15 June, 1999

NGST Ad Hoc Science Working Group
Minutes of ASWG Meeting# 7, 4 June, 1999, Chicago Ill.

Attendees: Mary Barcony (for Gene Serabyn), Kem Cook (for James Graham), Mike Fall, John Gardner, Tom Greene, Matt Greenhouse, Don Hall, Peter Jakobsen, Bob Kirshner, Simon Lilly, Knox Long, John MacKenty, John Mather, Mike Meyer, Mike Rich, Ethan Schreier, Eric Smith, Massimo Stiavelli, Peter Stockman, John Trauger. Marcia Rieke and Avi Loeb attended the NAS UVOIR panel meetings which conflicted with the ASWG meeting. Marcia, Ewine van Dishoeck, and Bruce Margon provided votes on the DRM programs prior to the meeting.

Activities:

Detector Working Group: Knox Long discussed the charter and membership of the detector working group. The aim is to put out a white paper defining the key parameters for NGST detectors, the current requirements, additional requirements, and their relative importance. The overall adequacy of the detector development efforts will be addressed.

Allocation Process: John Mather described the allocation process beginning with the "Woods Hole" meeting on Sept. 13-16 and ending with a recommendation from the ASWG to the NGST Project Scientist (Mather) in late November and a preliminary recommendation by Mather in early December and a Town Hall meeting at the AAS meeting in early January. The key issues had been hammered out in a meeting of the NASA, ESA, CSA project scientists, Greenhouse, Long, Schreier, and Stockman the previous night. In particular, the ASWG will be expanded by adding the PI s from the international studies and a selected number of additional members to create the "ASWG-plus" for the allocation process. The ASWG generally agreed with the process, with the chief sticking point being conflicts of interest (e.g. do the PI s attend and "vote" or do they take an alternative task, what about Co-Is or likely Co-Is, what about institutional conflicts, etc.) There is no legal issue since the recommendation is neither a procurement action nor specifies a particular vendor. However, it is important that the recommendation is perceived as being objective and unbiased. Mather will continue to work the details but is leaning toward separating the PI s from the ASWG (making the "ASWG-minus") for the final recommendation process at the end of the Nov. 3-5 meeting and the Nov. 23 meeting.

Actions: • Mather and Stockman will define the ASWG subcommittees and their charters. Mather will select the chairs (due ASAP)
• ASWG members may nominate additional members for the ASWG-plus and the rationale for the additional member (due 24 June).

Huchra Committee: John Mather and Knox Long discussed the charter and membership of the Huchra committee. The committee will consider generic NIR spectrograph concepts and their pros and cons for the NGST science mission. The membership of the committee is: John Huchra (Chair), Dave Axon, Jay Frogel, Lynne Hillenbrand, Knox Long, Guenther Hasinger, Garth Illingworth, Shobita Satyapal, and Ted Williams. The committee will meet by telecon and one face-to-face deliberation and submit its report to Ethan Schreier and hence John Mather by Sept. 1.

Actions: • ASWG members may nominate additional members for the Huchra committee and the rationale for the additional member (due 17 June).

Description of Allocation Process

1) Huchra Committee and US written reports due 1 Sep, ESA & CSA written reports due 1 Oct. Mailed to ASWG.

2) All oral reports due at Woods Hole meeting (Sept. 13-15): ASWG members note important technical and scientific issues (these will be collected.)

3) Community concept study teams other than those funded under NRA1 that submit both written and oral reports as per (1) and (2) will be included in the project evaluation process. (this opportunity will be advertised)

4) Full day plenary ASWG meeting at Woods Hole (parallel session Sept. 16) ASWG poses questions to the concept study presenters (e.g. three sessions covering NIR/Vis imaging, NIR spectroscopy, and MIR). These questions discussed in real time with issues taken away by study PIs as home work for November meeting. Huchra committee report presented and discussed. ASWG minus meets to discuss possible generic instrument configurations (this is ultimately what should be recommended by ASWG and Mather).

5) October: Technical panel meets at GSFC.

6) Plenary ASWG meets 3-5 Nov at STScI: Final presentation by study PIs focusing on issues raised during Woods Hole meeting. ASWG subcommittees and the Technical Review committee report to ASWG-plus. Various instrument configurations recapitulated. ASWG-minus begins to address charter questions (pros and cons, configurations, etc.) PI-team to study other issues and be available for questions. ASWG-minus given writing assignments.

7) ASWG executive committee meets 22-23 Nov. to review and finish report. Pis present additional recommendations on international contributions, technical issues, or possibly on nature of configurations.

8) December 1: Mather to issue draft recommendation and solicit feedback.

9) January: Town Meeting at AAS. This may simply be a "snapshot of work in progress" and an invitation for community feedback.

10) January 21 Deadline for public comments. Late January-February: Mather describes feedback and nature of final report at ASWG meeting. Each agency begins to prepare options for their contributions.

11) April 2000, NASA, ESA, CSA agree on boundaries of instrument responsibilities.

Discussion and Ranking of the DRM

Four theme leads (Meyer did both star and planetary system formation) presented an overview of the programs in their themes, their relative ranking of the programs, and what scientific capabilities were required for each program. At the end of each presentation, the ASWG members ranked the programs within each theme by ballot (1-number of programs in the theme). The major criteria were scientific importance and NGST uniqueness. It is likely that overall perceived complexity and costs of the required capabilities also influenced the scoring, although these factors were not discussed.

The average ASWG rankings as well as specific comments follows. The percentage of the 2.5 yr. DRM program to be devoted to each theme is noted after the theme title (Belmont ASWG Meeting, July 1998). The average ranks were calculated by adding up all scores and dividing by the number of ASWG members at the meeting (18). Actions: • ASWG Theme leads should submit their final time allocations by 15 June. The DRMs should be made consistent with this allocation (text and observation data) by 23 June.

Rankings within the 5 Themes

Cosmology and the Structure of the Universe (21%)	Ave. Rank
Mapping Dark Matter	1.6
Searching for the Reionization Epoch	2.0
Measuring Cosmological Parameters	2.5
Microlensing in the Virgo Cluster	3.9
IR Transients from GRBs and Hosts	4.4

Theme I: Bob Kirshner, theme lead. Top priority is mapping the dark matter. The discovery of cosmologically distant supernovae and high redshift IGM probes is considered to be free -- part of the various survey programs.

The Origin and Evolution of Galaxies (33%)	Ave. Rank
Form. & Evol. Galaxies- Imaging	1.2
Form. & Evol. Galaxies- Spectra	2.0
Form. & Evol. Galaxies- Obscured Starformation &AGN	3.2
Measuring the Rates of Supernovae	4.2
Form. & Evol. Galaxies- Clusters	4.8
Form. & Evol. Galaxies assoc. with AGN	5.5

Theme II: Simon Lilly, theme lead. Here the supernova Type Ia and II rates require dedicated spectroscopy which is charged to both Theme I and II. The UV-Opt. DRM is not ranked but was partly addressed in the imaging campaign. Of note, both visible imaging and MIR spectroscopy are part of the imaging and spectroscopy surveys (I & II). Loss of these capabilities would significantly limit the results of these surveys but not necessarily cripple them. The obscured star formation program (V) relies entirely on MIR imaging and spectroscopy.

The History of the Milky Way and its Neighbors (15%)	Ave. Rank
The Age of the Oldest Stars	1.4
Cool Field Brown Dwarf Neighbors	2.6
Ages and Chemistry of Halo Pops.	2.7
IMF for Old Stellar Populations	3.4

Theme 3: Mike Rich, theme lead. The Brown Dwarf program is new and still in draft form. Mike expressed some concern that the chemistry and ages of halo populations may be addressed using HST and ACS, WF3

The Birth and Formation of Stars (16%)	Ave. Rank
Physics of Star Formation: Protostars	1.3
Origins of Substellar Mass Objects	2.2
Evolution of Organic Matter in ISM-Astrobiology	3.2
Cosmic Recycling in the ISM	3.3

Theme 4: Mike Meyer theme lead. The ASWG raised concerns about the astrobiology program really addressing the origins of life. Most considered this program to be an extension of the ISM studies, but others wished to keep the astrobiology title to acknowledge the high priority placed upon such studies by the astrobiology community and the NASA long range strategic plan.

The Origins and Evolution of Planetary Systems (15%)	Ave. Rank
Evolution of Circumstellar Disks	1.7
Detection of Jovian Planets	2.1
Survey of Trans-Neptunian Objects	2.9
Properties of KBOs	3.3

Theme 5: Mike Meyer represented this theme, but much of the DRM adjustments were done by Marcia Rieke. The Trauger DRM to find Jovian-sized planets around nearby stars was merged with the original program for the search for planets around nearby stars.

The Overall Ranking of DRM Programs

After the presentations and individual ranking of programs within the themes -- a kind of warmup -- the ASWG ranked all 23 DRM programs, scoring each of the programs from 1-23. These scores were added to those from Marcia Rieke, Ewine van Dishoeck, and Bruce Margon to derive the order shown below. (Actually, these latter three lists were added post facto but the results did not change significantly and not at all for the highest ranked seven programs. The results are shown below in both tabular and graphical form. The ASWG drew the following conclusions relative to these ranks:

1) There is a statistically meaningful break between the highest seven programs and those that follow. These programs are led by the two original "Dressler" programs to study the formation of early galaxies and all will clearly make very important contributions to astronomy. The ASWG recommends that this set of seven programs define the "core" program of NGST for purposes of the Phase A studies and costing exercises. This decision responds to the recommendation of the NGST External Science Review (NESR) in this regard.

2) The 7 core programs require fundamental capabilities in visible imaging, NIR imaging and spectroscopy, MIR imaging and spectroscopy as shown in Table 2. These capabilities should be considered as essential during the Phase Astudies.

3) There may be another group of 6 programs that are deemed of higher priority than the remaining 10. These programs require additional capabilities such as coronagraphy and high resolution MIR spectroscopy. However, the dispersions and scatter in the scoring for these programs is such that strong distinctions amongst this set should probably not be made. Note that the standard deviation of the mean exceeds 1.4 in several cases, indicating an RMS scatter of greater than 5 ranking levels for such programs. In these cases, closer examination of the scores indicates a wide scatter of scores and not a Gaussian distribution. One might guess that such scatter might reflect scientific politics, but by comparing two thematically related programs, one sees not clear correlation in the scores on a voter by voter basis (e.g. one voter scores both high, another voter scores one high and the other low, etc.). We suspect that the cases for such programs still need refinement or that the capabilities that they require may daunt some of the ASWG members. We take some encouragement in noting that the final ordering of programs is at least consistent with the ordering within the 5 themes.

Rank	Score	SDM	DRM Title
1	1.9	0.4	Form. & Evol. Galaxies- Imaging
2	2.9	0.4	Form. & Evol. Galaxies- Spectra
3	6.2	0.9	Mapping Dark Matter
4	6.8	0.8	Searching for the Reionization Epoch
5	7.3	0.9	Measuring Cosmological Parameters
6	7.8	1.0	Form. & Evol. Galaxies- Obscured Starform. &AGN
7	8.4	1.0	Physics of Star Formation: Protostars
8	10.5	1.0	The Age of the Oldest Stars
9	11.3	1.4	Detection of Jovian Planets
10	11.8	1.5	Evolution of Circumstellar Disks
11	12.0	1.5	Measuring the Rates of Supernovae
12	12.1	1.1	Origins of Substellar Mass Objects
13	12.2	1.2	Form. & Evol. Galaxies- Clusters
14	13.9	1.3	Form. & Evol. Galaxies near AGN
15	14.1	0.8	Cool Field Brown Dwarf Neighbors
16	14.6	1.1	Survey of Trans-Neptunian Objects
17	16.0	1.4	Properties of KBOs
18	16.8	1.0	Evolution of Organic Matter in ISM-Astrobiology
19	17.0	1.1	Microlensing in the Virgo Cluster
20	17.0	0.9	Ages and Chemistry of Halo Pops.
21	17.6	0.9	Cosmic Recycling in the ISM
22	18.5	0.8	IR Transients from GRBs and Hosts
23	18.7	0.9	IMF for Old Stellar Populations

Table 1: The Ranked Design Reference Mission. The Core programs (1-7) are shaded

Rank	DRM Title	Scientific Capabilities
1	Form. & Evol. Galaxies- Imaging	2 micron dif.-limited imaging, wide FOV, 8-m sensitivity, 0.6-5 microns
2	Form. & Evol. Galaxies- Spectra	NIR multiplexed spectroscopy, 1-5 microns, R = 100-3000, 5-10 MIR spectroscopy, R=3000
3	Mapping Dark Matter	Widest FOV, stable PSF
4	Searching for the Reionization Epoch	Very sensitive NIR spectroscopy, R = 100-300
5	Measuring Cosmological Parameters	Ability to follow fields over months
6	Form. & Evol. Galaxies- Obscured Stars & AGN	MIR (10-28+microns) imaging and spectroscopy, R = 300
7	Physics of Star Formation: Protostars	MIR (10-28+microns) imaging and spectroscopy, R = 3000+
8	The Age of the Oldest Stars	Low scattering in PSF
9	Detection of Jovian Planets	5 micron coronagraph
10	Evolution of Circumstellar Disks	MIR spectroscopy, R=30000+
11	Measuring the Rates of Supernovae	Ability to followup imaging with weeks
12	Origins of Substellar Mass Objects	Core NIR imaging and spectroscopy
13	Form. & Evol. Galaxies- Clusters	Core NIR imaging and spectroscopy
14	Form. & Evol. Galaxies near AGN	Core NIR imaging and spectroscopy
15	Cool Field Brown Dwarf Neighbors	Core NIR & MIR spectroscopy
16	Survey of Trans-Neptunian Objects	Core NIR imaging
17	Properties of KBOs	Ability for slow linear tracking, MIR imaging
18	Evolution of Organic Matter in ISM-Astrobiology	Core MIR spectroscopy
19	Microlensing in the Virgo Cluster	Overall Field stability
20	Ages and Chemistry of Halo Pops.	V-band imaging desirable
21	Cosmic Recycling in the ISM	Core MIR spectroscopy
22	IR Transients from GRBs and Hosts	Targets of Opportunity - 4 day replanning
23	IMF for Old Stellar Populations	Core NGST angular resolution & sensitivity

Table 2: Scientific Capabilities of the Ranked Program. The Core Programs (1-7) are shaded.

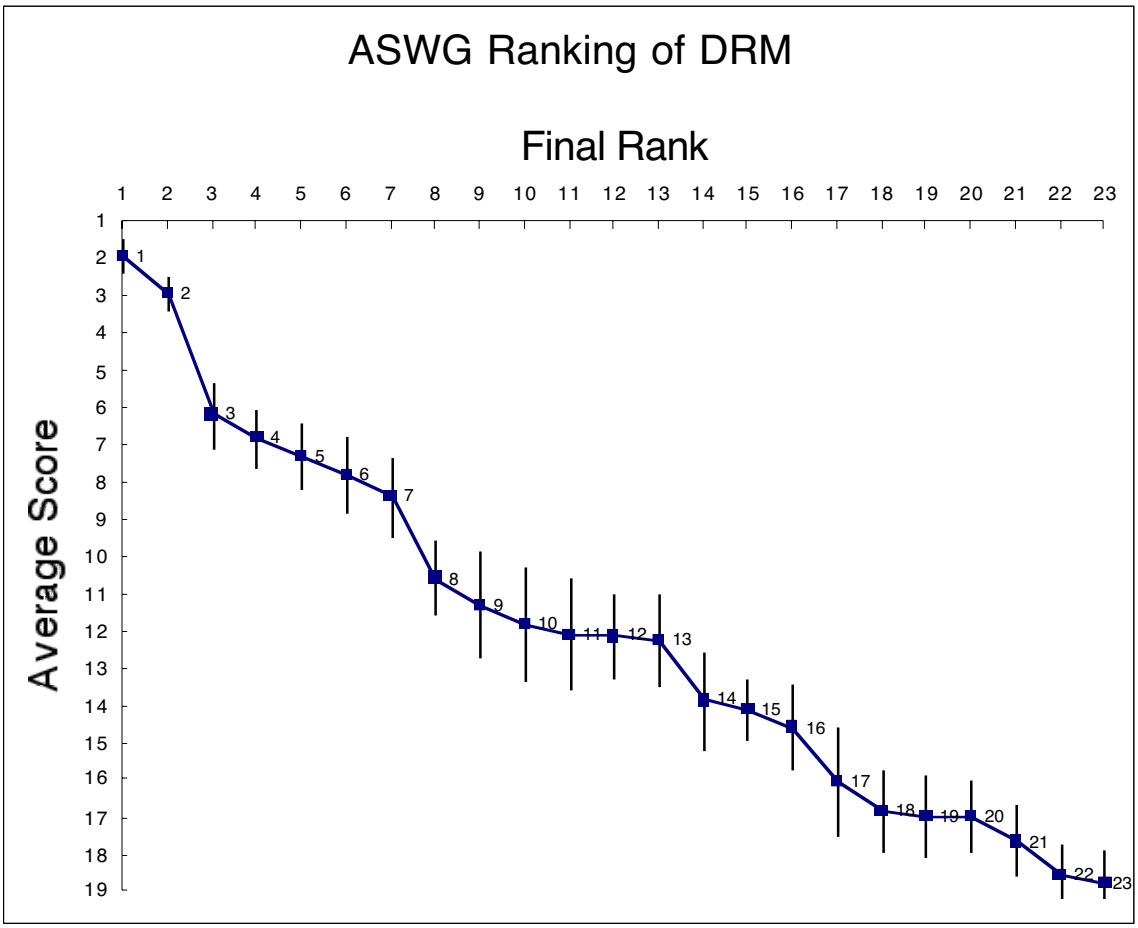

Figure 1: The final ranking of the DRM programs versus average score. Note the statistically significant jumps from 2-3 and from 7-8. The standard deviations of the mean are used to estimate sample uncertainties.