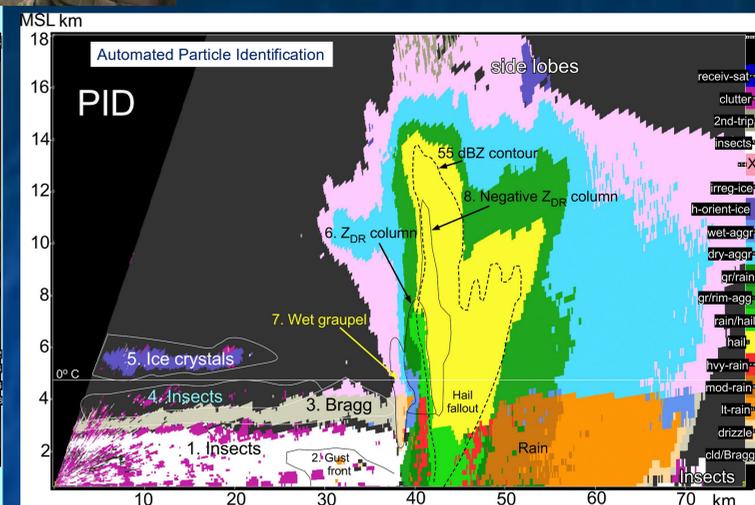
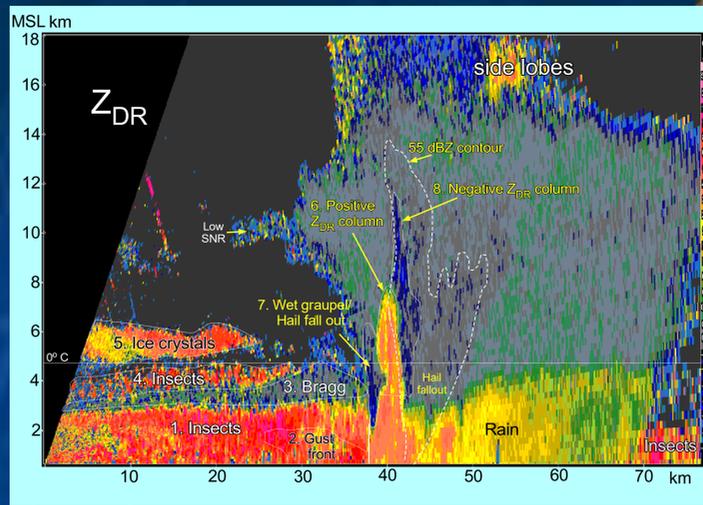
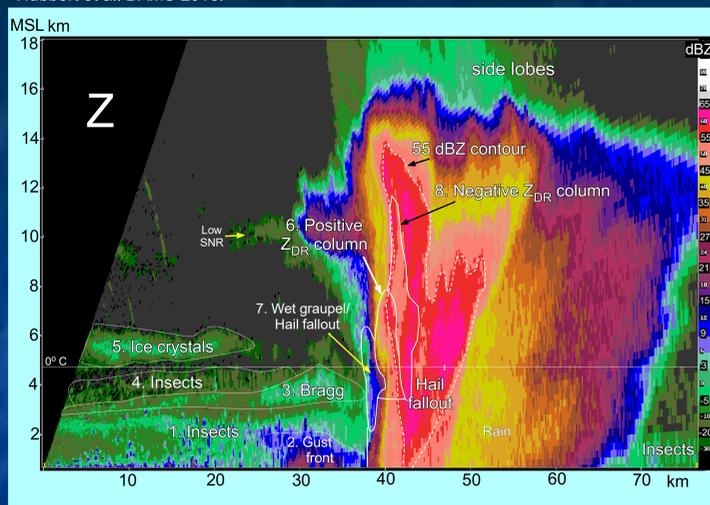


Hubbert et al. BAMS 2018.

# The Importance of S-Pol for Community Atmospheric Science Research

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"Directly proportional to data quality, quality science is. Hmm"



S-Pol measurements through large hailstorm in Kansas during PECAN, 2015

## INTRODUCTION

S-Pol is the only S-band (10 cm) radar with a narrow antenna beamwidth that is available to the NSF research community via the LAOF supported by NSF NCAR.

Its long wavelength provides *minimal attenuation* with *high data quality* through large storms and is very desirable for *microphysical interpretation*.

## S-Pol FEATURES

- Superior polarimetric performance
- Minimal attenuation (compare C and X bands)
- Scientist controlled scanning
- Fast alternating H/V (FHV) transmission (simultaneous and SPRT too)
- FHV mode: copolar receivers
- Superior Zdr calibration and Zdr estimates
- 150m range sampling
- Transportable
- Klystron – low noise
- 0.93° beamwidth
- RHIs and vertical pointing scans
- Radome-free operations
- Remotely operable
- Calibration stability
- Sensitivity to clear air boundaries
- Time series recording

## Science Enabled by S-Pol

- Mountain meteorology
- Fire weather
- Tropical meteorology
- Convection initiation
- Mesoscale meteorology
- Boundary layer meteorology
- Precipitation microphysics
- Storm Dynamics and Kinematics
- Model evaluation and data assimilation
- Radar software and algorithm development
- Refractivity measurements

## Education, Training, Outreach

S-Pol as an NSF Educational/Testbed Facility at the Marshall Field Site

- MTEC: Marshall Testbed and Education (in planning stage)
- S-Pol data in conjunction with other Marshall instrumentation
- Training with hands-on experience on radar technology, signal processing, data quality control, and scanning strategies, with possibility of **remote radar control at Universities (or anywhere)**



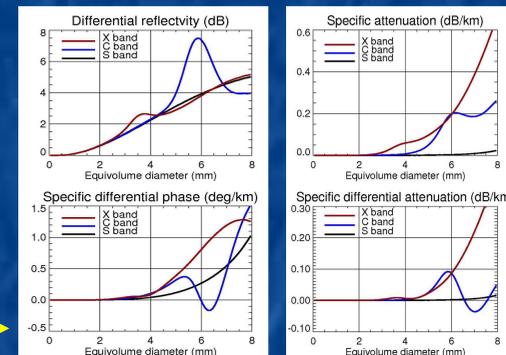
## Possible Future Upgrade

An INEXPENSIVE S-POL IMPROVEMENT: S and C BAND Dual-wavelength Observations for Increase Microphysical Information

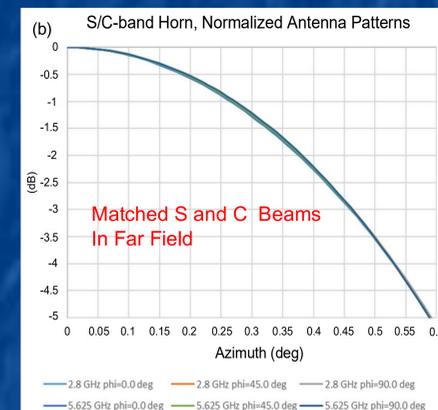
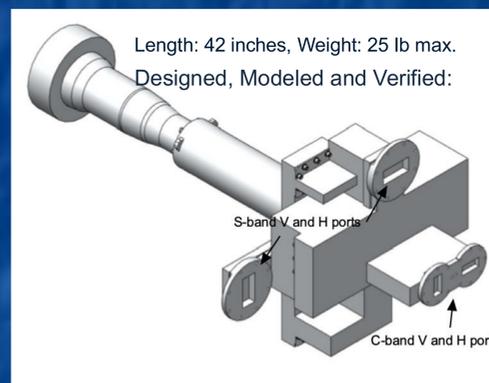
HOW TO MAKE S-POL DUAL WAVELENGTH RADAR??

ANSWER: Dual frequency feed horn with **MATCHED FAR FIELD MAIN BEAMS!**

Example Resonant Scattering Effects at S, C and X bands From Ryzhkov & Zrnich



The combination of S- and C-Band wavelengths significantly increase the microphysical information of precipitation particles. This has been demonstrated in several studies using **OU-Prime** data (C Band operated by the University of Oklahoma) and **KOUN** data (S Band, NEXRAD). There are modeling studies comparing precipitation particle scattering at S and C Band, which show that different sized/phase particles have significantly different radar signatures. These different scattering signatures can be leveraged to glean more information about the precipitation particles thereby enhancing not only resolution volume composition estimation but also general storm structure and dynamics.



- Improved particle identification and their trajectories due to C-band resonance scattering with S-band reference (e.g., improved hail detection/sizing).
- Increased unambiguous velocity due to dual wavelength (56 m/s or more).
- Canted ice crystal identification (i.e., electrification)
- Validation of forward operators in polarimetric emulators
- Dual wavelength spectral polarimetry
- Matched beam makes possible comparison of propagation variables (phidp and diff. atten.)
- Cost effective: about \$700k in parts
- Complements MTEC and student education

## Why is S-Pol Strategically Important to the NSF Community?

- The only long-wavelength radar available to the NSF community
- Limited attenuation, high DQ, polarimetric reference standard
- Scientist-controlled radar scans and operations
- Fast alternating H/V transmission for artifact free data
- A deployable facility for remote campaigns
- Scientific integrity and measurement robustness
- A training platform for scientists, engineers and graduate students
- A calibration benchmark for other radar systems
- A radome-free polarimetric reference system
- An S-Pol equivalent phased array radar would cost ~\$70 to \$100M

