Interferometric Measurements of the Outer Scale

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Phase (or Delay) Structure Functions for L_0 =10 m

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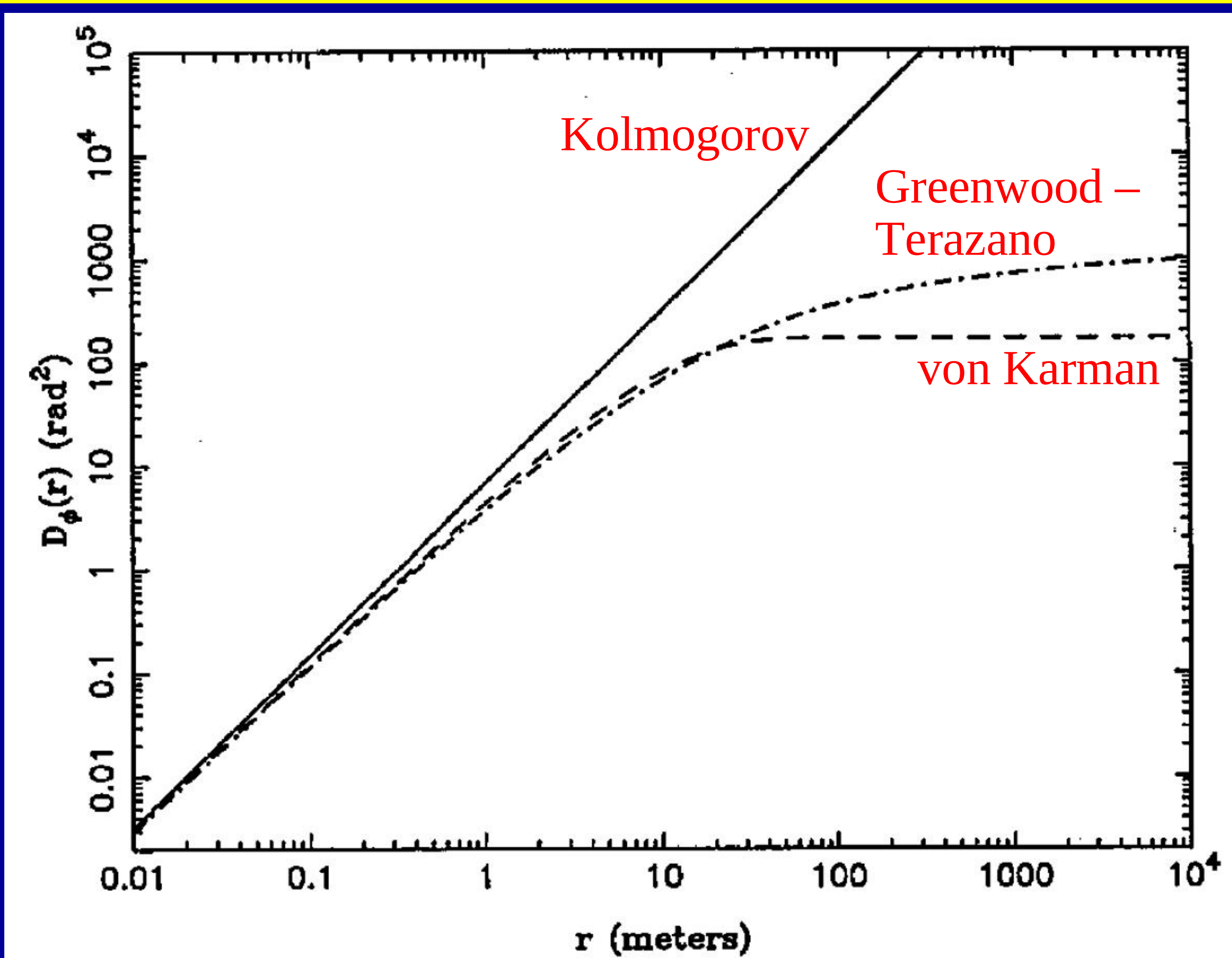
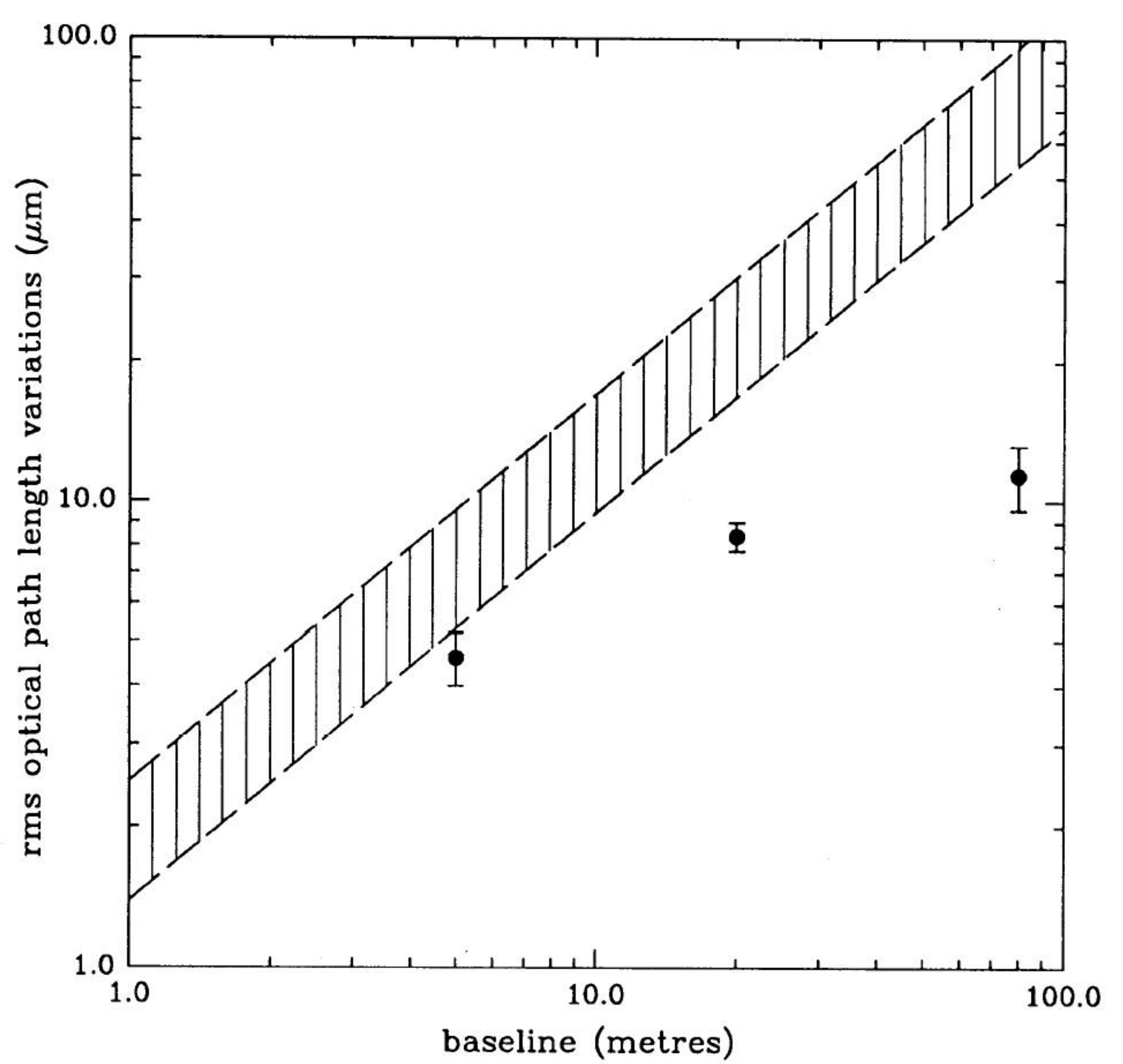


Why Measurements with an Interferometer?

- Quantity of Interest for adaptive optics on large telescopes is the power of phase fluctuations on scales up to 100 m
- Instruments such as Generalized Seeing Monitors extrapolate from small scales
- Extrapolation is model-dependent
- Interferometry provides direct access to fluctuations on scale of interest

Optical Pathlength Fluctuations versus Baseline Length (SUSI)



Hatched area: Kolmogorov model for extreme values of r_0 observed during run (data from angle tracker)

Theoretical Power Spectra of Interferometer Delay

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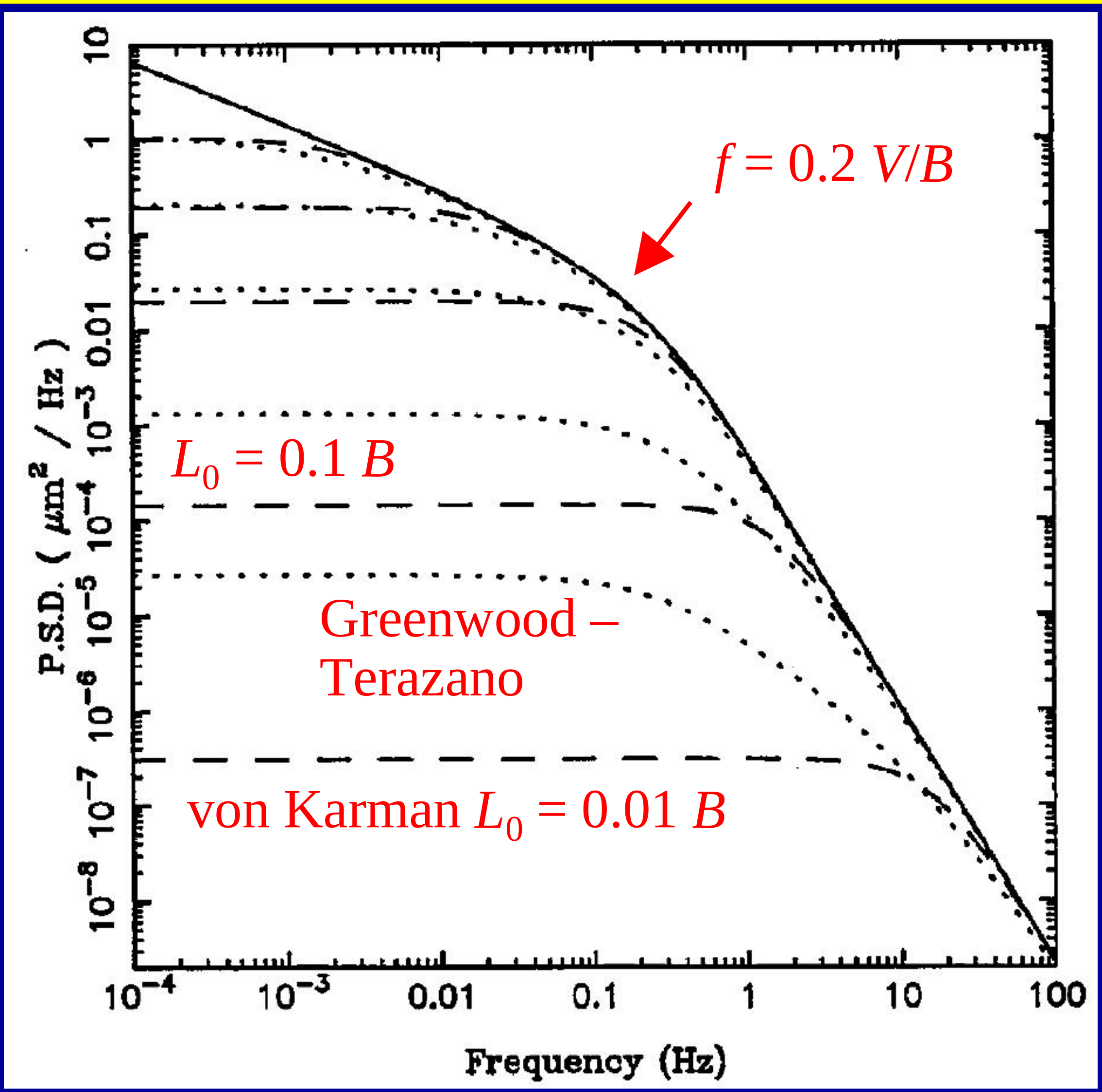
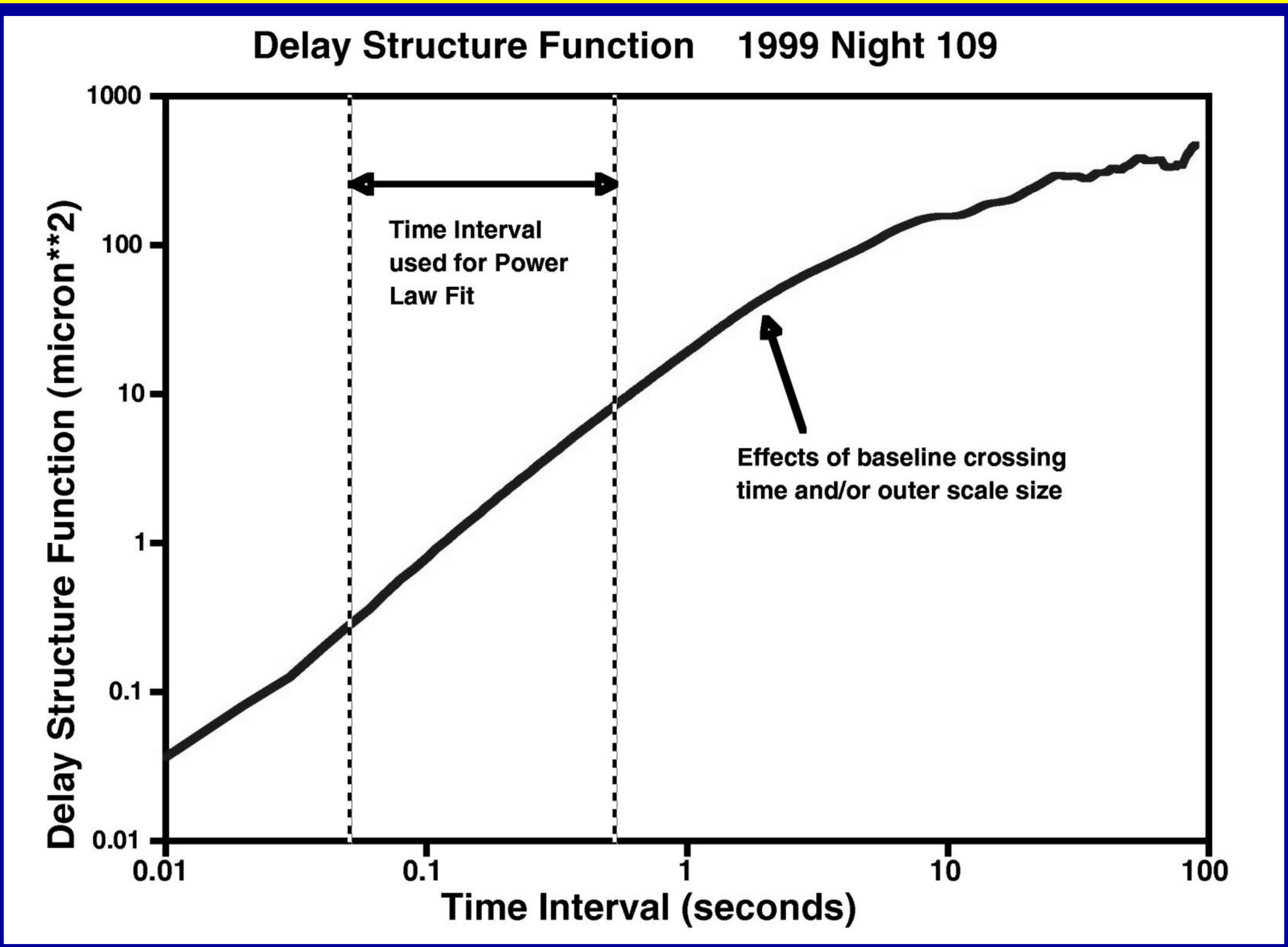


Typical Delay Structure Function from Palomar Interferometer



Palomar Analysis

- Degeneracy between outer scale and baseline crossing time
- Solution: joint analysis of delay structure function and angle tracking data
- Caveat: typical power law slopes less than Kolmogorov value

Slope of Palomar Delay Power Spectra

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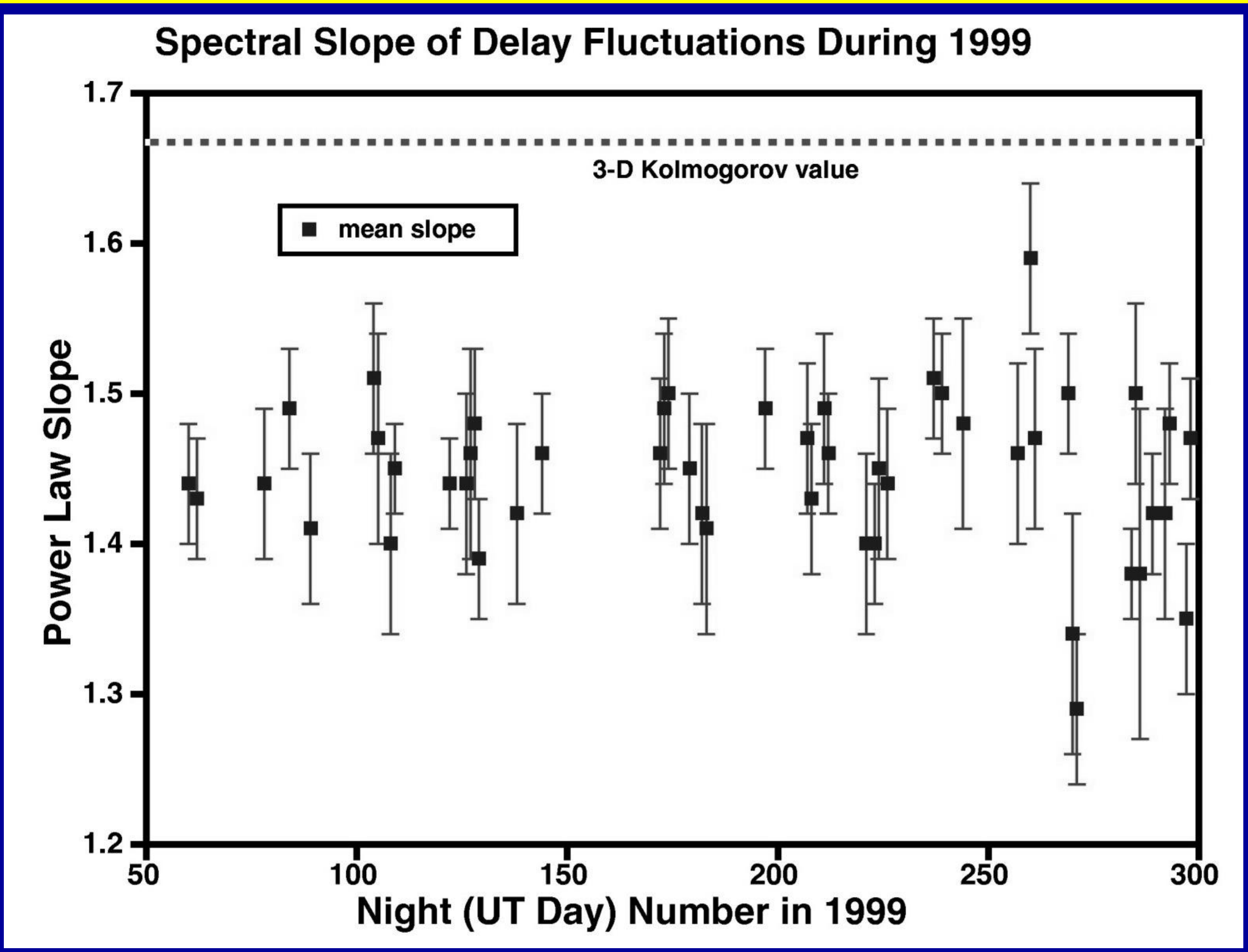
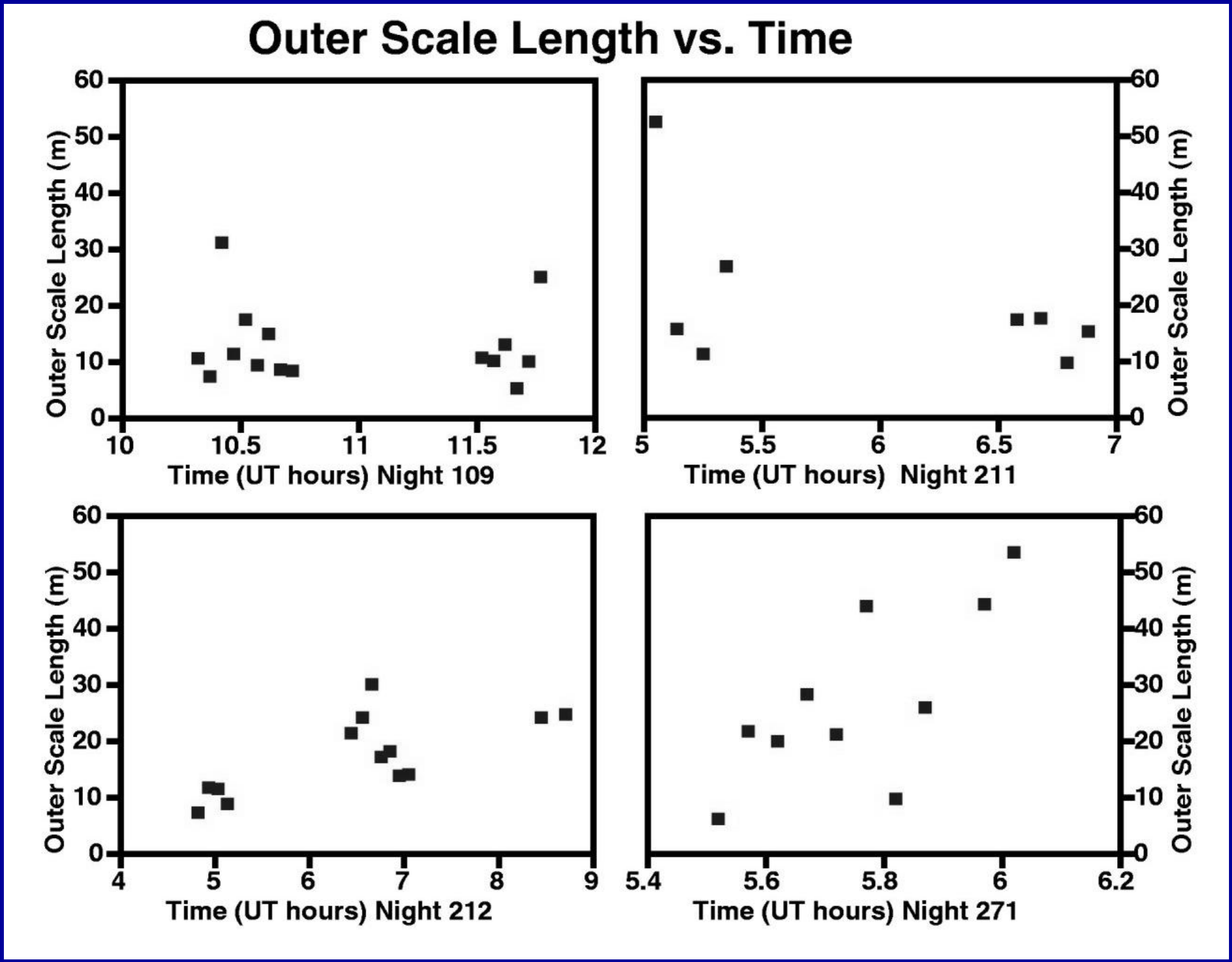
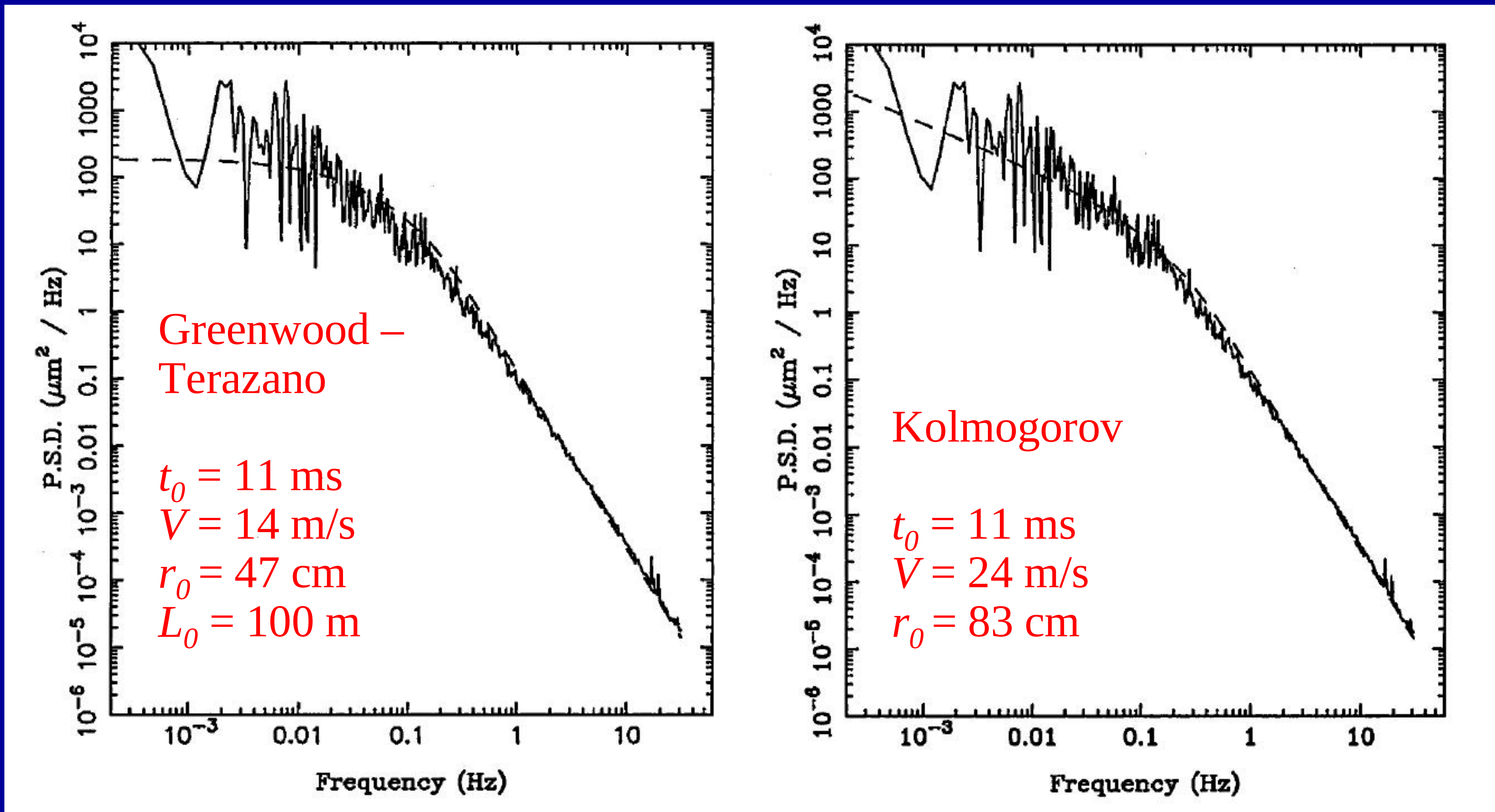


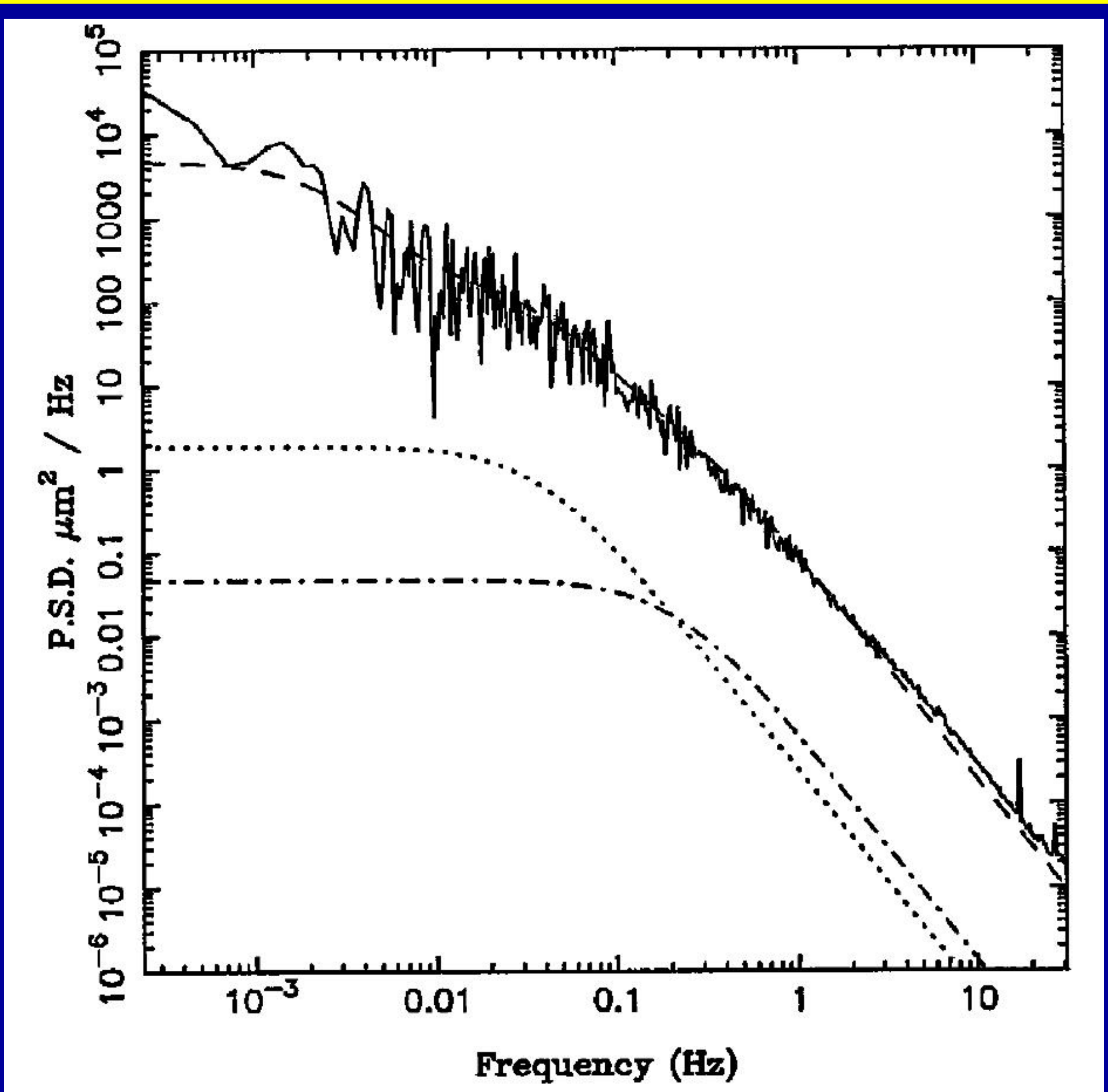
Outer Scale Measurements with Palomar Testbed Interferometer



Mark III (Mount Wilson) Data

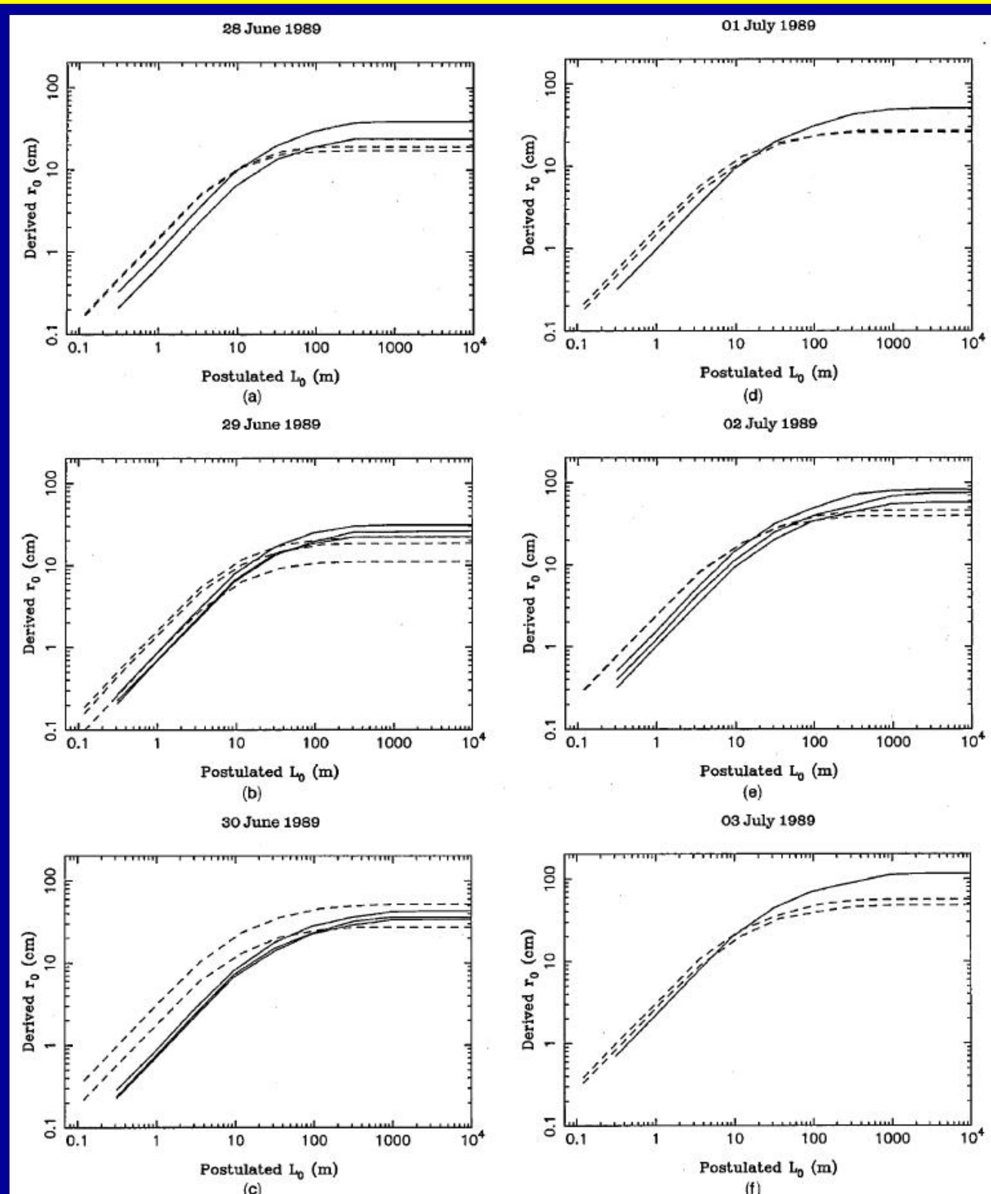


Effect of Multiple Layers



- Each layer has outer scale of 30 m
- Lower curves offset in plot by 2 decades

Observations on two Different Baselines (12 m and 31.5 m)



Conclusions

- Need good fringe tracking (long continuous time series)
- Multiple baselines, truly simultaneously if possible
- Combination with independent seeing monitor gives additional information
- Interferometry is useful for calibration of “small” instruments (GSM etc.)