Measuring Cn2 vs. height using a single Rayleigh star

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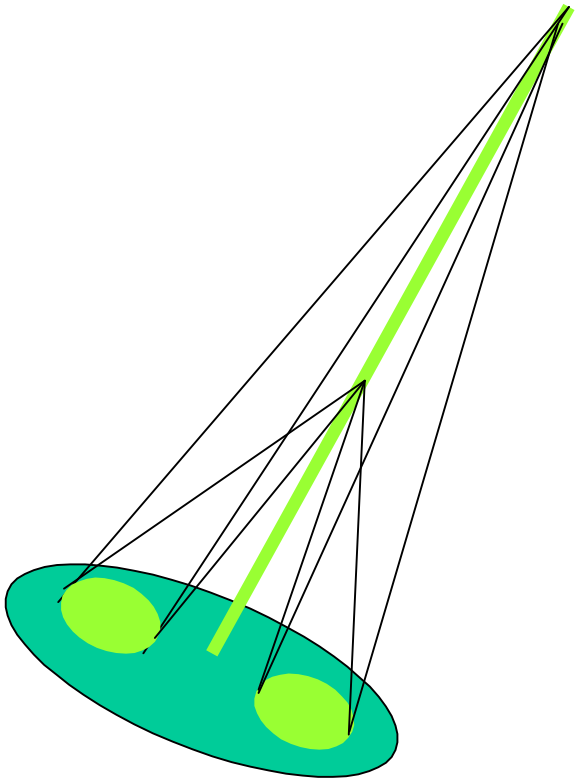
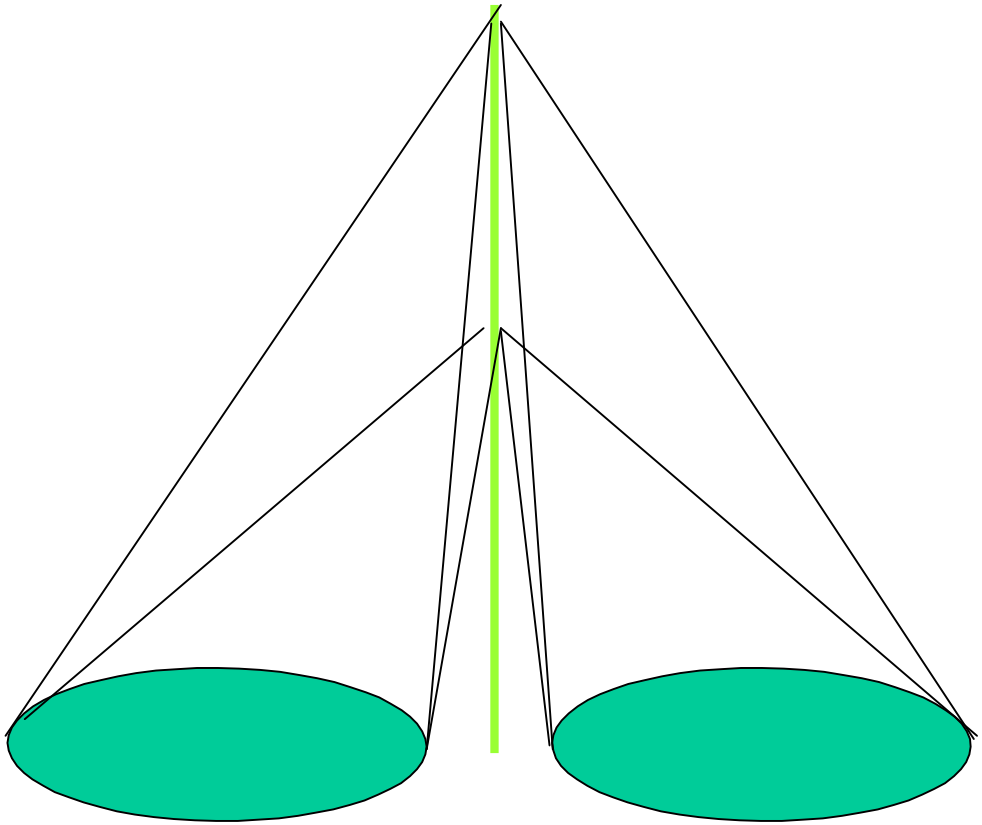
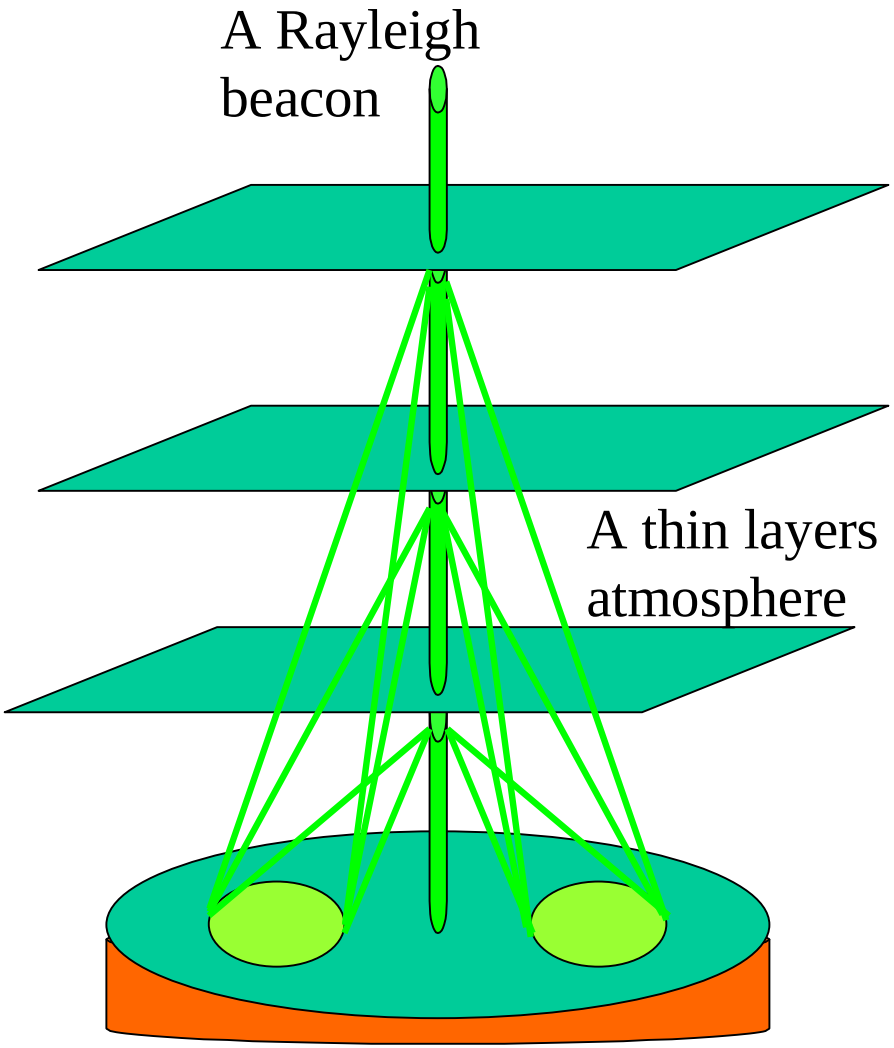
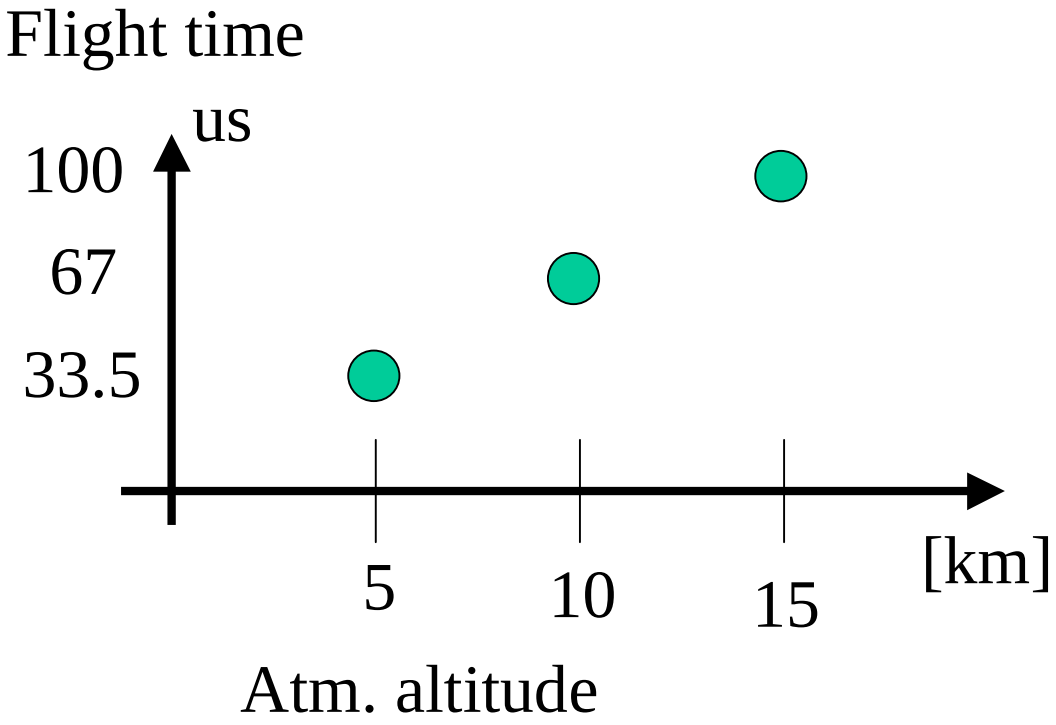




AO-Site Mini-Workshop, ESO Garching 13th October

The geometry





Two subapertures on a single telescope

Some formulas

i identifies the atmospheric layers

k the measurements at different times

$$\left\langle \left(\sum_{i=1}^{k} \vartheta_{1i} - \vartheta_{2i} \right)^2 \right\rangle = m_k$$

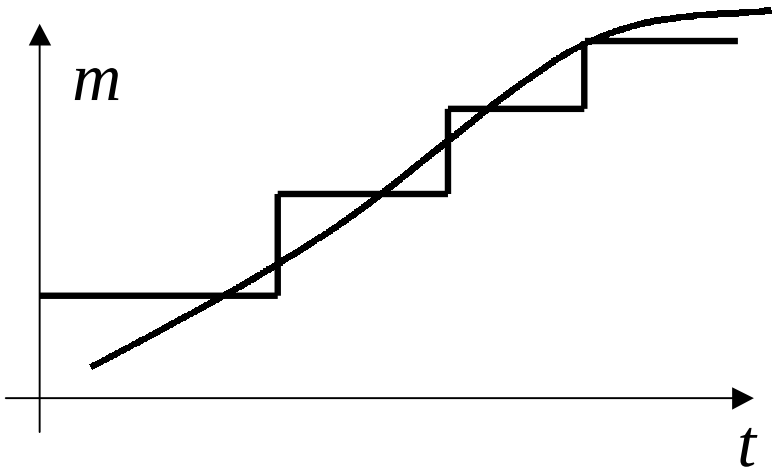
$$\left\langle \sum_{i=1}^{k} \left(\vartheta_{1i} - \vartheta_{2i} \right)^2 \right\rangle$$

$$\left\langle \left(\vartheta_{1i} - \vartheta_{2i} \right)^2 \right\rangle = 2\left(1 - \gamma_{12i}\right)\left\langle \vartheta^2{}_{1i} \right\rangle$$

$$\sum_{i=1}^{k} 2\left(1 - \gamma_{12i}\right)\left\langle \vartheta^2{}_{1i} \right\rangle = m_k$$

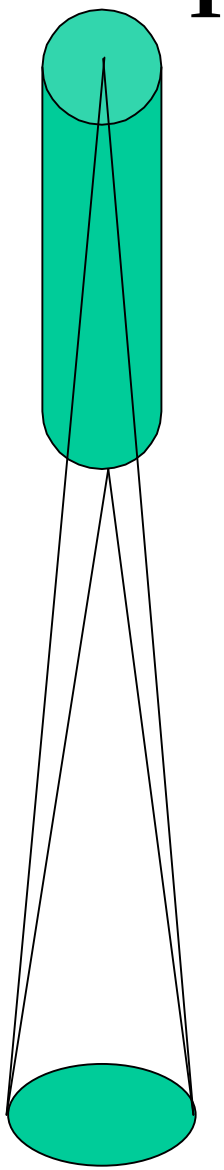
D/d, L0

Cn2



A linear system with k measurements

The backscattered photons



0.3m diameter subaperture

10^3 photons / m2 / m / J @ 532nm & 15km

$\gamma \sim 10^3 * 0.1 * 10^3 * 0.01 = 10^3$

$\gamma \sim 10^2$ Considering optical losses

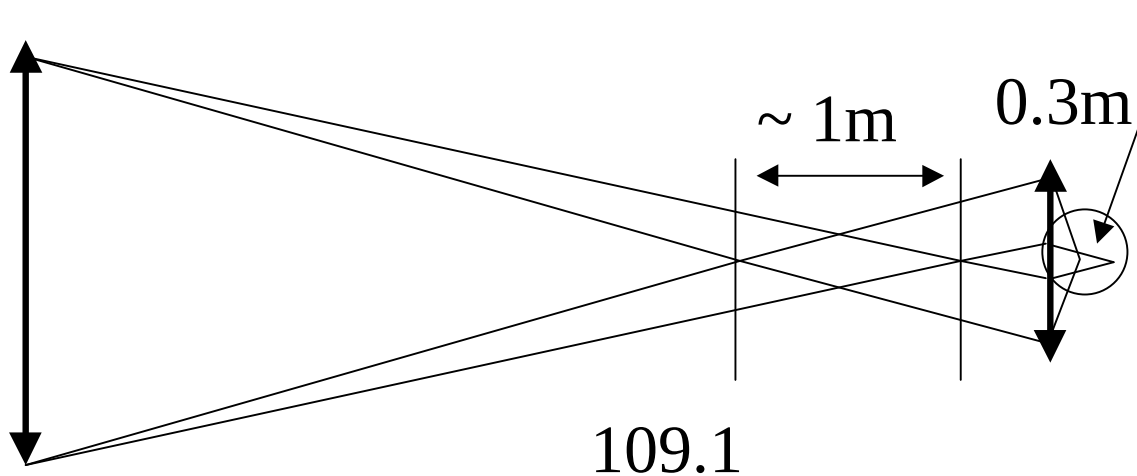
$$SNR = \theta / \gamma^{1/2}$$

10 pulses/s => 100mW laser

10^4 pulses ~ 16minutes

Optical Arrangement

1.5m tel.
30m focal length

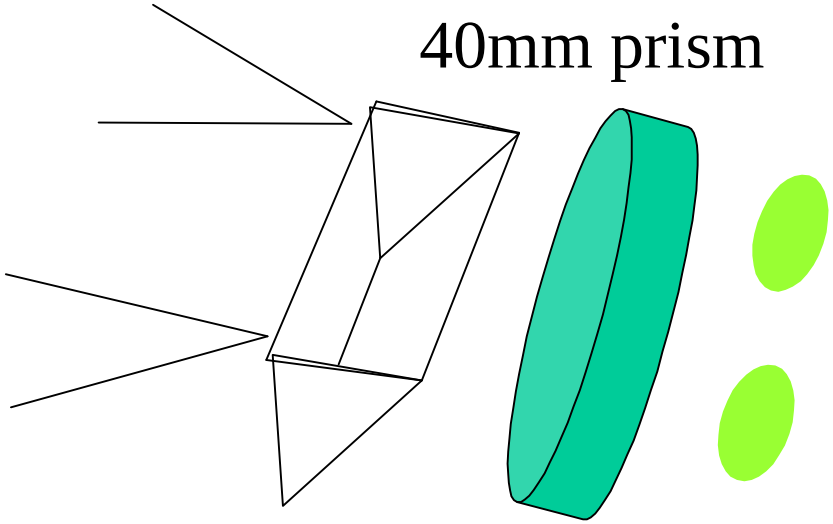


109.1

1km 20km

65mm diameter
100mm focal length

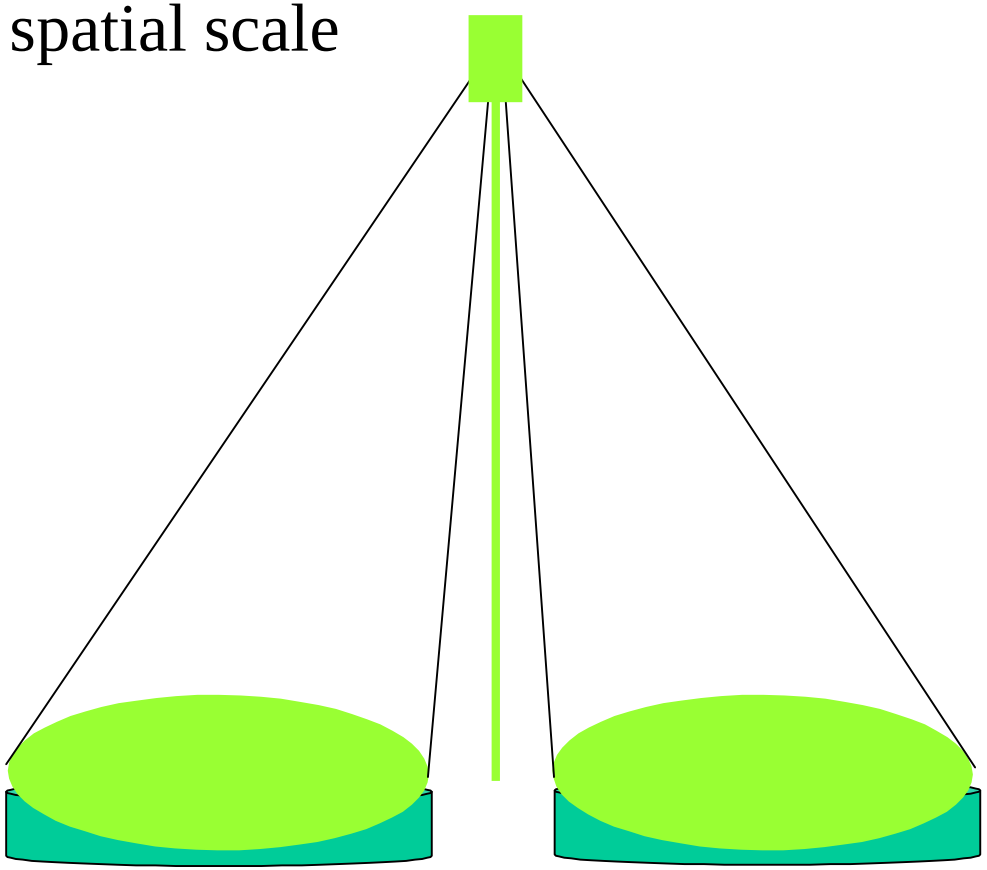
40mm prism



Pupil images on APDs
(20ns detection time)

Using different telescopes

- Separate the contribute of different layers
- Discarding ground layer (affected by telescope jitter)
- Correlation on large spatial scale



So.....

- A technique is proposed to measure the Cn2 of several layers using a single laser beacon of 100mW average power.

- Can we apply this technique to several telescopes many meters apart to measure correlations at spatial scale of the order of 10 - 100 m ?