

operations

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Ghost of telescope past...



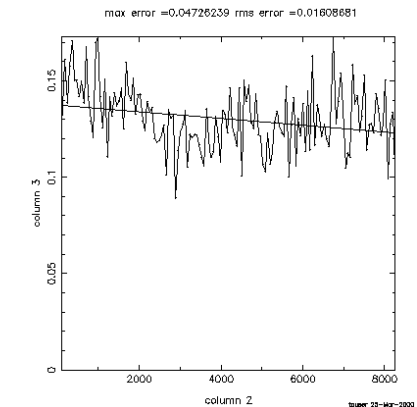
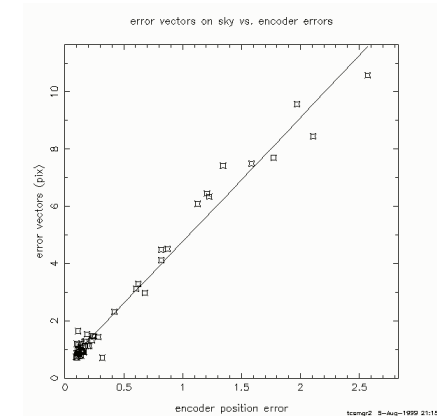
OWL Phase A Review - operations

- This is a presentation about what we will worry about, more than what we have worried about.
- Operations is traditionally split into **science** and **other** operations.
 - if it does good science everything must be fine.
- Is it worth worrying about any of this?
 - If you know all your problems, you have not thought enough about the telescope. If you don't then you have not thought enough about your telescope.



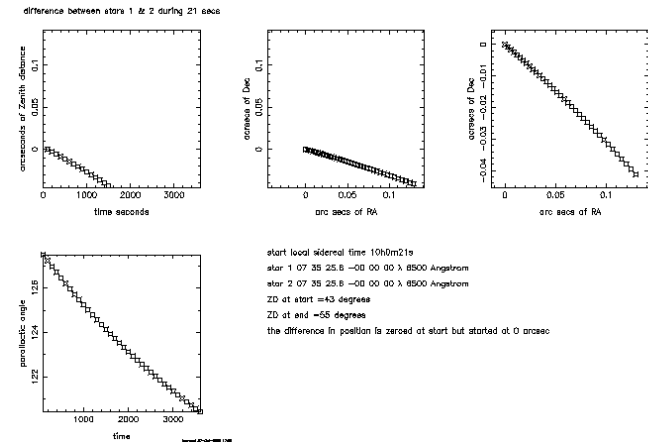
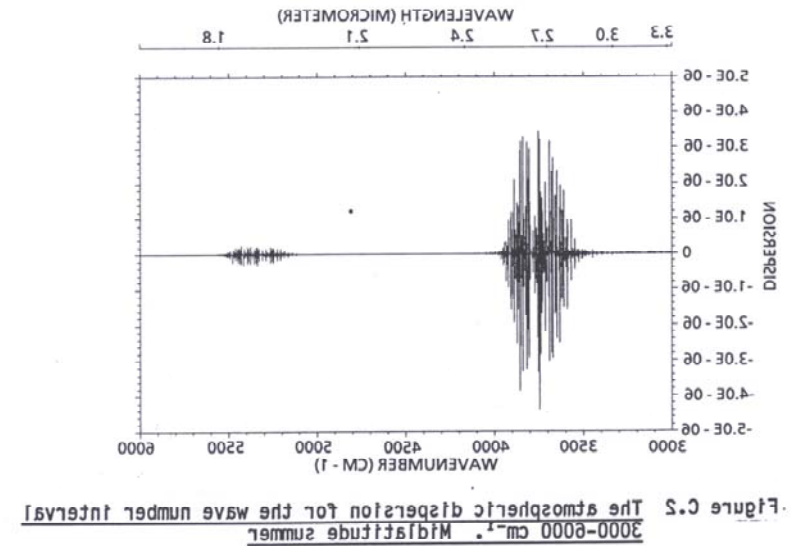
OWL Phase A Review - operations

- Astronomical system engineering.
- What does it take to operate any telescope?
 - Need to point. How accurately and how accurately do you need to know your source location
 - Need to track. 15 arcseconds per sec. Easy unless you need to de-rotate the field with an accuracy of 1mas at a distance of 2-m.
 - Need to keep the optics aligned either passively (old fashioned) or actively.
- In the current generation of telescopes we cope with all of this because we are still fundamentally at the telescope level working at the atmospheric limit of 100 mas.
- Are there intrinsic limitations for a ground based 100-m telescope?



OWL Phase A Review - refraction (coloured or not)

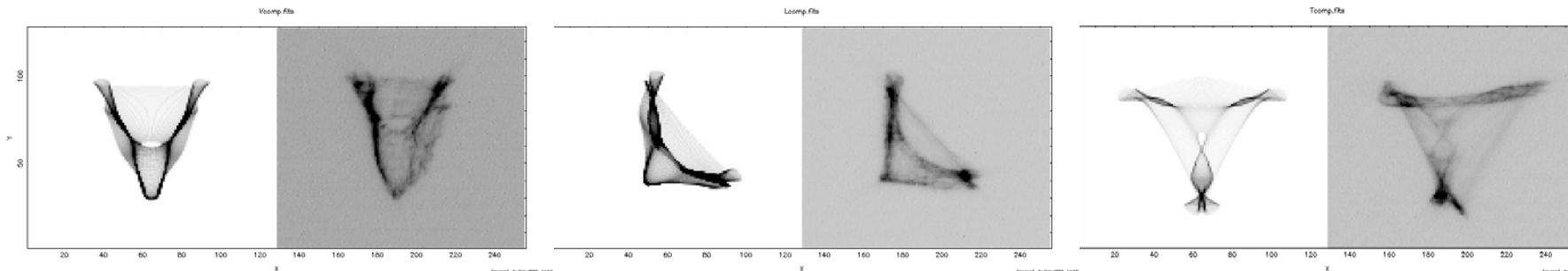
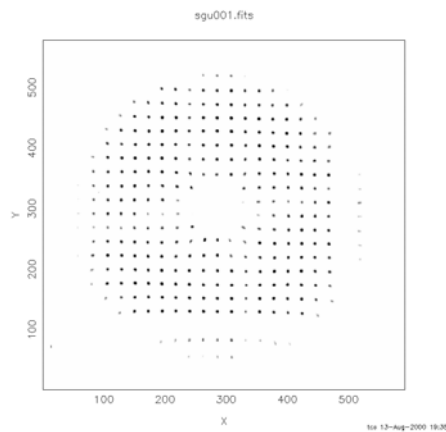
- Can one have a 1 mas PSF and if so for how long?
- Assuming now a non-turbulent atmosphere (or an AO corrected wavefront) are there other limitations?
- The refractive index of the atmosphere changes with wavelength and temperature, height and barometric pressure.





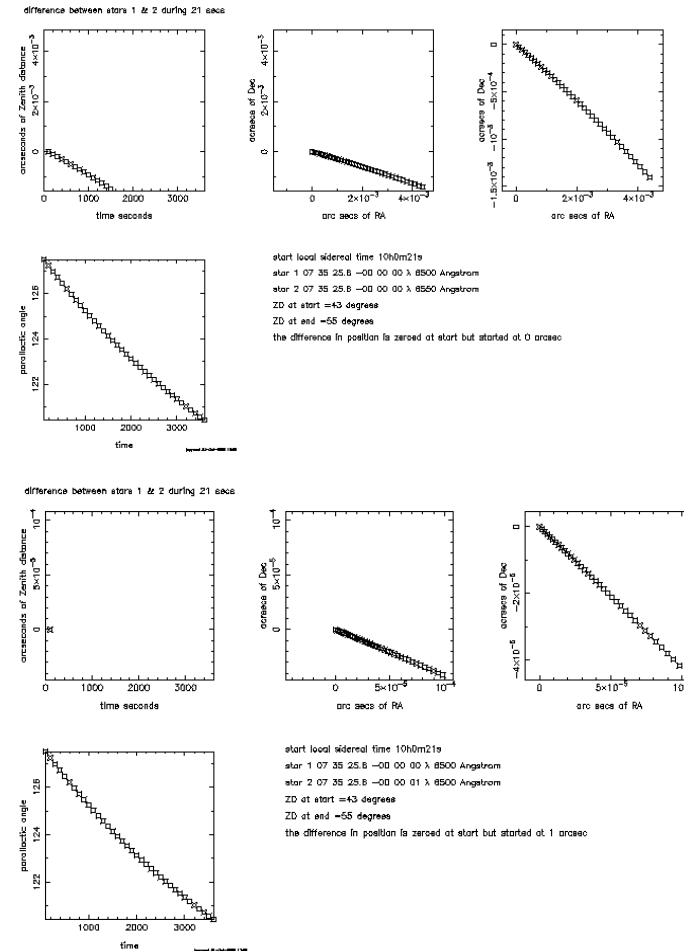
OWL Phase A Review - keeping the stars put

- Can one have a 1 mas PSF and if so for how long?
- If you are guiding at the edge of the field what do you need to worry about in order to keep the centre field in the right place.
- Stability of distortions. This is optical design specific. We need to look at this more. In principle, if you can control other aberrations then this is just another one. On the VLT we control pretty well.
- Accurate refraction terms. Over some time the field stretches differentially. This in principle is easy (the VLT already does all of this). Once you are tracking the only effects that matter are the differential ones.
- Accurate rotation terms. The field rotation will need to be solved. Since we will have multiple guide stars this is not a real problem but for the accuracy of 1mas we cannot rely on the theoretical rotation calculation.



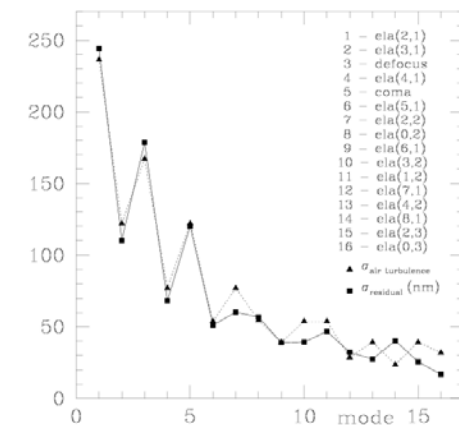
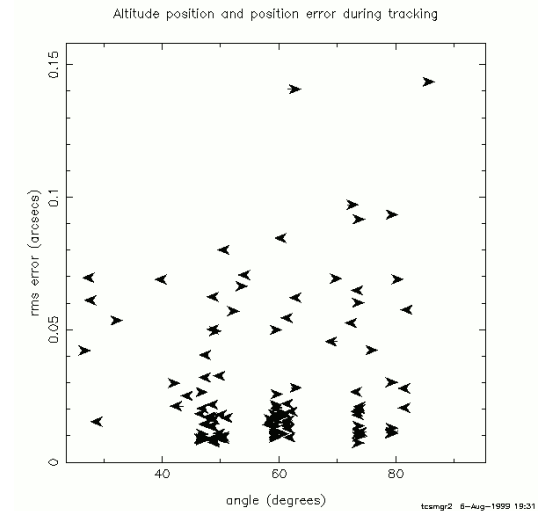
OWL Phase A Review - guide star colours

- Guide stars
- What is the meaning of guide stars in an adaptive telescope? What are we sensing and what are we guiding?
- Telescope axes, mirrors, focal plane...
- BAD: An error in the effective wavelength of the guide star of 50 Angstrom seriously affects the error budget for long exposures.
- GOOD: An error in the absolute position of a few arcseconds of the guide star will not affect the error budget.



OWL review: metrology

- In the era of telescopes just working metrology was a moot point. Maybe it makes operations easier (our view) maybe it makes software more complex.
- For OWL it is critical
 - what metrology is needed to establish the performance of the telescope
 - What metrology is needed to establish the correct failure location
 - What metrology is needed to commission the telescope
- Metrology is part of the design. It is needed for finding the dodgy segments, it is needed to ensure that loads are distributed properly. Metrology is not only about the system telling you what it is doing when it works properly but also that it is not working properly.
- How to introduce metrology without introducing complexity. The VLT system works remarkably well.





OWL Phase A Review - software complexity

- How complex does the software environment of the telescope need to be?
 - The VLT level of integration provides significant benefits in routine interfaces and standardized solutions.
 - The VLT level of complexity is approximately the limit of the long term support capabilities.
 - Complexity results in unreliability.

- For an OWL like environment it a less complex more compartmentalized solution is probably best.
 - Already existing solutions in the VLT and ALMA.
 - Re-examine the need for a large infrastructure.
 - Instead of databases and messages we can think of data products.

- We can probably neither afford to build (time wise as a minimum) nor afford to commission, let alone operate more than 2 to 3 millions of lines of code.

OWL Phase A Review - operations

- ADC
 - Do we need one, do we wish for one? Invert it and with a a few mas PSF you get a decent spectrograph out of the atmosphere.
- A site on earth will have good and bad nights. What do we do on the not so good but not so bad nights?
 - In the transition from tracking the axes of a telescope to tracking the focal plane we also have driven requirements on operations.
- What have astronomers to do with a machine as complex as an ELT/OWL?
 - Traditionally the astronomer had little to do with the telescope. Few souls ventured there.
 - The telescope invariably just worked. Is this the same for OWL? Will it be entrusted to operators or will we, as users, need to understand the apparatus again (HURRAH!)





OWL Phase A Review - operations

- This is a telescope with instruments. It will take images and spectra (there is little else you can do with light).
- How complicated can this be?
- When visitor and queue (classical and service - to mix terminologies) was implemented at the VLT and Gemini, the discussion with the community was somewhat one sided. It was deemed by the wise that this was the right way to go (supported by charts of seeing vs probability of observation etc). That it has been implemented successfully at the VLT is evident (to us anyway).
- Is this model applicable to OWL? Is OWL an experiment or a facility?



OWL Phase A Review - operations

- What will the data products look like?
 - Already at NACO we are able to store the AO corrections applied to the data.
 - Is there post-processing of data meaningful to improve the performance.
- How do you prepare an observation with OWL?
 - Do you need an accurate spectrum of your guide stars?
 - Not difficult but might need support facilities
- What do you need to know during observations?
 - Do you need to know the weather across a 100-m aperture?
 - What is weather anyway?
 - OH variability...
 - Temperature and pressure
 - Variability of turbulence



OWL Phase A Review - operations

- Discussions with the selected members of the community started within the FP6 programme.
- How big a field do you need and what is the density of sources? (do we need to observe the whole field or can we IFU the locations of the sources).
 - *One arcsec field is more than enough.*
 - *a few square arcminutes, only sources of interest to be IFU'ed*
 - *Two arcseconds around the stars, with one or two planets in the FOV.*

OWL Phase A Review - operations

- Discussions within the FP6 programme.
- How long would you integrate? (There are significant operational issues arising from short vs long integrations. Is it always the case that you will want to just reach the sky and move on)
 - *Not very long for each image (minutes?). Longer for spectra (tens of minutes?)*
 - *Per field, integrate 10 to 100 hrs, Tens of fields, Individual exposure time: a few minutes to be background limited between OH lines*

OWL Phase A Review - operations

- Discussions within the FP6 programme.
- The VLT is not operated in open loop active optics. It is likely that ELTs will win big when operated in Adaptive optics mode. Should we consider non-adaptive operations of an ELT? (please assume that we shall be able in average conditions to make some corrections.)
 - *I do not consider an ELT to be worth unless it is fully adaptive!*
 - *No no*
 - *Yes, absolutely!*



OWL Phase A Review - operations

- Discussions within the FP6 programme.
- As a prospective user, how do you think you would interact with a facility like an ELT?
 - *Any ELT where a "visiting astronomer" is admitted within 100 m from the control room should be closed and the director fired.*



OWL Phase A Review - operations

- Closing the loops both with the engineers (too early to catch the mistakes but not early enough to be worrying about them) and with the community.
- Can OWL be used by the community?
 - Probably but not obviously



Evolution from ideas to reality



Le télescope optique
de 16 m de l'ESO

VLT

