Achieving a Measurement Precision of 0.000002% or Better: Control What You Can, Track What You Can't

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Abstract: Many research efforts rely on observations to prove or disprove a hypothesis, to measure a long-term trend, or simply to explore uncharted territory. The science objectives generally dictate how "well" the measurements have to be made, dictating the accuracy and precision of the observations. Some investigations require that we make a measurement with very high precision. In this talk, I will introduce one such problem, where we need to measure a Doppler shift, or wavelength change in the visible spectrum to one part in fifty million in order to determine thermospheric wind profiles from a satellite in low earth orbit.

I will briefly go over the measurement concept and design of the Michelson Interferometer for Global High-resolution Thermospheric Imager (MIGHTI) instrument on the NASA Ionospheric Connection Explorer (ICON) satellite. In particular, I will discuss the challenges that arise from the precision requirement and how they are addressed by either using ways to control the instrument or by tracking any remaining effects that we cannot control, so they can be properly corrected during the data analysis.