

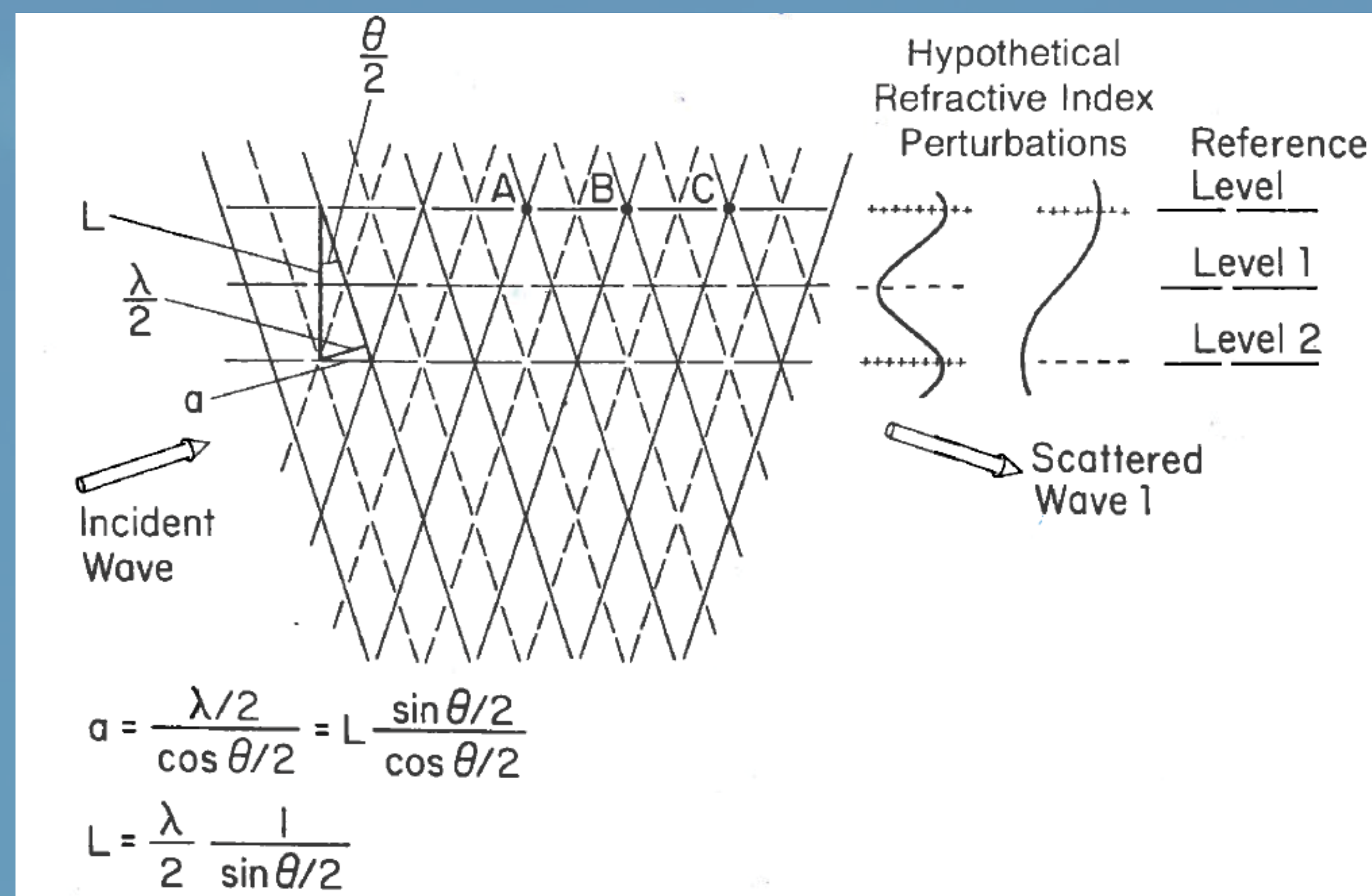


Uncertainty in the Absolute Calibration of Differential Reflectivity

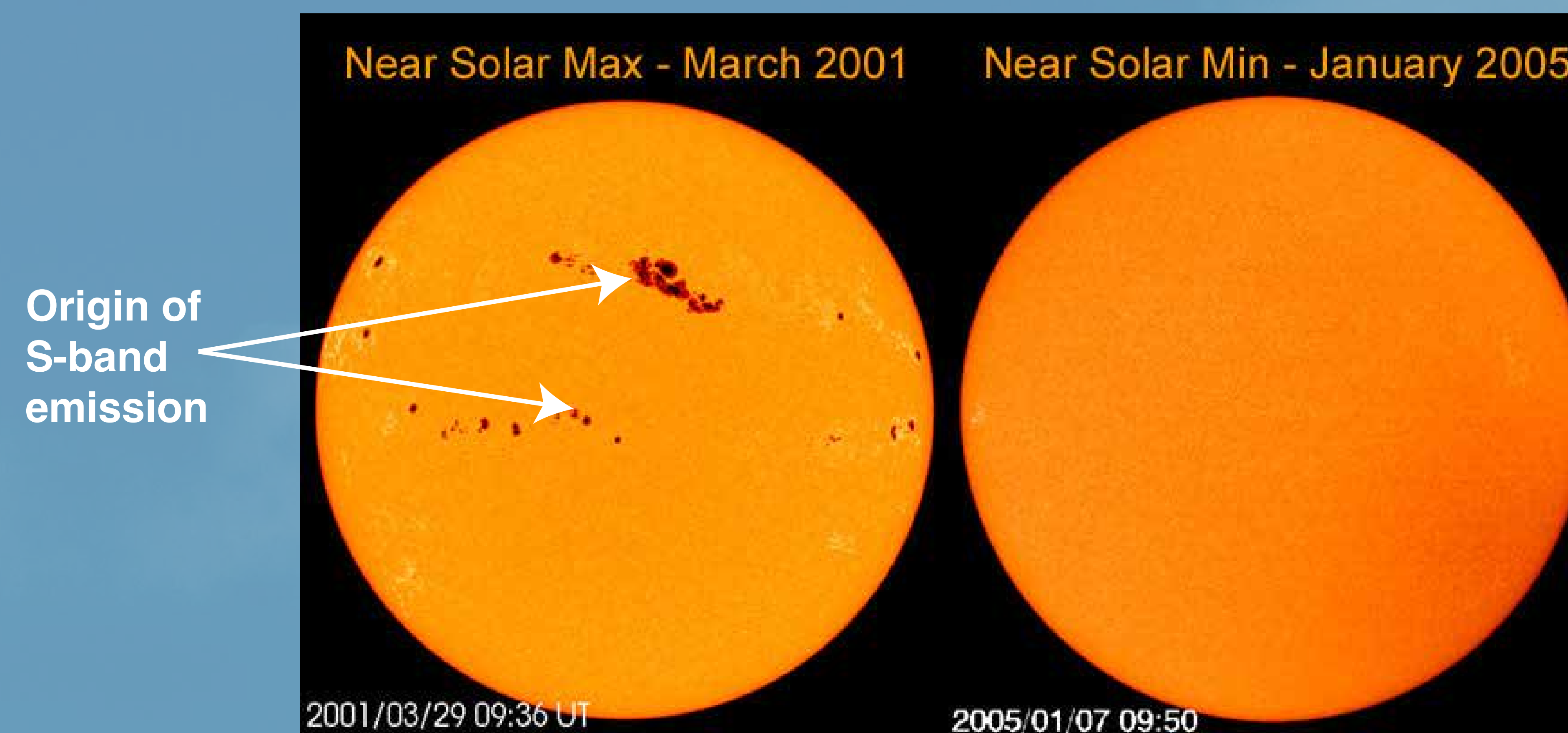
Earle R. Williams, Kenta T. Hood, David J. Smalley, Michael F. Donovan, Betty J. Bennett and Elaine Griffin, *Massachusetts Institute of Technology Lincoln Laboratory*

Criterion for calibration of high quality: the calibration standard is known to an accuracy exceeding the desired accuracy of any measurement (0.1dB)

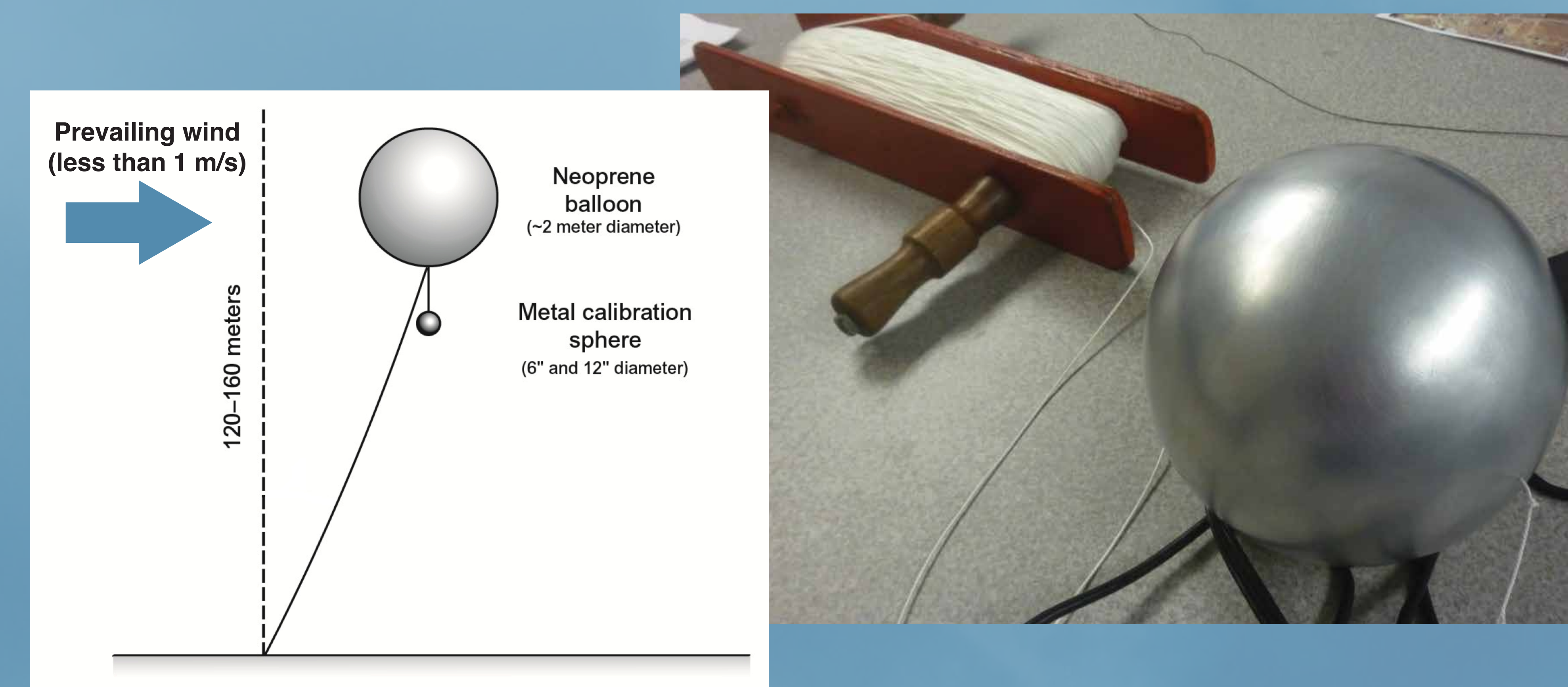
Bragg Scatter



The Sun



Metal Sphere

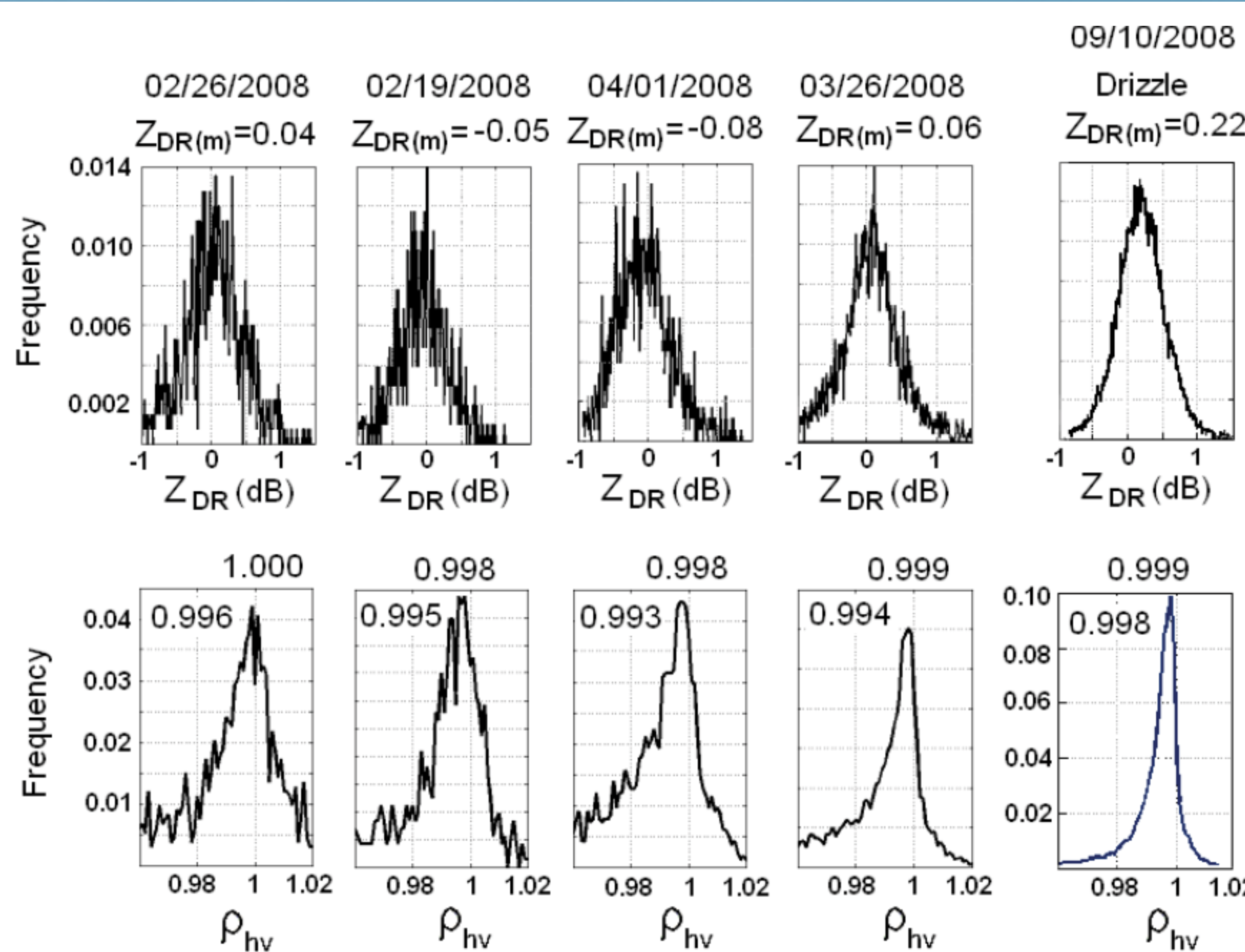


Expectation: $\overline{ZDR} = 0$

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Distributions of ZDR based on integrations of 128 samples

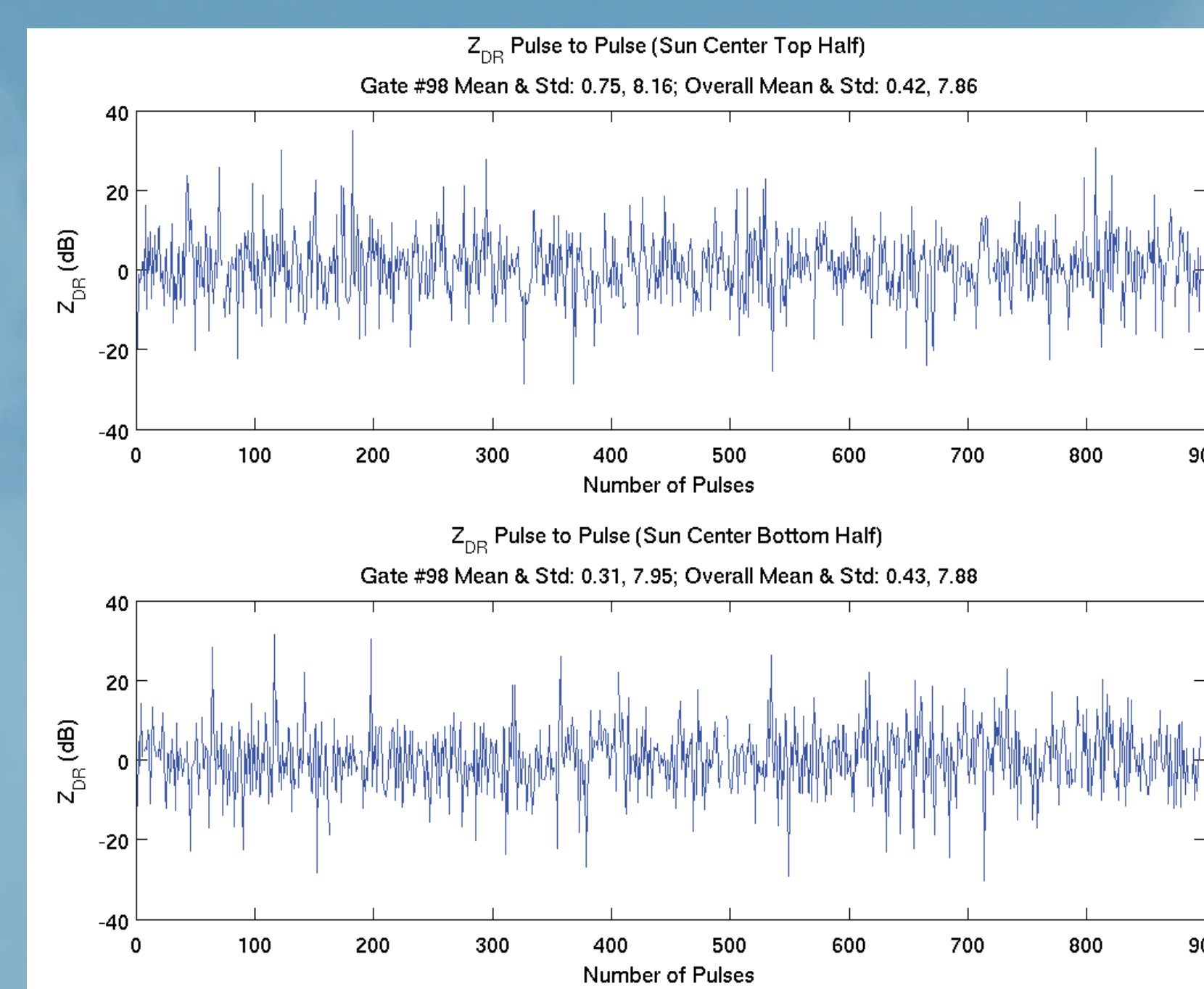


Hypothesis for variability: space-time variability of temperature/water vapor

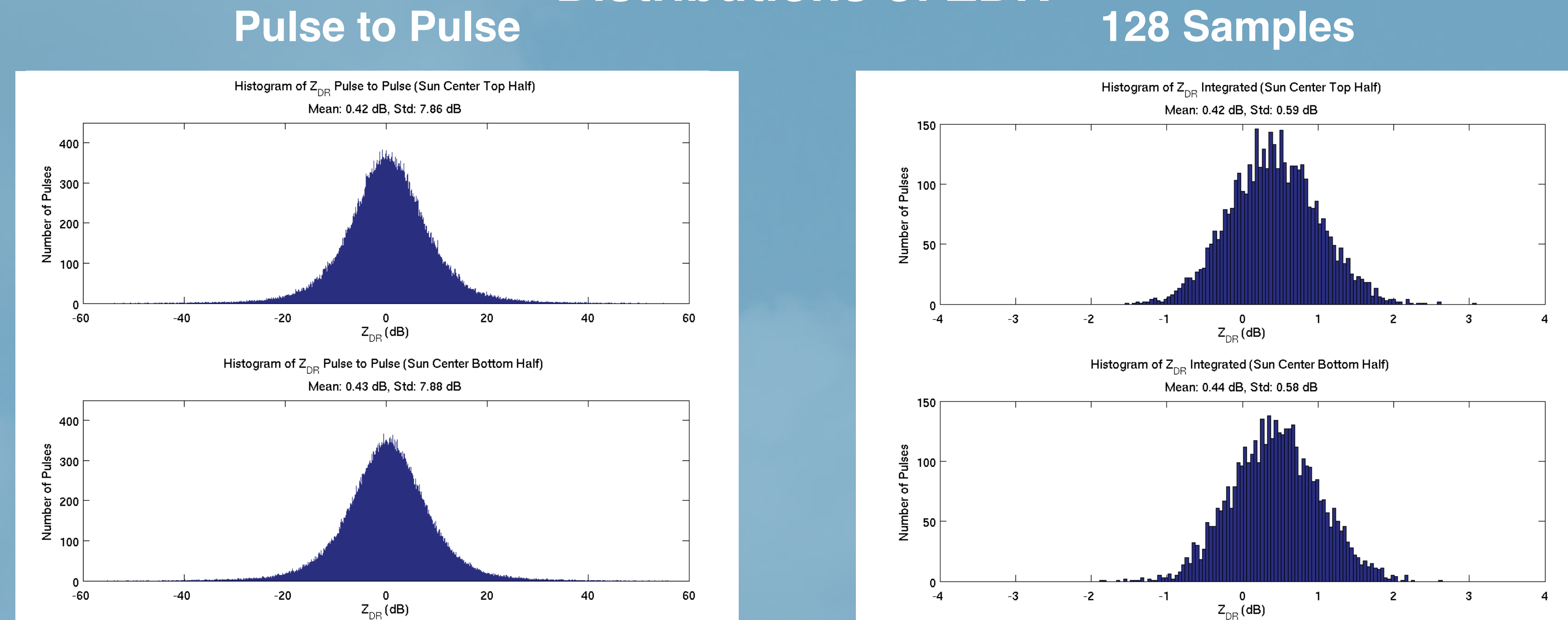
References:
Gossard, E.E. and R.G. Strauch, Radar observations of clear air and clouds, Elsevier, Amsterdam, 1983.
Melnikov, V., D. Zrnic, M. Schmidt, and R. Murnan, ZDR calibration issues in the WSR-88Ds, Report on 1013-MOU, 30 September, 2013.

Time Series "Pulse to Pulse"

The sun is highly variable on short time scales



Distributions of ZDR

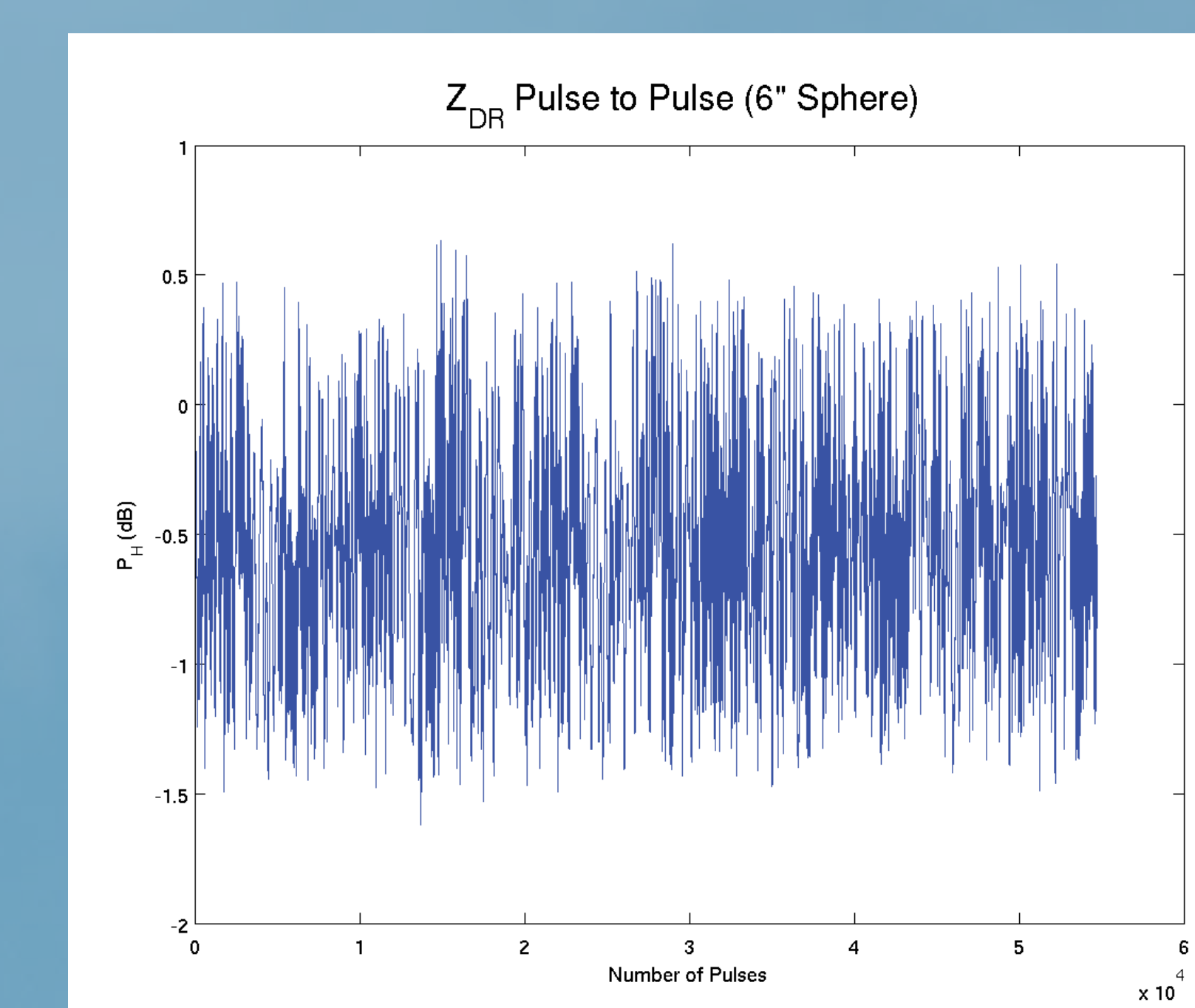


Hypothesis for variability: dynamic nature of sunspots

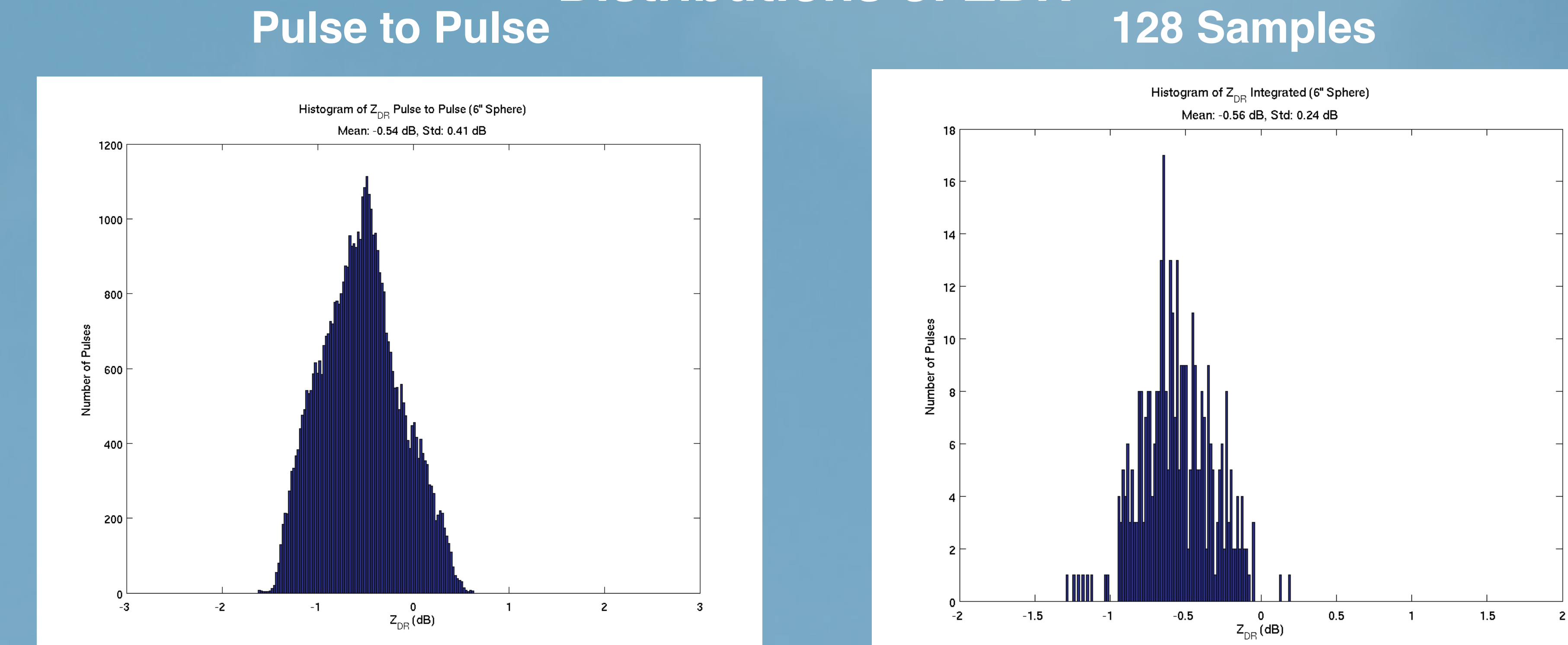
References:
Gabella, M., M. Sartori, M. Boscacci and U. Germann, Vertical and horizontal polarization observations of slowly varying solar emissions from operational Swiss weather radars, Atmosphere, 6, 50-59, doi:10.3390/atmos6010050, 2015.
Holleman, I., A. Huuskonen, R. Gai and P. Tabary, Operational monitoring of radar differential reflectivity using the Sun, J. Atmos. Oceanic Tech., 27, 881-887, 2010.
Küper, A., Introduction to Solar Astronomy and Radio Physics, Geophysics and Astrophysics Monographs, Reidel Publishing Company, 1979.
Tapping, K.F., The 10.7cm solar radio flux (F10.7), Space Weather, (in press), 2015.
Wheeler, A.D., Electromagnetic Scintillation, Vol. II Weak Scattering, Cambridge University Press, 2003.

Time Series "Pulse to Pulse"

Backscatter is highly variable



Distributions of ZDR



Hypotheses for variability: 1) Multipath interference 2) Effects of variable medium

References:
Tatarski, V.I., Depolarization of light by turbulent atmospheric inhomogeneities, Radio Physics and Quantum Electronics, 10, No. 12, 987-988, 1967.
Wheeler, A.D., Electromagnetic Scintillation, Vol. II Weak Scattering, Cambridge University Press, 2003.
Williams, E., K. Hood, D. Smalley, M. Donovan, V. Melnikov, D. Zrnic, D. Burgess, M. Douglas, J. Sandifer, D. Saxton, O. Boydston, A. Heck and T. Webster, End-to-end calibration of NEXRAD differential reflectivity with metal spheres, Conference on Radar Meteorology, American Meteorological Society, Breckenridge, CO., September, 2013.

Main conclusion: Achievement of 0.1dB absolute accuracy in the calibration of NEXRAD differential reflectivity is a challenging task