

```

37 ret = dmi(o_003_00,      $
38           o_009_00,      $
39           o_010_00,      $
40           o_010_01,      $
41           dmi_00010_p,    $
42           INIT=dmi_00010_c, $
43           TIME=dmi_00010_t)
44 IF ret NE 0 THEN ProjectMsg, "dmi"
45 ;;
46 IF this_iter EQ 0 THEN begin
47   idx=where(o_010_01.pupil)
48   rms=FLTARR(tot_iter)
49   atm=FLTARR(tot_iter)
50 ENDF ELSE BEGIN
51   dummy=moment(o_010_01.screen[idx],SDEV=sigma)
52   rms[this_iter-1]=sigma
53   dummy=moment(o_003_00.screen[idx],SDEV=sigma)
54   atm[this_iter-1]=sigma
55 ENDELSE
56 IF this_iter eq tot_iter THEN BEGIN
57   PRINT, 'mean rms = ', mean(rms[50:])*1E9, ' nm'
58   PRINT, 'rms(atm) = ', mean(atm[50:])*1E9, ' nm'
59   SAVE, rms, FILE='./Projects/AOC_Simul_LAST/rms_cor.g=0.05_mag=0.sav'
60 |  SAVE, atm, FILE='./Projects/AOC_Simul_LAST/rms_atm.sav'
61 ENDF
62 ;;

```

Performance assessment of the AOC system on a 1-m telescope: stellar mode characterisation and planetary mode development

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ABSTRACT

The Adaptive Optics at Calern (AOC) system aims to bring AO correction to 1-m class telescopes, which typically lack such capabilities, enhancing their high-angular resolution imaging performance. It offers both stellar (8.5 arcsec FoV) and planetary (30.5 arcsec/80.5 arcsec FoV) modes, guiding either on point sources or extended objects (such as Jupiter or Saturn). In the latter case, it introduces a filtering of the high-altitude turbulence, similar to ground-layer AO averaging, because high-altitude turbulence will be different around the edges of the planet, distorting the planetary disk, but not necessarily shifting the overall centroid. This work focuses on the ongoing characterisation and optimisation of the system, from near-infrared to visible wavelengths. We are developing both simulation tools and diagnostic/evaluation tools, and comparing simulations, telemetry, and on-sky data, aiming at refining wavefront control and improving robustness for both stellar and planetary observations.

Keywords: adaptive optics, 1-m class telescopes, planetary wavefront sensing, system characterisation, numerical modelling

1. INTRODUCTION

The Adaptive Optics at Calern (AOC) system is an adaptive optics (AO) bench currently being developed at the C2PU ([Centre Pédagogique Planète Univers](#)) facility of the Calern Observatory, Observatoire de la Côte d'Azur (OCA), near Nice (France). It is installed on the 1.04-m Epsilon (East) telescope at the F/35 Coudé focus, and aims to provide wavefront correction in both the visible and near-infrared domains.

AOC is designed as a flexible AO platform capable of operating on both unresolved (stellar) and extended (planetary) sources. It follows a standard closed-loop AO architecture in which the incoming distorted wavefront is measured, reconstructed, corrected by a deformable mirror (DM), and the resulting image is recorded for scientific analysis. The system is based on a 10×10 Shack-Hartmann wavefront sensor and a 97-actuator DM arranged in a Fried geometry. The optical beam is split into multiple channels dedicated to wavefront sensing, science imaging, and diagnostics, enabling simultaneous performance monitoring and scientific observations.

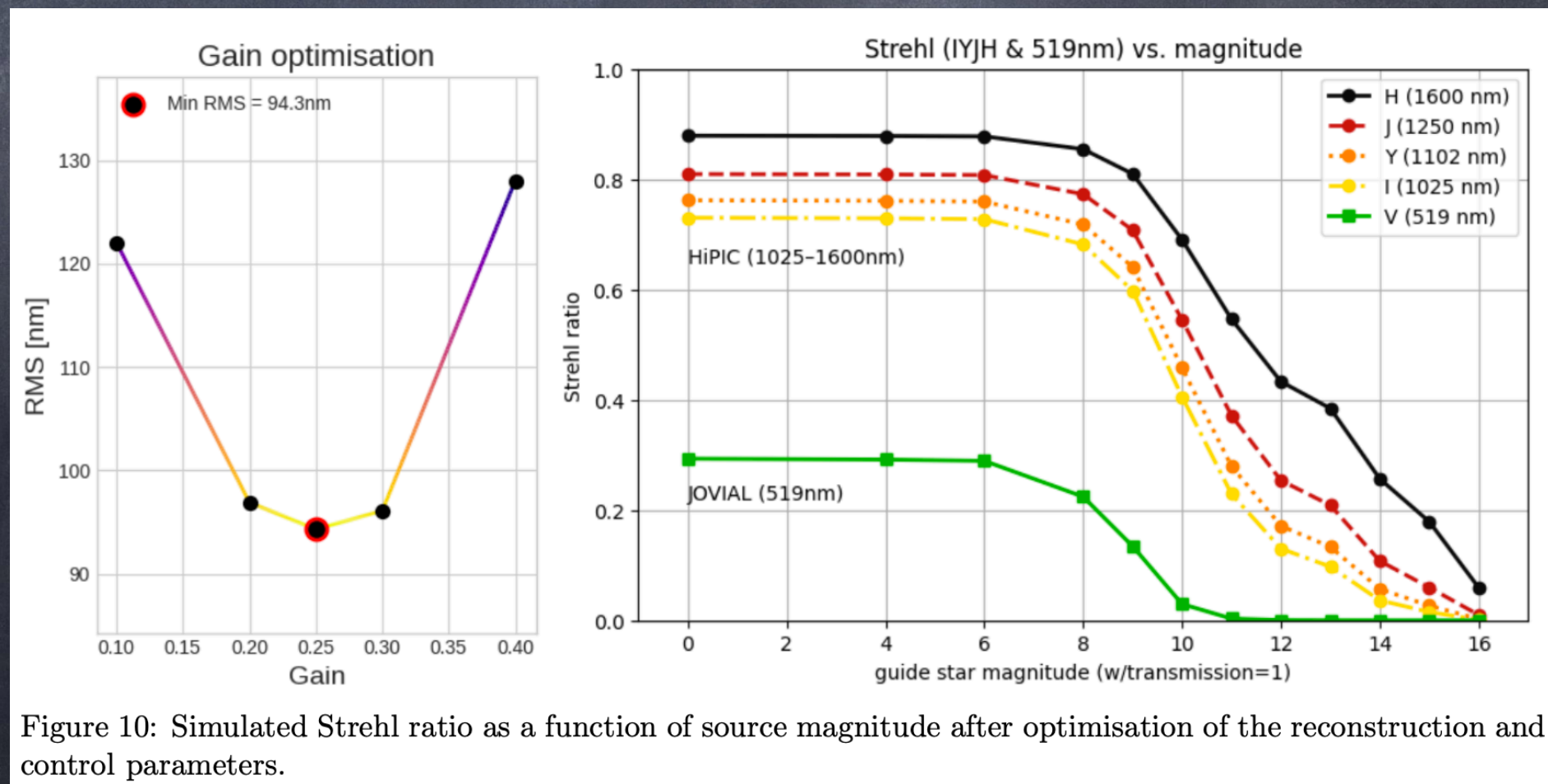
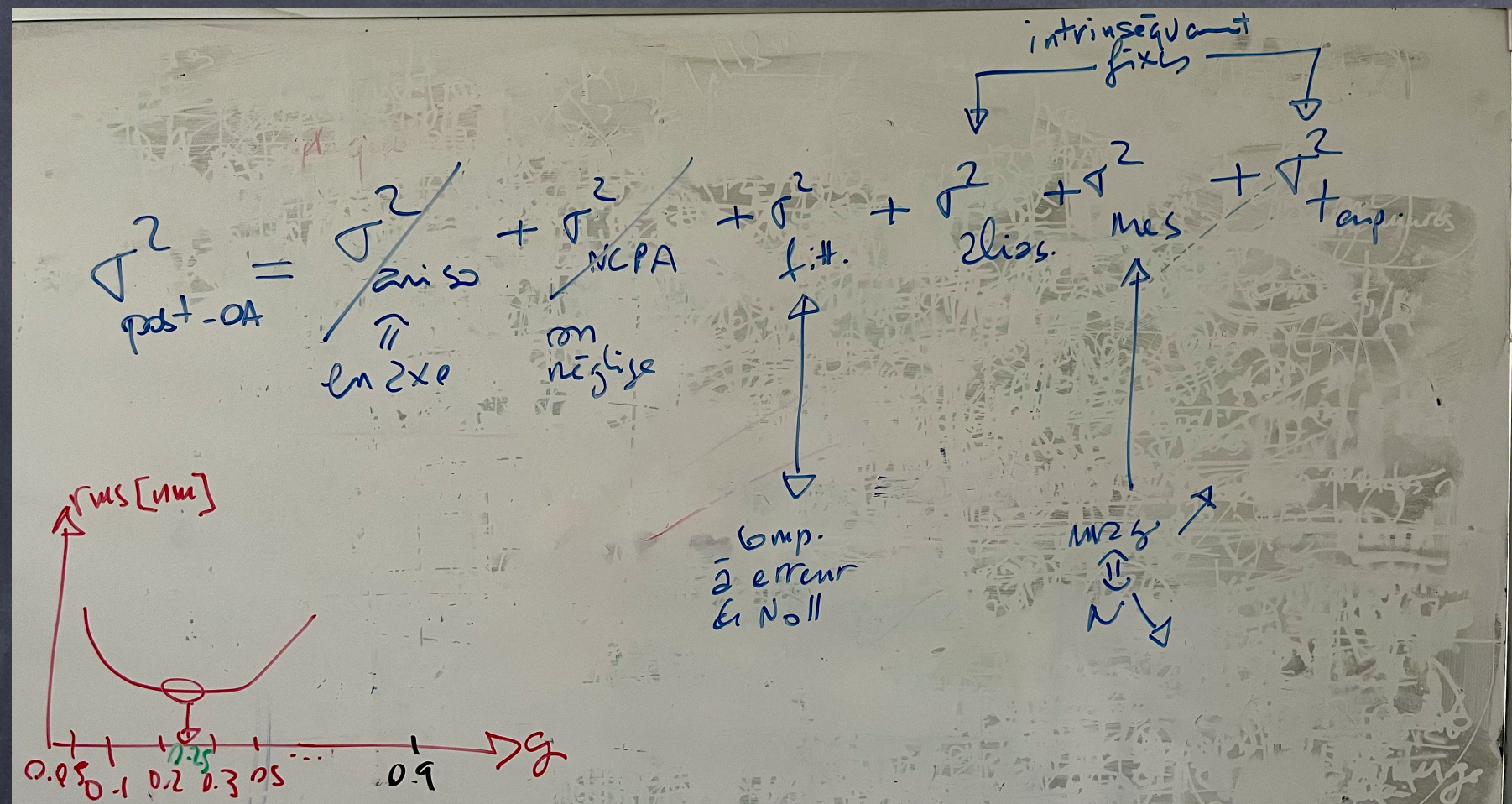
In this paper, we present an updated characterization of the AOC system and its recent developments since the initial description in Buralli et al. (2022)¹ and Abe et al. (2024).² We focus in particular on improvements in control strategies, system modelling, and on-sky performance in both stellar and planetary observing modes.

2. SYSTEM DESCRIPTION

2.1 AOC Overview

The telescope beam is redirected into a coudé path by mirrors M3 and M4 before entering the system. The remainder of the optical path is shown in the system bench view in Fig. 1 described in the following. After M4, it passes through a pupil derotator, which compensates for the pupil rotation introduced by the coudé configuration.

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- Theoretical part	[/40]
details:	
+ Exercices	[/20]
+ Optimisation & performance of an AO system in fct of photon noise	[/20]
details:	
. context & numerical modelling	[/2]
. loop gain optimisation & consequences on loop stability (rms(t)) (comp. with Fig.10 of AOC SPIE 2026)	[/6]
. rms(N_phot) and rms(mag.)	[/6]
. => retrieve that var_phot $\propto 1/N$	[/2]
. Strehl(mag, lambda)	[/2]
. ccl/transition	[/2]