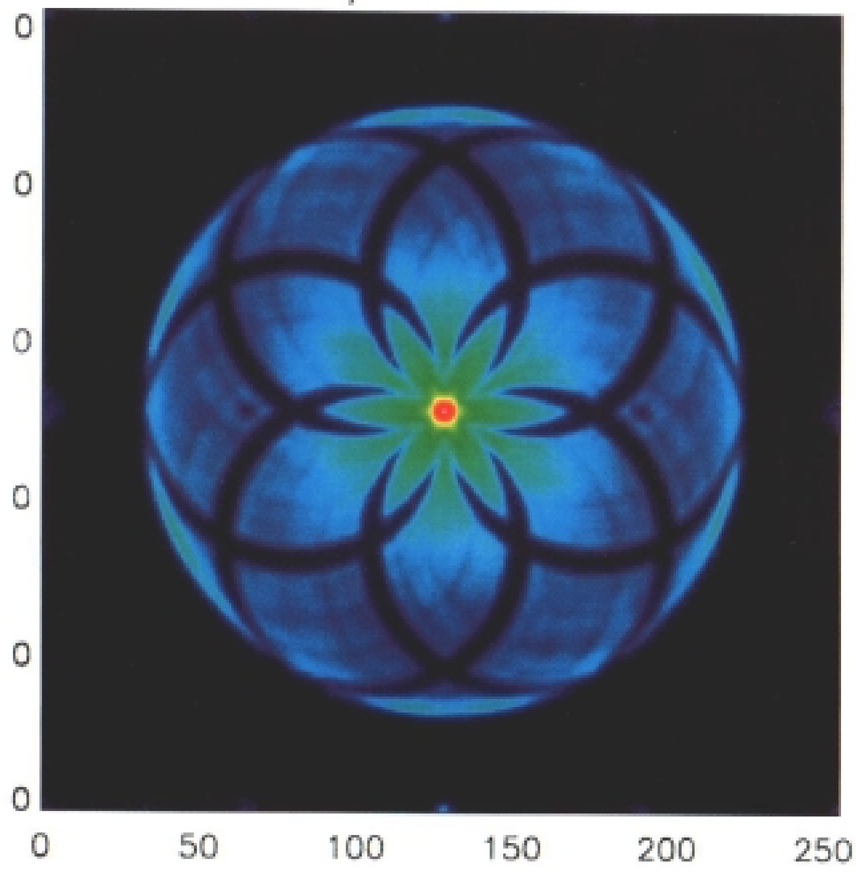
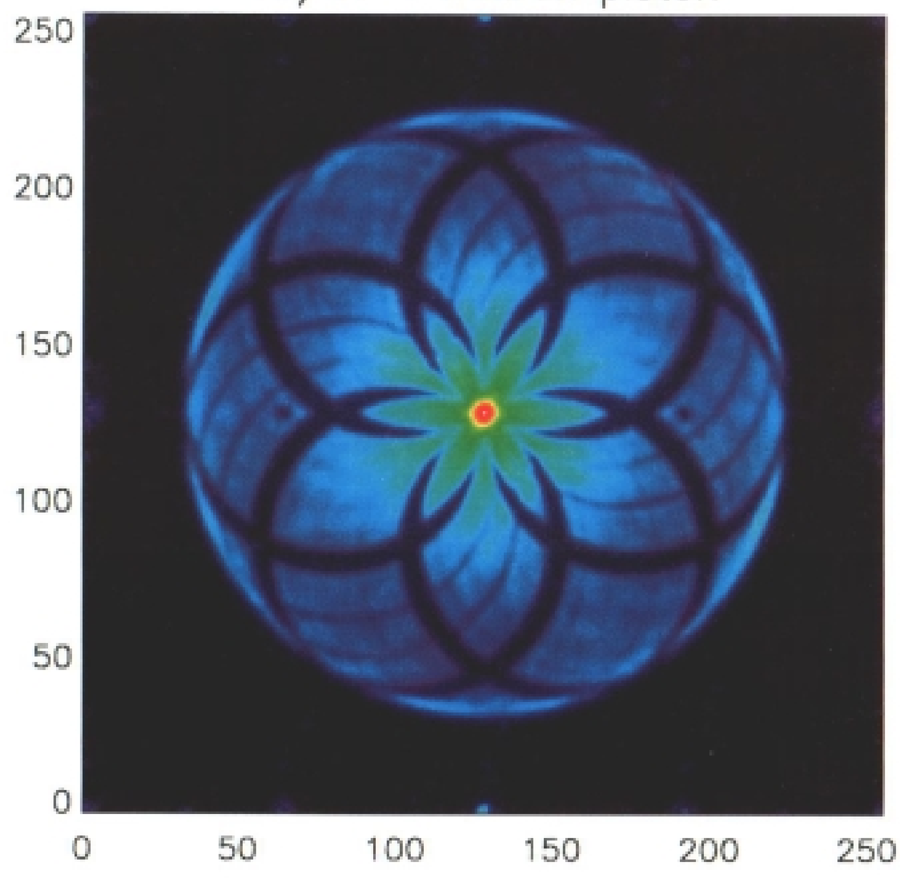
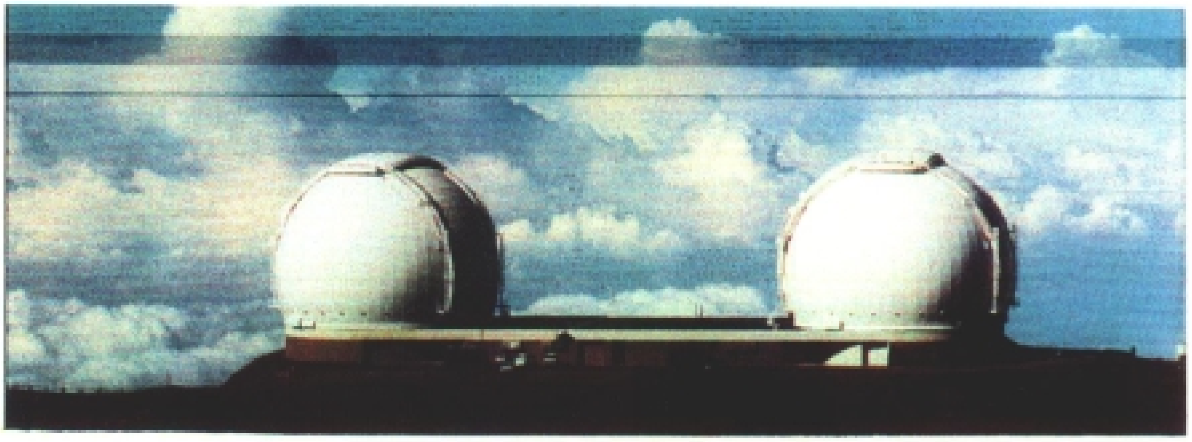
12/97 Phased



12/97 1 micron piston



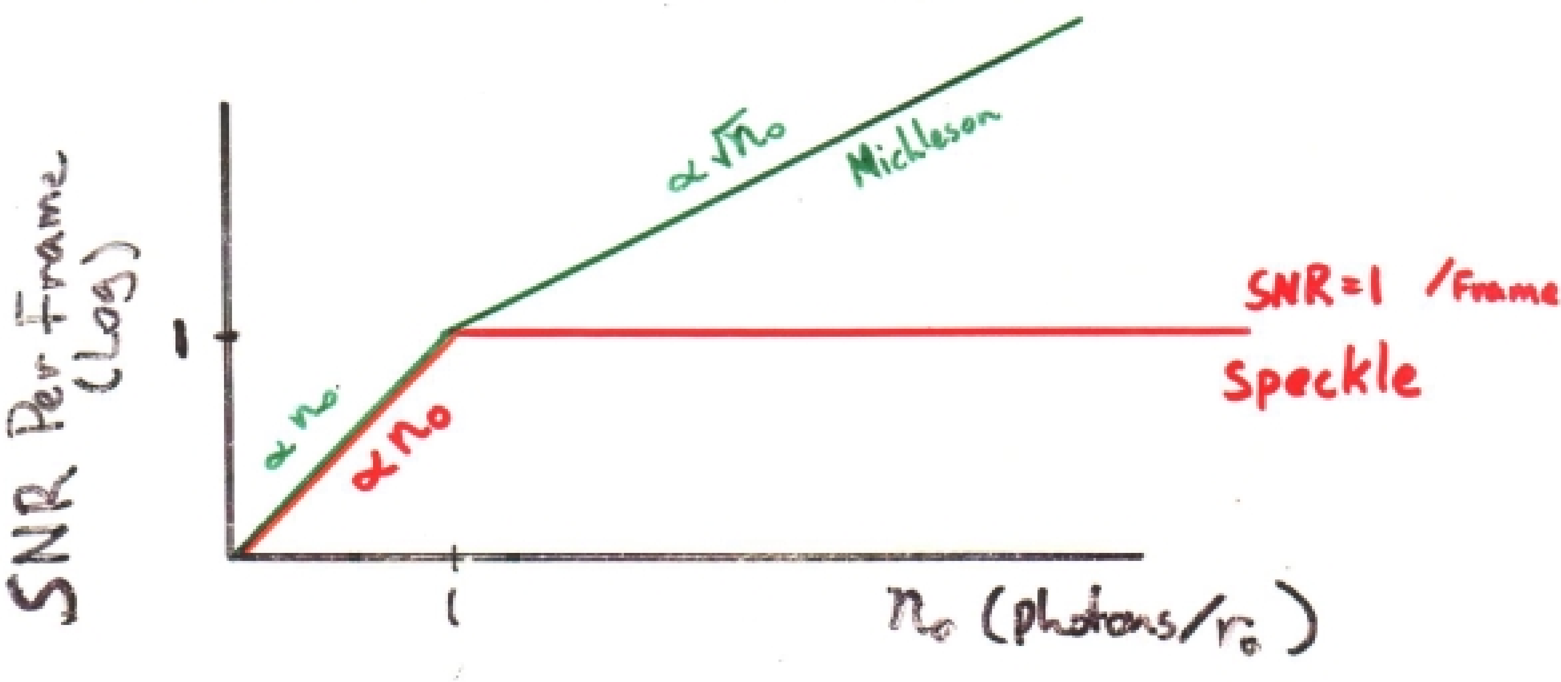


Signal-To-Noise.

$$SNR = \frac{R_B n_0^2}{\underbrace{A n_0}_{\text{Photon Noise}} + \underbrace{R_B n_0^2}_{\text{Atm Noise}} + \text{Readout Noise.}}$$

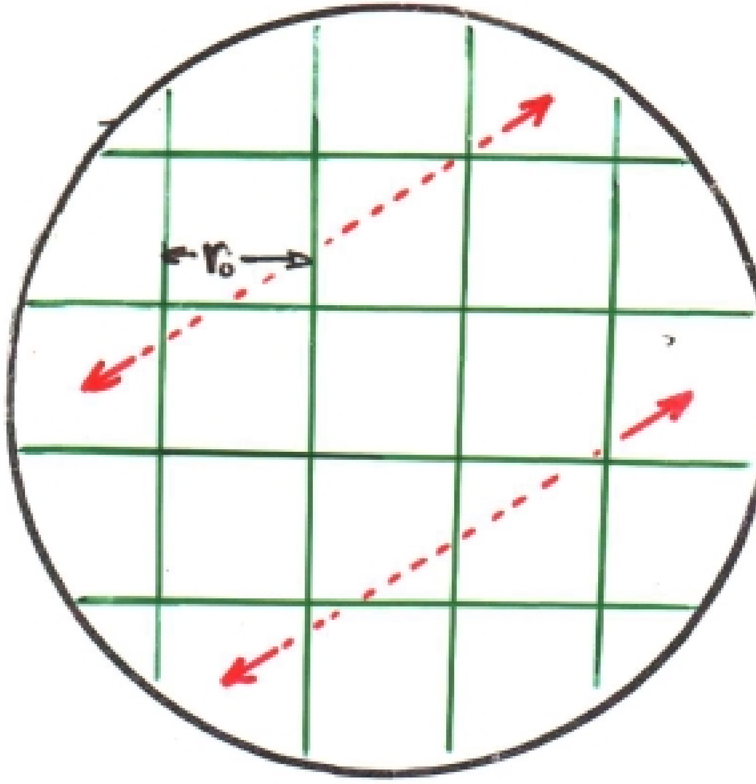
	Michleson (Atm Noise = 0)	**Speckle.**
High Light Limit	$SNR \propto \frac{n_0^2}{A n_0}$	$SNR \propto \frac{R_B n_0^2}{R_B n_0^2} = 1$
Low Light Limit.	$SNR \propto \frac{n_0^2}{\text{Readout (const)}}$	$SNR \propto \frac{R n_0^2}{\text{Readout.}}$

$\sqrt{R_n}$ Spectrum ⟹ Image Spectrum



Heuristic Model:

Divide Aperture into r_0-Size Patches:



n_0 Photons/subaperture

A = Total Area

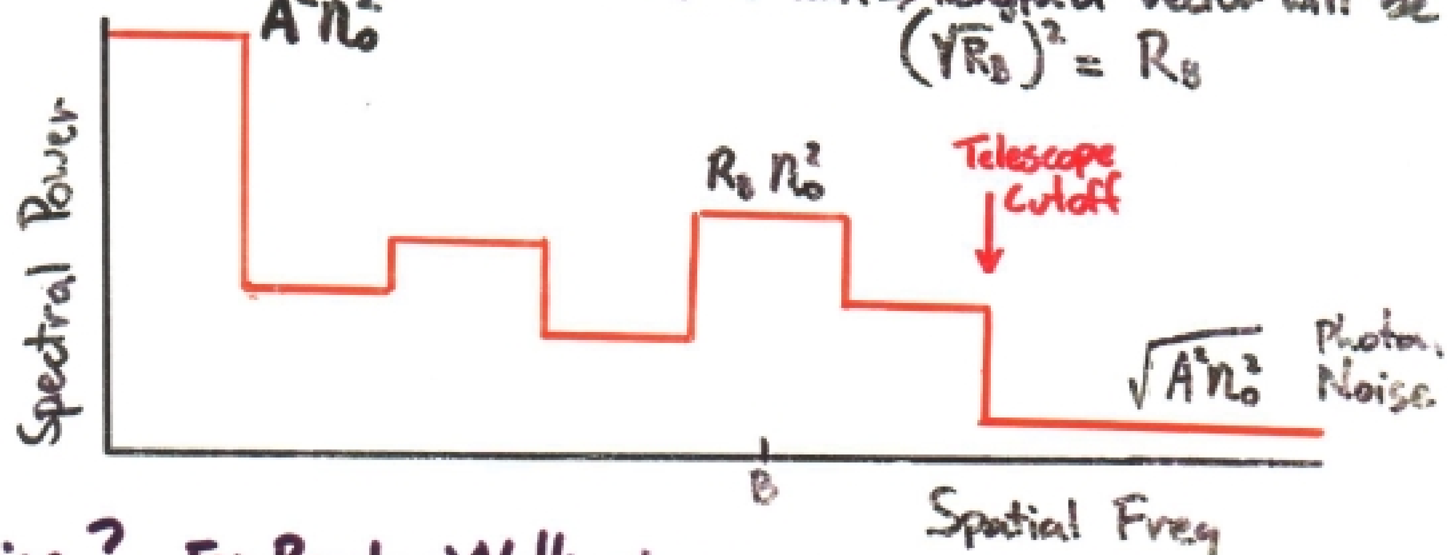
Let each patch have Random ϕ

Define the Redundancy R of baseline B

R_B = # Number of repetitions of baseline B in Pupil.

Power Spectrum:

At baseline B, R vectors add Incoherent
Random Walk ⇒ length of vector will be
$\left(\sqrt{R_B}\right)^2 = R_B$



Noise? For Random Walk, Variance = Mean.

$$\sigma(R_B n_0^2) = R_B n_0^2$$

Imaging through turbulence:

$$\text{Image}(\underset{\sim}{x}) = \text{Object}(\underset{\sim}{x}) \circledast \tau(\underset{\sim}{x})$$

Where $\tau(\underset{\sim}{x}) \equiv$ Instantaneous Atmosphere-Telescope Transfer Function.

↓ Taking fourier transform

Then: $$\hat{I}(f) = \hat{O}(f) \cdot \hat{\tau}(f)$$

Average over Many Frames: $$\langle|\hat{I}(f)|^2\rangle = |\hat{O}(f)|^2 \underbrace{\langle|\hat{\tau}(f)|^2\rangle}$$

Speckle Power Transfer Fn. obtained by obs. of Pt. source.

"Classical" speckle interferometry.

No Phase Recovery!

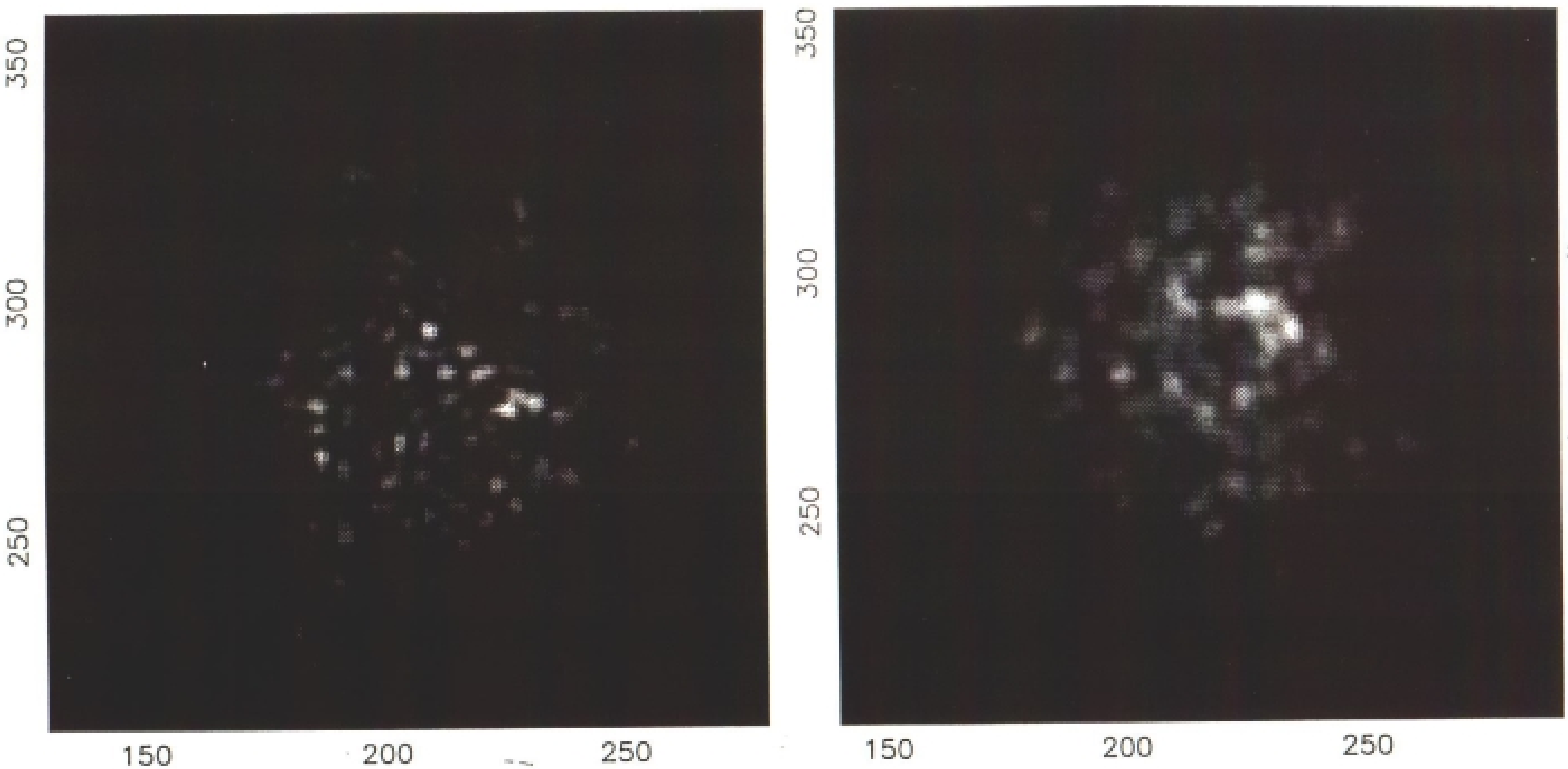


Figure 1.1: Short-exposure (10 msec) images taken whilst observing α Oph (left) and α Her (right). The wavelength of observation was 710 nm and the frames are 1.5″ squares. Clear differences between the unresolved α Oph and the resolved α Her can be seen from 'speckle patterns' such as these without the aid of any image processing.