CCD pixels.[2]

Jitter in the pointing of the telescope during an exposure measuring the PSF is another problem [compare Parts (A) and (B) of figure], and algorithms have been devised that account for the jitter.

For accurate phase retrieval, it is necessary to know the space-variant shift of the WF/PC obscurations relative to the OTA pupil. We determined the shift by reconstructing the magnitude of the wavefront in the exit pupil using the iterative transform algorithm.[1] We found that the shift was different from the design, indicating an unintentional misalignment of the optical axis of the WF/PC relative to the OTA.

An estimate of the spherical aberration of the HST's OTA, after accumulating results of several phase-retrieval groups and allowing for an estimated spherical aberration of -0.023 μm rms in a WF/PC relay telescope, is about -0.27 μm rms of wavefront error. This is equivalent to a primary mirror having a conic constant of -1.0142, as compared with the designed value of -1.0023, making the r^4 term of the mirror surface off by 2.3 μm at the edge.

References

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Optical NMR

By Myron W. Evans, University of Zurich

Optical NMR depends fundamentally on a nonlinear optical process—magnetization by the conjugate product of a circularly polarized laser. It appears to be of widespread interest because it combines laser physics and the physics and chemistry of magnetic resonance, two large contemporary fields. "Optical NMR" is the name given to an experiment in which a circularly polarized laser is used in a contemporary NMR spectrometer to induce extra magnetization and spectral features of analytical interest.

The simple initial "alpha theory" was initiated at the Cornell Theory Center.[1] It catalyzed the first experiment, by the team of Warren S. Warren at Princeton, using a very low intensity argon ion laser of only a few tenths of a watt CW power that is guided into an NMR tube with an optical fiber that maintains the all important circular polarization of the laser. With an extended chiral chromophore, broadening of NMR features has been definitively measured and separated from artifacts such as those due to heating. The results were well received in a conference in the United States.

The broadening is in the hertz range and represents the beginnings of an optical NMR spectrum, whose theoretical basis is being worked out by Evans and co-workers at Zurich, using optical pumping and semi classical (magneto-optic) theories. The ultimate theoretical aim is to present a resolved optical NMR spectrum, using the appropriate selection rules, which turn out to be quite different from conventional NMR. The molecular property responsible for optical NMR has been isolated. It is a magnetic/electric/electric hyperpolarizability, of SI magnitude about ten power minus 45 A m^4 V^{-2}. It is closely related to the tensor that mediates the well known Faraday effect and magnetic circular dichroism, and exists in diamagnetic and paramagnetic atoms and molecules, both chiral and achiral.

The initial alpha theory was valid for paramagnetics only. For a given laser intensity in watts per square meter, the expected broadening in hertz of the NMR line can be estimated. This is expected to be site selective, *i.e.*, different for each NMR line of a complex spectrum, or 2D NMR map, so that optical NMR would give very interesting supplementary experimental information. A resolved optical NMR spectrum would be much richer in detail than a conventional NMR spectrum for the same sample.

Reference

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Atmospheric Compensation Using Laser Beacons

By Robert Q. Fugate, Phillips Laboratory, and Charles A. Primmerman, Lincoln Laboratory

Researchers at MIT Lincoln Laboratory and the Air Force Phillips Laboratory have demonstrated real-time correction of turbulence induced atmospheric wavefront distortions using laser beacon adaptive optics.[1,2] These experiments could have a profound impact on the course of astronomy during the next decade. The new generation of 8-10 m telescopes will have impressive light gathering capability, but without atmospheric compensation, their resolving power will be no better than backyard amateur telescopes of a few centimeters diameter. Atmospheric compensation may be accomplished using bright stars but, unfortunately, complete sky coverage is not possible