April 16, 1998

To: ASWG Members
From: Peter Stockman
Subject: ASWG Meeting #3

The following are rather spotty and subjective minutes of the ASWG meeting. I had to miss portions of a few of the science talks, so please forgive the uneven treatment of these.

Key items: Next ASWG meeting will be in one of the weeks from July 27 - August 22. We will be requesting more detailed information about your availability during that period. We will try to maximize the attendance. This will probably be the last meeting before the Science PNAR -- a meeting where we critique the written DRM inputs and devise a strategy for the SRB 2 and PNAR meetings. This will also be the first meeting with the new ISIM PI representatives.

Homework:
1) All latex files or postscript files of DRM inputs are due to Piero Madau and me on July 14. We will send these around in hardcopy to all members but encourage you to interate these inputs within the ASWG before the deadline. Recall that you can send email to the entire ASWG by sending it to ngstaswg@hst.nasa.gov.
2) Please send Piero Madau the titles of your DRM programs and a two sentence description of these programs by May 1. These will be used at the upcoming AAS & Liege meetings.
3) If you presented material at the last meeting but did not provide a copy of your charts to me, please fax them to my attention at 410-338-1592

April 14, 15 1998 ASWG Meeting

Attendees: Peter Jakobsen, Simo Lilly, Peter Schneider, Phil Nicholson, Bob Fosbury, Marcia Rieke, Piero Madau, Mike Rich, Bruce Margon, Mike Meyer, Ed Weiler, Mike Hauser, Massimo Stiavelli, Jon Gardner, Matt Greenhouse, Mike Fall, Harley Thronson, Eric Smith, John Mather, Peter Stockman,

Absent: Don Hall, Bob Kirshner, Avi Loeb.

1.0 Welcome and Review of Agenda: New member, Peter Schneider, MPI f A, Garching, peter@mpa-garching.mpg.de

2.0 AAS & Liege Meetigs:
-- AAS. There will be an NGST exhibit. The ASWG members are invited to volunteer for manning the exhibit. A straw vote indicates that only about 5 may attend the AAS meeting.
-- Liege (Madau): The list of presentations was reviewed.
. We will follow up on ISO, SIRTF, and NICMOS science.
. The Web address is http://ecf.hq.eso.org/ngst/ngstconf/workshop.html
3.0 Project News
-- NASA (Mather, see viewgraphs)
. Most decisions about technologies and final architectures will be made around 2002.
. There will be a down-selection to 1 Phase B Contractor after Phase A.
-- ESA (Jakobsen)

. 3 Studies
Deep Orbit (internal)
Spectrograph Study (Selection June 24)
Telescope & Payload Study (Selection also in June-July timeframe)
. Science Team (Peter Schneider, M. McCaughrean (Potsdam), ... more the come.

-- CSA (Lilly)
. As of the quarterly in late Feb., pending the necessary funds, CSA has indicated that it will participate in NGST. This month, they will fund a number of instrument studies and potential aerospace contributions at the 50M level from Canadian industry.

4.0 NASA HQ News (Weiler)

-- Budget for Origins looks good but the budget for other programs are tied to the tobacco settlement which has run into problems in the Congress.
-- San Diego and Austin TX meeting are very important.
-- Joe Taylor will be the head of the next Decadal Survey.
-- Concerned about cost creep involved beyond 5 microns (or shortward of 1 micron)
-- Dan Goldin is pushing the Origins group to consider bigger and better things in the future. So NGST must appear as a stepping stone to very large apertures. Monoliths are probably not going to be acceptable.
-- We have friends on the Hill and close to the Hill that support NGST.
(Bill Smith, Kevin Kelly support NGST)
-- Letter to Al Diaz has been sent from Wes Huntress designating the STScI as the science operations center for NGST.

(Harley)
-- Reviewed the goals for the Science PNAR , 1-2 Oct. at the STScI.
-- Looks like there will be some funding for the ASWG members starting in late summer.
-- Urges members to keep an eye on the HQ Web site for meetings and other opportunities.

5.0 Views from the Community:

-- Mike Rich:
some people are concerned about the project meeting the cost cap.
UV people are upset about the lack of a plan for a UV-capable telescope.
Isn;t there too much emphasis on optical/UV/NIR , and little towards theory.

-- Marcia Rieke:
Science sounds great but are skeptical about the technical readiness and cost.
*** we should be more clear about the budget ***
*** we should ask the planetary people how they sold the Pathfinder to their community for 1/10 the cost of Viking***

-- Mike Meyer
Some people are not completely happy with the DRM -- too little science in their science area

-- Simon Lilly
Ditto about science width. Very positive except that star formation is not emphasized enough. Not going to understand star formation at high redshift if we don't know enough about it locally.

-- Ed Weiler

Have to remember that the one dimensional science outlook of the "black book" is good for staffers but needs to be broadened for the community across the entire Origins theme.
*** we can remind the NAS that
1) NGST won't start until it is ready and
2) other major missions have changed from their original designs before they were launched (AXAF, SIRTF). ***
*** In a year, we will be asked what this mission is. The core mission will have to be the NIR. If we can afford it, we will add on the following capabilities. ***

Lunch

1:00 Simon Lilly discusses the considerations of the Galaxy Group. They outline both the high level key questions and the observational survey that results. Lilly views NGST in two dramatic regimes: the unknown at redshifts out to z ~ 30 and our understanding of the evolution of galaxies over the last few merging times; z = 1-5.

There is clearly a need to connect to the SIRTF fields and deep HST fields taken in the B band (rest UV).

3:00 Peter Schneider: Weak Gravitational Lensing: measure of the power spectrum in the universe at redshifts of 1: 10 megaparsec scales. The strongest signal is found on fields of 3 arcminutes. Even bigger fields are needed for an easy interpretation.

moderate scales: can be used to measure dark matter, 1-3 per square degree from ground based surveys

smaller scales: measure dark matter in haloes in galaxies and cluster galaxies. Some early work shows that the halos in clusters are smaller than in the field. NGST could take this back to a redshift of 0.5-1.5.

Strategy: Observations of faint galaxies (to get numbers) but limited to the intrinsic ellipiticities of the galaxies (B band bad since they are lumpy). Also need very good PSF and stable in telescope. Best option is to calibrate it in the field that you take. The field should be as large as possible (> 1.5 arcminutes).

3:30 Peter Stockman: Discusses the use of NGST to follow-up GRBs that have no optical counterparts. Mixed reaction except for their use as beacons to study the IGM. Action item for Peter Jakobsen and Piero Madau: consider how to differentiate between thick Lyman-alpha forest and the un-ionized universe.

4:00 Matt Greenhouse/Jon Gardner/Harley Thronson/Mike Rich: Data Rights
Matt explains that his proposal was an attempt to use the NASA procurement policies that exist to create an effective data rights policy to provide about a year's proprietary rights. Mike Rich is concerned about the cherry-picking that can happen even with a one year protection. Jon Gardner argues that a one year proprietary period is a maximum period-- that the PI could have cherry picked if he/she wanted to. Harley says that the HQ policy is vague -- usually is stated is that the proprietary period should be as short as possible (one year is a typical example). Each project should develop a policy as early as possible which is good for their community with only a slight eye towards NASA-HQ. Bob Fosbury asks where the incentive comes from to write an excellent proposal. Clearly there are many motives. In Europe, the

proprietary period is usually 1 year (Fosbury) even though the funding for the science is found through other channels. Phil Nicholson and Marcia Rieke agree that GTOs don't need more than one year of proprietary period. Jon Gardner mentions that GTOs on HST could block targets for more than a year. Proposes that GTOs only block targets for a year at a time and that they then must observe those targets. Matt Greenhouse and Marcia Rieke discuss the related topic of cream-skimming by GTOs: chosing hundreds of bright objects at the outset. One solution was that the GTOs should submit their 1 year program right before the annual AO and have to stick to it. Jim Liebert and Jules Halpern will look over the report that is produced by Mike Rich's subcommittee from the point of view of the outside community. Mike Rich indicates that he is a little concerned about many large Legacy programs that have no specific individuals responsible for the data analysis.

5:00 Mike Meyer: Describes a program for observing the IMF down to Jupiter masses in star formation regions in the Milky Way and the LMC. This was one of the sessions that I missed but the upshot is that one can get down to 1 M Jupiter, below the fragmentation limit, in a number of different settings and metalicities. Mike did not present a program on protostars -- looking forward to that in July.

6:00 Dinner (Loco Hombre & Nifty-50s Diner -- milkshakes and Indian food!)

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8:00 Discussion: The Visible Option. The consensus of the committee was that the visible band was important for NGST and appeared at first glance to be a relatively low cost addition -- if one assumes that the optical and pointing quality of NGST at ~ 1.5microns was maintained. There is a subtle issue of poor performance if the DM or the primary mirror has 1/20 wave at 2 microns on 10 cm scales -- see the Angel paper in the April 1997 conference.

8:30 Phil Nicholson: The Kuiper Belt has become better understood and is an important link to the disks seen around protostellar systems and disks seen in star forming regions such as Orion. The physical scale seen in those systems is >~ 100 AU; the NGST could map the Kuiper Belt to radii of 100 AU, i.e. the same scale as those seen in external stars. Several resonances, such as the 3:2 resonance, trap and protect Pluto and most of the known KB objects. The chief advantage of NGST is that it can observed KB at radii beyond the 2:1 resonance at 48 AU, where it is expected that the KB are essentially pristine. The ones in the resonances have large eccentricities and inclinations. It is thought that most of the KB s near these resonances were swept out as some of the planets moved outward from their original orbits (?).

He suggests a strategy of observing a single field 3 times (2 hrs per field) at 2 day, 183 day period near 90 degrees. He calculates about 40 per NIR CAM field. He suggests about 25 fields so that the total time is 6.2 days for the survey. The followup spectroscopy would have R ~ 1000 in the NIR for the bright objects -- this is where most of the diagnostics are found. Lower resolution is useful for the fainter KB s. The thermal emission comes up around 20 microns. The tracking needed is very modest and is probably mostly needed in the followup observations.

9:20 Marcia Rieke: Utility of Rest Frame NIR observations for the studying of the Early Universe. Marcia shows the importance of the 1.6 micron peak in the Fnu versus wavelength spectrum. It is produced in the K-M class by the change in the opacity at the H- bound-free edge, It becomes prominent in any stellar population with ages

beyond 10^7 years. There is another spectral jump that could be used, say the 0.4 micron jump. It is, unfortunately, not a useful age or mass diagnostic. Modest bandwidth filters should be sufficient to detect it.

The CO-bands at 2.3 microns (the first overtone). These can be used for stellar velocity dispersions. It is a 15% deep feature -- stronger in supergiants than in giants. Need a MIR spectrometer and R ~ 5000 for stellar velocity dispersions (for 50-100). The fundamental at 4.6 microns would be equally sharp and stronger. The example she showed had a resolution of 3000, an accuracy of around 2% (rms) and 30 km/s dispersion accuracy. The second overtone band are often confused with Fe emission lines and are weaker. The main advantages are that these features are not affected by dust and that they are stronger than typical features in the optical. Most importantly is the weakness of features in the spectra of young stars. So in the early universe, this may be the best/only way to estimate stellar velocity dispersions.

AGN-surveys: A) One could envision a 1-5 micron slitless grism survey to maximize z-coverage. B) QSOs and Seyfert 1s have hot dust at 3 microns. Starburst galaxies do not show the hot dust feature (partly because they are self-absorbed). One could also use the 12 micron luminosity band that is ~ 10% the bolometric luminosity for <u>all galaxies</u>! (Seyferts -- starbursts -- normal galaxies -- ULIRG).

SIRTF will discover ultraluminous galaxies at z ~ 5. These will not be detected at the J,K rest wavelengths. These could be followed up by NGST. Simon Lilly asks what rest wavelength would give a clue to the star formation activity in this system, Marcia estimates that the upturn at 3-5 microns would indicate the presence of strong star formation but not necessarily its strength.

10:00 SIM: Ron Allen presents the scientific background to SIM and its status. SIM is currently in Phase A (two years) as of October '97. It is nominally a 5 year mission in a SIRTF-like orbit. The noise floor for SIM astrometry (a Micholson-interferometer) is 4 microarcsec. From photon statistics, it may be possible to reach this floor in 30 hrs for a 20th magnitude star.

Parallax to the LMC will done directly.
Proper motion and planet detection of Jupiters to 3 sigma, at 300 pc. An Earth-like star at 1 parcsec would make a 1 microarcsec motion -- too tough.
Nulling Beam Combiner: Faint companions and zodiacal dust: 1000-100 zodis measurable.
Targets of Opportunity
Imaging at the 10mas level. Ron shows the disk of M87 obtained in Halpha in 5 hr.

60% of the 5 year mission would be dedicated to the grid and a pre-defined set of astrometric targets (grid, distance scale, planets, etc.)

11:30 Michael Rich: Stellar Populations . Realistically, we cannot study the high surface brightness centers of galaxies. However, we can study the formation of halos across the Hubble sequence.

Are the oldest stars in all galaxies the same age?
How can ages and chemistry of stellar halos constrain the early, difficult to study the early epoch?
What is the evidence of Pop III stars? We should see populations of very metal poor stars in the halos of galaxies.
Is the IMF Universal ?

Will all the estimates for Ho and qo be consistent or should we consider using HST to estimate distances. Possible to measure the distance to Coma using the RGB tip.

Distance best given by Cepheids then RGB
Metalicity given by Giant Branch and V-I colors
Ages given White Dwarfs
Lower main sequence gives the IMF.

Younger populations are much easier to measure.
Distance: Cepheids
Age: Higher Turnoff, white dwarfs

To reach the turnoff in Virgo (halos), one needs to reach V ~ 35.
V ~ 32 to reach the HB at Virgo.
One can look at the IMF from the bar of the LMC to the Milky Way Galaxy

12:25 Bob Fosbury: AGNs
1) Study the environments of known AGN before and through the peak in the space density. Perhaps there will be clues that tell us when the AGN are formed (say in mergers) and whether they quench or enhance star formation.
2) AGN can illuminate parts of the ISM at rather large distances. We can use the reflected and reprocessed light from these halos to study otherwise invisible regions. With NGST, we can view this light in the rest visible and NIR where there are a lot of diagnostics. Polarimetry is particularly valuable for separating the reflected AGN light for the stellar continuum and scattered (in the telescope) AGN light.

1:00 Expert Assistance Demonstration in the Auditorium. The first prototype will be used for the ACS/HST and be available in late 1999.

2:00 Avi Loeb (Telecon): Discussed his new results for early supernovae and AGN. The supernovae could be detected at ~ 2.5 per NGST field per year (Type 1s) and 10x that for Type Iis. This assumes the usual peak in star formation at z ~ 1.5. Madau indicates that if there is additional dust coverage at early epochs, the rates could be substantially higher. Piero Madau, Zoltan Haiman, and Avi have considered how the HDF results constrain the parameters used in the theories for early star formation and AGN. The numbers are reduced -- since the HDF saw no such objects -- but there remains the potential for an upturn in the numbers as we go deeper and to longer wavelengths.

2:30 Homework assignments and the goals for the next meeting were discussed (see above.)