Synchronization of Chaotically Oscillating TWTs

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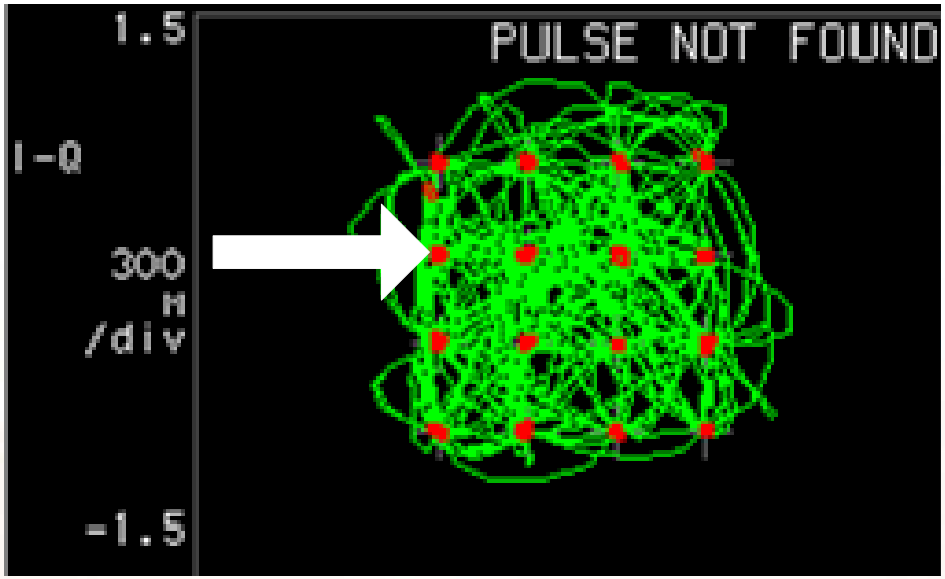
NATIONAL SCIENCE FOUNDATION

Data Communications

Need for higher data flow

Resistance to noise and other distortions

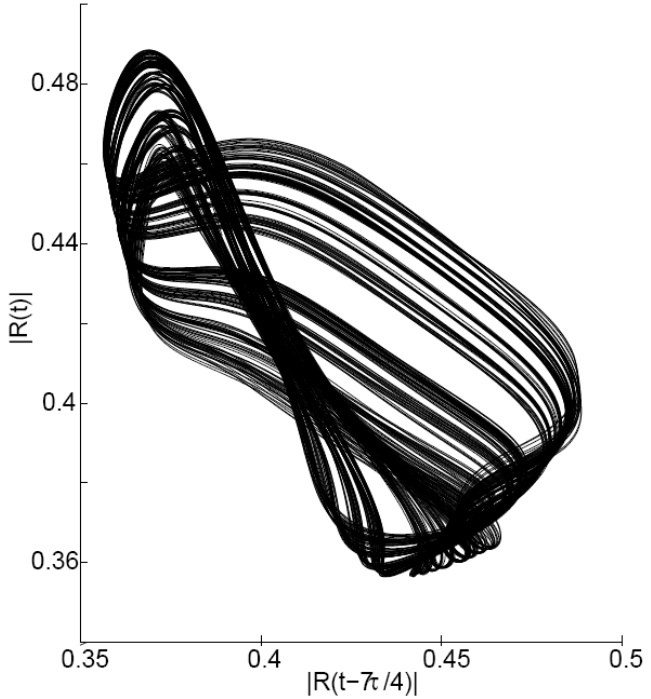
In a linear system, data is transmitted through phase and amplitude of signal



Linear regime has its limits

TWTs for Chaotic Synchronization

Modulate the parameters of the chaotic system to encode data in its dynamics

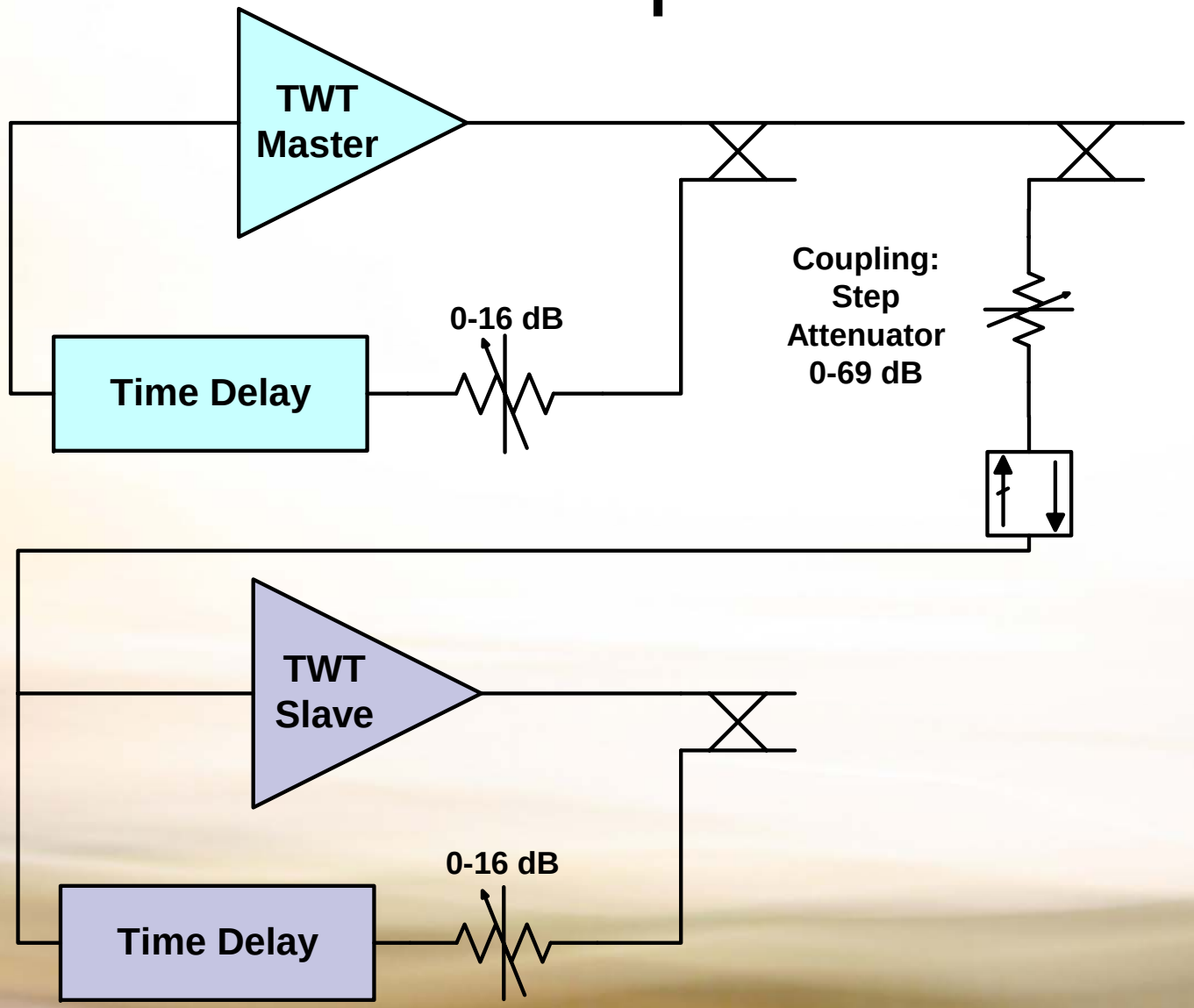


V. Dronov, M. R. Hendrey, T.M. Antonsen, E. Ott, Chaos **14,** 30 (2004).

Requires synchronization of transmitter to the receiver to decode

Using two coupled TWTs for data transmission

Setup

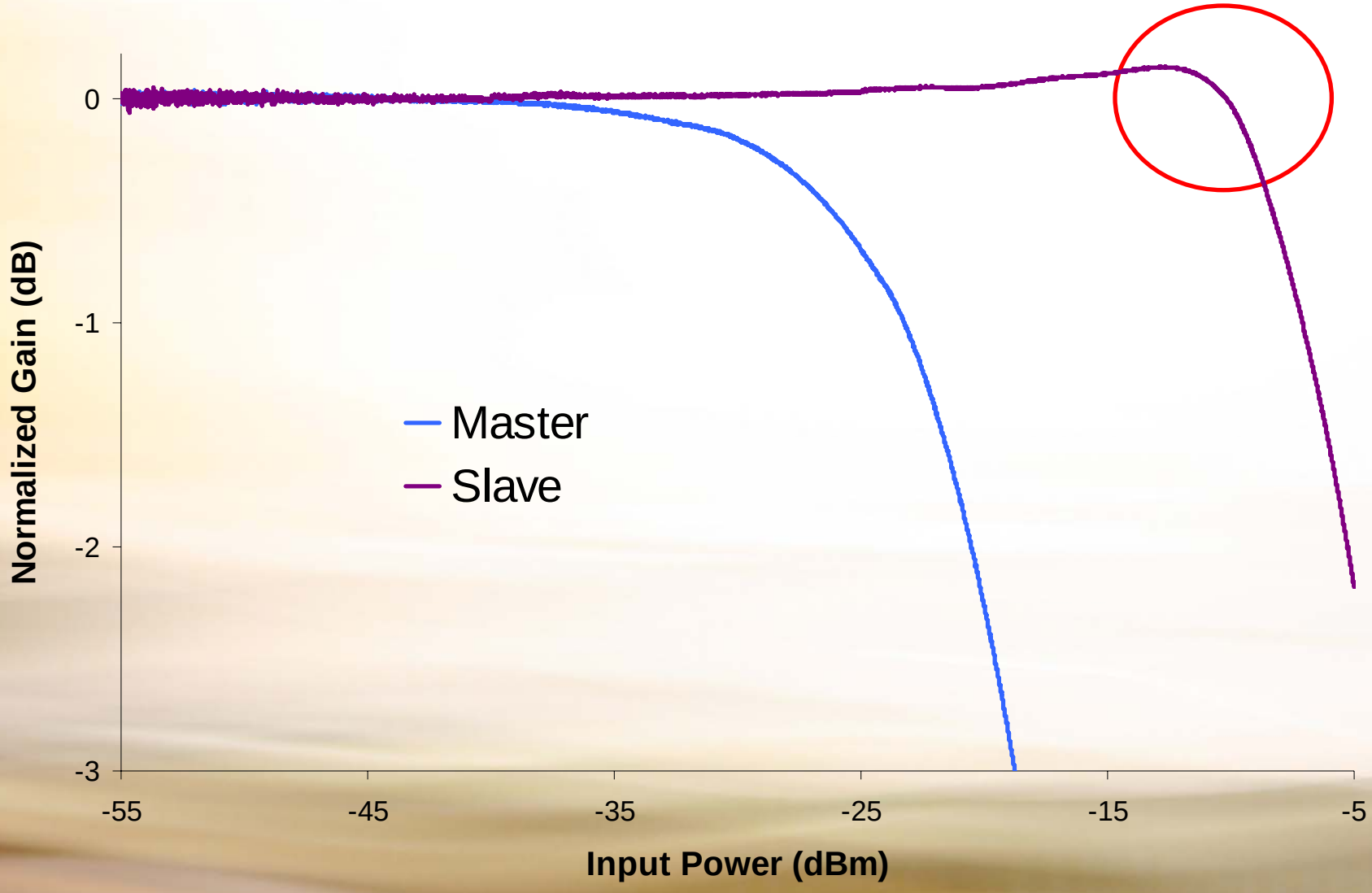

TWT
Master
0-16 dB
Time Delay
Coupling:
Step
Attenuator
0-69 dB
TWT
Slave
0-16 dB
Time Delay

Model v. Experiment

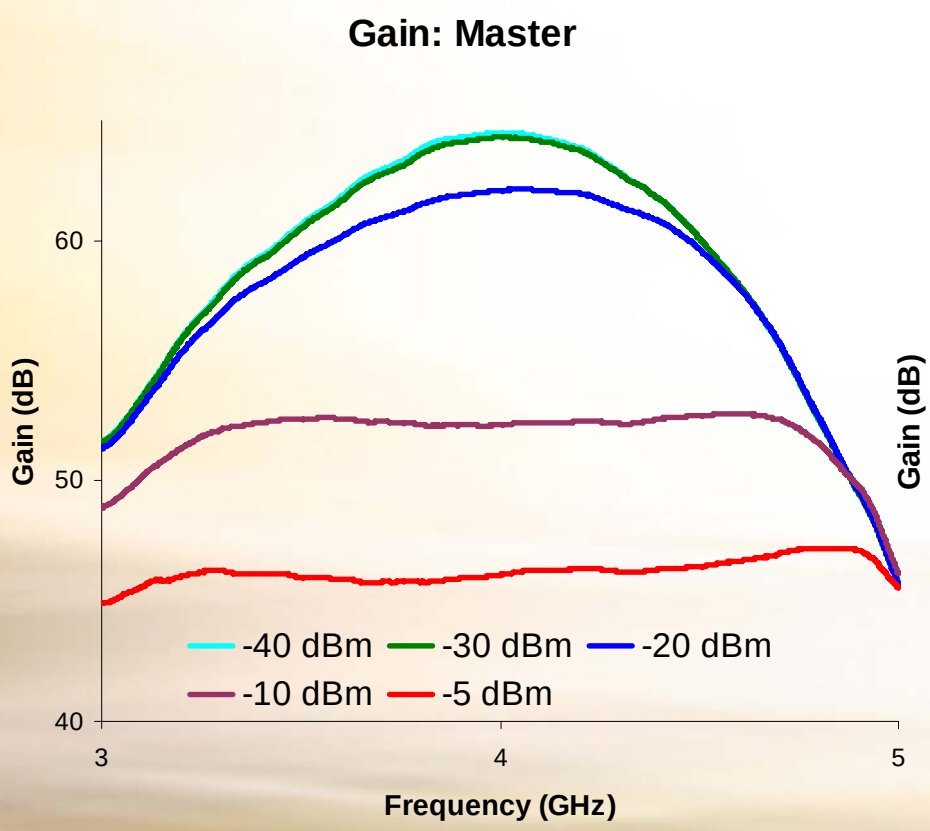
Ideal system: no inherent differences between transmitter and receiver

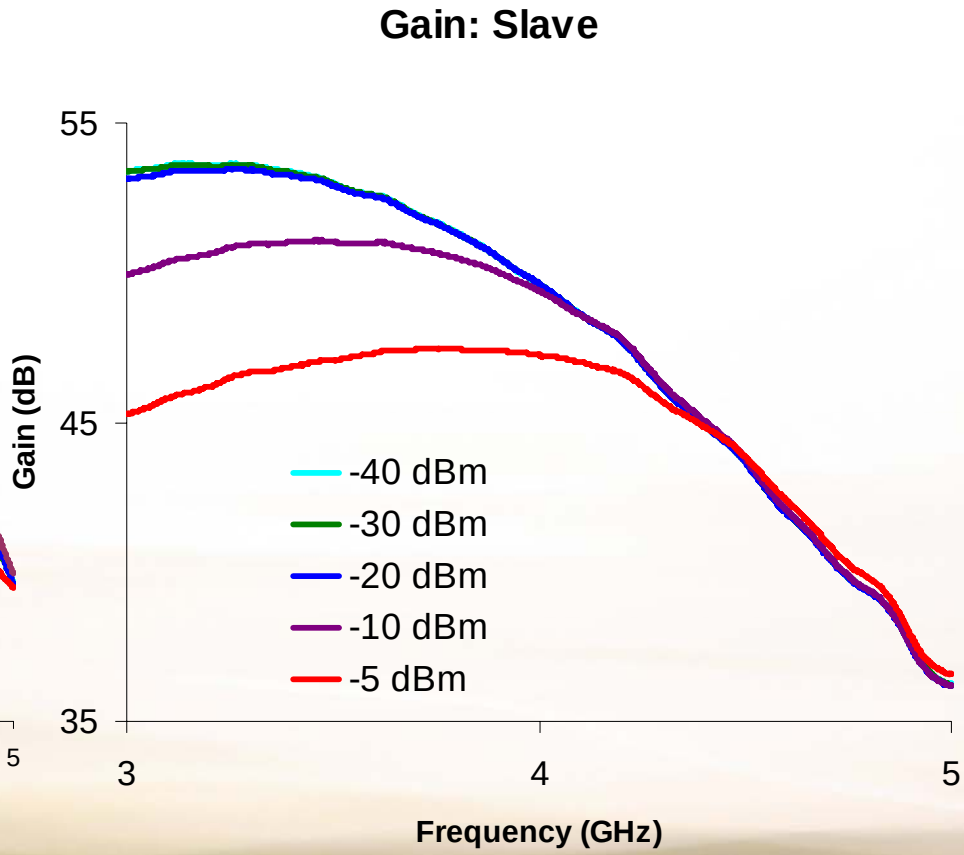
Reality: nonlinear characteristics are inherently different between manufactured TWTs

Gain Compression Comparison



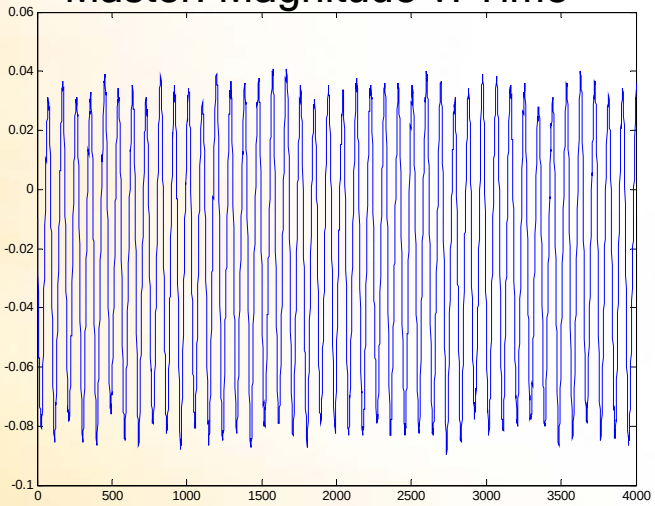
Frequency Characteristics



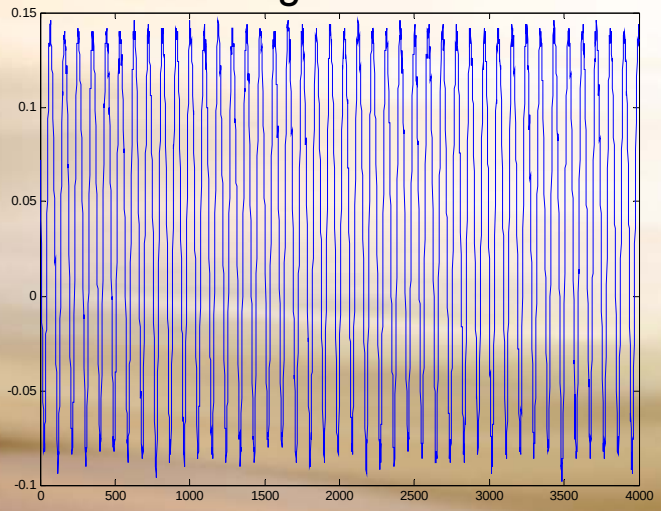


Synchronization in Experimental Data

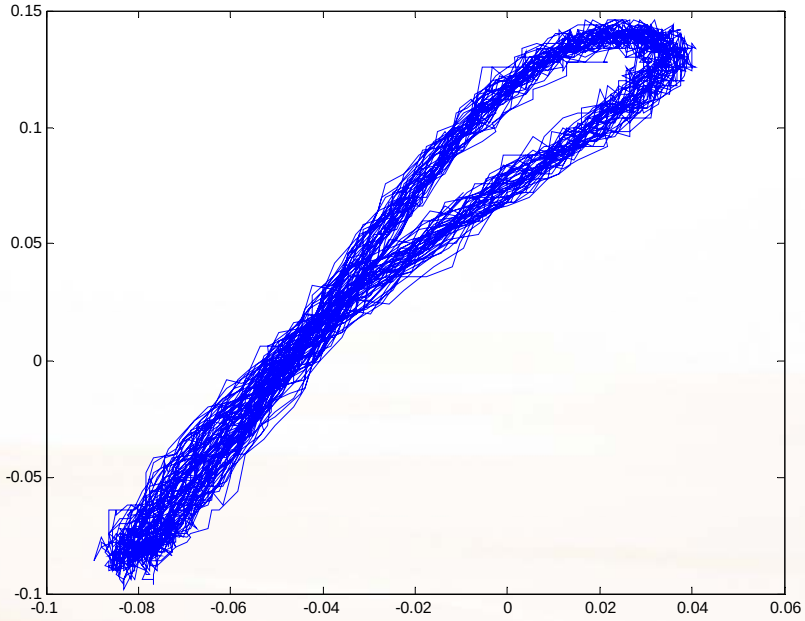
Master: Magnitude v. Time



Slave: Magnitude v. Time



Master v. Slave:
Amplitude/Phase Locking



Research

- Simulated a system of coupled TWTs with differing nonlinear characteristics to determine minimum coupling necessary to synchronize
- Measured phase synchronization of two coupled non-identical TWTs
- Examined the system at three stages of drive power to determine optimum synchronization
- Compared simulated and measured results