

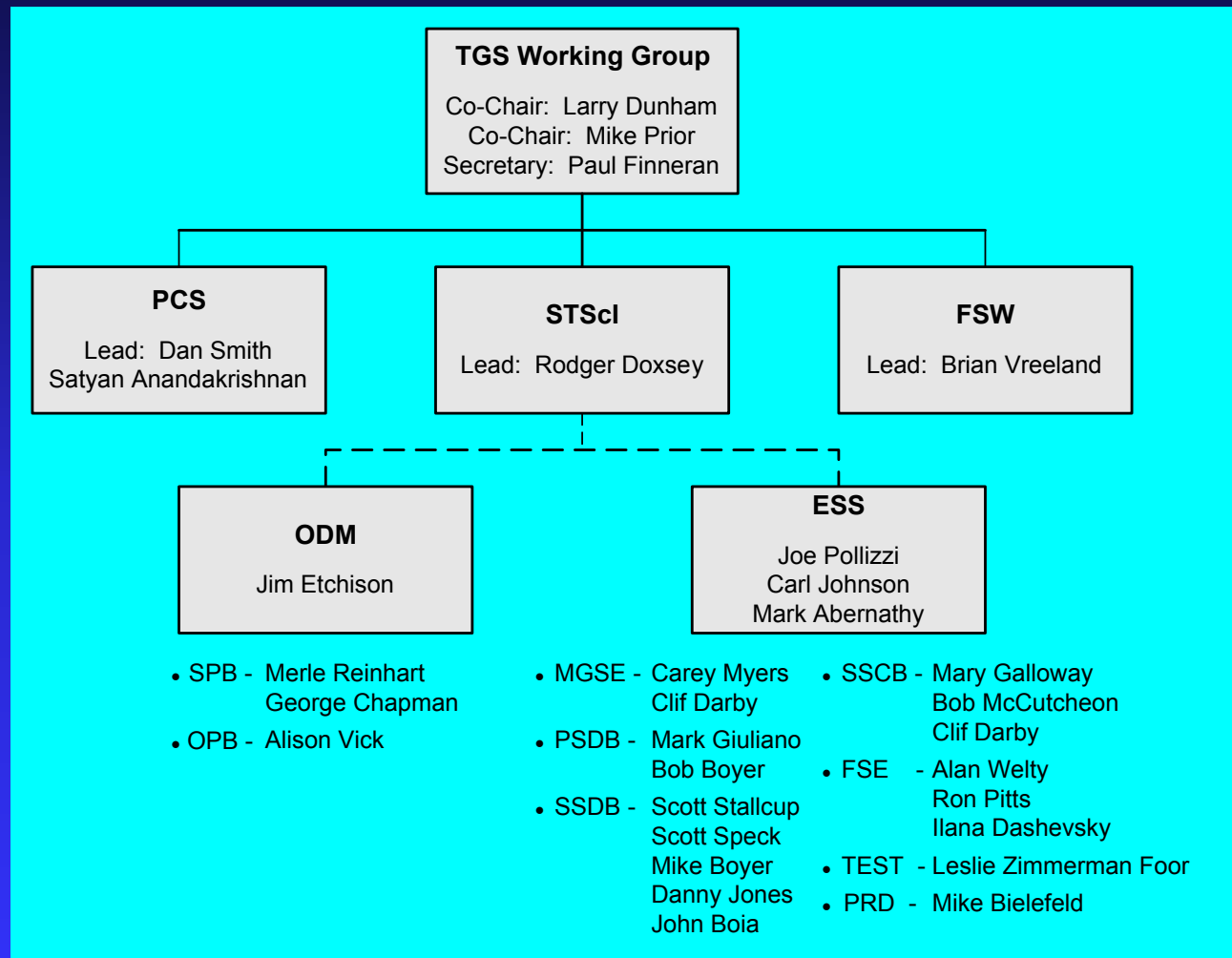


# Two-Gyro Science (TGS) Mode Status

HST MSR  
October 28, 2003

Carey Myers

# TGS Implementation Team



# Project-level Status

- ❖ Ops Concept / System Reqts. Review held Sept. 4, 2003
- ❖ System-level requirements
  - **Baselined at Level 4 CCB: October 2003**
  - **Submitted to Level 3 CCB**
- ❖ Preliminary Design Review scheduled for Oct. 30, 2003
- ❖ Critical Design Review scheduled for February 2004
- ❖ Three on-orbit tests planned: April, June, and Oct. 2004
- ❖ Operational Readiness Review scheduled for January 2005



# Scheduling System Status

- ❖ Phase I requirements completed
  - Ops Concept / Functional Reqts. Review held October 24th
  - Draft Phase I requirements document out for review
- ❖ Draft updates to ICD-11 and ICD-T1 out for review
- ❖ Updates to ICD-26, Part 2 underway (December 2003)
- ❖ SPIKE prototyping work ongoing
- ❖ Science impact studies ongoing
- ❖ Design Review scheduled for February 2004

# Interface Control Documents

ICD	Name	Changes	System Component					Status
			STScI			CCS / SAC	FSW	
			SPSS / SCS	CMD	PASS			
ICD-11	HST Science Scheduling to Mission Scheduling	Modify FHST statement; expand AUTO statement	X	X	X			Draft changes available
ICD-26, Pt 2	PASS to PDB	Update for two-gyro spacecraft characteristics, constraints and restrictions, and commanding	X		X			Draft changes in progress; will evolve throughout design process
ICD-T1	HST CCS to P&S	Add SAC and FSW star catalogs			X	X	X	Draft changes available

Note: ICD updates may be viewed at <http://hst.nasa.gov/sepg/web/dev/2gyrotab.htm>



# SPIKE Prototyping Efforts

- ❖ Since July 2003 the SPIKE team has been developing prototype two-gyro scheduling capabilities
  - The purpose of this effort is to provide tools that can be used to characterize and analyze the impact of two-gyro constraints on HST scheduling
    - ❖ The tools will support the science impact studies being performed by M. Reinhart and G. Chapman
  - The prototype will also form the basis of the final implementation of SPIKE two-gyro support



# SPIKE Study Support Status (1 of 2)

- ❖ CVZ scheduling study support – Completed
  - SPIKE already modeled FHST visibility
  - Verified correctness of the model
- ❖ All-sky target availability study support - Completed
  - Working on configuration and delivery issues
  - Added FHST overlap constraints to SPIKE
  - Integrated with SPIKE constraint and visualization tools
  - Integrated with orientation restrictions



# SPIKE Study Support Status (2 of 2)

- ❖ Current cycle scheduling study support (Jan. 2004)
  - Complete SAA modeling
  - Perform TRANS preparation work to account for less visibility time due to extended PCS acquisition times
  - Requires no TRANS code changes
    - ❖ Model times via input parameters
    - ❖ Use existing TRANS orbit fill capability to shrink orbits
    - ❖ Rebuild TRANS with new visibility model table

# Science Impact Studies

- ❖ CVZ scheduling study (nearly complete)
  - Evaluated north and south CVZs
  - Number of usable orbits varies from ~7 to 15 per day
  - Scheduling efficiency  $> \sim 50\%$  is implied
- ❖ All-sky target availability study (in progress)
  - Proposals / targets to be used have been written
  - Use two levels of pointing uncertainty to evaluate scheduling sensitivity
  - Expect to be completed by end of year
- ❖ Current cycle scheduling study (early next year)
  - Evaluate what percentage of entire cycle is schedulable

# TGS Implementation Schedule (1 of 2)

ID	Task Name	Start	Finish	2003												2004											
				J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D					
1	<b>TGS Concept and Requirements</b>	<b>6/30/03</b>	<b>12/30/04</b>	[Gantt bar from 6/30/03 to 12/30/04]																							
2	Working Group Support (TGSOWG)	6/30/03	12/30/04	[Gantt bar from 6/30/03 to 12/30/04]																							
3	TGS Concept/Reqs. Definition (all teams)	6/30/03	9/29/03	[Gantt bar from 6/30/03 to 9/29/03]																							
4	ICD 11 Updates	8/1/03	9/30/03	[Gantt bar from 8/1/03 to 9/30/03]																							
5	ICD 26 Updates	10/1/03	11/28/03	[Gantt bar from 10/1/03 to 11/28/03]																							
6	TGS Ops Concept/Requirements Review	10/24/03	10/24/03	[Gantt bar at 10/24/03]																							
7	FHST Engineering Support	7/1/03	12/31/03	[Gantt bar from 7/1/03 to 12/31/03]																							
8	SPIKE: FHST Model Feasibility	7/1/03	8/11/03	[Gantt bar from 7/1/03 to 8/11/03]																							
9	SPIKE: Initial FHST Visibility Support (no S/	8/11/03	10/22/03	[Gantt bar from 8/11/03 to 10/22/03]																							
10	Science Impact (Ops Testing)	10/1/03	2/27/04	[Gantt bar from 10/1/03 to 2/27/04]																							
11																											
12	<b>Phase I Implementation</b>	<b>10/22/03</b>	<b>8/31/04</b>	[Gantt bar from 10/22/03 to 8/31/04]																							
13	Phase I Design (all teams)	10/22/03	1/30/04	[Gantt bar from 10/22/03 to 1/30/04]																							
14	Design Review	2/4/04	2/4/04	[Gantt bar at 2/4/04]																							
15	SPIKE: Full FHST Visibility Support	11/10/03	12/19/03	[Gantt bar from 11/10/03 to 12/19/03]																							
16	SPIKE: FHST Model Refinement	12/19/03	1/28/04	[Gantt bar from 12/19/03 to 1/28/04]																							
17	SPIKE: Ops Test Updates	3/1/04	5/28/04	[Gantt bar from 3/1/04 to 5/28/04]																							
18	TRANS: Support for Initial Testing	11/3/03	12/1/03	[Gantt bar from 11/3/03 to 12/1/03]																							
19	TRANS: Design and Implementation	12/1/03	1/29/04	[Gantt bar from 12/1/03 to 1/29/04]																							
20	TRANS: Ops Test Updates	3/1/04	5/28/04	[Gantt bar from 3/1/04 to 5/28/04]																							
21	Identify Post-baseline SPIKE/TRANS work	6/1/04	8/31/04	[Gantt bar from 6/1/04 to 8/31/04]																							
22	SPSS Build A: Data Structure Updates	11/3/03	1/5/04	[Gantt bar from 11/3/03 to 1/5/04]																							
23	SPSS Build B: NGSS, SPSS Initial Support	12/17/03	4/29/04	[Gantt bar from 12/17/03 to 4/29/04]																							
24	SPSS Build C: SPSS/SCS Full Support	2/26/04	6/28/04	[Gantt bar from 2/26/04 to 6/28/04]																							
25	SPSS Build D: Cleanup	5/7/04	8/31/04	[Gantt bar from 5/7/04 to 8/31/04]																							
26	PASS: PCS Init (Visibility)	1/14/04	4/14/04	[Gantt bar from 1/14/04 to 4/14/04]																							
27	PASS: PCS/FHST Support	3/1/04	6/25/04	[Gantt bar from 3/1/04 to 6/25/04]																							
28	PASS: GSACQ, Constraints and Cleanup	6/1/04	8/31/04	[Gantt bar from 6/1/04 to 8/31/04]																							
29	Acquisition Logic Requirements Review	12/8/03	12/8/03	[Gantt bar at 12/8/03]																							
30	CMD: New cmd/cmd block definitions	1/2/04	5/27/04	[Gantt bar from 1/2/04 to 5/27/04]																							
31	CMD: Instruction sets/Certification	2/2/04	8/13/04	[Gantt bar from 2/2/04 to 8/13/04]																							
32																											



## Risks (1 of 2)

- ❖ SPSS scheduling algorithms are complex, and there are many event scenarios to consider; some scenarios may be missed
  - Mitigation: Begin design process with definition of scenarios; develop test cases for each
- ❖ Overlap of flight software two-gyro work with scheduling system software implementation might cause late-breaking requirement changes
  - Mitigation: Incorporate flexibility into design; parameterize data; implement software in phases, with well-defined areas first
- ❖ Onboard testing of two-gyro mode operations does not occur until late in the scheduling system software implementation; unanticipated design changes may be needed
  - Mitigation: Incorporate flexibility into design; parameterize data; incorporate updates in Phase II

## Risks (2 of 2)

- ❖ Different occultation algorithms between SPIKE, SPSS, and PASS scheduling systems could limit the capability to generate two-gyro science plans. Under three-gyro mode, FHST visibility mismatches have been minor; for two-gyro mode, they may become a significant problem
  - Mitigation: Start with CVZ observations to minimize mismatches; ensure that SPSS is more restrictive than PASS; review the study on algorithmic differences; consider integrating SPSS algorithm into PASS (Phase II)
- ❖ Pointing error inherent under two-gyro control may cause antenna / communications problems
  - Mitigation: Consider applying attitude uncertainty to antenna area in PASS; minimize time under large attitude uncertainty

# Issues

- ❖ Scheduling system issues currently being worked through OBADWG
  - Handling of type 2 slew FHST shutter / availability commanding
  - Placement of type 4 slews (Are they allowed before GSACQ?)
  - FHST maps / automaps: Are they needed? Should duration be limited?
  - Is the second OAD always required? (Currently assuming so)
  - FHST / GOB
    - ❖ Is it required for every GSACQ, or only the first in the sequence, or at all?
    - ❖ Is it before, at, or after GSACQ?
  - GSACQ scenario changes unknown
  - Earth calibrations: Are they needed in two-gyro? How will they be scheduled?