
HIFI AOT Checkout in PV-II

Schedule Recovery Scenarios

Version 1.1 of 23/11/2009, by P. Morris

Abstract

This document summarizes scheduling considerations for resuming HIFI AOT Checkout in PV-II in January 2010.

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Prepared by:	P. Morris	11 October 2009
Checked by:		
Authorized by:	P. Roelfsema	

Distribution

ESA:		
D. Teyssier		ESAC
HIFI steering committee:		
F. Helmich		SRON
HIFI project:		
P. Roelfsema		SRON
M. Olberg		SRON
V. Ossenkopf		U. Cologne

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Contents

1. Introduction	4
2. AOT checkout activities	4
3. Context with the HIFI Priority Science Program (Phase 1).....	5
3.1 LO Frequency and Mode Statistics	5
3.2 Basic Conclusions for Testing	8
3.3 Band 7b/C+.....	8
3.4 IRC+10216 and DBS Mode Testing.....	9
3.5 Spectral Scans	9
3.6 Special Testing	10
4. Target visibilities in January – March 2010	10
5. Schedule Considerations	12
6. Scheduling, analysis, and turnaround times.....	13
7. Working Conclusions	13

1. Introduction

Approximately 165 hours of the nominal AOT checkout plan remains to be carried out in so-called PV-II, assumed to commence following redundant side switch-on and ~5 ODs of initial check out. I provide assessments on resuming operations in January 2010 such that PV-II and AOT checkout observations are scheduled on the observatory starting roughly in the 2nd week of January.

The emphasis on specific Observing Modes and target types in both windows is strongly weighted by the draft contents of the HIFI PSP. However, I do not provide a detailed inventory of mode tests and test times here (more details on mode usage in the PSP are needed to balance this with), and stick to the scope of schedule issues.

In the next sections, first I give a high level assessment of what still has to be carried out, irrespective of switch-on date or specific sources. Then I show the visibilities of the target holdings for AOT checkout, including the sources identified to be part of the PSP, and then assess the November and February windows with these sources. In both cases, consideration is given to carrying out the AORs in blocks of 5 ODs, and what resource issues have to be considered.

2. AOT checkout activities

For reference, the status of AOT checkout through OD80 has been summarized at the PV Mid-term review <http://www.herschel.be/twiki/bin/view/HCaISG/PVMidTermReviewmeeting> and the HIFI consortium meetings in September <https://kt.sron.nl/browse.php?fFolderId=4705>

We currently agree that the DBS modes in Point and Mapping AOTs are furthest along towards validation. Most of the SIS bands have been sampled, though there are several frequencies which have been planned after OD80. The HEB bands are poorly tested using instrument settings updated after OD39 (first light).

What remains as far as DBS mode performance verifications, therefore, are tests to fill in specific frequencies on point and marginally extended targets, and must include some repeatability and cross-modes tests on defined sources using all of Point mode DBS and FastDBS, Mapping mode DBS and Fast DBS raster, and Mapping OTF mode. All of this can be done in ~1.5-2 ODs.

The Spectral Scans are not well tested and still require coverage in most SIS and HEB bands distributed across the DBS, Frequency Switch, and Load Chop modes, frequency coverage at moderate and high redundancies (requiring suitable line-rich sources), and possible optimizations in tuning and internal load measurement cycling. Testing Spectral Scans (including Frequency Switch and Load Chop modes) accounts for the majority of the remaining time invested in AOT testing. This

is important to remember for PSP, that Spectral Scans should not be risked before the corresponding part of the AOT program can be carried out.

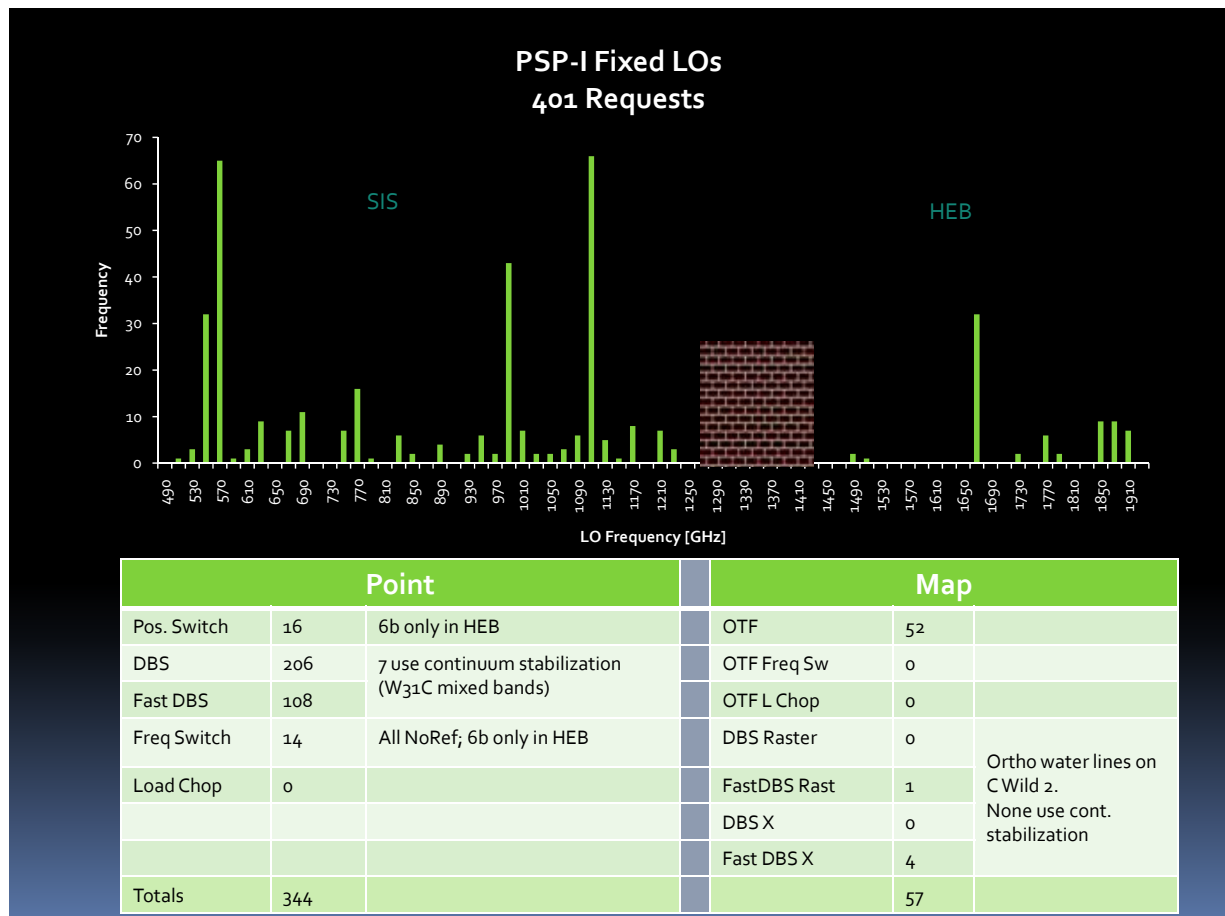
Specific tests designed to characterize repeatability also remain to be carried out: AOR to AOR (same target and observing scheme in sequence and separated in time), and in cross-mode fashion (same target and frequency using different observing modes). These test combined instrument + telescope repeatability and are critical for describing the relative accuracy of the system. These tests are mostly built into the nominal AOT checkout program.

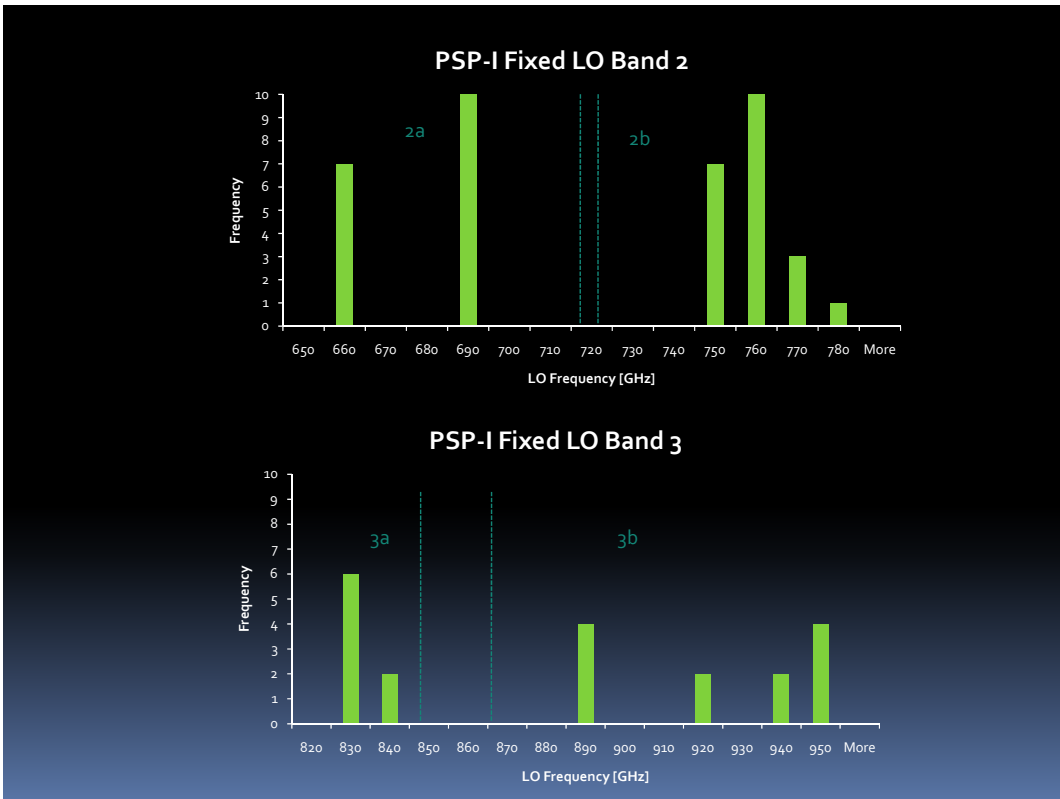
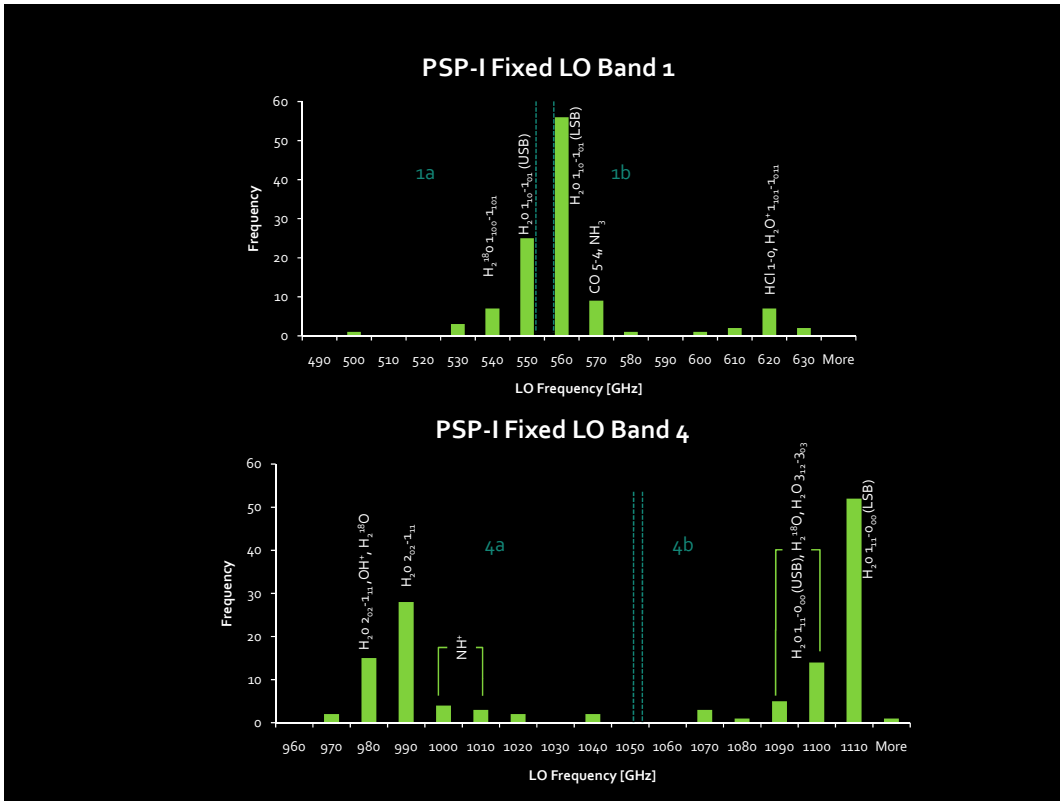
3. Context with the HIFI Priority Science Program (Phase 1)

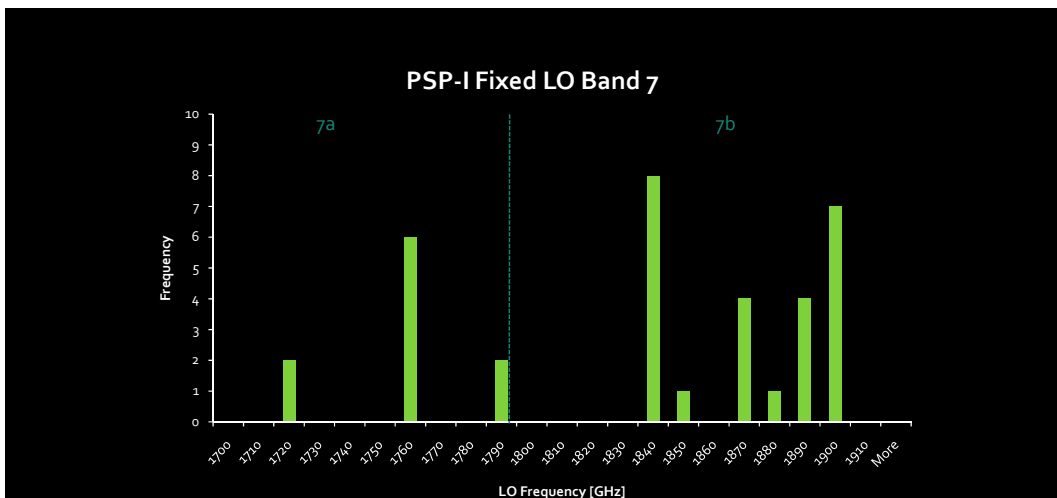
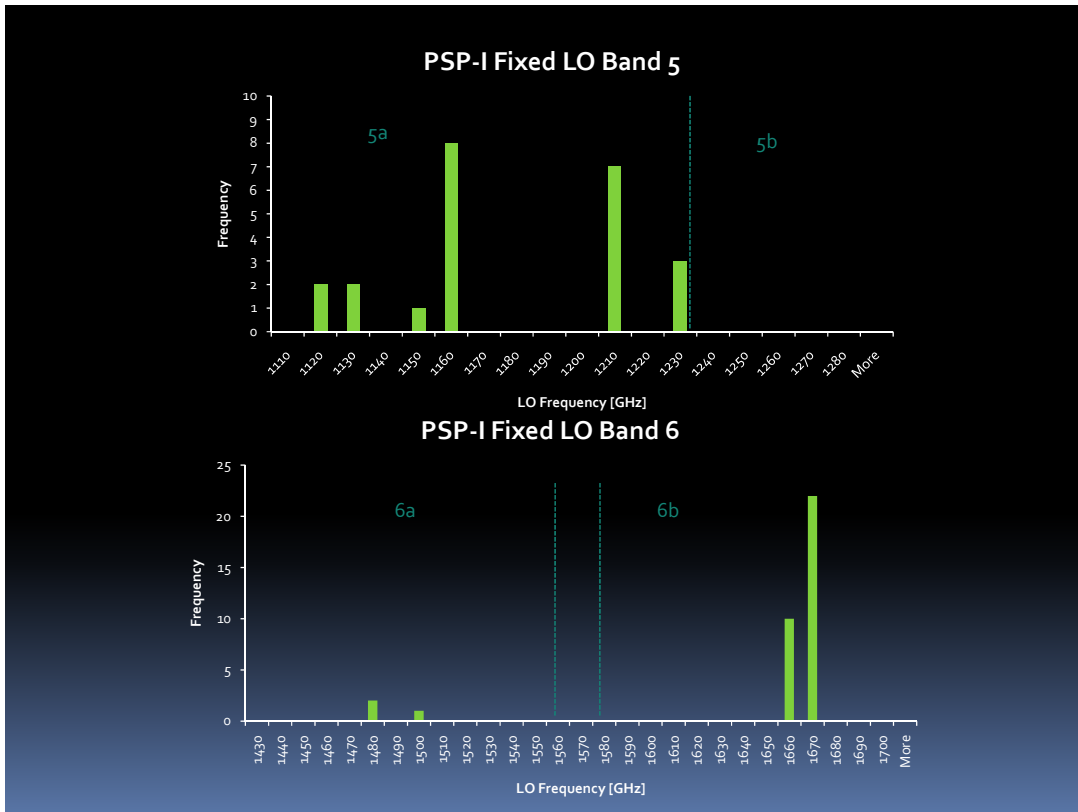
The following are extracts of a presentation in Utrecht on 16 November 2009, which provides statistics on LO frequencies and Observing Mode usage among PSP-I AORs devised by the HIFI GT KPs immediately following the September 2009 HIFI Science Consortium meeting in Cologne.

3.1 LO Frequency and Mode Statistics

Note, binning is to 10 GHz in the following histograms.







Note: these charts in the way the frequencies are binned may hide that users have requested unruly frequencies (too close to spurs, IF saturation, etc, as should be corrected with the HSpot spur warning tool).

Are the LO tunings being requested the only options for some programs? E.g. 1100 GHz.

SScan tests should help survey the regions of good vs bad regions.

PSP-I Spectral Scans ~210 hours

NGC6334I, IRAS 16293, Orion KL, Orion KL CR, NGC253, IRC+10216, Mars = 80 Requests[†]

Band	Coverages				Modes			
	Full scans	Redundancies	Part'l scans	Redundancies	DBS*	Fast DBS*	Freq Switch	Load Chop
1a	6	2 (3), 6(1), 8 (2)	0	---	5	1	0	0
1b	6	2 (3), 6(1), 8 (2)	0	---	5	1	0	0
2a	5	2 (3), 8 (2)	0	---	4	0	0	1 (NoRef)
2b	6	2 (3), 6(1), 8 (2)	0	---	5	1	0	0
3a	5	2 (3), 8 (2)	0	---	4	1	0	0
3b	6	2 (3), 6(1), 8 (2)	0	---	5	1	0	0
4a	6	2 (3), 6(1), 8 (2)	0	---	5	1	0	0
4b	6	2 (3), 6(1), 8 (2)	0	---	5	1	0	0
5a	5	2 (3), 6(1), 8 (2)	0	---	4	1	0	0
5b	5	2 (2), 6(1), 8 (2)	0	---	4	1	0	0
6a	5	2(1), 4(2), 8 (2)	1	2 (1)	5	1	0	0
6b	5	2(1), 4(2), 8 (2)	2	2(2)	5	2	0	0
7a	4	4(2), 8(2)	1	2(1)	4	1	0	0
7b	4	2(1), 4(2), 8 (2)	2	2(2)	4	2	0	0

*All DBS and FastDBS are selected without continuum stabilization

† The only source visible is NGC253 until Jan 24. NGC6334I, IRAS16293, Orion not available until early-mid February. IRC+10216 not until April, Mars not until March.

3.2 Basic Conclusions for Testing

- DBS modes are clearly favored in Pointed and SScan AOTs, we will proceed to front-load these in the schedule.
- Maps favor OTF -> must cross test these with DBS.
 - Currently we have no direct comparisons of OTF vs DBS raster at identical dimensions, sampling, and noise goals.
- Frequency switching is requested but we can fairly easily continue to test FSwitch on targets where we are anyway testing DBS
 - Save the LO band switch, and time in coming back or going to another target later, and remove pointing uncertainties.
- No Load Chop requests
 - However, we maintain that this should be spot-tested in case of issues with FSwitch.
 - GOTC+ wants to stay with PointFSwitch or PointLoadChop (NoRef!).
- 1a/1b and 4a/b most requested. 5a is unrequested, 6b very little
- No continuum stabilization is selected among the DBS observations, we should nonetheless ensure this works especially in the case of Spectral Scans.

3.3 Band 7b/C+

- Stabilization and optimization of LO frequencies for C+ at various redshifts will be done as a COP-II activity, but will likely occur during at least the first block of PV-II. The updates will feedback into subsequent PV-II block.
- 6 targets request C+ observations in PSP-I. 4 of them are not available until late February, the other two (S140 and Arp220) have good visibilities
 - ⇒ **There is no urgency to “push” mode testing** here, it can be done right to the end of PV without compromise to the PSP sources.
 - ⇒ **We prefer not to test un-optimized C+ observations** simply to test the AOT logic... the quality of the data are crucial to the performance metrics and data processing... unless we are allowed to drop a couple of short tests using current settings as we left off on OD81, on a source while the engineering tests are in progress. One goal is to test pointing in band 7 (so-called FPG3), doing this on a carbon star while we are anyway in 7b will save a band-switch to 7a.

3.4 IRC+10216 and DBS Mode Testing

- 44 hours (HSpot 4.3.6) in the PSP: SScans @ r=2 and fixed LOs on water lines.
- For AOT checkout, IRC+10216 makes the ideal source because of brightness and ground-based legacy.
 - 3x3 Nyquist DBS Raster at the beginning of the OD
 - Immediately repeat, then later in the OD, then at the end, then similar on the next OD.
 - Fixed DBS after a band switch
 - Comparable OTF Map, position switched and frequency switched
 - Fixed point DBS and position switch
 - Mainly on the CO lines, which can be directly compared to ground observations (e.g. JCMT) , possibly water (in the PSP).
 - SScans at varied redundancy?
 - This full set of observations would nearly accomplish DBS commissioning, plus “top-down” calibration assessments, plus mapping mode cross-comparison, and very likely supply PSP itself.
 - WE DO NOT HAVE IRC+10216 AGAIN UNTIL APRIL!
 - What compact source to replace? → **omicron Ceti** (by Pepe Cernicharo’s strong recommendation).

3.5 Spectral Scans

- PSP-I requests SScans over all bands, almost full coverages, at 7 unique positions (2 in Orion)
- Only one source NGC253 is available in January, only until Jan 24.
 - Requests ~9 hours, only Bands 1-4, lowest redundancy.
- We need a line-rich source to test SScanDBS, SScansFastDBS, and SScanFSwitch (for IRAS16293) at different redundancies.
- Note that NGC253 will drop out of visibility before turnaround of testing results, mode release, and first PSP scheduling by HSC, so we will plan to observe

this galaxy at least the DBS modes in some bands, but not necessarily over different redundancies.

- A source that is at least moderately line-rich is needed to observe at different redundancies to get a firm handle on line confusion and sideband deconvolution. Orion not available until early February.
- What is the recommendation to start? → O-rich star **omicron Ceti!**

3.6 Special Testing

- Narrow absorption lines, for frequency/velocity calibration checks.
 - We will have a database of lines to statistically check the frequency scales. Mars will supplement in late March.
 - A very narrow line source, couple hundred km/s, is also needed.
 - APEX source WB497 is proposed by the calibration team for monitoring.
- Related, we must visit absorption lines against a strong continuum, e.g. the Sgr sources, to demonstrate accurate line/continuum ratios in DBS, profile fitting, etc.
 - Maryvonne Gerin has proposed water lines on targets in Sgr. Eta Car may also serve meanwhile.
- Frequency grouping in SScans
 - Only 3 short SScans run during PV-I request a frequency grouping > 1.
 - Student-assisted data analysis on the effects of shared calibrations is ongoing, we should try to supplement the data in the course of the checkout without significant cost in observing time.

4. Target visibilities in January – March 2010

The visibility charts below contain the current set of AOT checkout targets, updated for the objects listed in the PSP (target names in red). They are not all going to be observed; rather they comprise a database of sources that will be available in whichever window is settled for resuming PV-II.

AOT Target Visibility
14 May 2009 Launch

Project: _____
Today's Date: **10/10/2009** (Sat) (vertical red line)
Start Date: **8/10/2009** (Mon) First Day of Week (Sun) 2

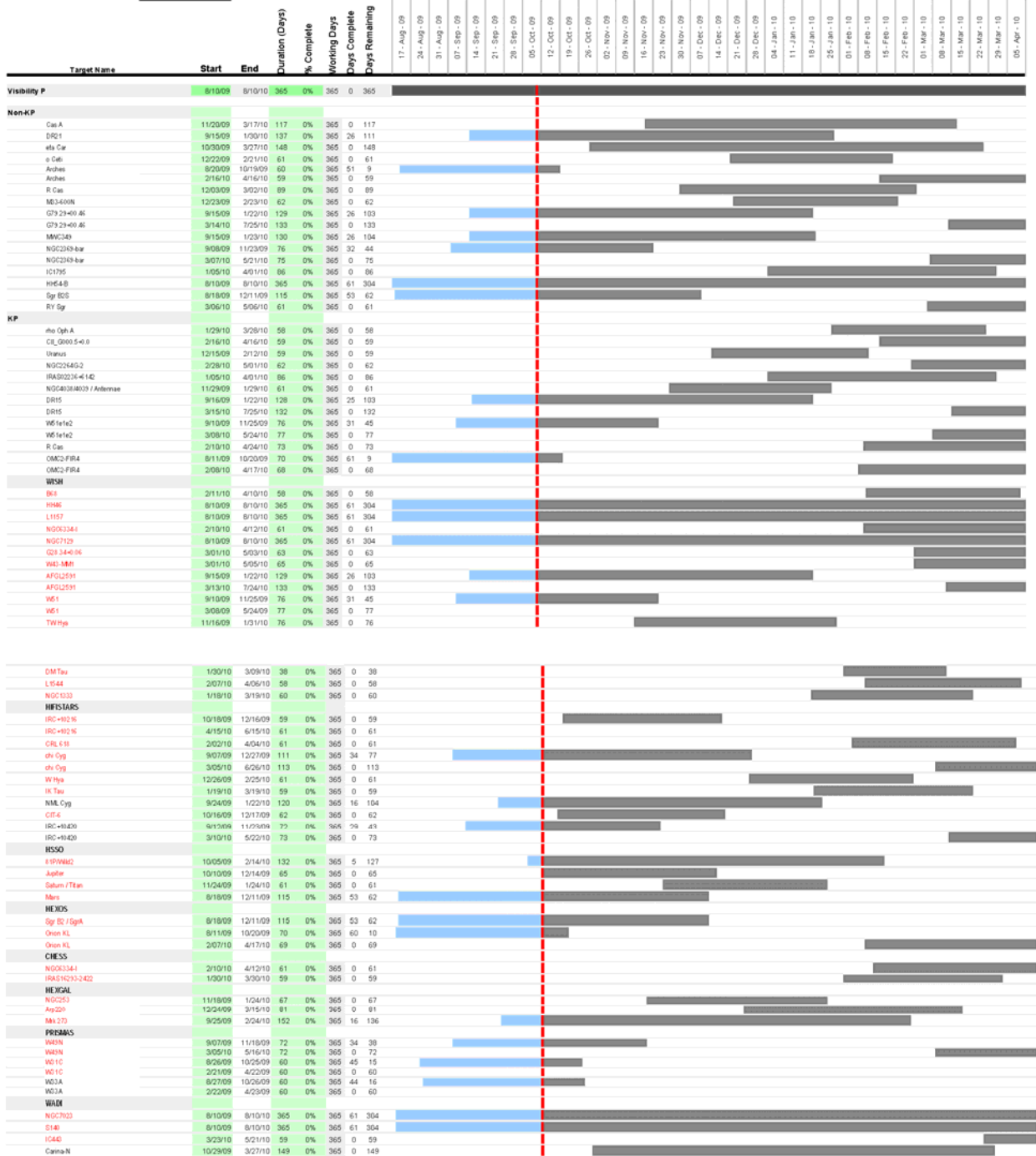


Figure 1: Target visibilities. The vertical red line means today.

AOT Target Visibility
 14 May 2009 Launch

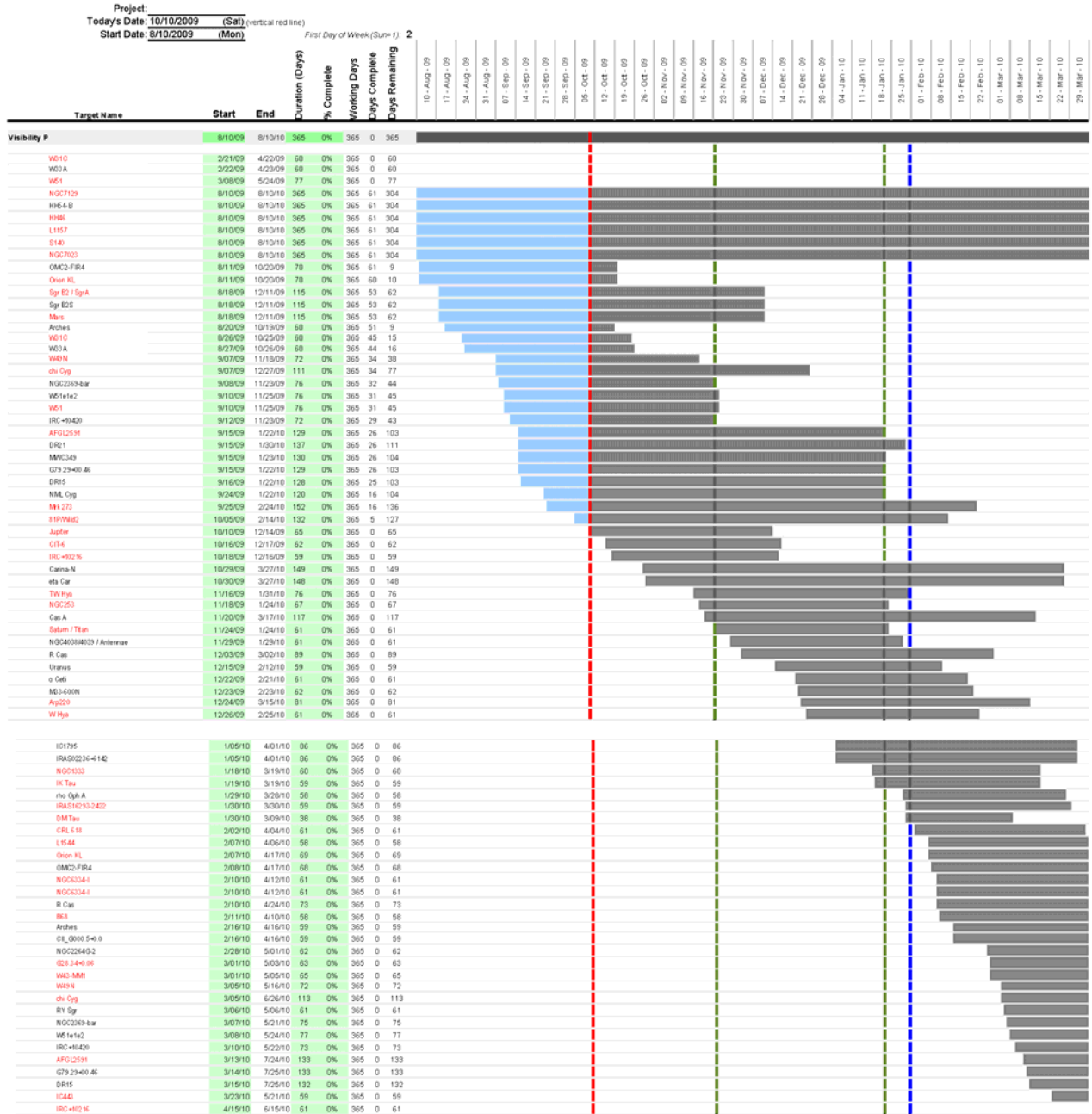


Figure 2: Target visibilities sorted by initial appearance. The vertical red line means today. The vertical green lines indicate an 8 week window for PV-II starting 23 November. The vertical blue lines indicate an 8 window starting 1 February. [The 2nd blue line at the end of March may not appear in the exported figure shown above.]

5. Schedule Considerations

The 165 hours of remaining AOT checkout is not very dependent on when HIFI is switched on. About half of this had been planned in for the period of ODs 81 through 93, that included the Galactic Centre, Orion, Ophiucus, and even though a November switch-on would imply fainter targets, some switching can be achieved.

From a scheduling standpoint AOT checkout would be more straightforward to carry out in early February since the sky is essentially the same (almost 6 months since the LCU event will have transpired), and would basically allow checkout to continue where it left off in OD81. There are also no manpower resource issues anticipated within the core AOT group, and no significant interruptions for holidays that are likely to occur after a mid- or late-November switch-on.

The main draw-backs are the loss of IRC+10216 and Mars, which together can very well accomplish the set of DBS mode and repeatability tests mentioned above.

6. Scheduling, analysis, and turnaround times

OD Blocks. After surveying the sources in both windows, and approximating the test times, I can conclude that it should be possible to schedule AOT tests over something like three 5 OD-blocks for PV-II (including calibration and ongoing COP activities in parallel). In other words, sources and times will allow this.

Data Analysis. Experience has shown us that essential functional and performance analysis time is on average twice the observing time. 5 ODs of observing needs 10 ODs analysis. We should maintain this for conservative planning purposes, considering the importance to get the answers right the first time on behalf of the PSP's goals. It's critical to safeguard this time for possible resource issues mentioned with the mid-November switch-on.

Uplink Delivery Cycle. Following 10 days analysis of 5 ODs observing, a minimum of 3 days to make uplink changes should be planned. In total this is a minimum of 13 days between the end of the previous 5-OD block and the start of the next one, *plus* what MOC will require to build and load the uplink products.

7. Working Conclusions

At the moment there are no blocking issues with AOT checkout proceeding in mid or late January, extending into February and possibly March, weighted by the PSP and specifically which sources (KP/PSP and non-KP) are available in these periods. 5 OD blocks of observing are possible, as long as a 10-day analysis and 3-day uplink modification periods are respected.

PSP AORs are not recommended to be scheduled until after initial block has been carried out and analyzed, and an updated statement on AOT readiness has been provided.