

An instrument to determine the coherence time of atmospheric turbulence:

The fast defocus monitor (FADE)

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$r_0^{-5/3}$	$= 0.423 k^2 \int C_n^2 dh$	Fried parameter
τ_0	$= 0.314 r_0 / V_{5/3}$	coherence time
$V_{5/3}^{5/3}$	$= \int V^{5/3} C_n^2 dh / \int C_n^2 dh$	

Current methods of coherence time measurement

Method	Measured quantities	Mirror diameter /m	Problems
SCIDAR	$C_n^2(h), V(h)$	>1	Needs large telescope
Balloons	$C_n^2(h), V(h)$	none	Expensive, no monitoring
AO system	r_0, τ_0	>1	Needs working adaptive-optics system
SSS	$C_n^2(h), V(h)$	>0.4	Low height resolution
GSM	$r_0, V(h), \tau_{AA}$	0.1 (4 telescopes)	No obvious relation to τ_0
MASS	τ_0^*	0.02	Biased (low layers ignored)
DIMM	r_0	0.25	Indirect τ_0 estimate
FADE	r_0, τ_0	0.35	Might be discovered in: Kellerer, A., Tokovinin, A., A&A (2007)

h height of turbulent layer

r_0 Fried parameter

C_n^2 refractive index constant

τ_0 coherence time

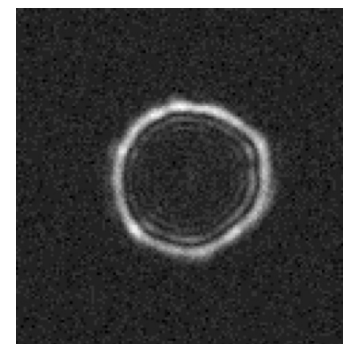
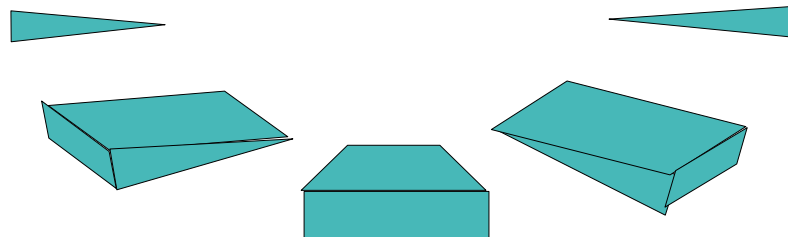
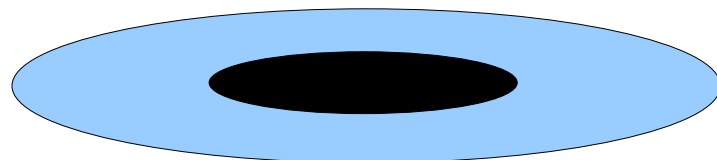
V speed of turbulent layer

τ_{AA} coherence time of angle-of-arrival fluctuations

DIMM
non isotropic



FADE
isotropic

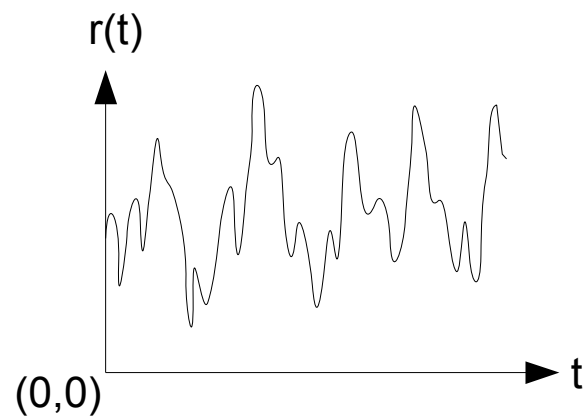
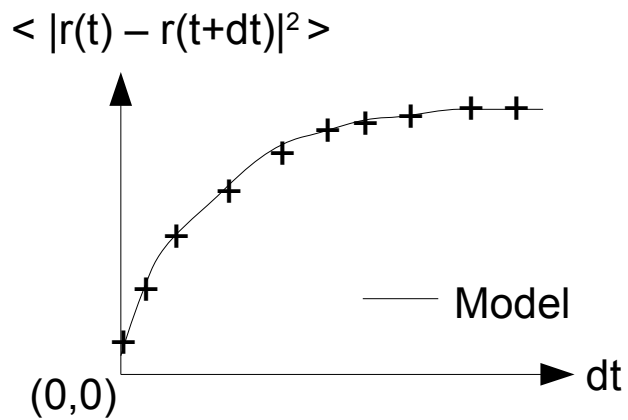
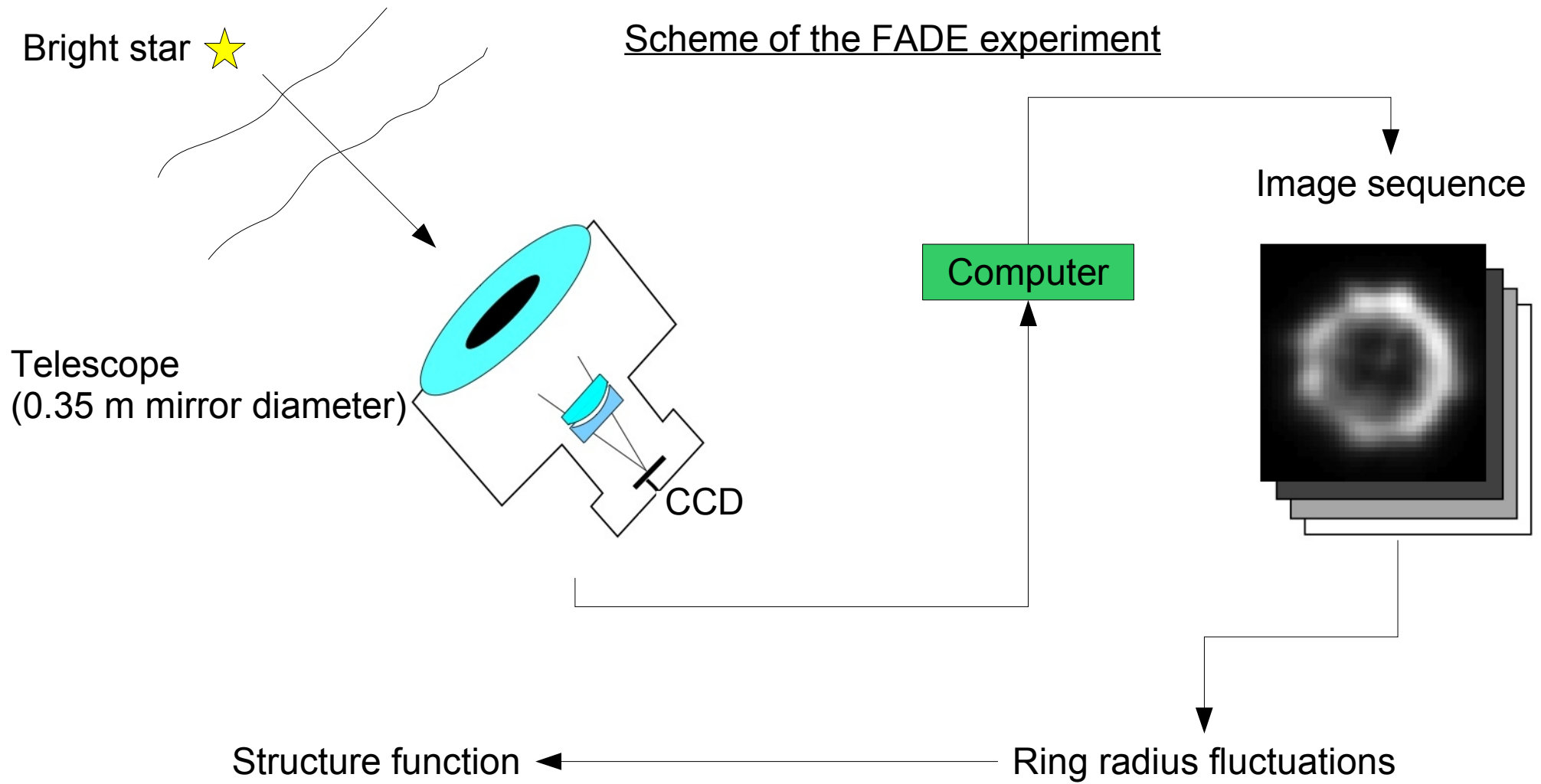


Mask

Conic
aberration

Resulting image

Scheme of the FADE experiment



Observations at Cerro Tololo, Chile

October 29th - November 2nd 2006

FADE prototype

DIMM

MASS

Component

Description

Telescope

Celestron C14
D=356mm f=3860m

Central obstruction

Circular mask
150mm diameter

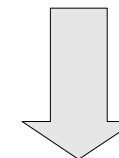
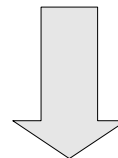
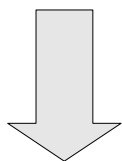
Aberrator

2 *Linos* lenses,
f=+/-50mm

Detector

Prosilica 640x480 pixels,
frame rate up to 740Hz

Installed on a 6m high tower
at 10m distance from FADE

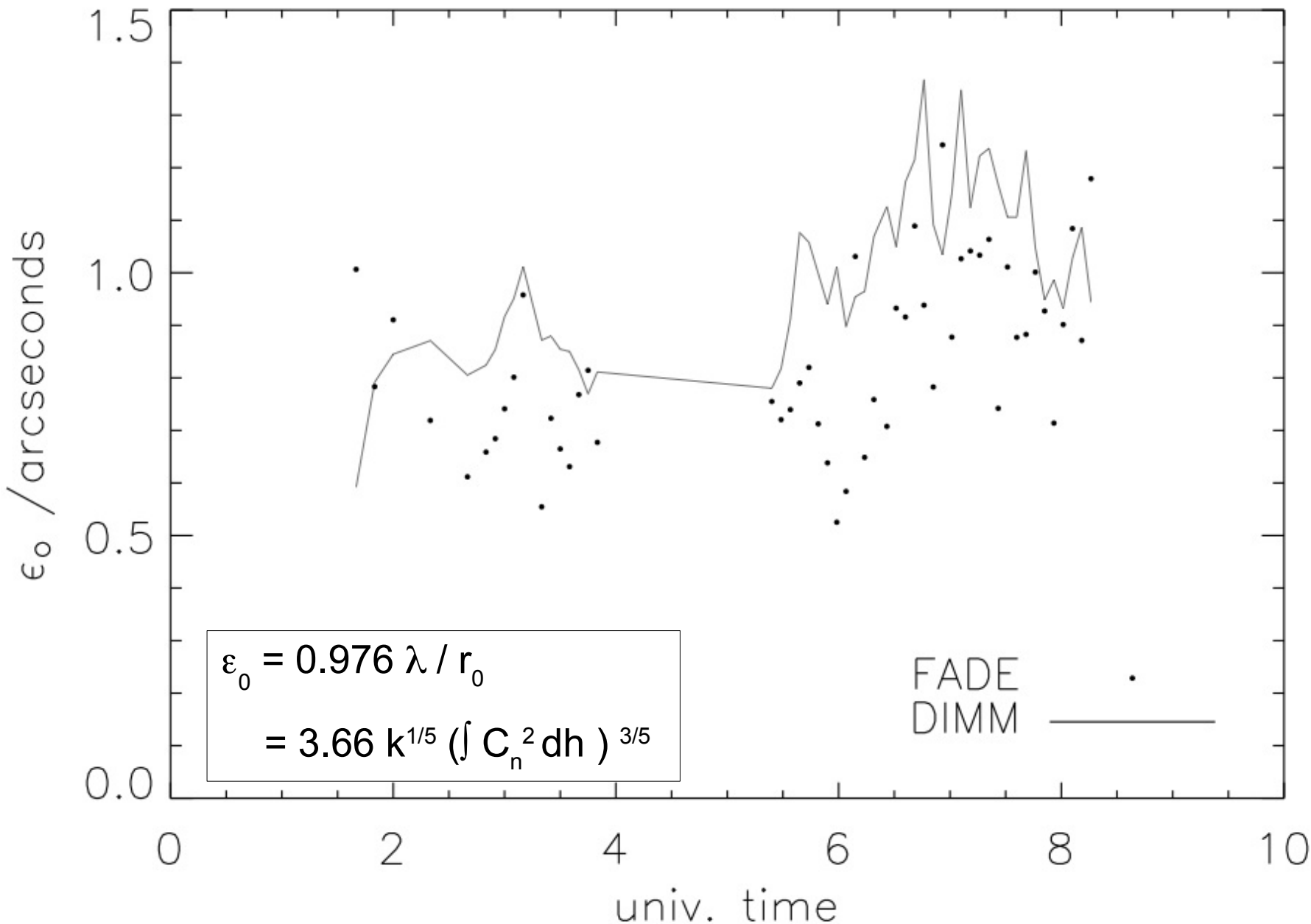


Fried parameter, coherence time

Fried parameter

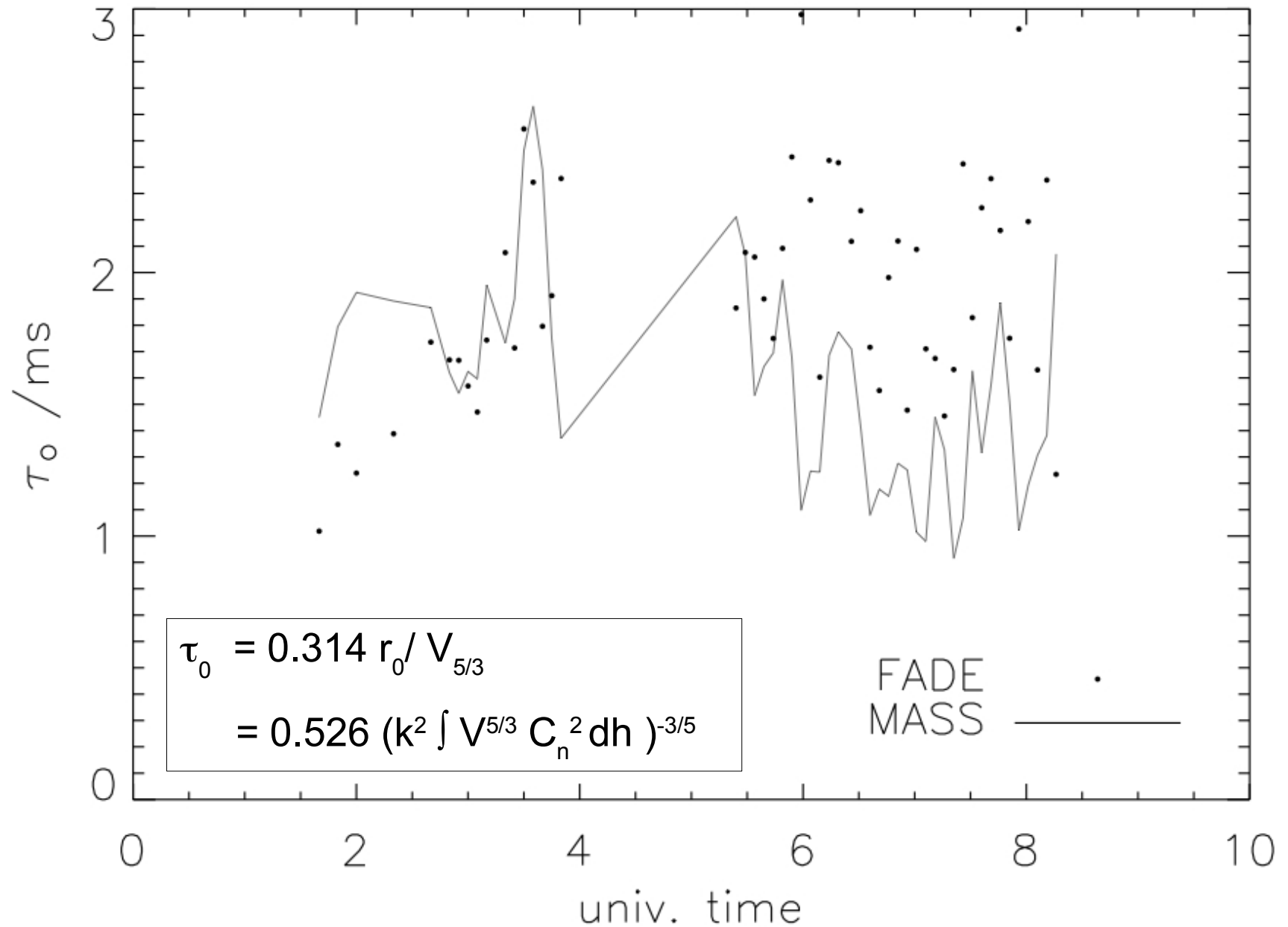
Coherence time

Seeing derived in terms of FADE and DIMM
Observations at Cerro Tololo, November 2nd 2006



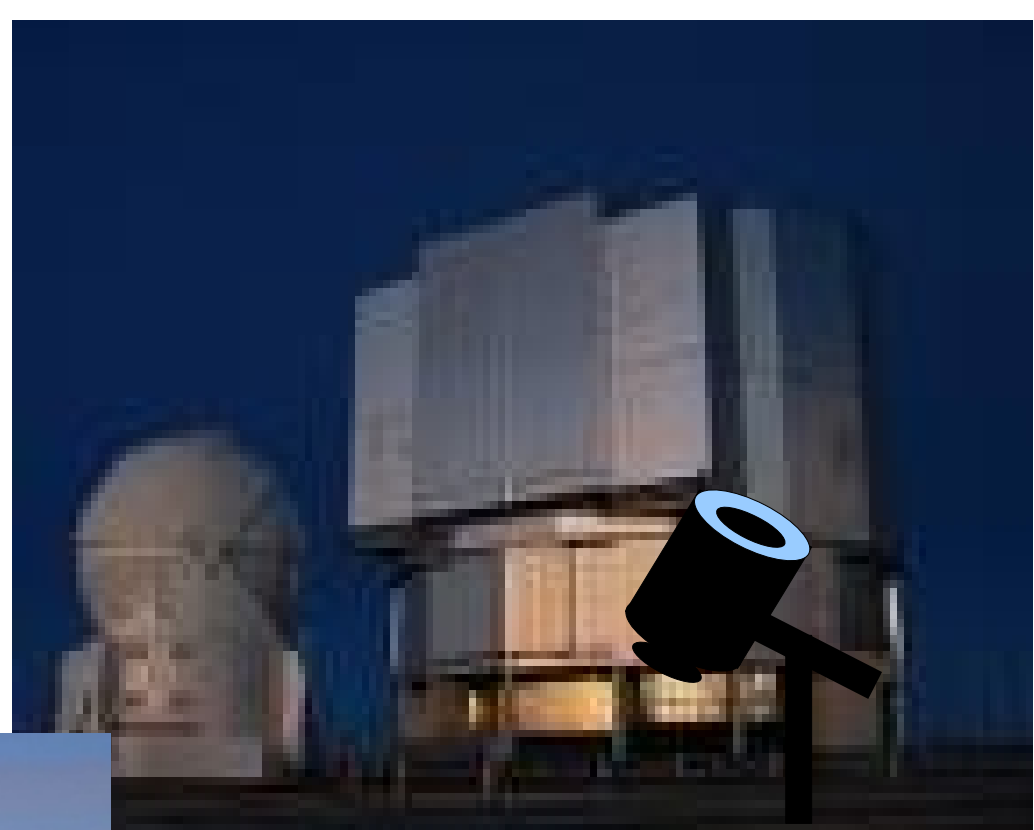
Coherence time derived in terms of FADE and MASS

Observations at Cerro Tololo, November 2nd 2006



Perspectives:

- Test the validity of FADE estimates:
Simultaneous observations with an
adaptive optics system or an interferometer



- Measure τ_0 at potential observatory sites
such as Dome C, Antarctica.

Kellerer, A., Tokovinin, A., A&A (2007)
« Atmospheric coherence time in interferometry:
definition and measurement »