



# The NCAR/EOL 449 MHz Wind Profilers

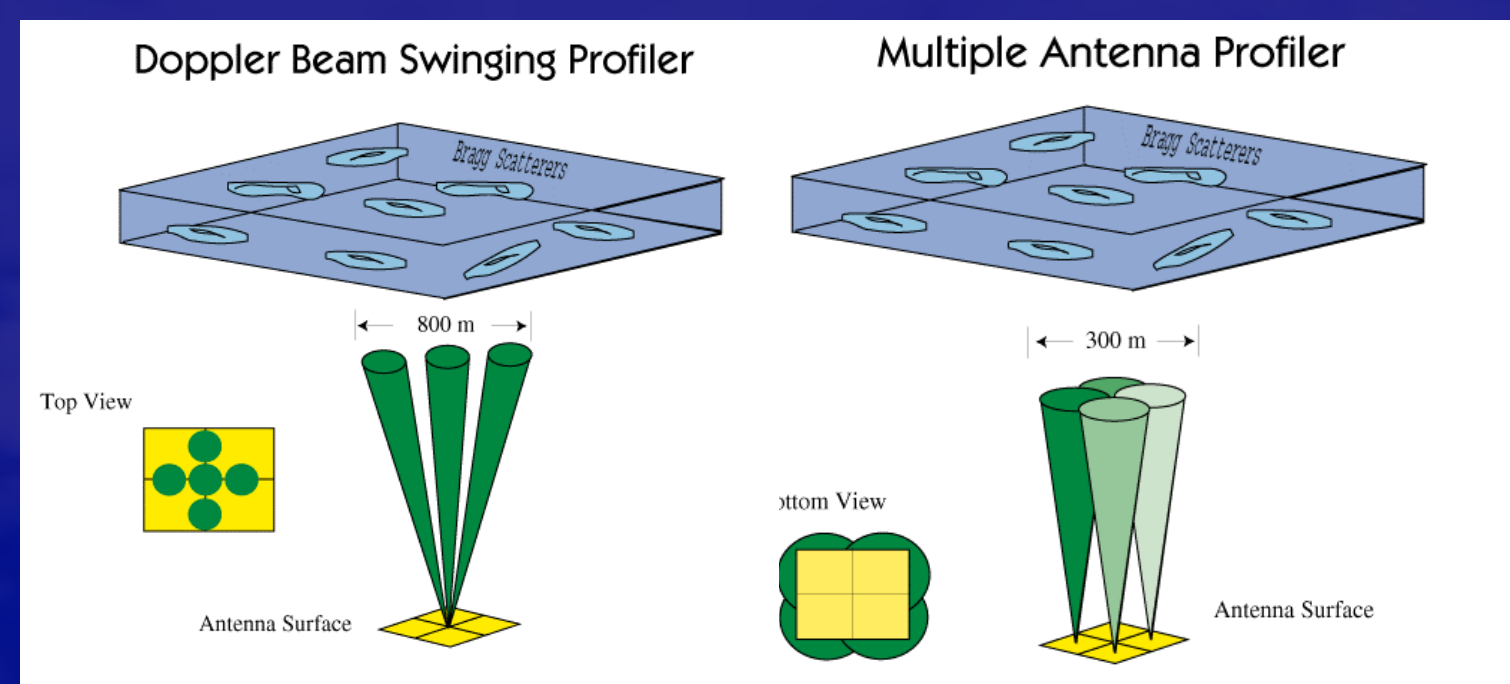
John Soltzak, William Brown, Alexander Lee, Gary Granger, Isabelle Suhr, Charlie Martin, Terry Hock, et al.  
National Center for Atmospheric Research's Earth Observing Laboratory  
Boulder, CO USA



## Spaced Antenna Method<sup>[1,2]</sup>

The NCAR/EOL 449 MHz wind profiling radars utilize a space antenna (SA) array method to calculate winds that has several advantages over traditional Doppler beam steering (DBS) profiling radars.

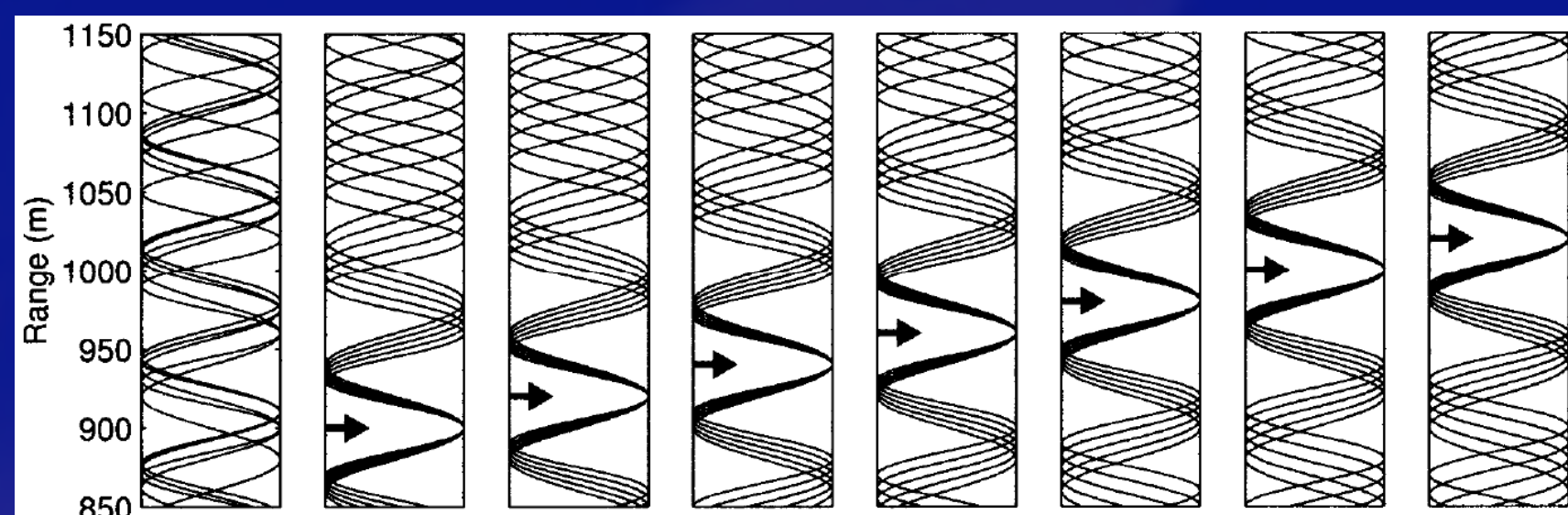
- DBS method assumes homogeneous wind field across wider area, especially at higher range gates.
- Using SA, the wind components are calculated from the time lag between antennas that maximized the cross-correlation of the received signals between antenna.
- Both allow the SA method to calculate winds at a higher temporal resolution and without the homogeneous assumption.



## Range Imaging<sup>[3,4]</sup>

Range Imaging (RIM) processing is available with the NCAR/EOL 449 MHz wind profiling radars.

- RIM uses closely spaced frequencies (frequency diversity) and frequency domain interferometry.
- Overcomes bandwidth/pulse length limitations in order to increase power on target without loss of range resolution.

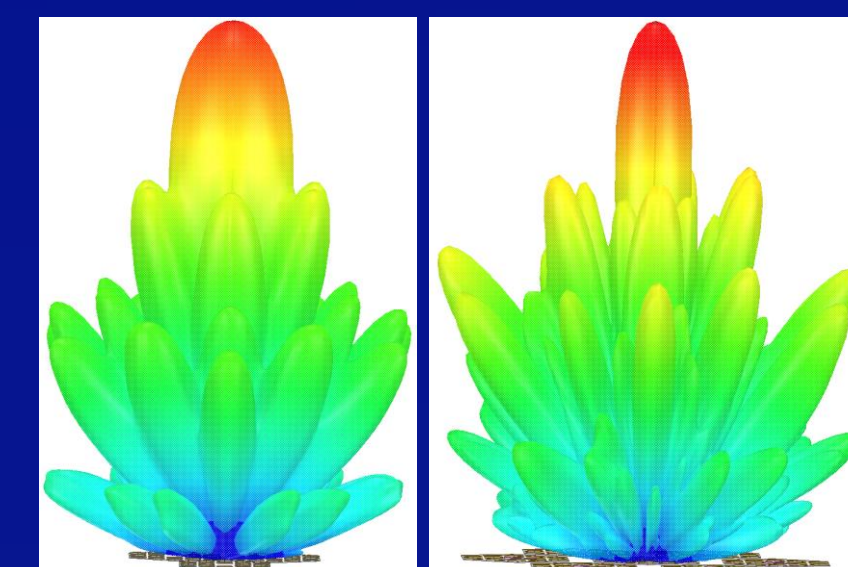
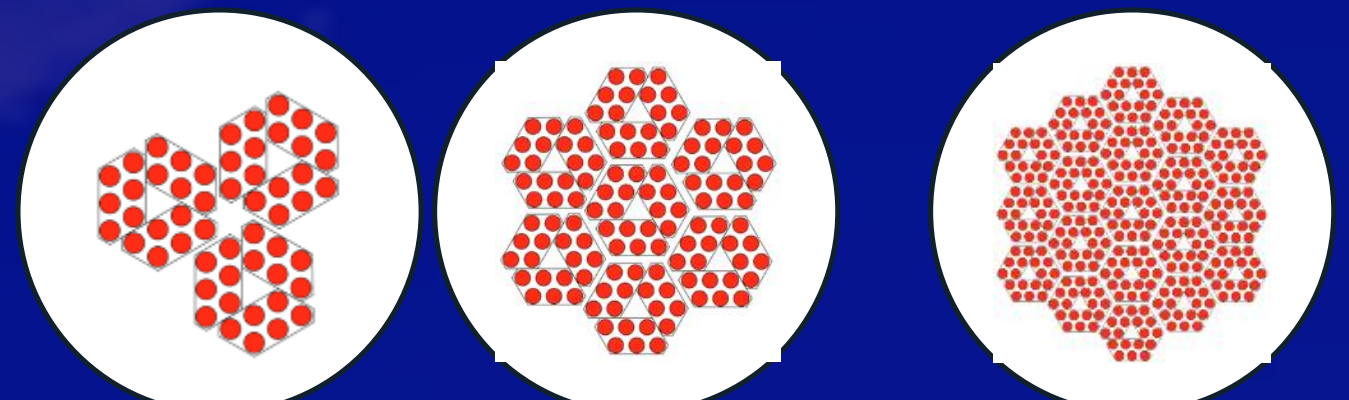


## Modular and Mobile 449 MHz Wind Profilers

### Modular 449 MHz Wind Profiler

- Modular design allows for flexible configurations.
  - Boundary layer: 3 - panels.
  - Mid-troposphere: 7 - panels.
  - Full troposphere: 19 - panels (future).
  - 2 kW and 5 kW transmitters available.
  - 1.4 kW per hexagon panel (future).

3-Panel Gain: 24.7 dB    7-Panel Gain: 27.8 dB    19-Panel (future) Gain: ≥ 30 dB (est.)



Hokitika, NZ  
DEEPWAVE 2014

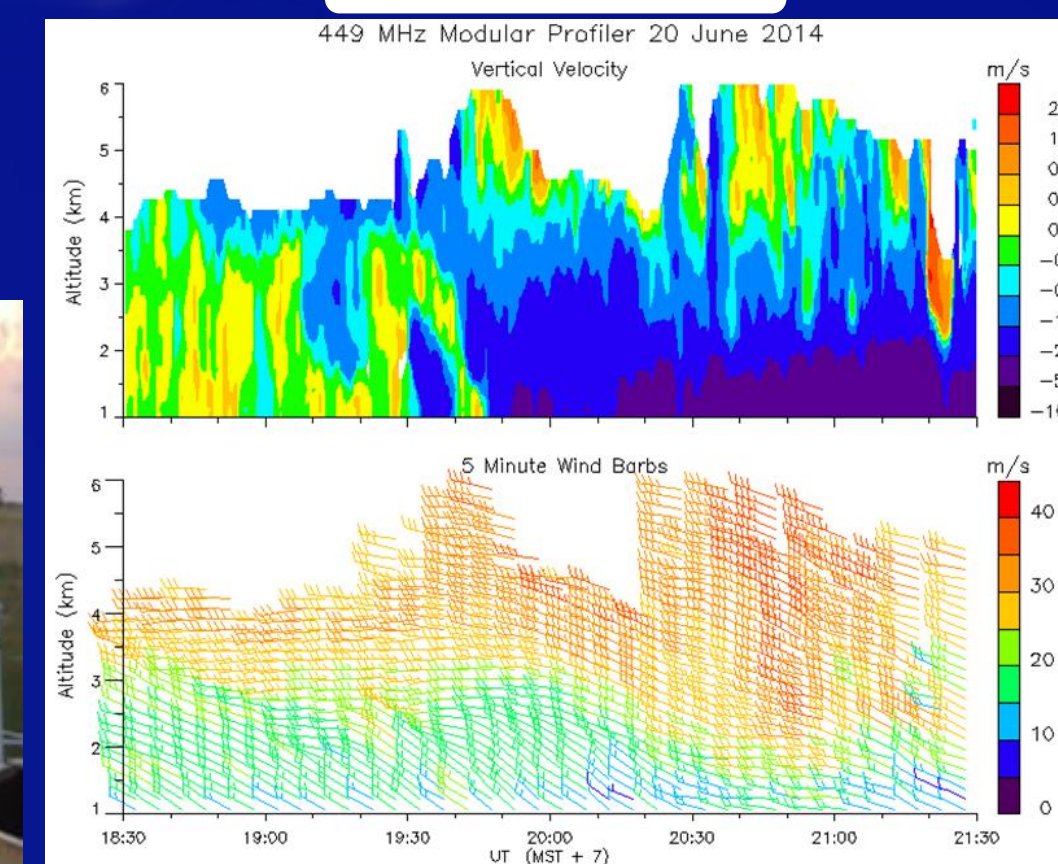
### Mobile 449 MHz Wind Profiler

- Vehicle or trailer mounted wind profiling radar.
  - Designed for chase operations.
  - Single antenna module.
  - Three 1400 W HPA modules.
  - Under development.



Hays, KS  
PECAN 2015

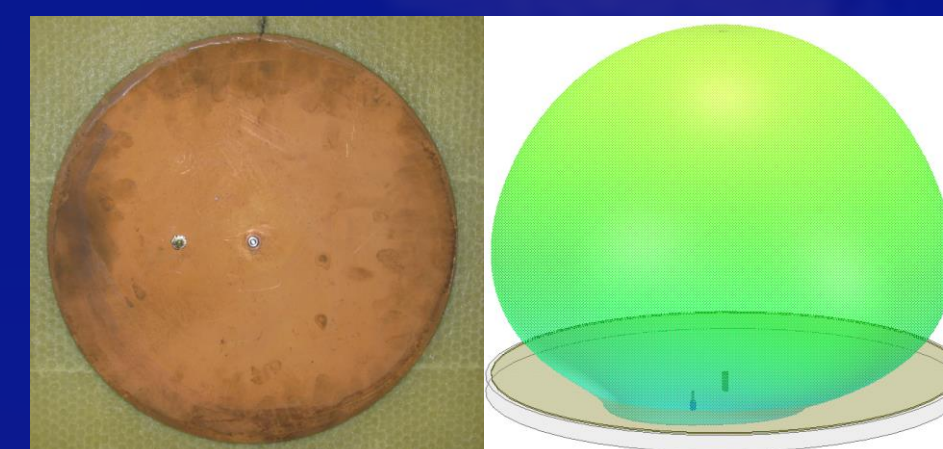
### Data Products



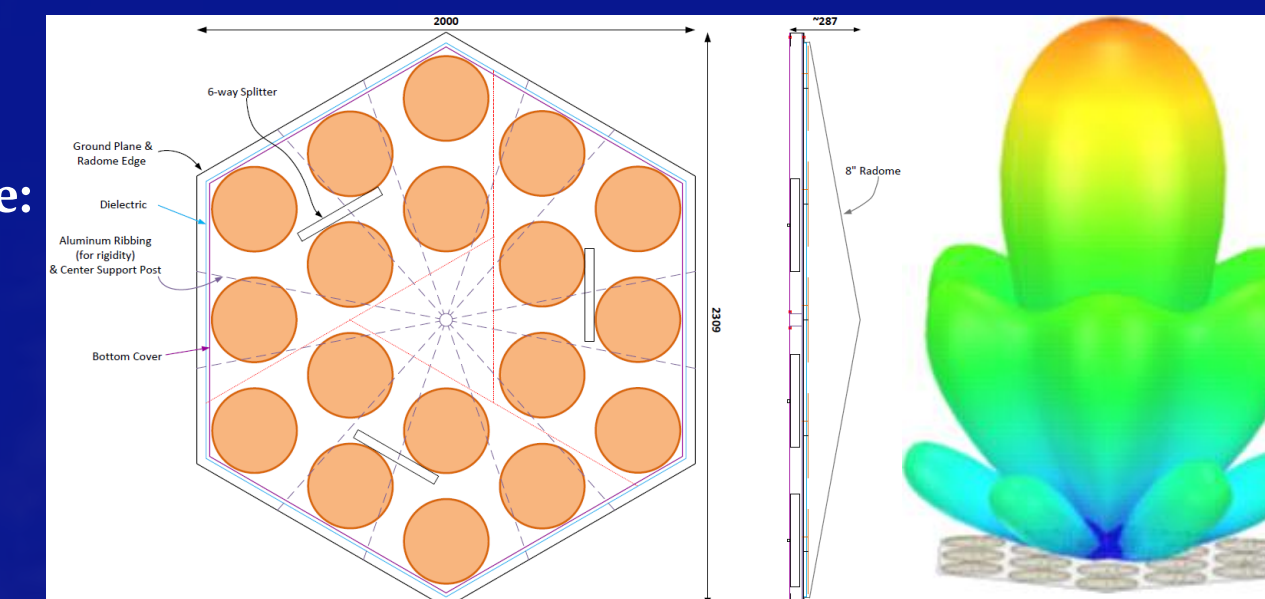
## Antenna Array Module

Hexagonal antenna modules made up of 18 circular patch elements fed in phase.

- Patch elements:
  - Dia. = 174 mm.
  - 12.7 mm thick substrate.
  - Gain: ~10 dB.



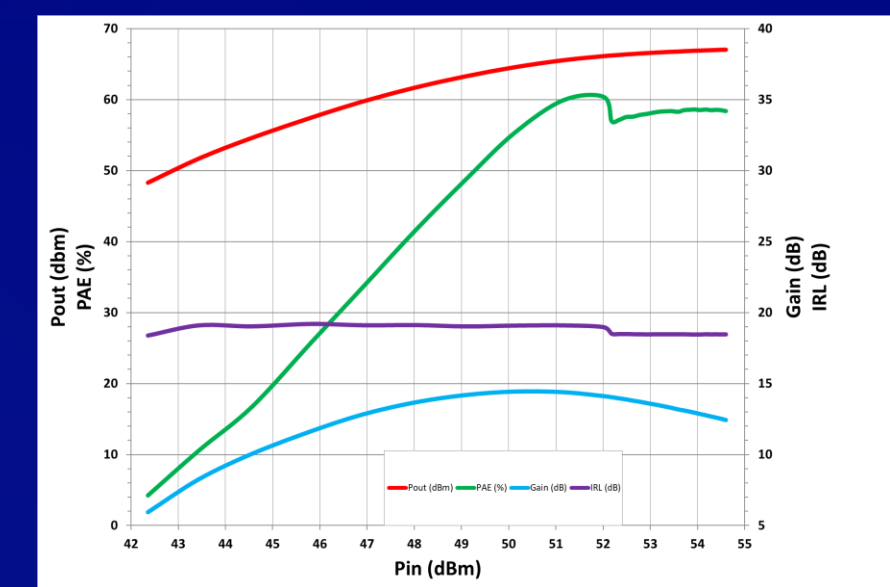
- 18 - element array module:
  - 2.3 meters across.
  - ≤ 300 mm tall.
  - Gain: ~19.9 dB.



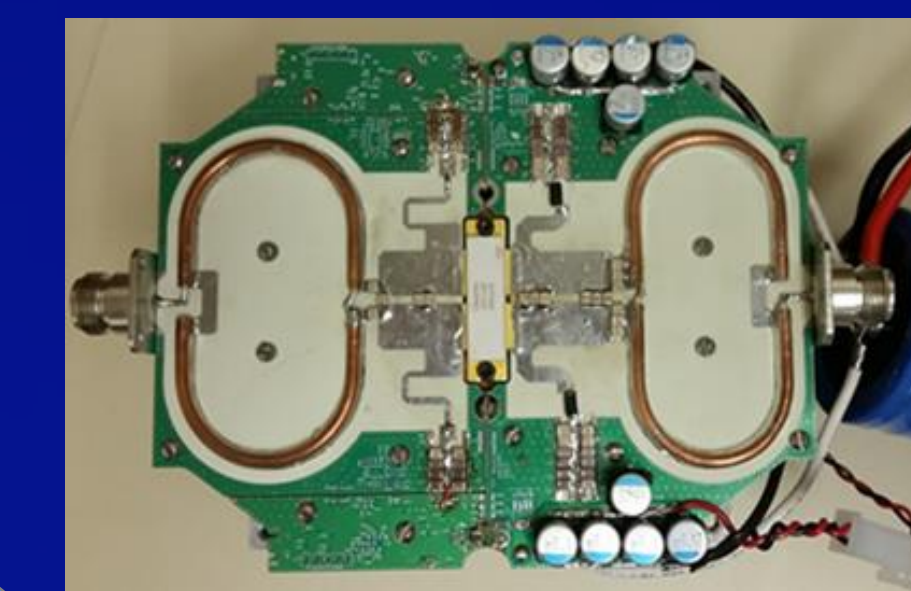
## HPA Module

449 MHz high-power amplifier (HPA) module for use in modular and mobile wind profilers.

- LDMOSFET based design.
- 1400 W RF power per module.
- 5000+ W amplifier:
  - P1dB: +67.0 dBm
  - RF Gain: 14.5 dB.
  - PAE: ≥ 60%
  - IRL: ≥ 17 dB



1400 W  
HPA Module



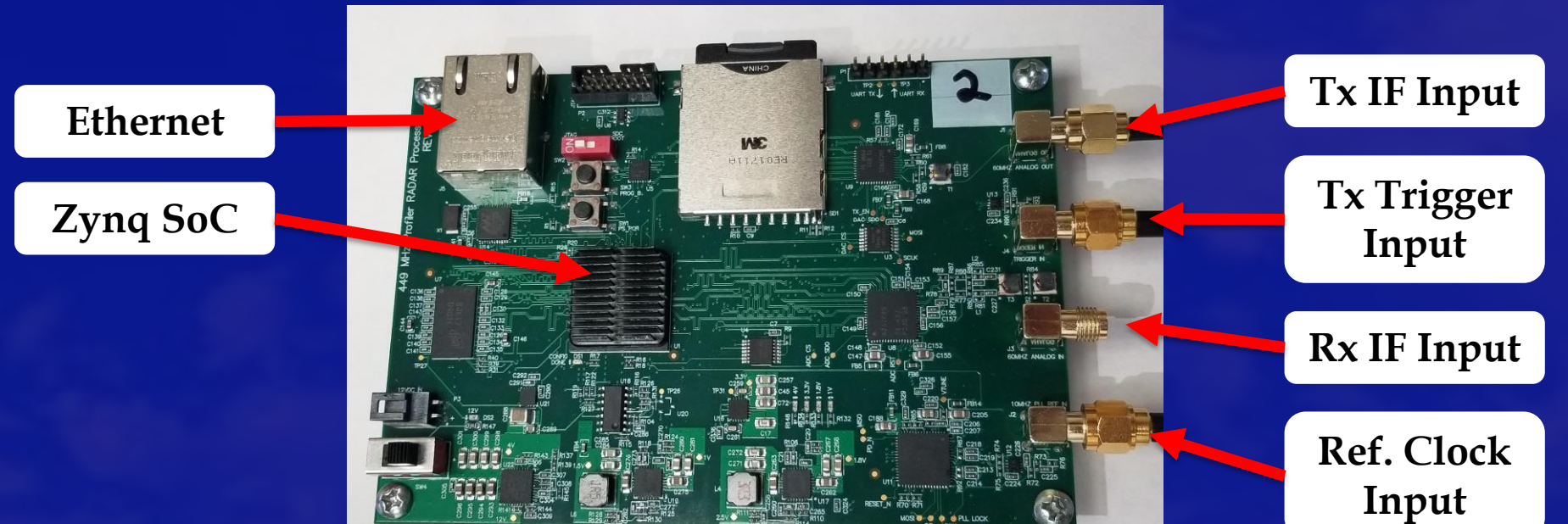
5000+ W  
HPA Module



## SDR Module

Xilinx Zynq System-on-Chip (SoC) based software defined radio (SDR) transceiver.

- 1 - Tx and 1 - Rx channel per module.
- Time synchronizing inputs.
- Ethernet backhaul to host computer.



[1] S. A. Cohn, et al, Validation of a UHF spaced antenna wind profiler for high-resolution boundary layer observations, Radio Sci., vol. 32, no. 3, pp. 1279-1296, 1997.

[2] S. A. Cohn, C. L. Hallway, and R. J. Doviak, High time-resolution wind profiling with the NCAR/ARM MAPR, Abstracts, Atmos. Radiation Meas. Program Science Team Meeting, San Antonio, TX, March 1996, pg. 24.

[3] Palmer, R. D., T.-Y. Yu, and P. B. Chilson, Range imaging using frequency diversity, Radio Sci., vol. 34, no. 6, pp. 1485-1496, 1999.

[4] P. B. Chilson, et al, Implementation and validation of range imaging on a UHF radar wind profiler, J. of Atmos. and Oceanic Tech., vol. 20, no. 7, pp. 987-996, 2003.