# Theory and Measurements of Wide-Band Fiber-Optic Links

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Fiber-optic signal links are widely used in radio astronomy since they permit transmission of signals over large distances with little loss, provide excellent electrical isolation, and are compact. Wideband links are particularly challenging since the spectral power density is low for a given bandwidth compared to a narrow-band link. The signal power density has to be well above the link noise floor, but the total power should not be high enough to cause gain compression.

We examine the theoretical limits to optical link performance, considering both the noise sources and gain compression mechanisms. Noise sources include photon statistical noise, laser noise, thermal noise, and amplifier noise. Gain compression depends on the modulation mechanism for the laser (direct or external), and depends on the modulating waveform. We compare the effects for sinusoidal and Gaussian noise input signals.

From the preceding considerations, we derive relationships that specify the dynamic range available for specified amounts of added noise and compression. These reveal the importance of such things as optical loss, laser power, and gain slope compensation.