

# Adaptive Radio-Frequency and Plasma Lab (ARPL)



COLLEGE OF ENGINEERING  
THE UNIVERSITY OF TOLEDO

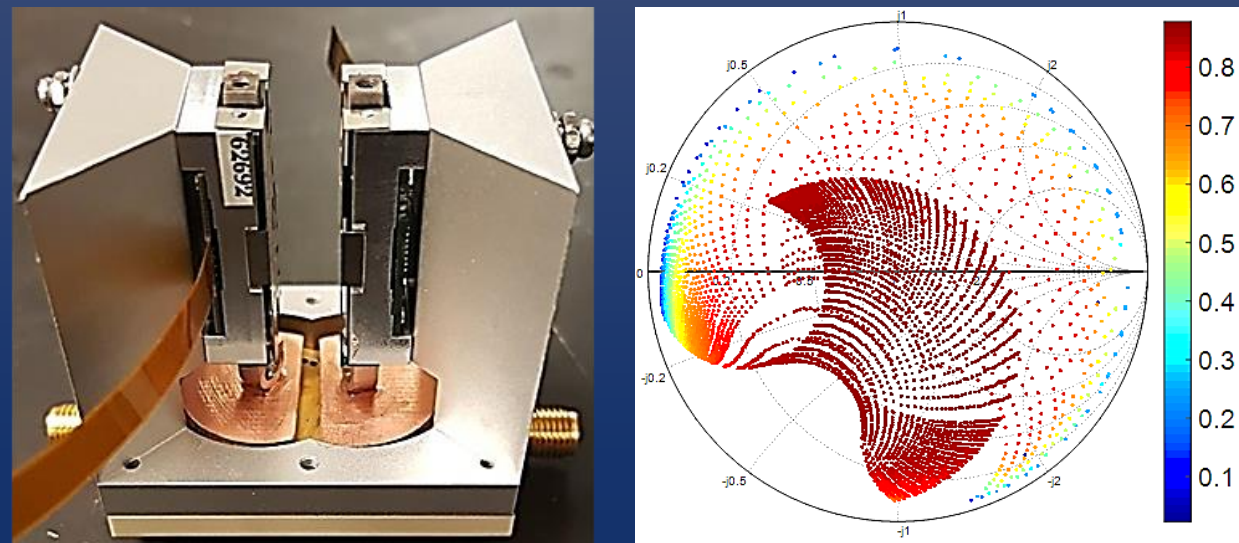
The University of Toledo, College of Engineering, EECS Department

## ARPL Mission

- The coming generations of multiband and multi-functional systems require high-performance, reliable and low-cost reconfigurable RF electronics.
- The current tuning technologies are suboptimal for high-power scenarios and difficult compromises are often required.
- Our targeted problem:  
**Tunable High-Power RF Electronics for Adaptive Multi-Functional Systems**

## Electronic Impedance Tuner

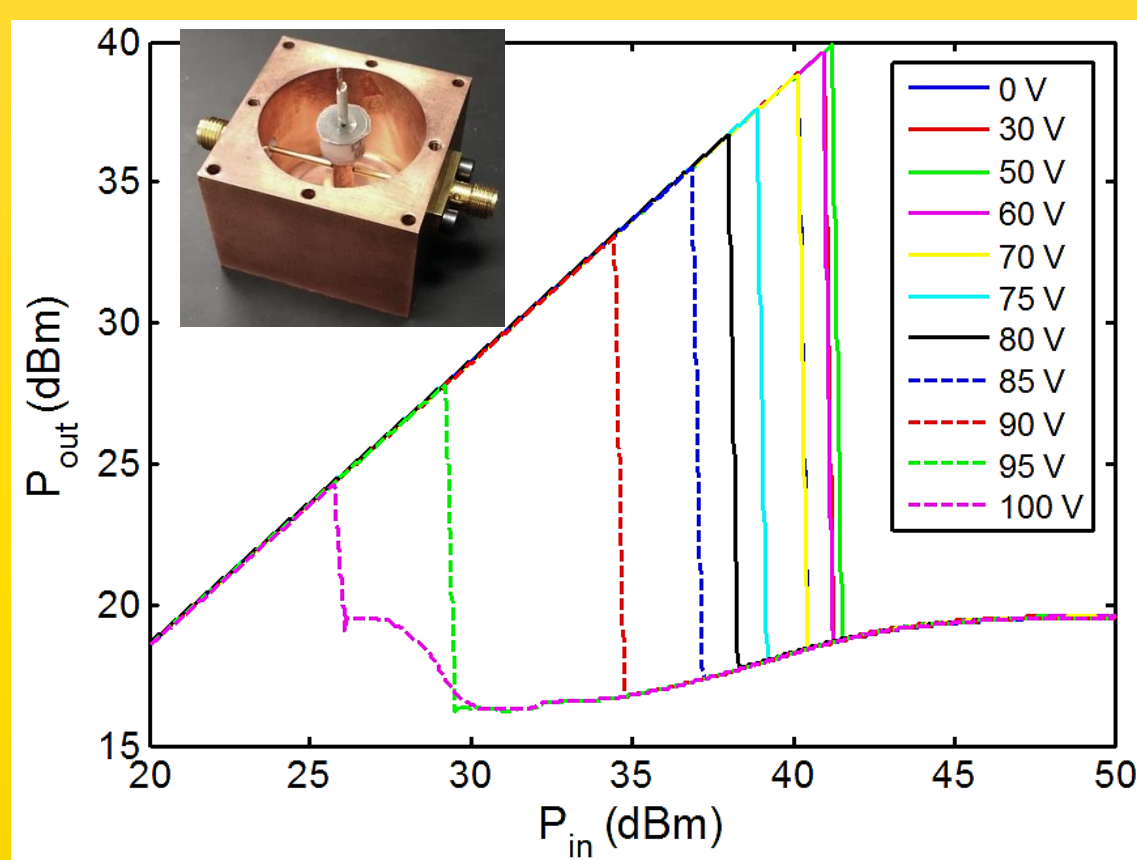
Impedance tuners are employed to achieve widely tunable complex loads.



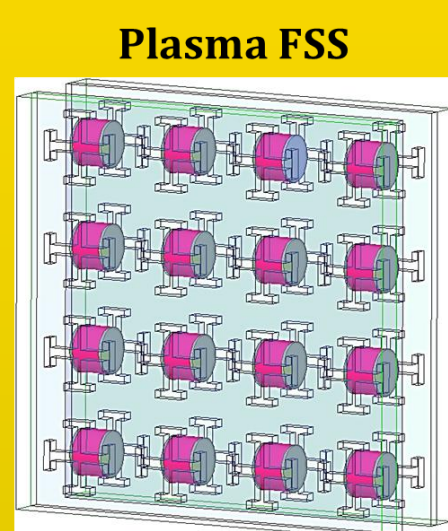
- wide coverage (> 90% of Smith Chart)
- high power (> 100 W)
- low loss (< 0.5 dB)
- highly linear (IIP3 > +64 dBm)
- wideband (> 52%, larger order wider BW)
- very stable performance
- tested with a SDR benchmark in the ARL

## Power Limiter & Protection

(against HPM and EMP)

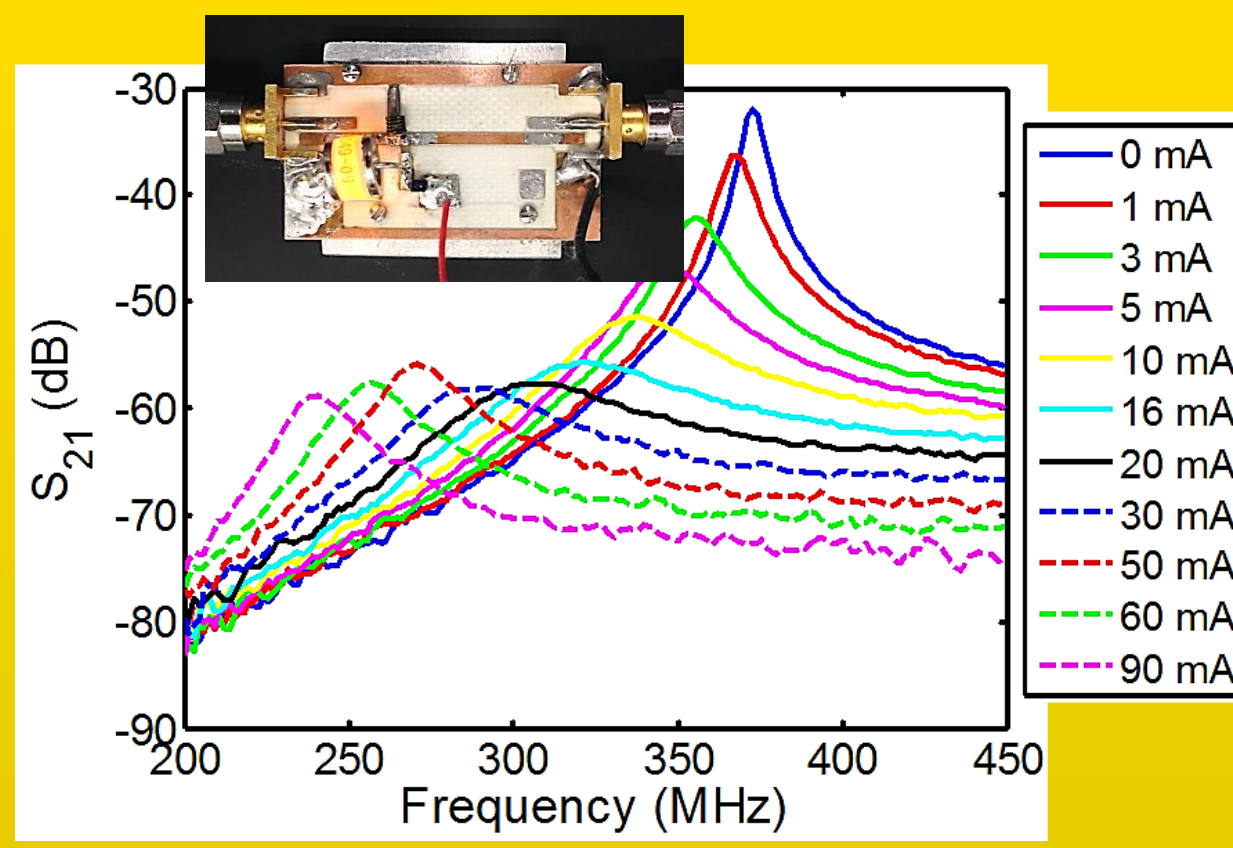
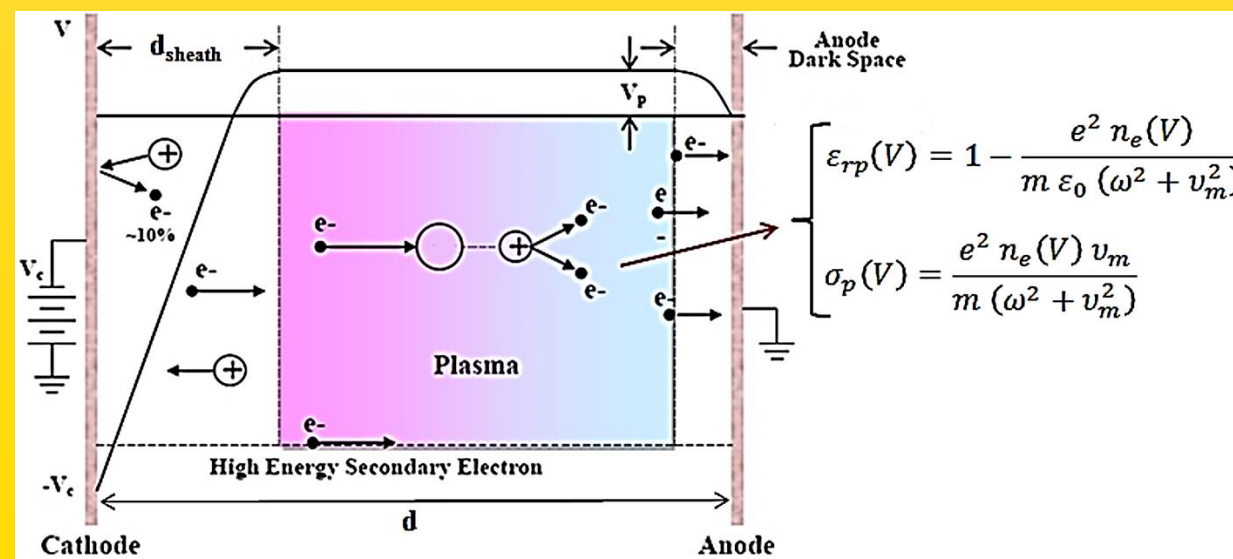


- ✓ self-sustained
- ✓ high power
- ✓ low loss
- ✓ tunable threshold
- ✓ nanosecond response
- ✓ stable performance



## Plasma Tuning

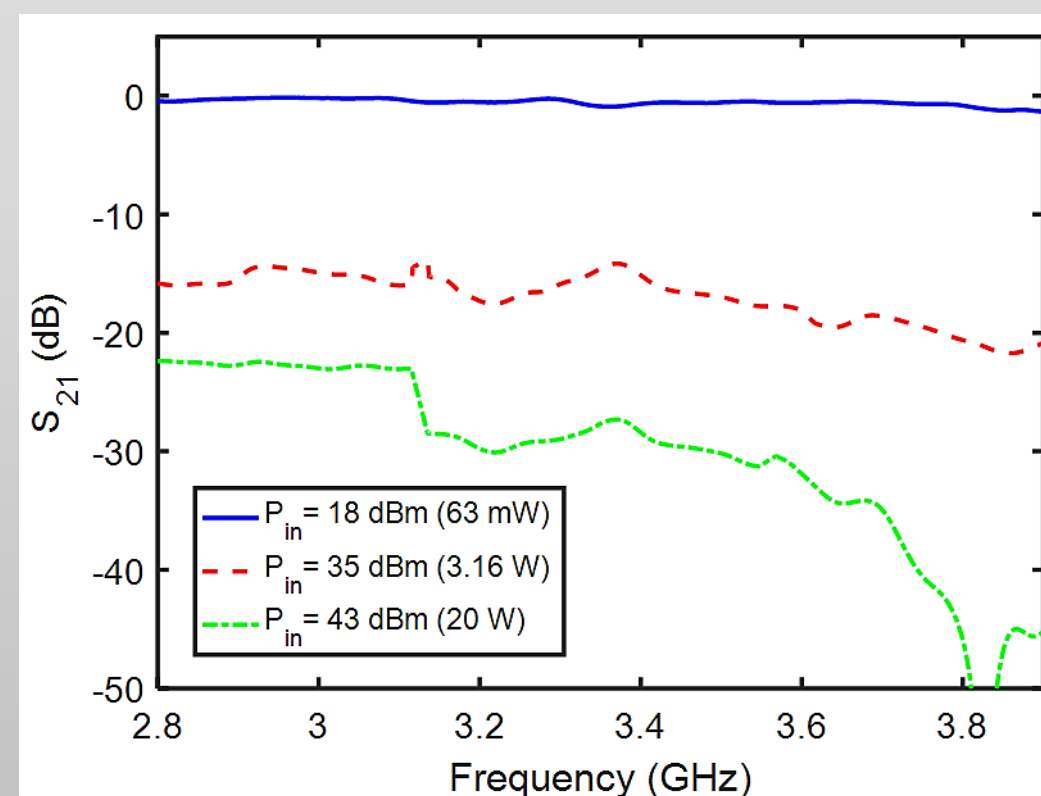
- Plasma EM properties and sheath thickness can be electronically tuned.



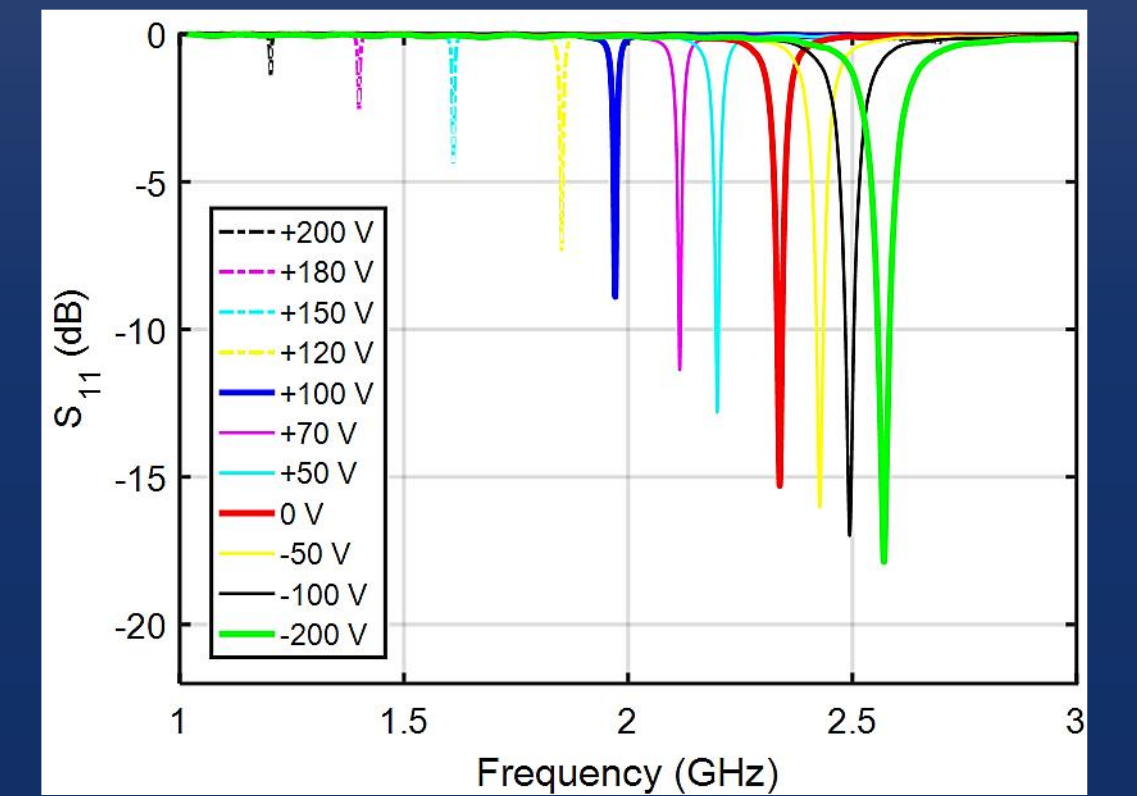
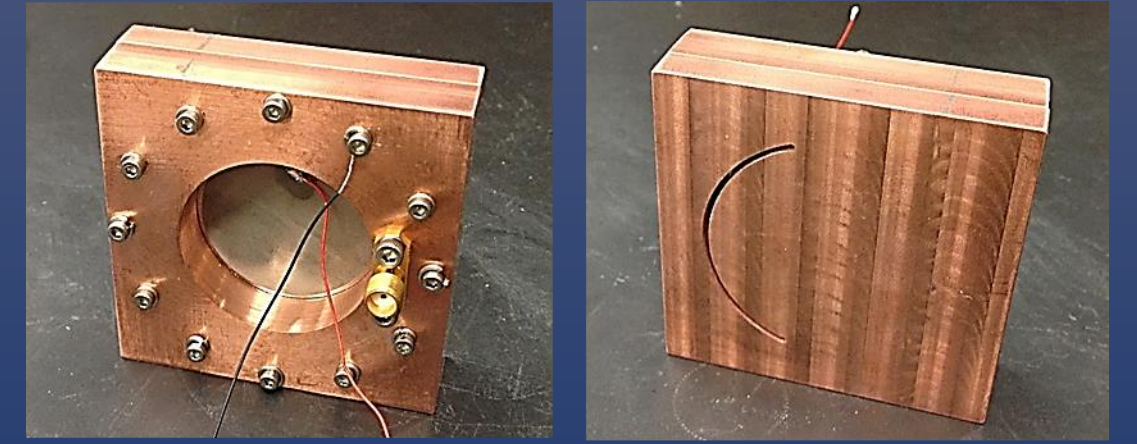
## Microwave Power Switching



- Resonant SPST
- S-band
- Plasma switching
- Quasi-absorptive
- $\alpha$ -discharge



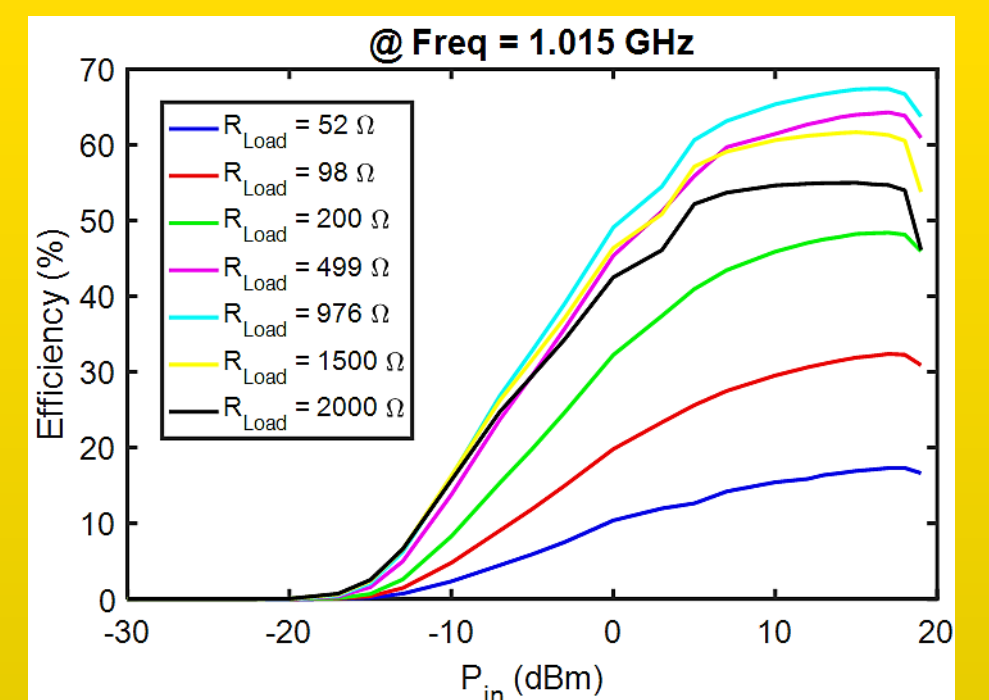
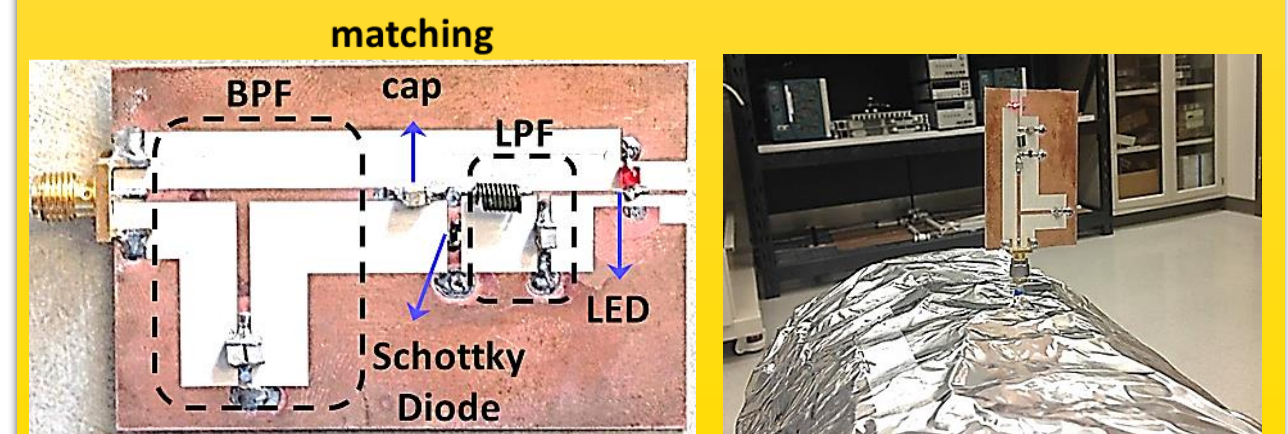
## Tunable High-Power Antenna



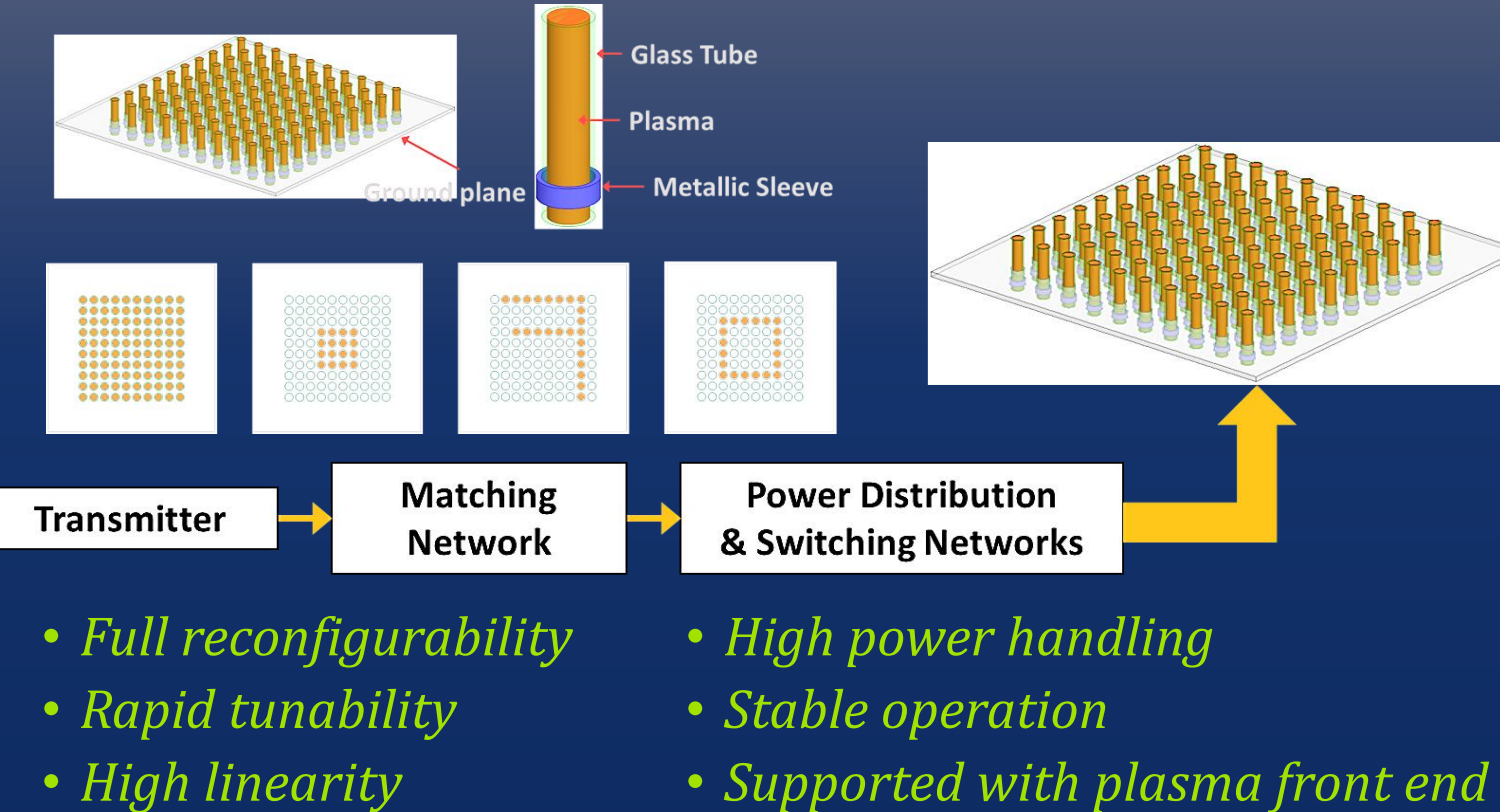
- a piezo-tunable EVA cavity resonator + an annular radiating slot
- 5 dBi gain and efficiency of > 85%
- realizable on PCB for integration
- both single and dual polarizations

## Wireless Power Transfer

Wireless powering of agricultural sensors



## Plasma Pixel Antenna



## Other Topics:

- wideband and efficient electrically-small antenna (ESA)
- plasma metamaterials
- inverse scattering and microwave imaging
- low-power microplasma sources
- field emitters for vacuum electronics
- modeling of EM/plasma
- low-cost RF sensors

## For more information:

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