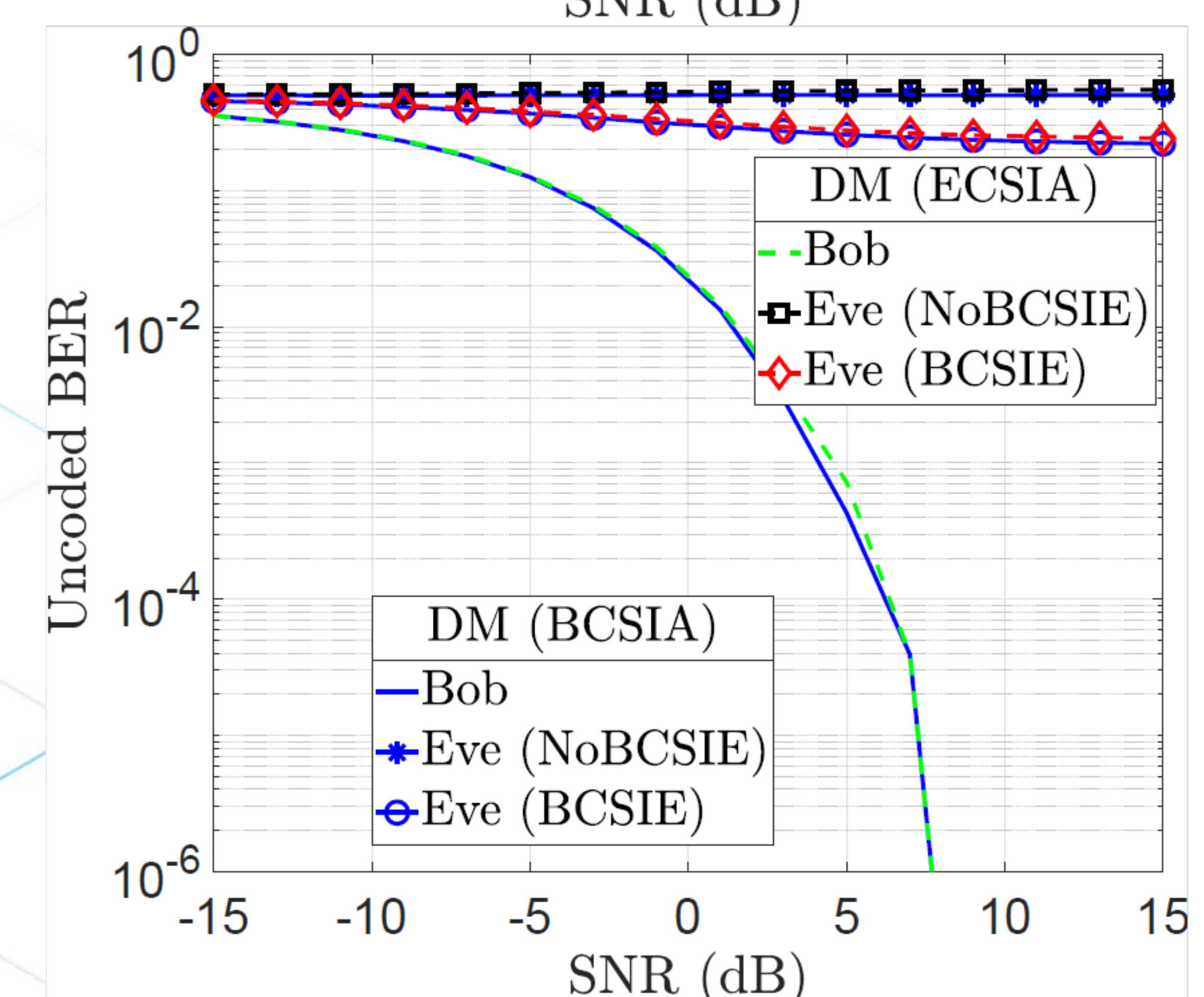
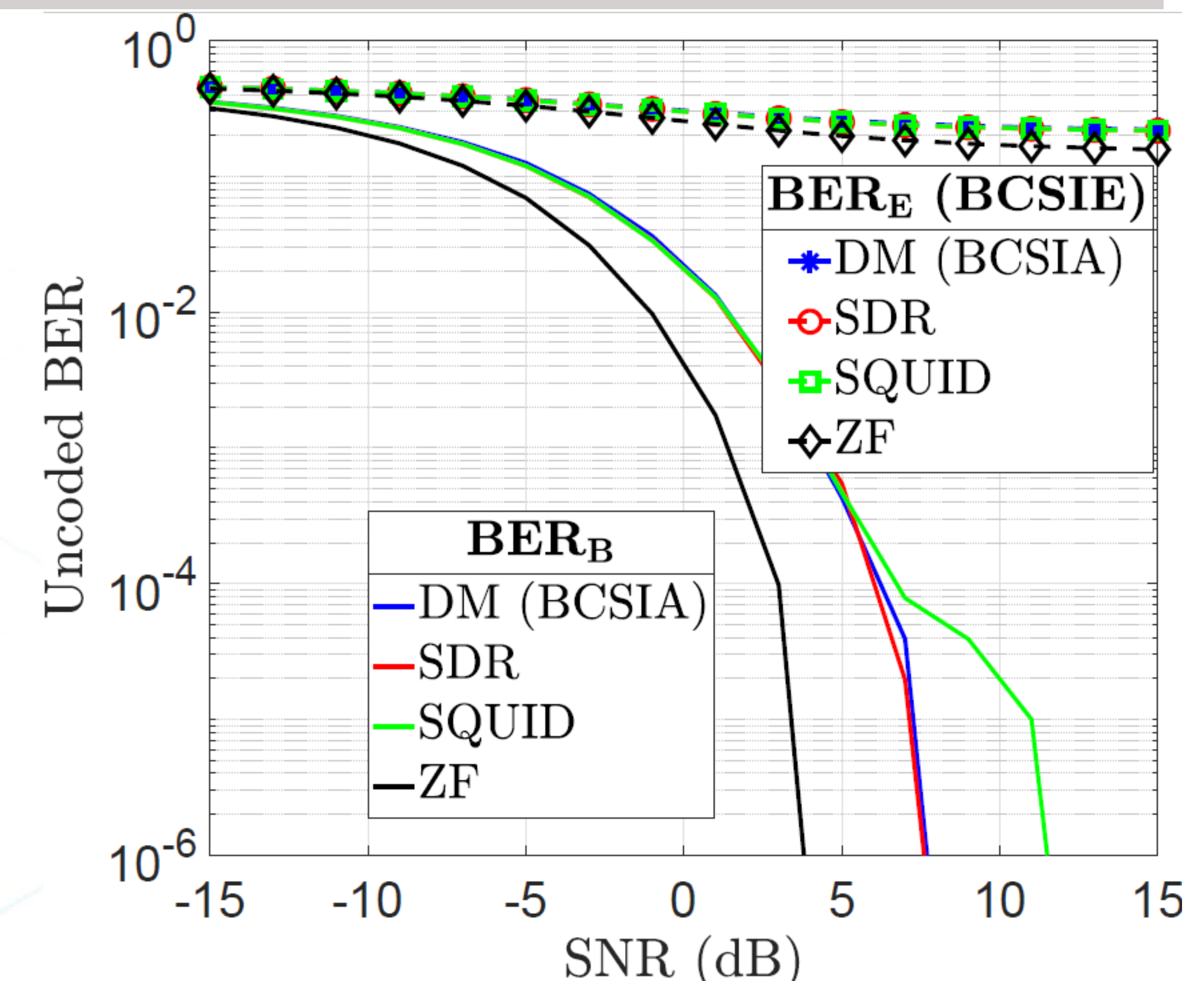
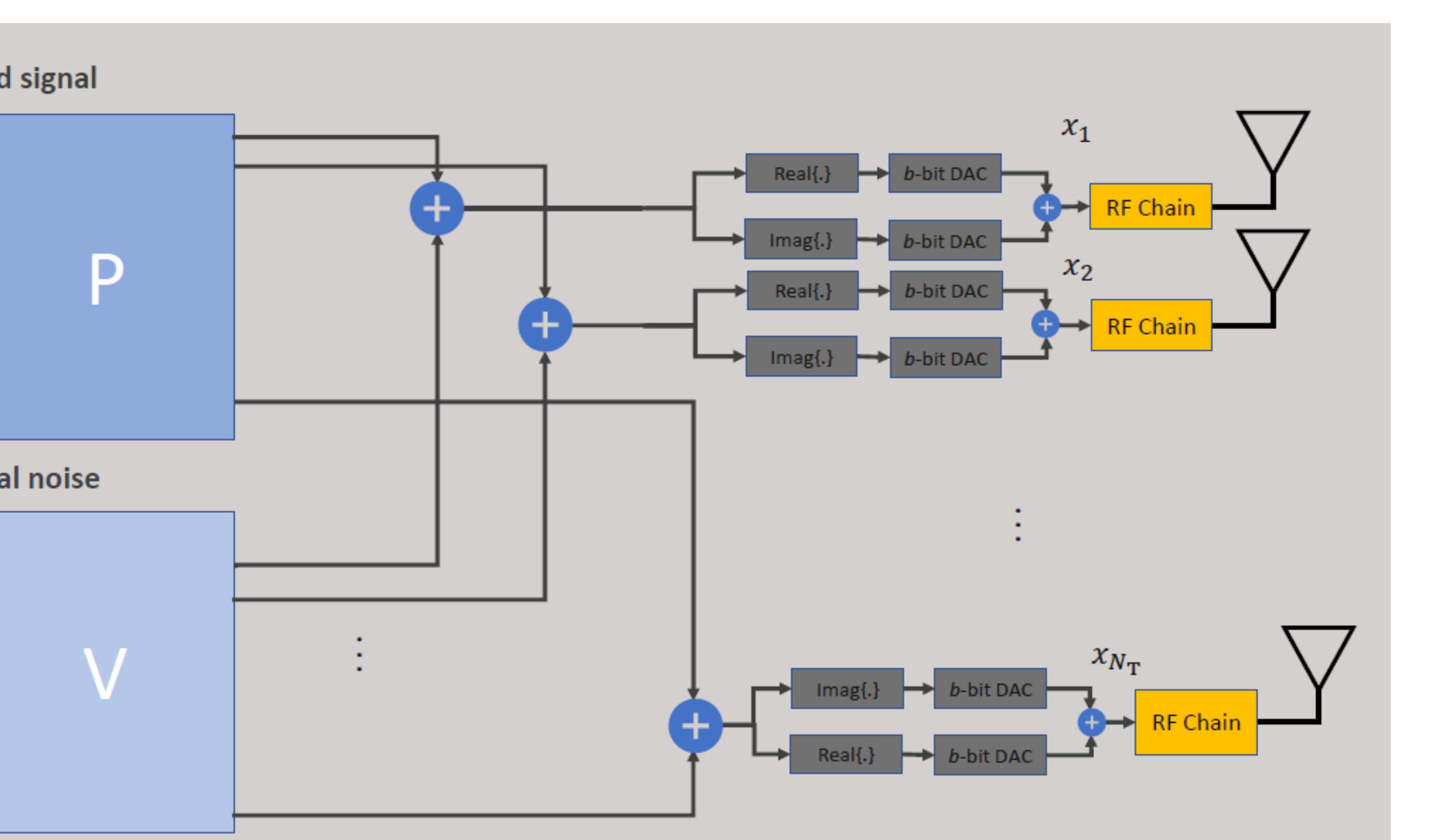
Secrecy rate for low resolution MIMO



Secrecy rate as function of Signal vs. Artificial Noise power allocation

## Publications

- "Physical Layer Security at a Point-to-Point MIMO System With 1-Bit DACs and ADCs", IEEE Wireless Communications Letters, May 2023.
- "Directional Modulation-Aided Secure MIMO Communication Using 1-Bit Converters", submitted to IEEE Transactions on Vehicular Technology, Feb 2023.
- "An Innovative Secure & Energy Efficient Sub-Terahertz Wireless System for 6G", INL Invention Disclosure Record (IDR) BA-1289.



Performance of Direction Modulation in Low Resolution MIMO

Project Number: 22A1059-031FP

LRS Number: INL/MIS-23-74197

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