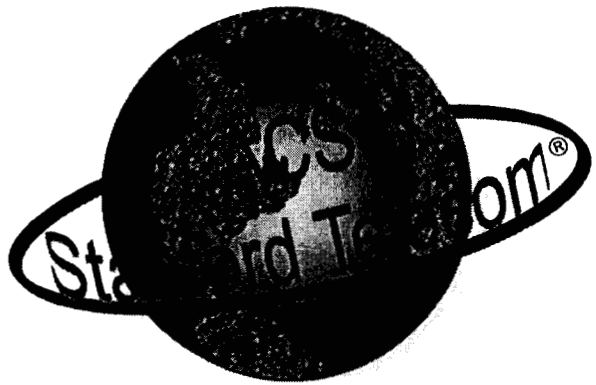


ACS/STel Depolarization Experiment

June 3, 1999

Cynthia Grinder

Introduction

- **Experiment**
  - Utilize the NASA ACTS to provide measurements for the evaluation of rain, ice and cloud degradations on a Ka-band space to ground link.
  - Make the first rain and ice depolarization measurements in the Washington DC area.
  - Utilize Parallel Weather Measurements
    - Dulles Radiosonde Data, FSL Forecast Data, RTNEPH Cloud Data, NOWRAD Precipitation Data, APT Radiometer and weather gauges.

Introduction - cont...

- **Background**
  - ACTS Program developed by NASA to Study Propagation Effects on Ka-Band SGLs
  - 5 Years of Co-polarized Attenuation (CPA) data collection completed Dec 1, 1998
  - ACTS Satellite in operation until June 1, 2000
    - N-S station keeping turned-off Aug 1998
    - Expect ~0.8°/year drift
    - NASA designed orbital tracking system for APT
  - NASA Glenn has granted STel use of the Reston, VA and White Sands, NM APTs for Dual-Polarization Measurements

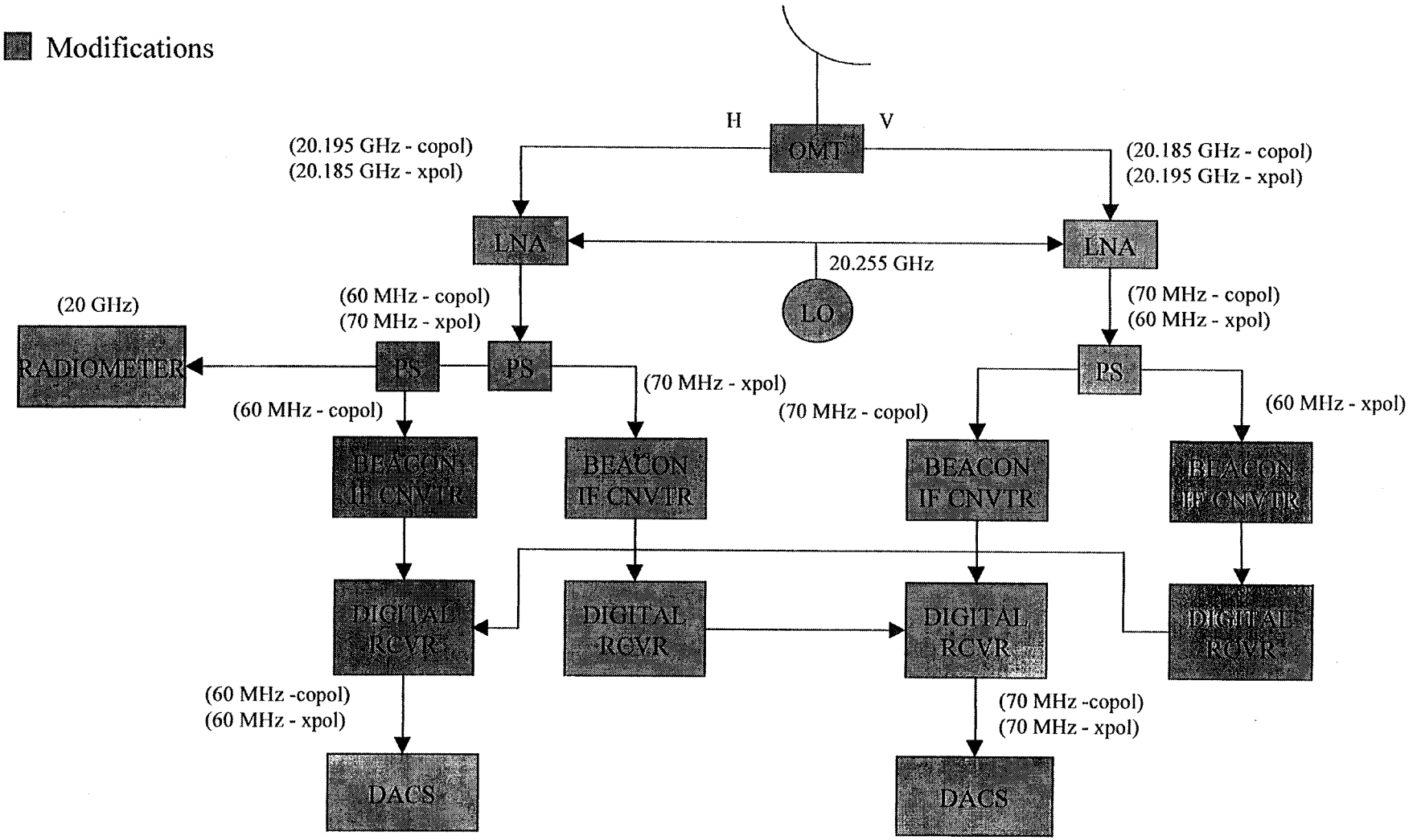
STel Depolarization Experiment

- **STel upgraded APT for Tracking and 20 GHz Dual Polarization Measurements**
  - Moved Reston APT to STel's Ashburn Research Facility (February 1999)
  - NASA Installed Orbital Tracking Hardware (April 1999)
  - Modified terminal for dual-pol measurements (May 19-21, 1999)
    - White Sands APT required for two additional IF chains
    - STel Contracted Dave Westenhaver (WWW, Inc.) for dual-pol upgrades
  - Started depolarization data collection (May 21, 1999)
  - Cover will be installed to avoid wet antenna and feed effects (June 1999)
  - Data will be analyzed on a monthly basis as well as during single hydrometeor events

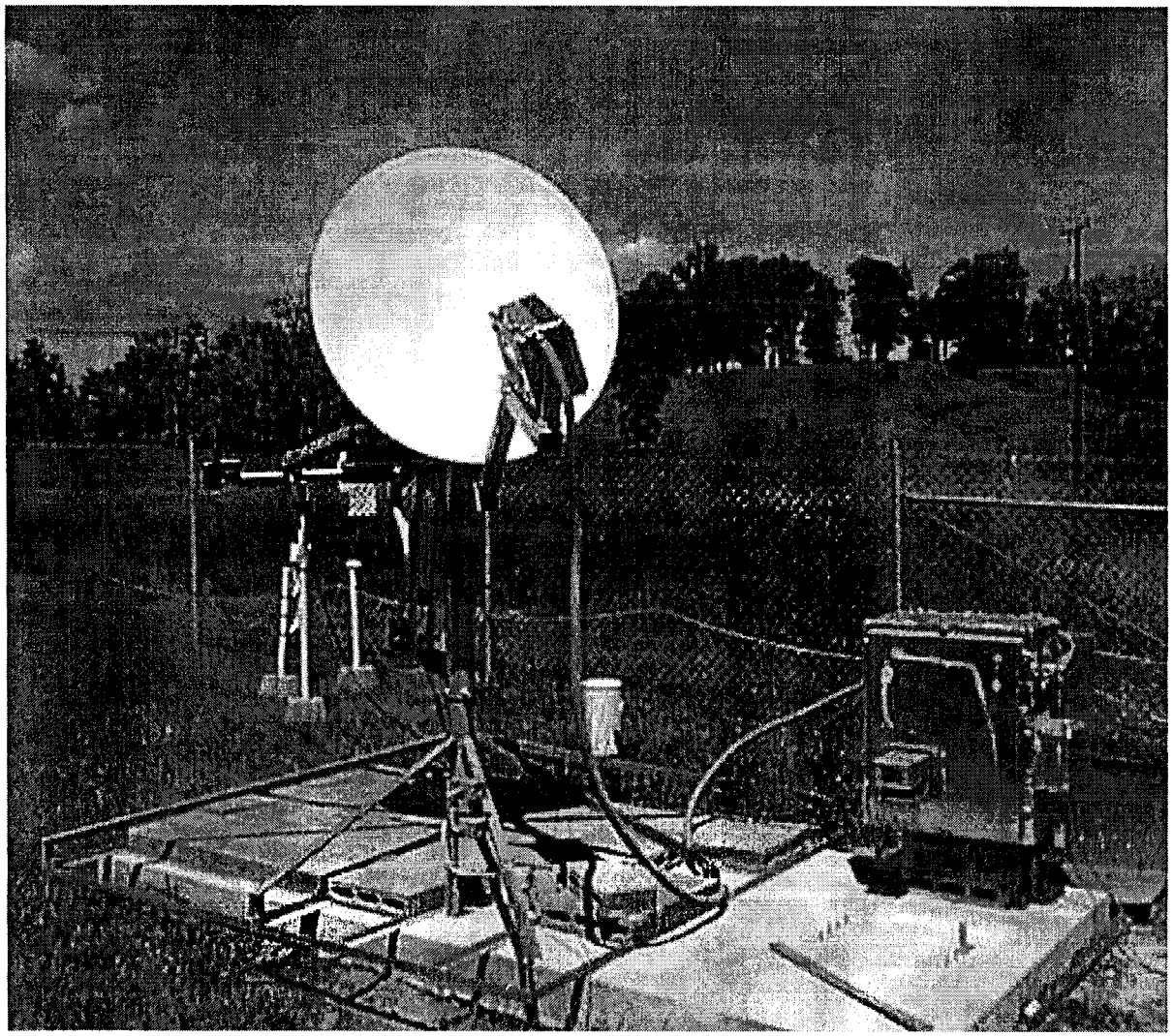
STel's Dual-Pol ACTS Specifications

- **Measured Parameters**
  - CPA Magnitude and XPD Magnitude & Phase
    - Full Atmospheric Depolarization Characterization at 20 GHz
      - 20.185 GHz: transmit vertical, receive horizontal & vertical polarization
      - 20.195 GHz: transmit horizontal, receive horizontal & vertical polarization
    - 1 sample per second recording standard
    - Up to 20 samples per second recording mode available
  - Radiometer: 20 GHz
  - Weather: Rain rate (CRG, TBG), Temperature, Relative Humidity, Wind Vector, Barometric Pressure
- **Site Specific Parameters for Ashburn, VA**
  - Elevation Angle: 39.2°, Azimuth: 213.3°, Polarization Tilt: 25.65°
  - Altitude: 250 m, Latitude: 39.01° N and Longitude: 77.33° W
  - Measured Isolation: ~30dB @ 20 GHz

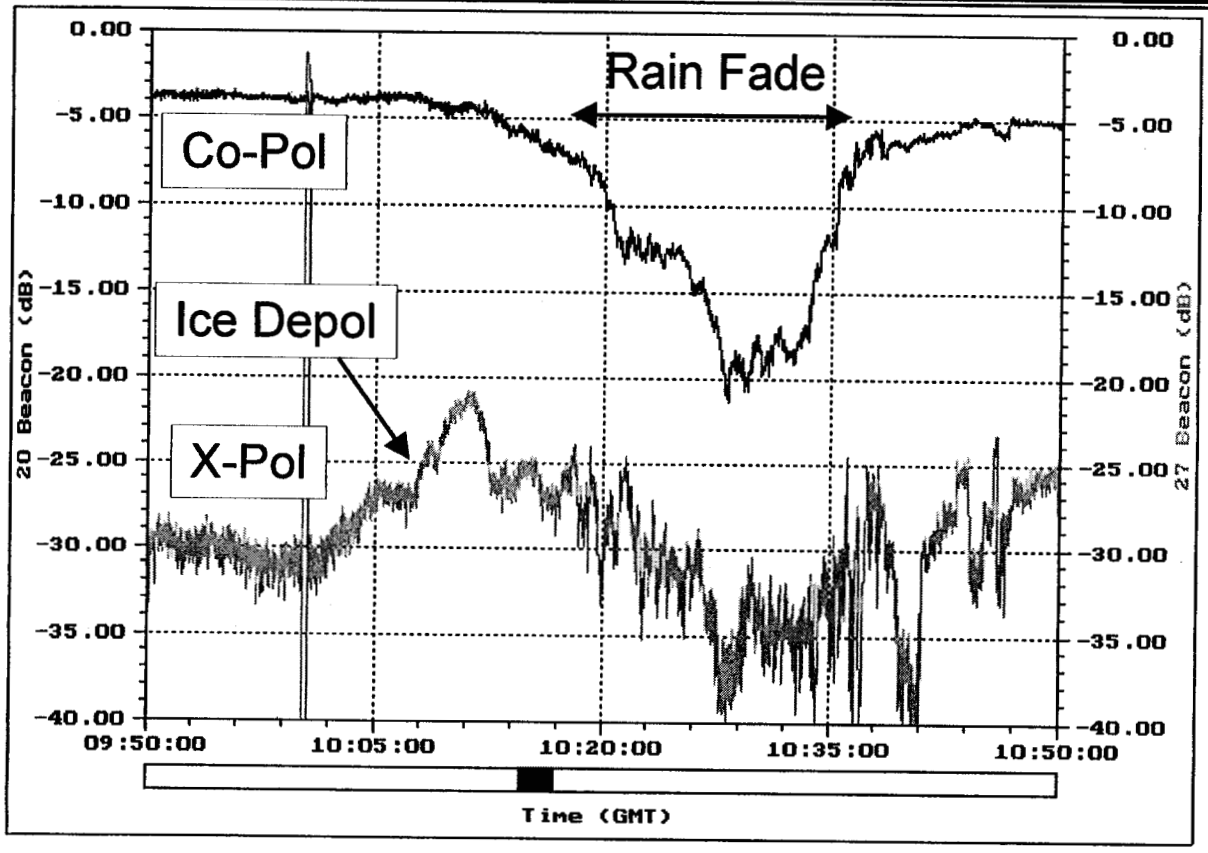
ACTS Modified Terminal Block Diagram



Depolarization Measurement System

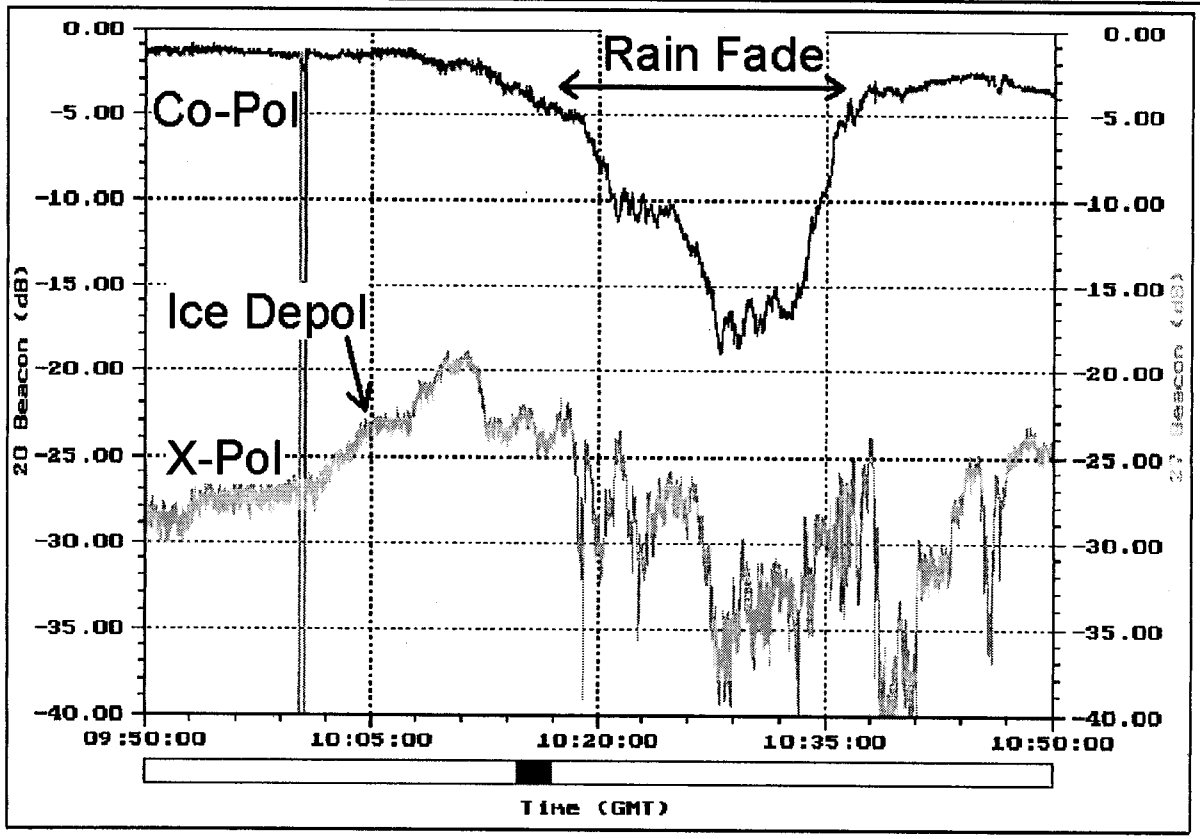


Rain event 5/24/99



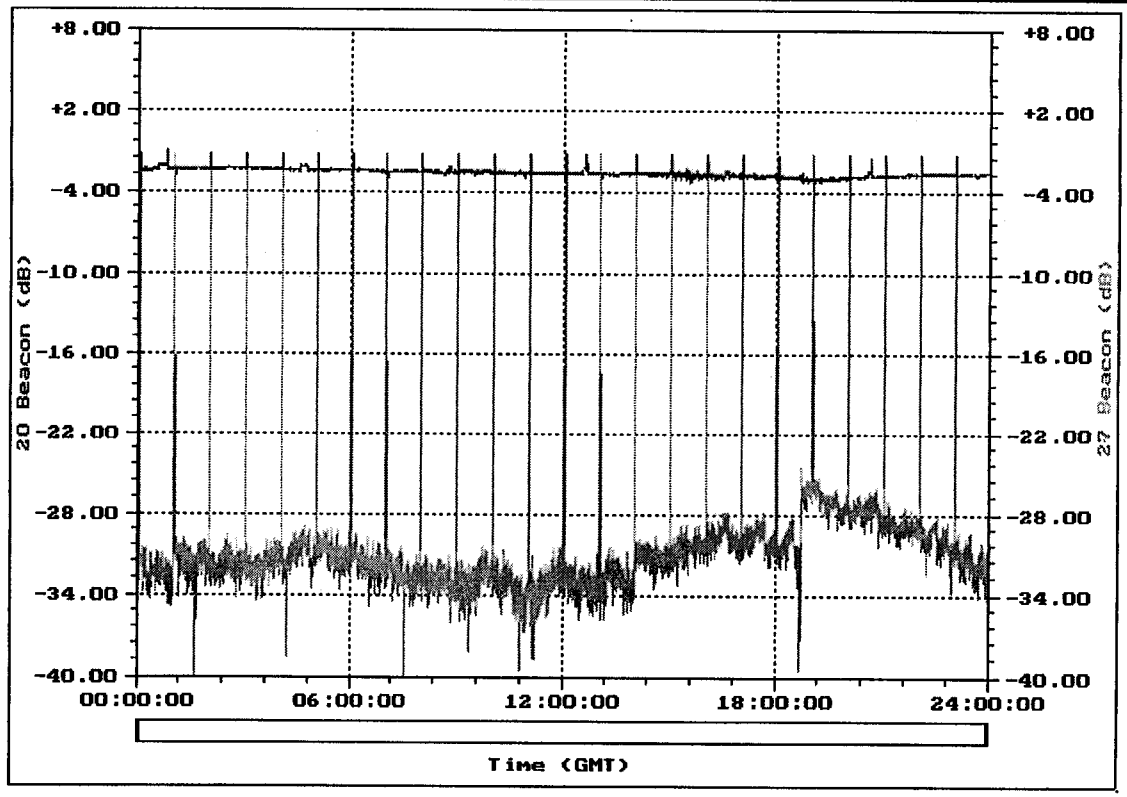
- 20.185 GHz - Vertical channel
- Lots of lightning that day, but no anomalous depol was apparent

Rain event 5/24/99



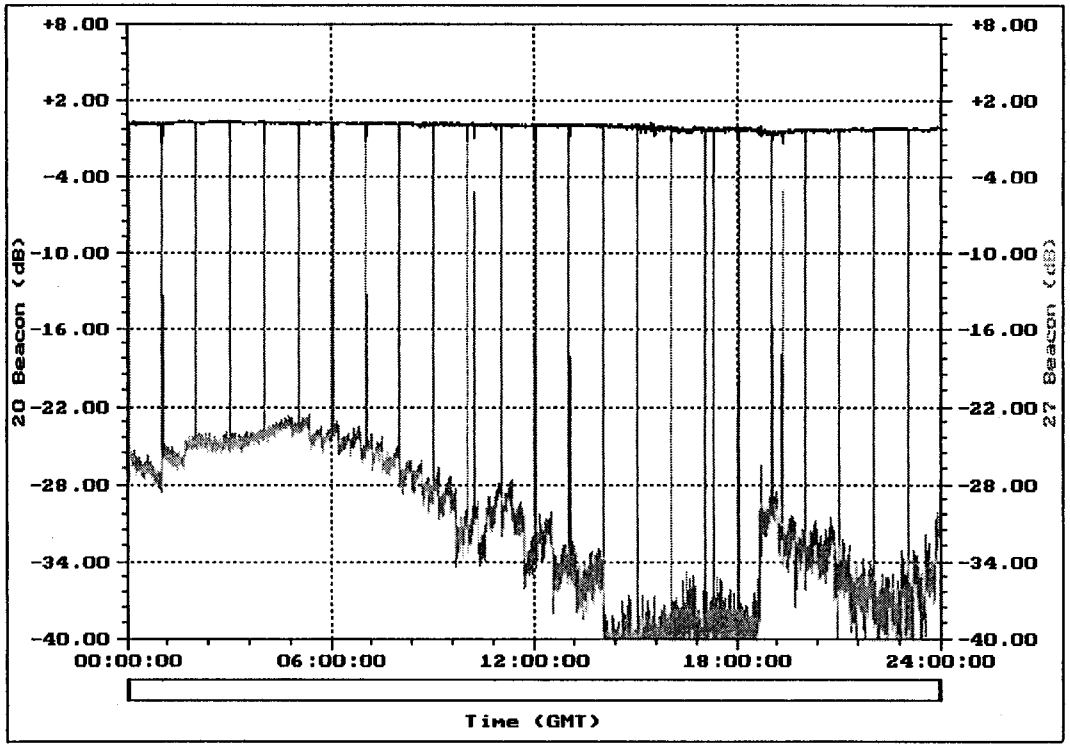
- 20.195 GHz - Horizontal channel
- Behavior almost identical though attenuation on horizontal channel is ~1-2 dB greater as predicted by models

Vertical Clear Air Reference



- 20.185 GHz channel
- 5/26/99
- ~30 dB isolation constant through the day

Horizontal Clear Air Reference



- 20.195 GHz channel
- 5/26/99
- X-pol channel less stable

Sample of Questions to be Analyzed

- How does the Cross-Polarization Discrimination (XPD) caused by rain and ice behave?
- Are the available prediction models for rain induced XPD applicable at Ka-band?
- Will Ice induced XPD contribute significantly to link availability?
- Will cloud attenuation be a factor in low margin systems?
- Are existing combined effects models sufficient for specifying propagation margins to insure link closure?
- How significant are scintillation effects?

Conclusion

Key Points

- STel plans to collect one year of depolarization measurements (June 1999 - June 2000)
- Data collected to date shows ice and rain depolarization occurring - First ice and rain depol measurements made in Washington DC area
- ~30 dB isolation between CPA and Xpol signals seen

What is Next?

- Determine what calibration is necessary
- Modify preprocessing tool ACTSPP
- Analyze data