HINODE OBSERVING PROPOSAL: DEFINITION OF HINODE MODES

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1 PRELIMINARY REMARK

This document describes the Hinode modes for the Sunrise Observing Runs (OR). The document is a first draft and requires further refinement involving Hinode planners and Sunrise investigators.

2 INTRODUCTION

The Sunrise ORs are defined in the "Sunrise Observing Plan". Sunrise observations will be performed as a sequence of these ORs. This sequence is defined in the Sunrise timeline (see Sec. 3), also described in the document "Sunrise Observing Plan".

Every Sunrise OR requesting for Hinode co-observations was analyzed and the corresponding Hinode observing sequence was defined. To simplify the Hinode operation every single Sunrise OR ID directly corresponds to a specific Hinode observing sequence.

3 SUNRISE / HINODE TIMELINE

The Sunrise timeline is defined as a sequence of pre-defined observing runs (ORs) for the instruments IMAx and SUFI. These ORs define all instrument parameters, like filter position and sequence, wavelength positions. Additionally, these modes contain pointing information, either in absolute coordinates (e.g. disk center, μ=0.8 at equator) or in targets of opportunity (e.g. a pore or a sunspot).

The latest version of the timeline is summarized in the document “Sunrise Observing Plan” in Chapter 9. Note that this is not yet the final timeline. The important parameters of this timeline for coordinated observations are extracted and published on a website. This website will contain:

- The past, current and future pointing of the Sunrise telescope,
- the past, current and future Sunrise OR,
- and a selection of transmitted thumbnail images of Sunrise observations.

The website will be updated automatically. Any change in the timeline (e.g. caused by the appearance of a sunspot or due to technical problems) will be reflected in near real-time. An ALERT flag on the website will inform the co-observers about timeline changes.

The 1:1 correspondence of the Sunrise ORs with the Hinode observing modes should greatly simplify the planning and accomplishment of the joint observations.

Table 1 gives an example of the Sunrise timeline (copied from the document “Sunrise Observing Plan”, Chapter 9). Only after the final definition of the timeline an exact calculation of the Hinode data volume will be possible. The timeline starts at a time t=0. The UTC time of this starting time depends on the exact Sunrise launch time and the length of the commissioning phase.

Table 1: Timeline TL_DC_2 (proposal driven: D2). The Sunrise action (OR) corresponds uniquely defines a Hinode observing run (see Sec. 4)

Time (min from t=0)	Action (OR)	Duration (min)	Comment
0	CV5-6 (μ=1)	45	omit if concatenated to T_DC_1
45	D2_1	180	
225	CV-6/6 (μ=1)	50	include dark current and CWS calib.
275	D2_2	60	
335	D2_3	120	
455	CV-6/6 (μ=1)	50	include dark current and CWS calib.
505	CL-3/2 (μ=1)	15	
520	D2_4	120	
640	CL-3/2 (μ=1)	15	
655	CL-3/6 (μ=1)	30	include dark current and CWS calib.
685	D2_5	120	
805	CL-3/6 (μ=1)	30	
835			

We are aware of the problem caused by the late knowledge of the UTC times. We therefore kindly ask for Hinode support on a daily operation base. This should allow for joint Hinode-Sunrise observations as early as possible, and will guarantee an optimum overlap of observations in case of target changes (e.g. sunspot observations).

The eclipse season will not allow for SOT/SP scans much longer than 60 minutes. The Hinode observing runs defined in Sec. 4 do not yet reflect this fact. Longer SP scans must be interrupted and recorded in two or three steps.

4 HINODE OBSERVING RUNS

The list of Hinode Observing Runs (ORs) directly corresponds to the Sunrise ORs, described in chapter 8 of the document "Sunrise Observing Plan".

Note: Sunrise will operate using a correlation tracker. Therefore the Sunrise pointing will follow the solar rotation. For all pointing positions specified below solar tracking is requested.

Color Coding: the Hinode modes defined below should be prioritized according to the color scheme in case of data volume limitations.

- red - highest priority
- blue - mid priority
- black - lowest priority

Note: The priorities in this document still need to be evaluated and discussed.

Note: Data volumes given in the tables below are not accurate / missing. A careful calculation of data volume is to be done.

4.1 DISK-CENTER MODE: MINIMUM SUCCESS (D1)

For this Sunrise mode no Hinode support is requested.

4.2 DISK-CENTER MODE: PROPOSAL DRIVEN (D2)

Sunrise OR ID	Time [min]	Pos	SOT/SP	SOT/NFI	SOT/BFI	XRT	EIS	Prop.
D2_1	180	x=0 y=0	a) 4.8s, 0.16", 2-side (optional: 1-side), 64min, 123"x123", Q65 (660 Mbits) b) 3.2s, 0.32" (60 min), 1.5"x82", 1-side, Q65 (600 Mbits)	Na IV ±160, 2x2, 123"x123", 64s cadence, >1hour (260 Mbits)	CaH, G-band, 111"x111", 2x2, 64s cadence (330 Mbits)			A.12, B.1
D2_2	60	x=0 y=0	9.6s, 0.16", 2-side, 60min, 60"x82" (250 Mbits)	Na IV ±160, 2x2, 120"x120", 64s cadence, >1hour (260 Mbits)				A.9, A.10,
D2_4	120	x=0 y=0		Mg IV ±116mA, 20s cadence, 2x2, 82"x82" (380 Mbits)	G-band for alignment, 82"x82", cadence as bitrate permits			I.2, A.12

4.3 TARGET MODE (T)

Sunrise OR ID	Time [min]	Pos	SOT/SP	SOT/NFI	SOT/BFI	XRT	EIS	Prop.
T_A_1 T_C_1	10	μ=0.8 μ=0.6 μ=0.4		Na IV ±160, 2x2, 164"x164", 64s cadence, 10 minutes (85 Mbits)	CaH, G-band, 111"x111", 2x2, 64s cadence (55 Mbits)			A.12, (E.2?), K.2
T_A_2	120	μ=0.8 μ=0.6 μ=0.4 μ=0.3	4.8s, 0.32", 15"x82", 2-side (optional: 1-side), Q65, 1 map every 30 minutes (110 Mbits per hour)	Mg IV ±116mA, 60s cadence, 1x1, 82"x82" (510 Mbits) desired: also H-alpha and NaID	CaH, 111"x111", 1x1, 600s cadence, >60 minutes (300 Mbits)	C-Poly and Be-Med, 60s cadence, 522"x522"		A.12,B. 1,(B.2), V.1, (G.5 ?)
T_C_3	30	μ=0.8 μ=0.6 μ=0.4 μ=0.3	9.6s, 0.32" (60 min), 1.5"x82", 2-side, Q65 (600 Mbits)	Na IV ±160, 2x2, Q75, 225"x113", 120s cadence, 30 minutes (60 Mbits) H 6563, 2x2, Q75, 225"x113", 60s cadence	Blue cont., 2x2, Q85, 221"x111", 60s cadence (200 Mbits) CaH, 2x2, Q75, 221"x111", 120s cadence (100 Mbits)	C-Poly, 30s cadence, 384x483 pix	Small rasters in TR and coronal lines with a context image (madj_qs_small and madj_qs)	(A.12,) (B.1). B.2
T_D_1	180	μ=1						(G.1 ?)

4.4 CONDITIONAL MODE (C)

Sunrise OR ID	Time [min]	Pos	SOT/SP	SOT/NFI	SOT/BFI	XRT	EIS	Prop.
C3a C3b	75 (15x5) 120	Disk center		Na IV ±160, 2x2, Q65, 164"x164", 90s cadence	CaH, 2x2, 55"x111", 30s cadence G-band, 2x2, 55"x111", 90s cadence	Al/Poly, 1x1, 320"x320", 20s cadence		A.1, (B.2)
C4a C4b	75 (15x5) 120	Disk center	4.8s, 0.32", 38"x164", 2-side (optional: 1-side), repeat 10x	Na IV ±160, 2x2, Q65, 164"x164", 60s cadence	CaH, 2x2, 111"x111", 60s cadence G-band, 1x1, 55"x111", 60s cadence	Al/Poly, 1x1, 320"x320", 40s cadence		A.2
C6a C6b	120 50 (10x5)	Each of 5 μ pos (center to pole)	4.8s, 0.32", 2-side (optional 1-side), 164"x164", Q65	Na IV ±160, 2x2, Q75, 225"x113", 120s cadence H 6563, 2x2, Q75, 225"x113", 60s cadence	Blue cont., 2x2, Q85, 221"x111", 60s cadence CaH, 2x2, Q75, 221"x111", 120s cadence	C-Poly, 30s cadence, 384x483 pix	Small rasters in TR and coronal lines with a context image (madj_qs_small and madj_qs)	A.4, (G.2?), (G.3?), A.13

4.5 OPPORTUNITY MODE (O)

Sunrise OR ID	Time [min]	Pos	SOT/SP	SOT/NFI	SOT/BFI	XRT	EIS	Prop.
O_A_1 O_A_2 O_A_3 O_A_4	45 45 15 15	each target position[1]	4.8s, 0.16”, 1-side, FOV: full sunspot + moat	Na IV ±160, 2x2, Q75, FOV: sunspot + moat, 120s cadence	CaH, 2x2, Q75, FOV: sunspot + moat, 120s cadence	C-Poly, Al-Poly		All C TBD!!
O_D_4	30	Center of target[2]	4.8s, 0.16”, 2-side, FOV: 105”x80” around pore	Na IV ±160, 2x2, Q75, FOV: 105”x80”, 120s cadence	CaH, 2x2, Q75, FOV: 105”x80”, 120s cadence	C-Poly, Al-Poly		All C TBD!!

[1] Target: large sunspot with penumbra; point to 4 positions: a) 2 on the line connecting spot center and disk center (DC), covering limb side, b) 1 on perpendicular line through spot center, centered on penumbra, c) 1 covering the umbra.

[2] Target: pore, developing active region, point to 15 positions (3×5 SUFI mosaic) to cover 105"×80", central tile contains pore