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Trial run of SWIFT instrument mounting onto PALAO

Version 1.1

Anna Moore

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Caltech Optical Observatories
California Institute of Technology
Pasadena, CA 91125

Abstract

This document summarises the trial installation of a mock-up of the SWIFT instrument onto the PALAO bench while located on the Cassegrain ring of the 200” Hale telescope at Palomar Observatory.

Version History

Version	Date	Author	Comments
1.0	2006-07-29	AMo	
1.1	2006-08-04	AMo	Updates from Fraser

Contributing Authors

Antonin Bouchez

Mike Doyle

John Henning

Jeff Hickey

Steve Kunsman

Anna Moore

Hal Petrie

Bob Thicksten

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1 Introduction

Please abide by Word formatting rules when editing this document, in particular, use only the provided styles (there are 35).

Dimensions given without units are in SI (millimeter) format.

1.1 Overview

SWIFT (or O-SWIFT) is a red-optimized IFU spectrograph under design at the University of Oxford. The instrument will mate directly to the PALAO optical bench and will be commissioned at the telescope in March 2008.

The SWIFT enclosure is substantially bigger than the current PALAO science instrument-PHARO. As summarized in the current Interface Control Document any instrument of this size must be supported and transported while inside the dome using a custom designed handling cart. The same handling cart is used to mount the instrument onto the PALAO optical bench, while the bench is mounted to the Cassegrain ring of the 200" Hale telescope. It is noted that this is a different procedure than that currently used for PHARO, where the instrument is mounted to the PALAO optical bench prior to installation on the telescope.

The SWIFT team is well advanced and has designs for both the instrument and handling cart. We present here results of a trial run of the installation procedure required to place SWIFT on the telescope using the SWIFT handling cart. Also tested is a similar procedure for mounting SWIFT onto the PALAO optical bench, itself mounted to the AO spit, located in the AO lab on the ground floor of the 200" dome at Palomar.

1.2 Scope

On 26th July 2006 a mock-up of the SWIFT instrument and handling cart were assembled on the ground floor of the 200" dome. Foam was used to represent the volume of the SWIFT instrument (roughly 54" by 18" by 26"). Given time limitations the SWIFT handling cart was approximated using various items such as a trolley, cardboard box for necessary height adjustment and two cardboard sections mimicking the longest members of the SWIFT handling cart. A picture of the assembly is shown in Figure 1 (left) with a schematic of the SWIFT handling cart with mounted instrument shown in Figure 1 (right). Critical dimensions have been added to both drawings for aid in comparing the mock set-up to reference drawings.

1.3 Reference documents

[1] PALAO design specifications (Dekany *et al*., 1998, SPIE, **3353**, 56)

1.4 Reference links

PALAO Interface Control Document version 2:
http://www.astro.caltech.edu/twiki_oir/bin/view.cgi/Palomar/SWIFT/ICDs

PALAO (JPL): http://ao.jpl.nasa.gov/Palao/PalaoIndex.html

PALAO (COO): http://www.astro.caltech.edu/palomar/AO/

PHARO: http://astrosun2.astro.cornell.edu/research/projects/PHARO//pharo.html

SWIFT: http://www-astro.physics.ox.ac.uk/instr/swift/index.html

1.5 Acronyms

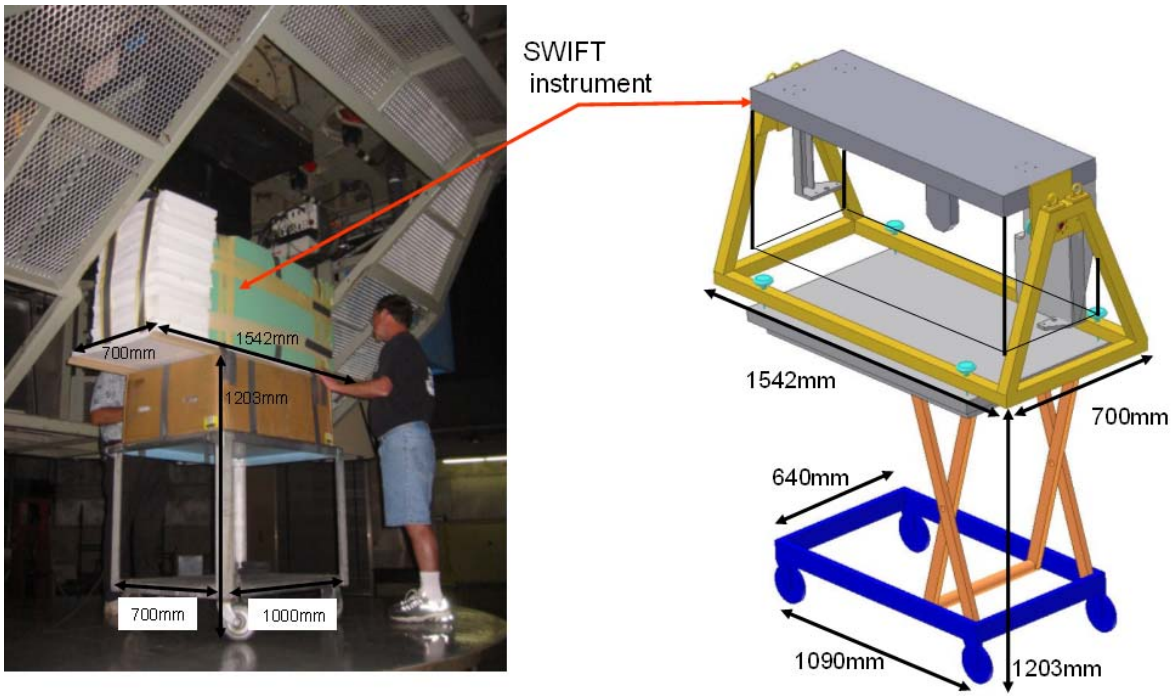

Figure 1: (left) Mock-up of the SWIFT instrument and handling cart, with critical dimensions labelled (right) Schematic of the SWIFT handling cart with the instrument mounted shown in the heighest position (courtesy of Fraser Clarke and the SWIFT team)

2 Procedure for mounting PALAO on telescope

For completeness we briefly summarize the installation of the PALAO optical bench on the Cassegrain ring of the 200” Hale telescope. This procedure occurs prior to the mounting of SWIFT and is by no means described in full detail here.

2.1 PHARO

Here we describe installation of the bench without any science instrument attached. It should be noted that the AO bench together with PHARO can be installed directly onto the telescope in an identical manner to that described and is in fact the current method of installing PHARO onto the telescope. This permits mounting and testing of the science instrument on the PALAO optical bench while both are located on the spit in the AO lab. Though mounting of the instrument onto PALAO in the AO lab is permitted, it is not permitted for instruments the size of SWIFT to be mounted onto the telescope together with the PALAO bench.

2.2 Mounting procedure

1. The PALAO electronics rack is lifted by forklift and mounted on the outside of the Cassegrain cage as shown in Figure 2;
2. The electronics unit of the AO science instrument is installed in a similar manner;
3. The hatch of the Cassegrain cage is removed as shown in Figure 3;
4. The PALAO cart supporting the PALAO optical bench is placed onto the hydraulic platform located underneath the Cassegrain cage in the correct orientation as shown in Figure 4;
5. The PALAO cart is lifted through the entrance of the Cassegrain cage using the hydraulic platform as shown in Figure 5;
6. As the PALAO bench approaches the Cassegrain ring of the telescope, as shown in Figure 6, adjustments are made to the XY position of the PALAO bench to align 4 guide pins, mounted to the top of the bench, with 4 holes in the Cassegrain ring mounting plate. Fine XY adjustment is permitted of such a heavy instrument due to the design of the AO cart. This is described in further detail in Section * and is suggested as a feature for any instrument handling cart.
7. When the guide pins are fully inserted into the respective holes the instrument is locked into place, shown in Figure 7;
8. The PALAO bench is shown from underneath in relation to the opening in the Cassegrain cage immediately after installation in Figure 8.

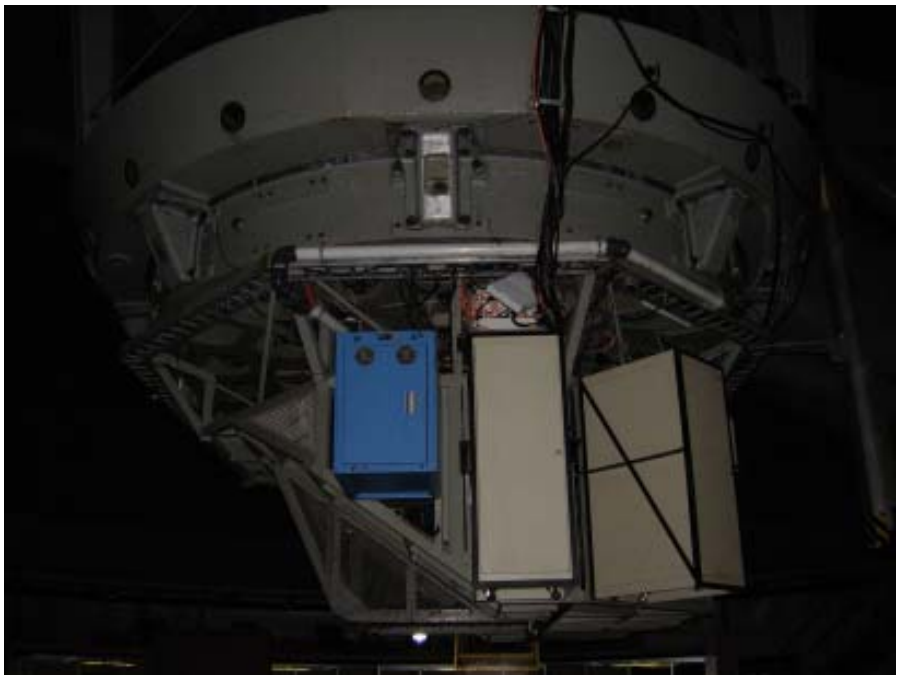

Figure 2: Electronics racks mounted to the outside of the Cassegrain cage. Instrument specific racks are removed with the instrument to allow testing off the telescope.

Figure 3: The Cassegrain mounting ring of the 200” Hale telescope with cage in place. The door of the cage has been removed to permit instrument change.

Figure 4: The PALAO optical bench supported by the AO cart prior to lifting into the Cassegrain cage. The AO cart is orientated into the correct position on the hydraulic platform.

Figure 5: Careful lifting of the AO cart with PALAO system through the entrance of the Casegrain cage under careful supervision by Steve Kunsman.

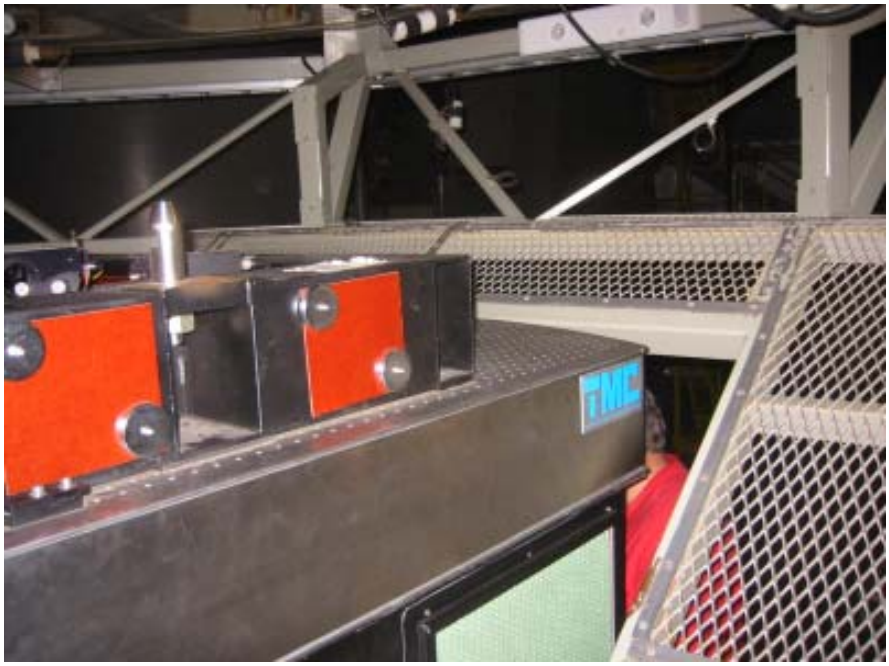

Figure 6: The PALAO optical bench entering the Cassegrain cage. One of the 4 guide pins is shown top-left

Figure 7: The PALAO bench locked onto the Cassegrain ring

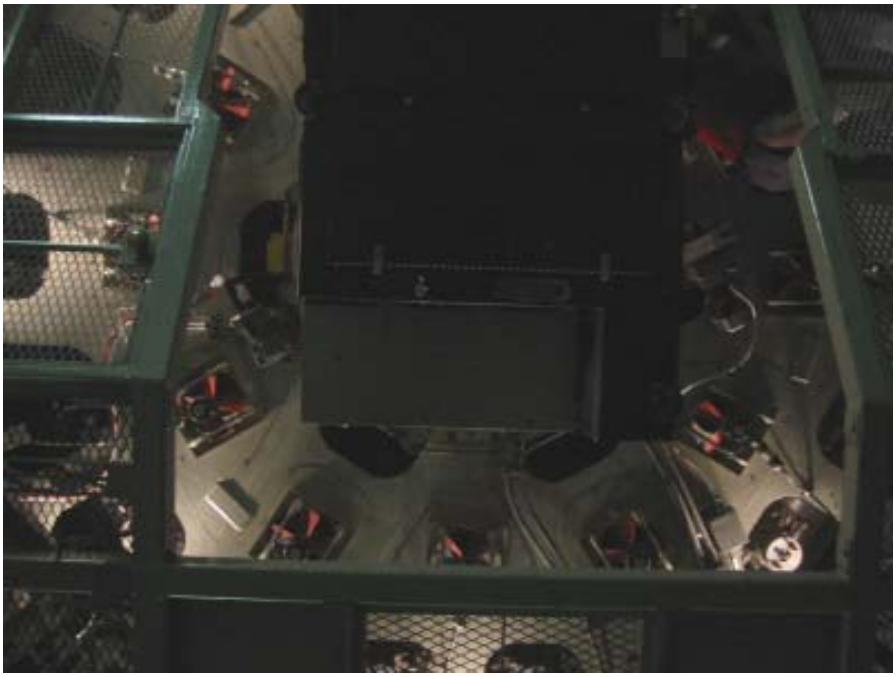

Figure 8: A view of the PALAO bench mounted on the Cassegrain ring of the 200” Hale telescope immediately after installation. No science instrument is mounted to the bench.

Figure 9: The PALAO bench is rotated on the Casssegrain ring by 180^{o} prior to installation of the SWIFT instrument

3 Procedure for mounting SWIFT to PALAO on telescope

The procedure commences directly after Section 2.2.

3.1 Mounting procedure

1. The Cassegrain ring is rotated by 180^{o}, shown in Figure 9;
2. The SWIFT handling cart is placed onto the hydraulic platform in the correct orientation, shown in Figure 10
3. After the widest section of the SWIFT handling cart (corresponding to the base of the A-frame as shown in Figure 1) has cleared the narrowest section of the Cassegrain cage opening the handling cart is rolled southward (towards the AO bench) such that the instrument is roughly aligned directly below the 3 attachment points (not shown in Figure 11).
4. As the SWIFT instrument approaches the PALAO optical bench the handling cart itself is used to provide the X/Y/Z fine motion to align the 3 pads on the underside of the SWIFT instrument to corresponding mating pads permanently located on the surface of the PALAO bench. This process is represented in Figure 12.
5. With the 3 pads mated, the clamps surrounding the pads are secured sequentially using a suitable tool. This is represented in Figure 13.
6. The A frame of the SWIFT handling cart is unbolted from the SWIFT instrument;
7. The SWIFT handling cart is lowered to the dome floor and stored;
8. The Cassegrain cage door is lifted into position using the hydraulic platform, shown in Figure 14.
9. The SWIFT instrument (26inch depth) can rotate comfortably 360o inside the Cassegrain cage with the cage door in place, shown in Figure 15.
10. Modelled to a depth of 26inches the SWIFT instrument clears the Cassegrain cage by at least 38cm during a full 360^{o} rotation. The closest approach is shown in Figure 16.

Figure 10: A mock-up of the SWIFT handling cart and instrument, placed on the hydraulic platform in the correct orientation

Figure 11: The SWIFT handling cart is adjusted in position when the widest dimension has cleared the narrowest secition of the cage opening. Note that part of the foam section representing SWIFT has been removed to avoid conflict with the current AO enclosure

Figure 12: Final adjustment of the SWIFT position to align with the 3 mouting pads located permanently on the AO bench (representative in this photo)

Figure 13: There is 20mm of clearance between the SWIFT enclosure and the PALAO optical bench to allow insertion of a tool that secures the 3 mounting pads.

Figure 14: Installation of the Cassegrain cage door

Figure 15: The mock-up SWIFT instrument on the PALAO bench with the Cassegrain cage door in place

Figure 16: With a depth of 26inches the SWIFT instrument clears the Cassegrain cage by at least 38cm during a full 360^{o} rotation

4 Mounting SWIFT to PALAO on the AO-spit

This section is not strictly a mounting procedure, but a test of the mock-up of the SWIFT handling cart for mounting SWIFT onto the AO spit.

4.1 Summary

1. The mock set-up of the SWIFT handling cart was placed underneath the AO spit and adjusted in height such that the SWIFT instrument would be close enough to the AO bench for securing, as shown in Figure 17. The tape measure shows roughly 700mm of distance from the foam panel representing the base of the A-frame to the pivot point, about which axis the SWIFT instrument rotates.
2. Any obvious collision between the handling cart and AO spit was checked. Summary photos are shown in Figure 18 and Figure 19, but in conclusion there are no collision issues between the existing design of the SWIFT handling cart and AO spit.

Figure 17: The SWIFT handling cart positioned underneat the AO spit at a suitable height to mount the SWIFT instrument to the PALAO optical bench.

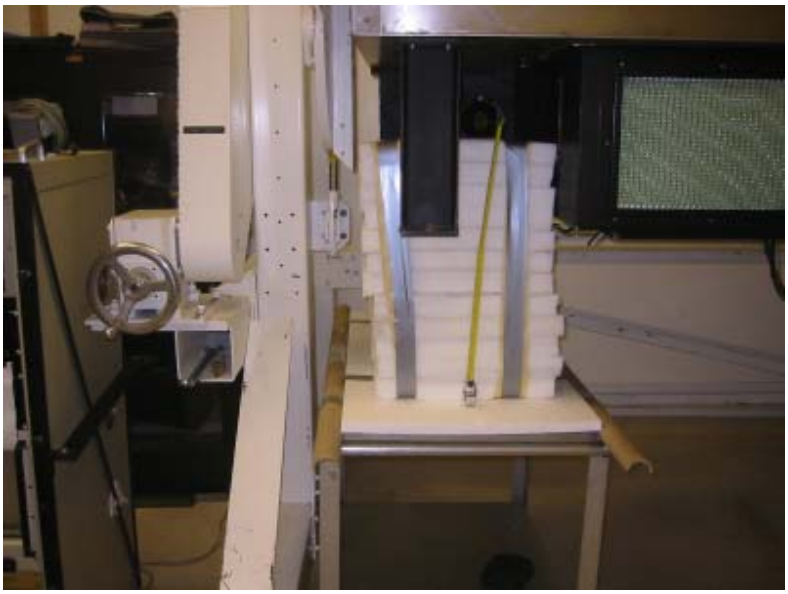

Figure 18: Sufficient clearance exists between the left-hand (cardboard) rail and the AO spit support frame

Figure 19: Sufficient clearance exists between the rails and rear cross-member of the AO spit

5 Precision movement of the handling cart

One possible problem with the design of the SWIFT handling cart was noted during the trial run. This related to the lack of fine adjustment possible in the X/Y plane using the cart wheels only. It is important that the SWIFT instrument be aligned to within a millimeter or possibly better, specifically the 3 mounting pads must be sufficiently co-aligned prior to securing the clamps.

The PALAO handling cart, shown in Figure 20, provides suitable fine precision movement of the 4 guide pins by design that is summarized in Figure 21 and Figure 22. For reasonably heavy instruments that require precision alignment as in the case of SWIFT such a design or equivalent is encouraged.

Figure 20: The PALAO handling cart allows adjustment of the PALAO optical bench in X/Y and Z directions. This facilitates quick alignment of the 4 guide pins of the PALAO optical bench with the 4 guide holes of the Cassegrain ring

Figure 21: The upper support frame of the PALAO handling cart can move in the X/Y plane relative to the lower frame by means of 4 spring loaded ball bearings, one of which is shown above

Figure 22: The upper support frame of the PALAO handling cart is locked relative to the lower frame for transport within the dome.