

Monthly Status Report
Robert Stobie Prime Focus Imaging Spectrograph
March 2007

K. Nordsieck

This RSS monthly report summarizes the RSS status as of March 31, 2007.

Optics and Testing

- Monochromator transmission results for the lens coupling fluid demonstrate that the RSS UV transmission loss is definitely due to the Cargille LL5610 lens fluid in the multiplets, contaminated by the expansion bladder polyurethane.
 - Lens fluid samples were drawn from all five RSS multiplets. A 1-mm thick sample of all five shows a strong drop in transmission at 380 nm, with a subsidiary absorption feature at 305 nm. This matches the absorption seen in four of the five multiplets, which have pathlengths of ~250 microns. Fresh lens fluid from the bottle used to fill the multiplets has no such feature, and meets the Cargille specification. So the problem stems from contamination of the fluid after assembly of the multiplets.
 - Samples of fresh fluid were incubated for 50 - 100 hours at room temperature with various materials used within the multiplets, including metals, viton (O-rings), and polyurethane (expansion bladders). The fluid exposed to polyurethane shows precisely the UV absorption signature seen in the multiplet fluid samples: 50 hours of exposure caused a 1-mm path to drop to ~20% transmission below 380 nm. The viton-exposed fluid shows a slight ~20% roll-off below 350 nm, but this signature is not seen in any of the RSS multiplets, probably because of a limited contact area.
- Current and future efforts toward a repair of the UV loss problem include:
 - Investigation of other optical systems that have tested and/or used these materials. Polyurethane (and viton) is listed as compatible with the Cargille LL5610 lens fluid. An aggressive compatibility test was done by the DEIMOS team and written up in Hilyard, Laopodis, and Faber 1999 (SPIE **3786**, p482). They found both LL5610 and LL1074 fluid to be chemically compatible with the "ether-based polyurethane" chosen for the RSS bladders. DEIMOS also used this material (with LL1074 fluid). ESI used it with LL5610. However, no optical transmission tests were performed, and neither DEIMOS nor ESI goes below 380 nm, so it appears that they were lucky. Of two existing UV spectrographs known to use LL5610, the UNC Goodman camera did not use expansion bladders, and we are still investigating the Keck LRIS-B optomechanical materials.
 - Monochromator transmission curves of various combinations of fluid (e.g., LL5610 and LL1074) and bladder materials (e.g., "finger-cog" materials also used as expansion bladders by IMACS) will be carried out: short room-temperature tests will be used for quick elimination together with longer elevated-temperature tests for promising materials.
 - Investigate stainless steel bladders as a possible solution. This was previously discarded because these bellows are typically so stiff that unacceptable pressure would build up in

the multiplets.

- We will proceed with flushing the fluid first from the non-NaCl multiplets and the beam-splitter, since that needs to be done regardless of the ultimate bladder/ fluid choice.
- Monochromator transmission measurements have been repeated for the multiplets that showed apparent grey transmission loss. With a more careful control of the lens alignment, we find that a grey loss (of about 15%) is actually seen only in the camera triplet. This makes it likely that the grey loss is not due to a lens fluid effect, but rather to the apparent element contact already noted in the camera triplet. We will proceed to disassemble the camera triplet far enough to identify the problem and verify that no damage has been done to the optical elements. This will require care not to expose the NaCl surfaces to humid air.
- Spectrum Thin Films is evaluating the failed field flattener coating that is implicated in the "yellow ghost" problem. They have indicated that they have found the source of the problem and have a proposed fix. More details on this will be forthcoming.

Mechanical

- Slitmask mechanism. The slitmask mechanism is being redesigned to eliminate the jamming which plagued its early operations. The reworked mechanism has been assembled, and the test apparatus is ready for testing, likely to begin with the next two weeks.
- Grating mechanism. We have been attempting to alleviate excessive bearing play in the grating rotation stage, which has been implicated in the cross-dispersion spectral mode image motion observed during commissioning. A new grating rotation stage has been received. The mechanical interface is being reworked to be compatible, since this is an "improved" stage with a slightly different bolt pattern. The old stage has been disassembled and excessive bearing play has been identified. The manufacturer has agreed to a fix for this. When complete, the bearing play of both units will be measured and the better one re-integrated with the instrument.
- Filter mechanism. A modification of the filter holders has been devised that will prevent wear on the bar codes that makes them unreadable after several months of use. All the existing filter holders have now been so modified.
- Etalon mechanism. A modification to the etalon seating fixture has been designed to improve the etalon flexure during an observation. Machining will now proceed.
- Baffling. New baffling material has been procured to repair the moving baffle and make it more robust. An improvement to the filter insertion seal is also being investigated.
- Storage boxes have been designed for slitmasks and filters when they are not in the magazines. Both boxes have now been finished.

- A bracket has been completed to mount the UW Startracker on top of RSS to provide a wide-field (7°) digital image of the telescope field of view. This is to be used for evaluation of cloud cover and for outreach.
- Installation/ removal improvements. The spare invar tubes from the RSS structure have been shipped to South Africa. These will be used to modify the structure to allow routing of payload cabling beneath the instrument, allowing its removal and installation without decabling the payload.
- Humidity sensors for the instrument air supply are being procured.

Control

- Electronics box fixes: New, more robust electronics box brackets have been designed for the PSC1 and PSC2 boxes; The PDS and SCB box brackets are in progress.
- Detector work continues:
 - Amplifier crosstalk. This problem is definitely within the cryostat, and will require major surgery to fix. A reassessment of the benefit/ risks of such a fix will be undertaken before proceeding.
 - Anomalous CCD full well. This is now known to be associated with the CCD output node. Apparently, in the "high sensitivity" mode that is currently being used, the signal saturates the output amplifier at 150 ke. It would be possible with the current interface to switch to a "low sensitivity" mode, which would have a maximum signal of 600 ke, accommodating the full capability of the chip summing wells. This mode is being investigated.
 - The vacuum valve has been reoriented and reworked to improve pump-down operations on the telescope.
 - An improved binning scheme proposed by Ted Williams, which eliminates fractional pixels between amplifiers, has been assessed. It should be relatively easy to implement.
 - Implementation of the Fabry-Perot ring diameter calculation in PDET will be postponed until commissioning.
- Coding of the high level PCON control software is in progress.

Management

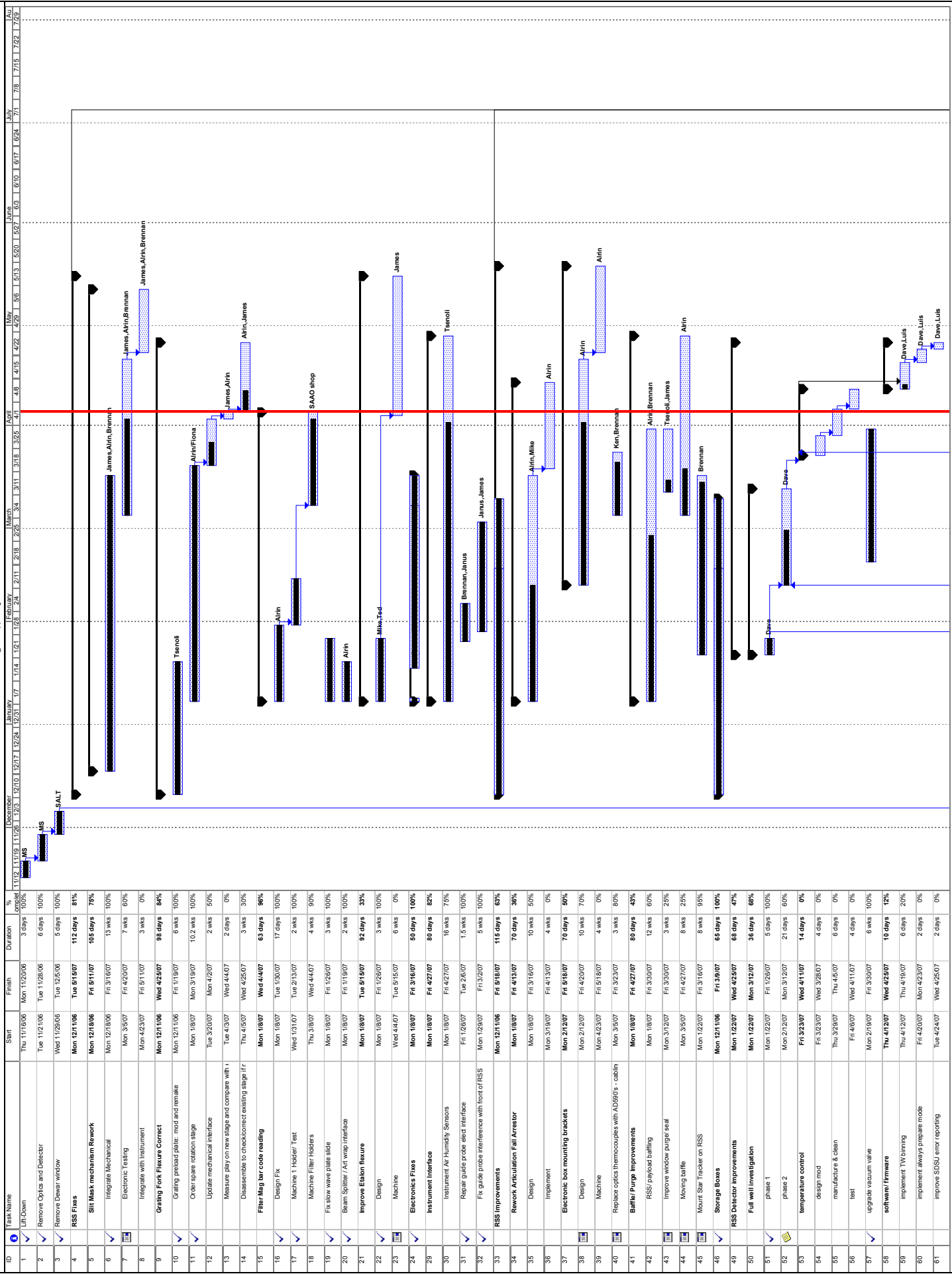
- The RSS schedule has been updated, and is attached to this report. Again, the optics repair section has been completely reworked to reflect our new understanding of the repair process. Our current best estimate of the ship date to South Africa is June 18, 2007, about two weeks later than the previous schedule, and six weeks later than the original repair schedule. This would place lift of RSS onto the telescope on 23 July, 2007, with recommissioning extending into August. This schedule is based on the assumption that compatibility tests for new fluid/

bladder combinations will take six weeks (including one month at elevated temperature), and that disassembly of the multiplets will not be required as a part of this repair. The repair of the camera triplet element contact will require disassembly, but that will be done in parallel with the compatibility tests.

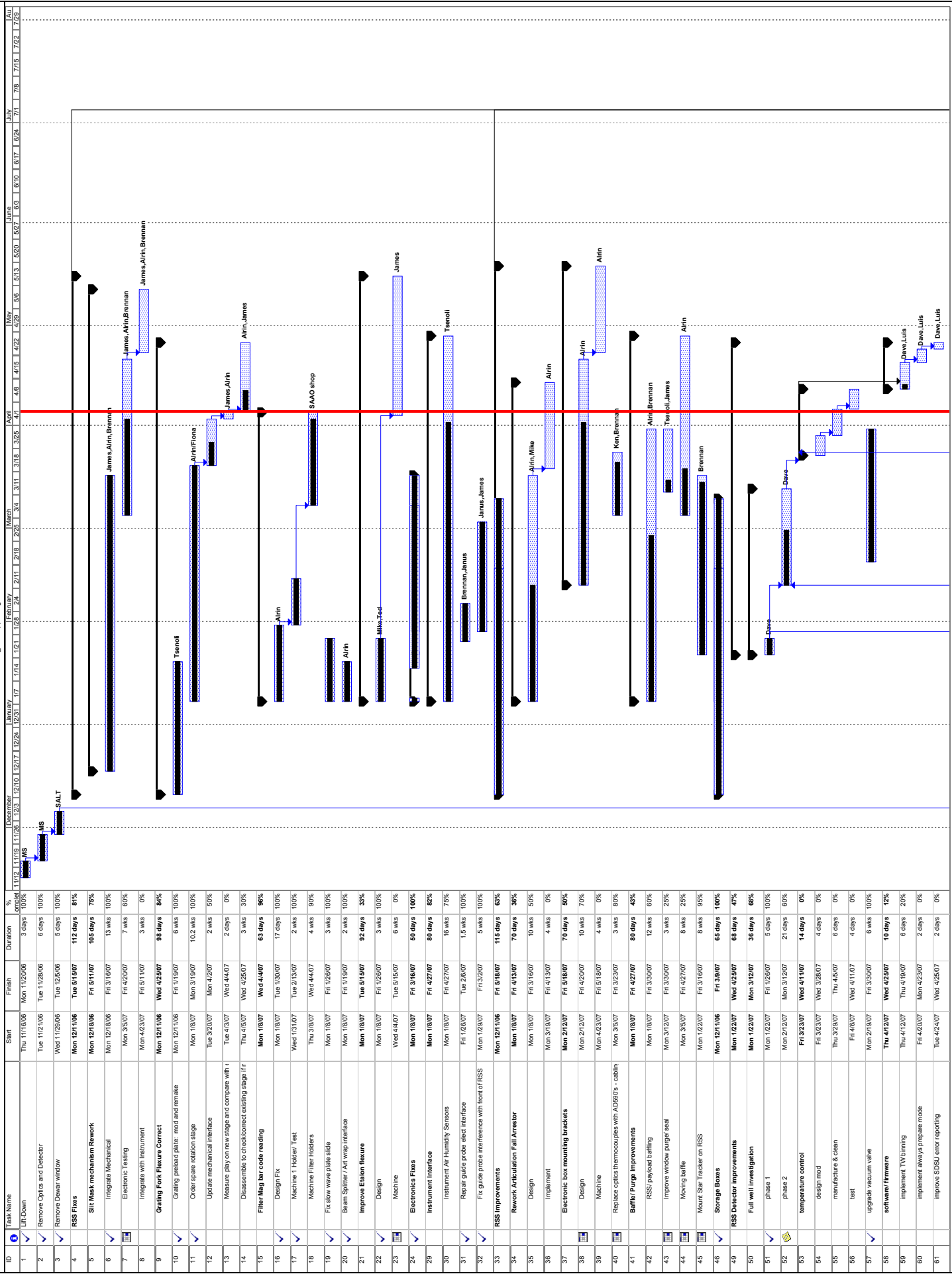
- Work proceeds on 2006 Quarter 3 Quarterly Management Report.

Activities for next month

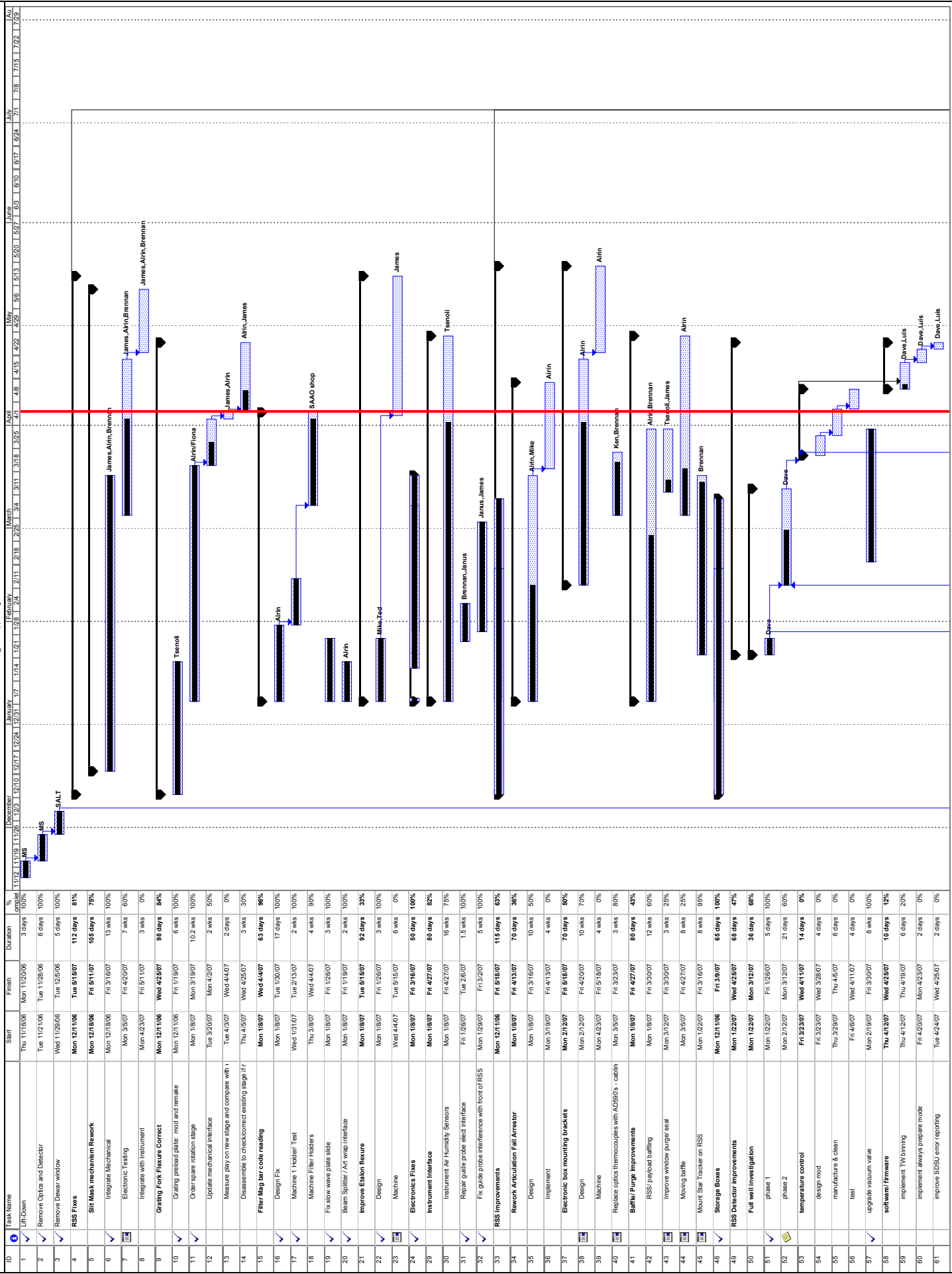
- Analysis
 - Work on analysis of polarimetric commissioning data.
- Optics
 - Test compatibility of possible fluid/ bladder materials at Pilot Group. Start flushing of multiplets.
 - Spectrum Thin Films inspection of and attempt to clean field flattener.
- Mechanical
 - Test the reworked slitmask mechanism.
 - Finish grating rotator interface modification; repair old rotation stage.
 - Machine improved etalon seat.
 - Finalize redesign of articulation fall arrester.
 - Finish design of improved electronics box brackets.
 - Design modification of the RSS mechanical interface to simplify instrument installation and removal.
 - Review optics and instrument installation/ removal procedures.
 - Work on baffling improvements for the moving baffle and filter insertion seal.
- Control
 - Continue coding of PCON high-level control software.
- Detector
 - Complete full well and crosstalk investigations.
- Management
 - Finish Quarter 3, 2006 Quarterly Report.



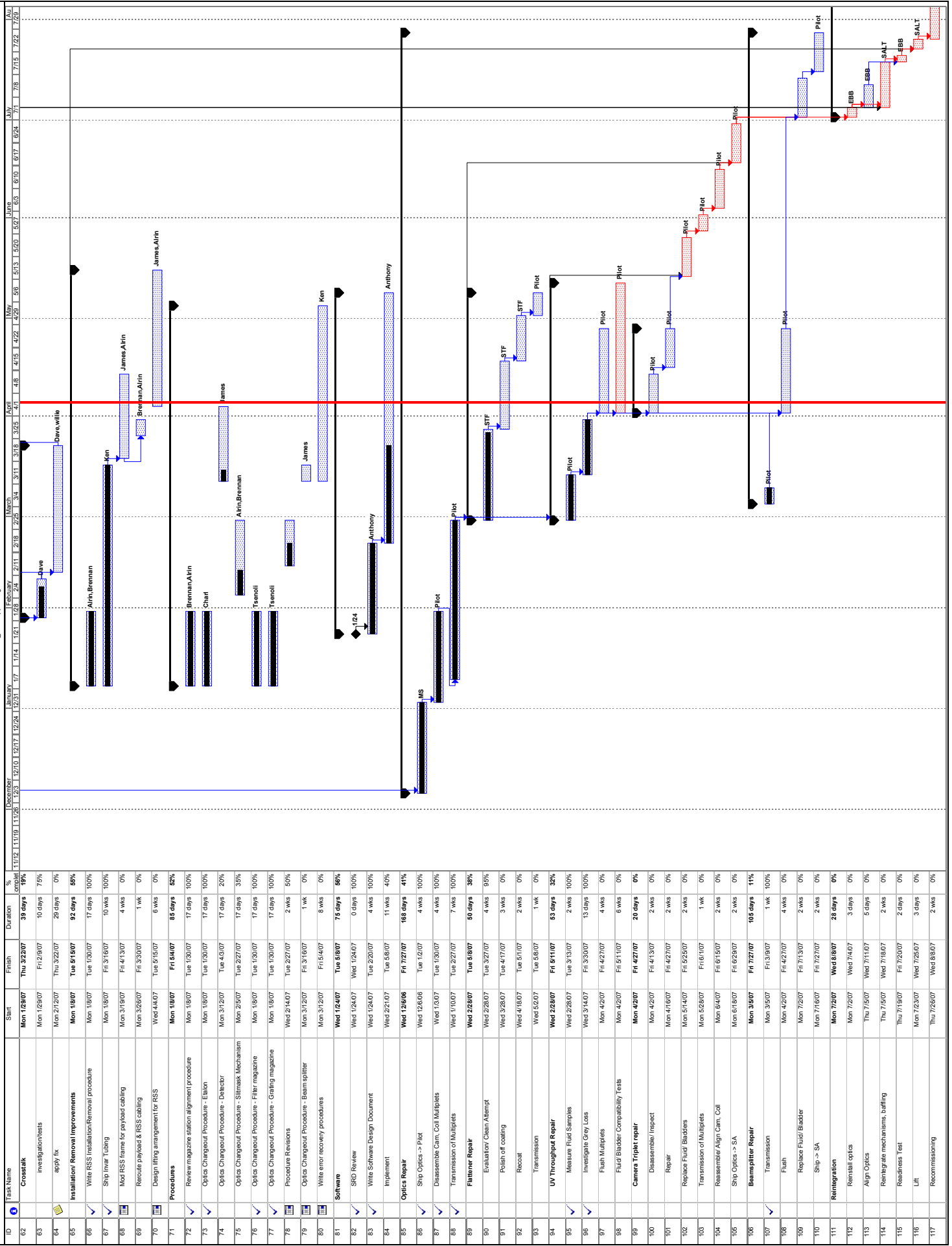
ID	Task Name	Start	Finish	Duration	%
1	Lift-Down	Thu 11/16/06	Mon 11/20/06	3 days	100%
2	Remove Optics and Detector	Tue 11/21/06	Tue 11/28/06	6 days	100%
3	Remove Denar window	Wed 11/29/06	Tue 12/5/06	5 days	100%
4	RSS Fixes	Mon 12/11/06	Tue 5/1/07	112 days	81%
5	Silt Mask mechanism Rework	Mon 12/18/06	Fri 5/11/07	105 days	75%
6	Integrate Mechanical	Mon 12/18/06	Fri 3/16/07	13 wks	100%
7	Electronic Testing	Mon 3/5/07	Fri 4/20/07	7 wks	60%
8	Integrate with Instrument	Mon 4/23/07	Fri 5/11/07	3 wks	0%
9	Grating Fork Flexure Correct	Mon 12/11/06	Wed 4/25/07	98 days	84%
10	Outer space rotation stage	Mon 12/11/06	Fri 1/19/07	6 wks	100%
11	Update mechanical interface	Mon 1/8/07	Mon 3/19/07	10.2 wks	100%
12	Measure play on new stage and compare with 1	Tue 4/3/07	Wed 4/4/07	2 wks	50%
13	Disassemble to check/correct existing stage if r	Thu 4/5/07	Wed 4/25/07	3 wks	30%
14	Filter/Mag bar code reading	Mon 1/8/07	Wed 4/4/07	63 days	96%
15	Design Fix	Mon 1/8/07	Tue 1/30/07	17 days	100%
16	Machine 1 Holder/ Test	Wed 1/31/07	Tue 2/13/07	2 wks	100%
17	Machine Fiber Holders	Thu 3/8/07	Wed 4/4/07	4 wks	90%
18	Fix slow wave plate slide	Mon 1/8/07	Fri 1/26/07	3 wks	100%
19	Beam Splitter / Act wdg interface	Mon 1/8/07	Fri 1/19/07	2 wks	100%
20	Improve Etalon flexure	Mon 1/8/07	Tue 5/1/07	92 days	33%
21	Design	Mon 1/8/07	Fri 1/26/07	3 wks	100%
22	Machine	Wed 4/4/07	Tue 5/15/07	6 wks	0%
23	Electronics Fixes	Mon 1/8/07	Fri 3/16/07	50 days	100%
24	Instrument Interface	Mon 1/8/07	Fri 4/27/07	80 days	82%
25	Instrument Air Humidity Sensors	Mon 1/8/07	Fri 4/27/07	16 wks	75%
26	Repair guide probe elect interface	Fri 1/26/07	Tue 2/6/07	1.5 wks	100%
27	Fix guide probe interference with front of RSS	Mon 1/29/07	Fri 3/2/07	5 wks	100%
28	RSS Improvements	Mon 12/11/06	Fri 5/18/07	115 days	63%
29	Rework Articulation Fall Arrestor	Mon 1/8/07	Fri 4/13/07	70 days	36%
30	Design	Mon 1/8/07	Fri 3/16/07	10 wks	50%
31	Implement	Mon 3/19/07	Fri 4/13/07	4 wks	0%
32	Electronic box mounting brackets	Mon 2/12/07	Fri 5/18/07	70 days	90%
33	Design	Mon 2/12/07	Fri 4/20/07	10 wks	70%
34	Machine	Mon 4/23/07	Fri 5/18/07	4 wks	0%
35	Replace optics thermocouples with AD590's - cabin	Mon 3/5/07	Fri 3/23/07	3 wks	80%
36	Buffer/Purge Improvements	Mon 1/8/07	Fri 4/27/07	80 days	43%
37	RSS payload baffling	Mon 1/8/07	Fri 3/30/07	12 wks	60%
38	Improve window purge seal	Mon 3/12/07	Fri 3/30/07	3 wks	25%
39	Mounting baffles	Mon 3/5/07	Fri 4/27/07	8 wks	25%
40	Mount Star Tracker on RSS	Mon 1/22/07	Fri 3/16/07	8 wks	95%
41	Storage Boxes	Mon 12/11/06	Fri 3/9/07	65 days	100%
42	RSS Detector Improvements	Mon 12/20/07	Wed 4/25/07	65 days	47%
43	Full well investigation	Mon 12/20/07	Mon 3/12/07	36 days	68%
44	phase 1	Mon 12/20/07	Fri 1/26/07	5 days	100%
45	phase 2	Mon 12/20/07	Mon 3/12/07	21 days	60%
46	temperature control	Fri 3/23/07	Wed 4/11/07	14 days	0%
47	design mod	Fri 3/23/07	Wed 3/28/07	4 days	0%
48	manufacture & clean	Thu 3/29/07	Thu 4/6/07	6 days	0%
49	test	Fri 4/6/07	Wed 4/11/07	4 days	0%
50	upgrade vacuum valve	Mon 2/19/07	Fri 3/30/07	6 wks	100%
51	software firmware	Thu 4/12/07	Wed 4/25/07	10 days	12%
52	implement always prepare mode	Thu 4/12/07	Thu 4/19/07	6 days	20%
53	implement always prepare mode	Fri 4/20/07	Mon 4/23/07	2 days	0%
54	improve SRSU error reporting	Tue 4/24/07	Wed 4/25/07	2 days	0%



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62	Crosstalk	Mon 12/8/07	Thu 3/22/07	39 days	0%
63	investigation/tests	Mon 1/29/07	Fri 2/9/07	10 days	75%
64	apply fix	Mon 2/12/07	Thu 3/22/07	28 days	0%
65	Installation/ Removal Improvements	Mon 1/8/07	Tue 5/15/07	92 days	55%
66	Write RSS Installation/Removal procedure	Mon 1/8/07	Tue 1/30/07	17 days	100%
67	Ship liner tubing	Mon 1/8/07	Fri 3/16/07	10 wks	100%
68	Mod RSS frame for payload cabling	Mon 3/19/07	Fri 4/13/07	4 wks	0%
69	Reoute payload & RSS cabling	Mon 3/26/07	Fri 3/30/07	1 wk	0%
70	Design lifting arrangement for RSS	Wed 4/4/07	Tue 5/15/07	6 wks	0%
71	Procedures	Mon 1/8/07	Fri 5/4/07	85 days	52%
72	Review magazine station alignment procedure	Mon 1/8/07	Tue 1/30/07	17 days	100%
73	Optics Changeout Procedure - Etalon	Mon 1/8/07	Tue 1/30/07	17 days	100%
74	Optics Changeout Procedure - Detector	Mon 3/12/07	Tue 4/3/07	2 wks	20%
75	Optics Changeout Procedure - Stigmast Mechanism	Mon 2/5/07	Tue 2/27/07	17 days	35%
76	Optics Changeout Procedure - Filter magazine	Mon 1/8/07	Tue 1/30/07	17 days	100%
77	Optics Changeout Procedure - Grating magazine	Mon 1/8/07	Tue 1/30/07	17 days	100%
78	Procedure Revisions	Wed 2/14/07	Tue 2/27/07	2 wks	50%
79	Optics Changeout Procedure - Beam splitter	Mon 3/12/07	Fri 3/16/07	1 wk	0%
80	Write error recovery procedures	Mon 3/12/07	Fri 5/4/07	8 wks	0%
81	Software	Wed 1/24/07	Tue 5/8/07	75 days	56%
82	SRD Review	Wed 1/24/07	Wed 1/24/07	0 days	100%
83	Write Software Design Document	Wed 1/24/07	Tue 2/20/07	4 wks	100%
84	Implement	Wed 2/21/07	Tue 5/8/07	11 wks	41%
85	Optics Repair	Wed 1/26/06	Fri 7/27/07	168 days	41%
86	Ship Optics -> Pilot	Wed 1/26/06	Tue 1/2/07	4 wks	100%
87	Disassemble Cam, Coil Multiplets	Wed 1/30/07	Tue 1/30/07	4 wks	100%
88	Transmission of Multiplets	Wed 1/10/07	Tue 2/27/07	7 wks	100%
89	Flattener Repair	Wed 2/28/07	Tue 5/8/07	50 days	38%
90	Evaluation/ Clean Attempt	Wed 2/28/07	Tue 3/27/07	4 wks	95%
91	Polish air coating	Wed 3/28/07	Tue 4/17/07	3 wks	0%
92	Recast	Wed 4/18/07	Tue 5/1/07	2 wks	0%
93	Transmission	Wed 5/2/07	Tue 5/8/07	1 wk	0%
94	UV Throughput Repair	Wed 2/28/07	Fri 5/11/07	53 days	32%
95	Measure Fluid Samples	Wed 2/28/07	Tue 3/13/07	2 wks	100%
96	Investigate Grey Loss	Wed 3/14/07	Fri 3/30/07	13 days	100%
97	Flush Multiplets	Mon 4/2/07	Fri 4/27/07	4 wks	0%
98	Fluid Bladder Compatibility Tests	Mon 4/2/07	Fri 5/11/07	6 wks	0%
99	Camera Tripket repair	Mon 4/2/07	Fri 4/27/07	20 days	0%
100	Disassemble/ Inspect	Mon 4/2/07	Fri 4/13/07	2 wks	0%
101	Repair	Mon 4/16/07	Fri 4/27/07	2 wks	0%
102	Replace Fluid/ Bladders	Mon 5/14/07	Fri 5/25/07	2 wks	0%
103	Transmission of Multiplets	Mon 5/28/07	Fri 6/1/07	1 wk	0%
104	Reassemble/ Align Cam, Coil	Mon 6/4/07	Fri 6/15/07	2 wks	0%
105	Ship Optics -> SA	Mon 6/18/07	Fri 6/29/07	2 wks	0%
106	Beam splitter Repair	Mon 3/5/07	Fri 7/27/07	105 days	11%
107	Transmission	Mon 3/5/07	Fri 3/8/07	1 wk	100%
108	Flush	Mon 4/2/07	Fri 4/27/07	4 wks	0%
109	Replace Fluid/ Bladder	Mon 7/2/07	Fri 7/13/07	2 wks	0%
110	Ship -> SA	Mon 7/16/07	Fri 7/27/07	2 wks	0%
111	Reintegration	Mon 7/2/07	Wed 8/8/07	26 days	0%
112	Reinstall optics	Mon 7/2/07	Wed 7/4/07	3 days	0%
113	Align Optics	Thu 7/5/07	Wed 7/11/07	5 days	0%
114	Reintegrate mechanisms, buffing	Thu 7/5/07	Wed 7/18/07	2 wks	0%
115	Readiness Test	Thu 7/19/07	Fri 7/20/07	2 days	0%
116	Lift	Mon 7/30/07	Wed 7/25/07	3 days	0%
117	Recommissioning	Thu 7/26/07	Wed 8/6/07	2 wks	0%