W. M. KECK OBSERVATORY

Degraded Laser Power Tradeoffs

KECK ADAPTIVE OPTICS NOTE XXX

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December 16, 2008.

ABSTRACT

We explore the NGAO design performance and subsystem flow-down requirements as a function of available SOR-equivalent return sodium D_2 laser power put into a fixed 60" diameter asterism composed of 4 or 6 laser beacons (always one central, with either 3 or 5 add'l beacons on a 60" diameter circle.) We find that, for a range of NGAO science cases and seeing conditions, that optimal performance is obtained for

50W of laser power leads to N_{ast} = 4 and N_{subap} ~ 56 subapertures across the pupil; equivalent to N_{ast} = 6 and N_{subap} ~ 48

75W of laser power leads to N_{ast} = 4 and N_{subap} ~ 64 subapertures across the pupil; equivalent to equivalent to N_{ast} = 6 and N_{subap} ~ 56

100W of laser power leads to N_{ast} = 6 and N_{subap} ~ 62 subapertures across the pupil

where the choice between N_{ast} = 4 or 6 is a shallow performance discriminator when considering only a single on-axis evaluation (science) points as was done herein. Thus lower complexity in the projector and high-order laser wavefront sensor (fewer beacons, greater allowable sensor noise) can be traded off against lower complexity in the deformable mirror (fewer actuators). Required performance in the real-time controller is increased for greater actuator count, but reduced for the corresponding reduction in number of laser wavefront sensors entering into the tomographic reconstruction calculation. We believe these trades are likely to favor fewer beacons, overall.

We assume that an additional 25W (SOR-equivalent return) laser power is also available as patrolling 'point and shoot' laser beacons to improve tip-tilt NGS multi-object AO (MOAO) performance. The basic conclusions of this study, however, concentrate on high-order error terms and are largely independent of the PnS design choice.

We suggest future simulations should explore the detailed performance of N_{ast} = 4, 5, or 6, (one central) assuming 75W of fixed-asterism laser power and N_{subap} = 56, for asterism diameter in the range of 40" - 60". In particular, we recommend exploring the quality of the MOAO point and shoot technique for N_{ast} = 4 vs. N_{ast} = 5.

To help assess the cost-effectiveness of the PnS method, we should also consider the performance comparison of a 75W fixed-asterism, no PnS option relative to a comparable 50W + 25W PnS architecture.

1. Introduction

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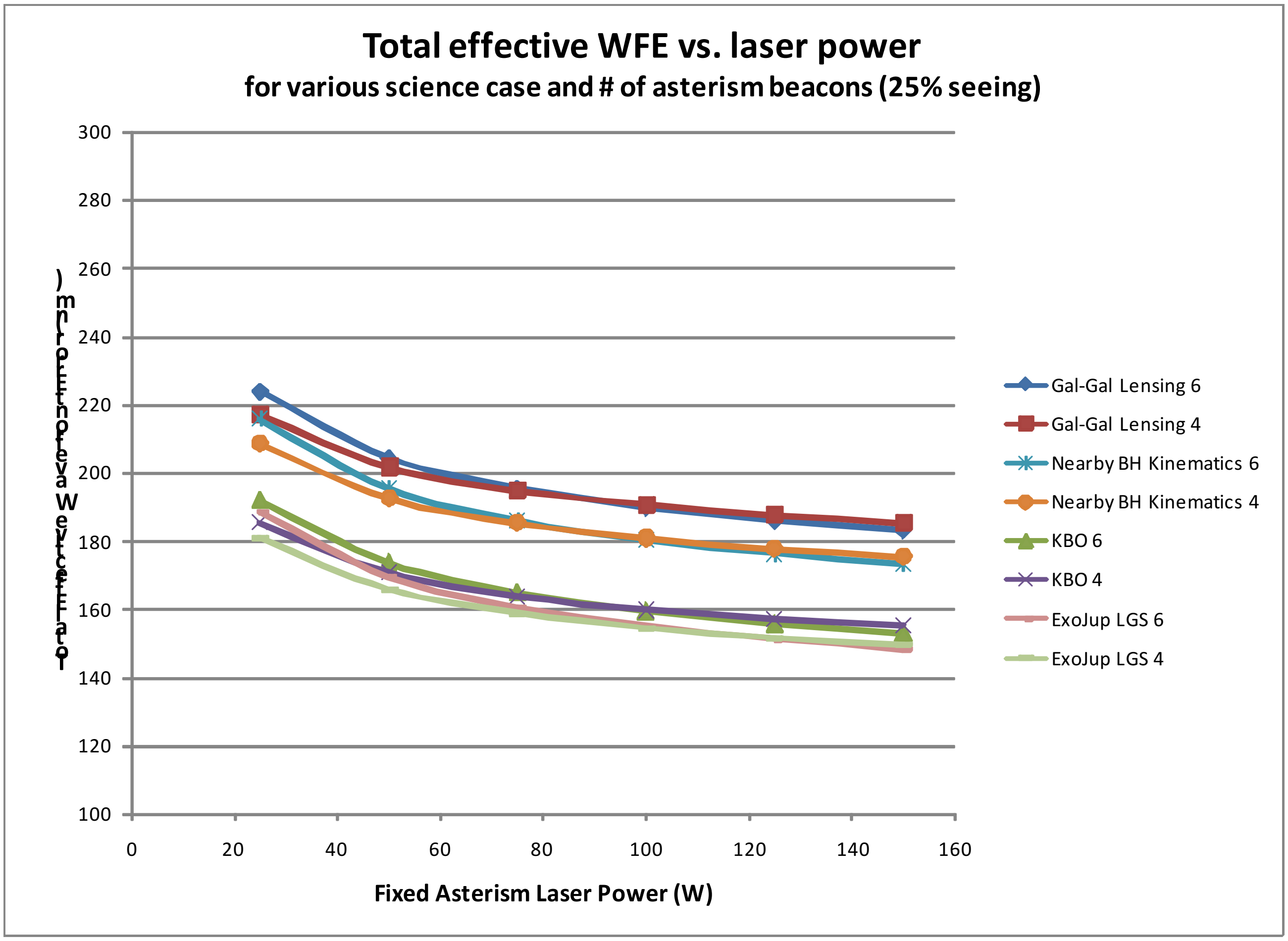
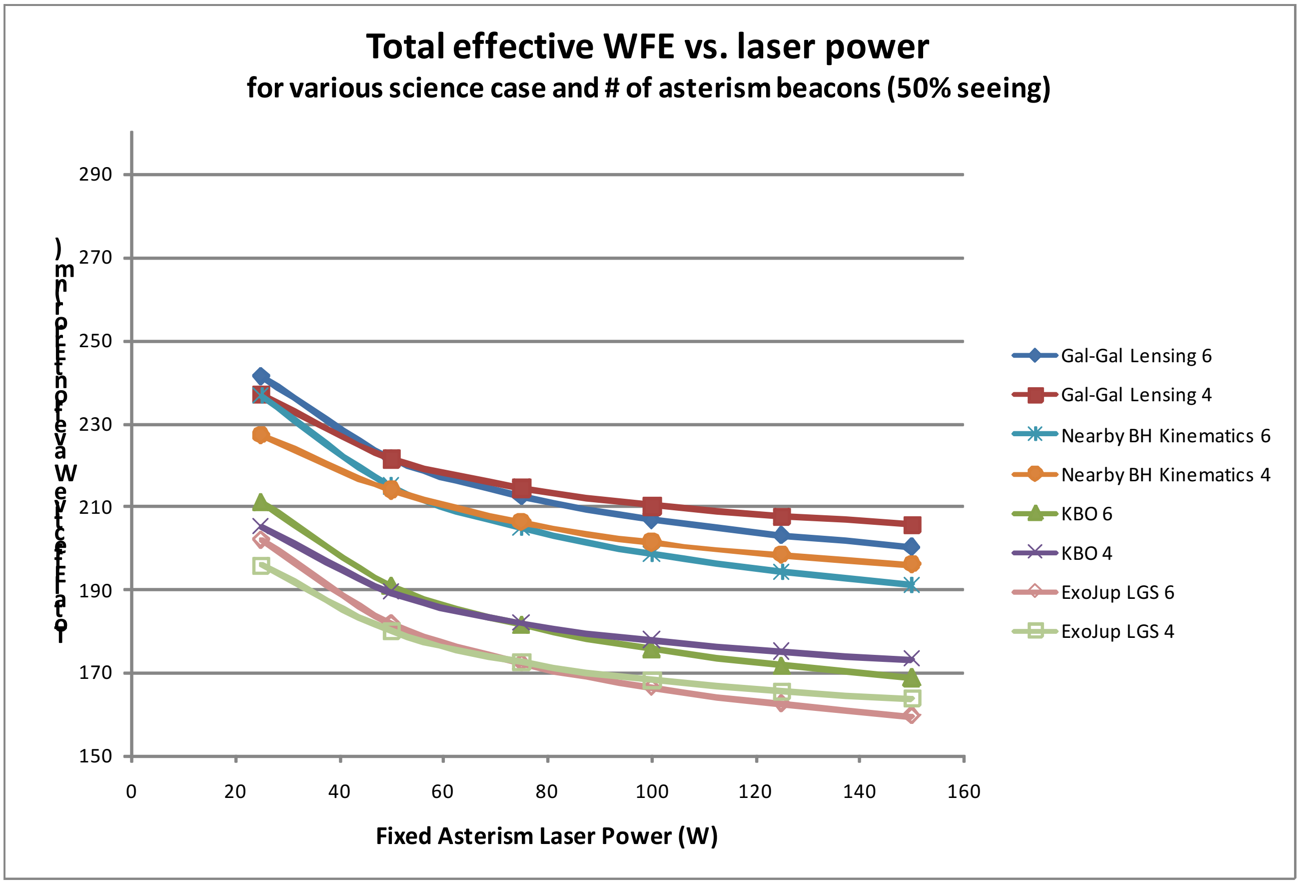


Figure 1 Text goes here.



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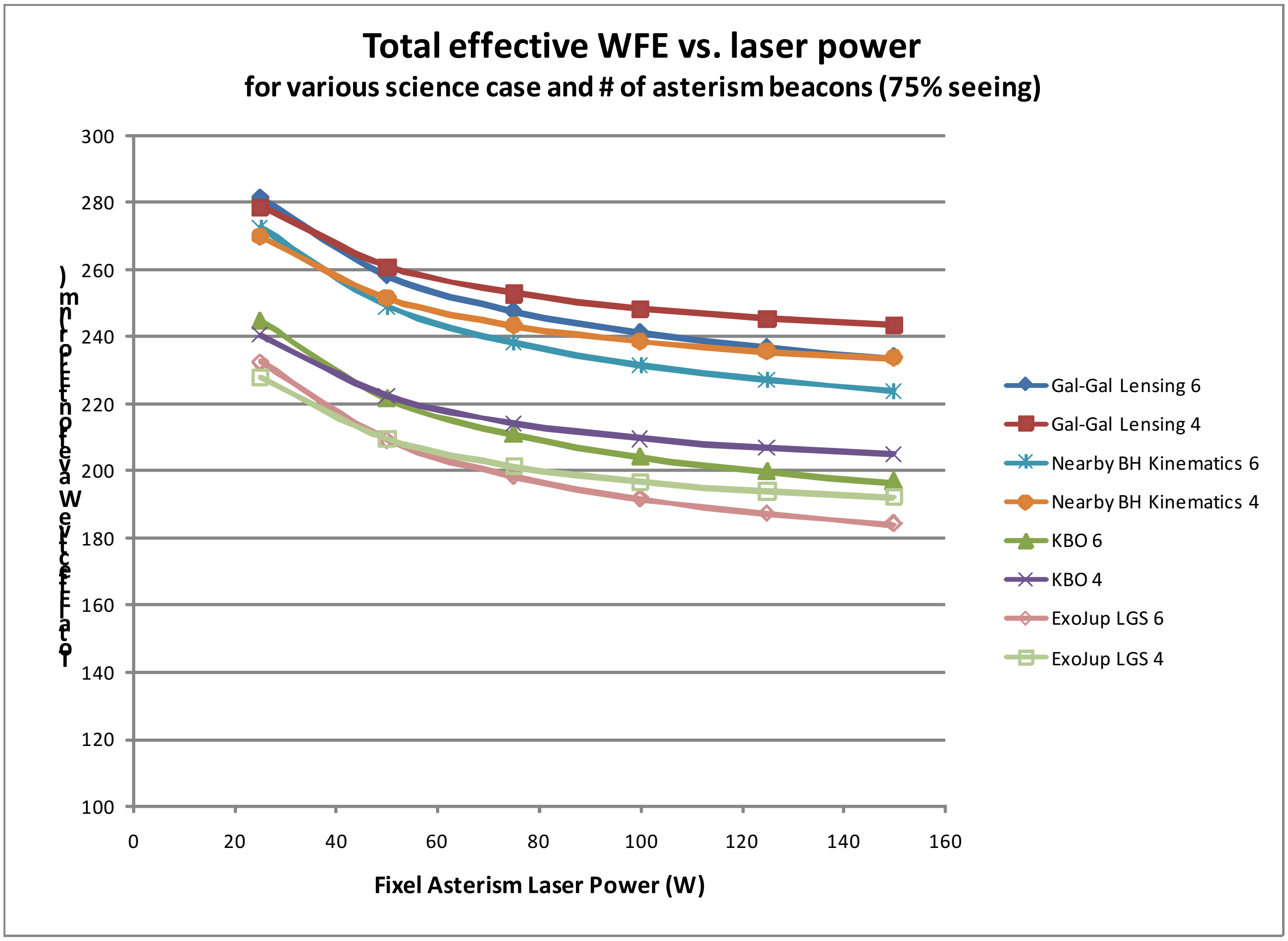

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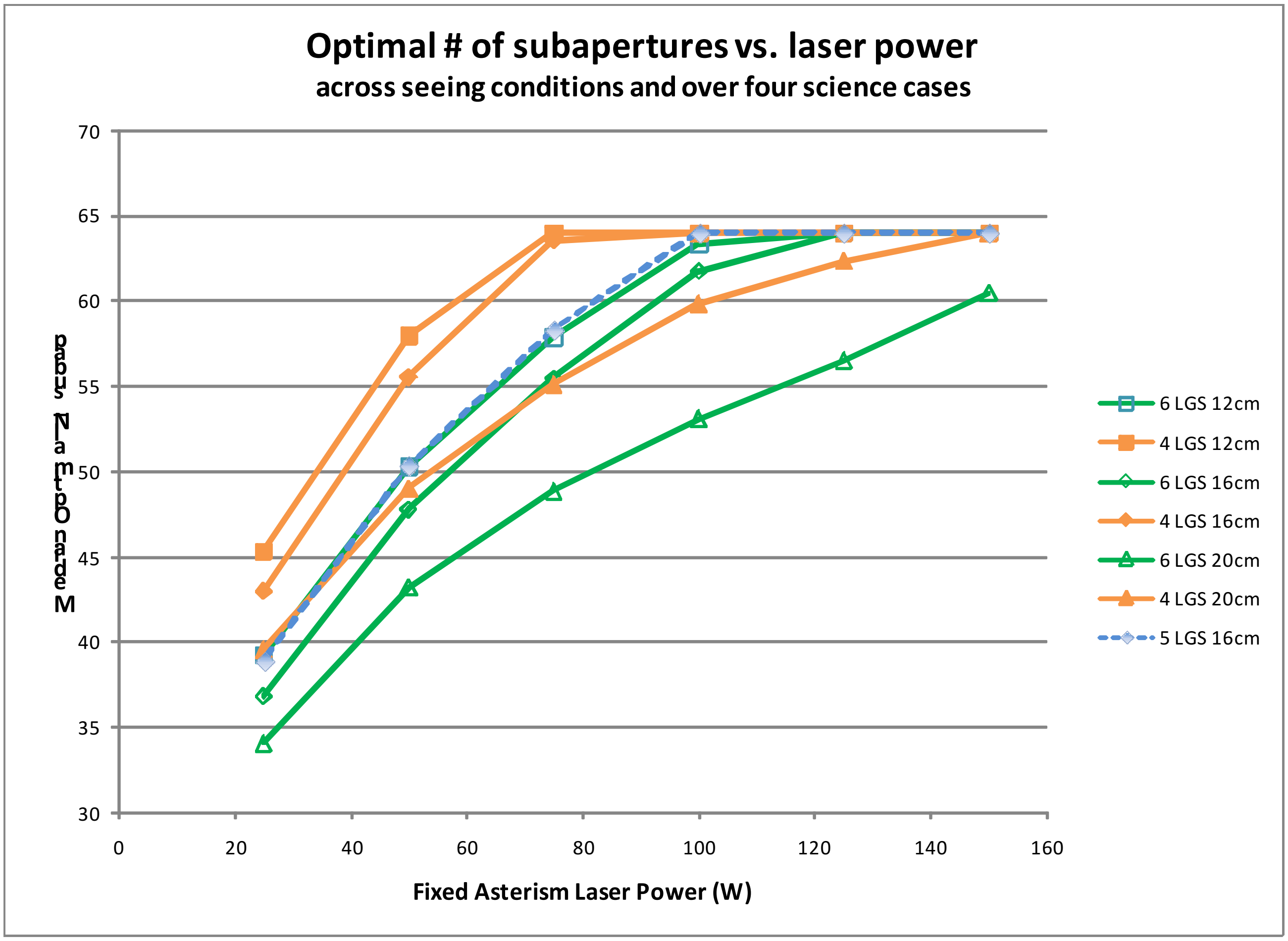

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