Problems that Herschel Users are Likely to Encounter During Early Operations:

At some level, Herschel data processing and (probably all) software is currently incomplete and will continue to be less than complete throughout early mission operations. NHSC should prioritize software implementation to alleviate those problems most likely to arise. One concern is that the available software is slow. The NHSC should carefully examine community needs and requirements, and then set priorities on where input is either critical or of significant added value.

The NHSC fully agrees with this assessment and recommendation. Appropriate steps will be taken to set priorities based on community needs. The HSC and NHSC Data Processing Workshops that have just been held provide good initial feedback to start that process.

The current plan relies on solutions that will be provided by the instrument teams and NHSC staff; this is reasonable for now. Experience on other missions, however, indicates that ultimately a broader community will have to become involved in refining data processing. Existing plans to involve community input exist but should be placed on a firmer and more transparent basis.

Agreed.

Access to Data

Current plans call for users to access their data through the HSC archives. Many data packages will involve sizes in the range of several gigabytes, and users will be required to download their data directly from HSC. Early tests of ftp download from different locations within Europe and the US have been inconsistent; some users find that the download can often be unacceptably slow. While NHSC experience indicates that transfer from HSC to anywhere in the US is similar to transfer to NHSC, these transfer rates should be more widely checked to make sure they are acceptable to all potential users. A particular concern is that observations with the Photodetector Array Camera and Spectrometer (PACS) will yield especially large data sets entailing unacceptably long download times.

At the moment, NHSC is not involved in this problem but may need to make itself responsible if access to data proves to be a widespread problem. The difficulty is acerbated by measures to assure the security of the archived data. It is important for NHSC to at least develop a plan for providing large data sets, should transfer rates prove so slow that this seriously hampers distribution to US users from the HSC near Madrid.

Agreed and the NHSC has started to take steps to make this issue both better understood, and to increase awareness. The NHSC has plans to quantitatively assess data transfer rates to be completed during the PV phase (when many types of data will be available). Also, a concern has been raised to the Herschel Science Ground Segment Steering Group. An action item was assign at ESAC to understand the issue. NHSC will work with

the ESAC officials with this action.

Help Desk

The availability, as soon as possible, of simulated data could help alleviate pressure on the helpdesk, especially as the open time proposal deadline approaches. Simulated data products for all instruments and point response functions should be a priority so that potential and selected teams can develop a better understanding of the data products and software tools. This would also facilitate the development of new tools and algorithms by the community. In brief, data set availability should be thoroughly linked to the release and availability of data processing tools.

A significant amount of simulated and test data have been released as part of the Data Processing Workshops. This should go a long way to resolving this issue until real, in flight data can be utilized.

There is some residual concern that the community may not be sufficiently educated about the abilities of the instruments. Instrument "Pocket Guides" and links to other instrument documentation highlighted on the front webpage (as for the Spitzer Science Center website) could greatly enhance a potential user's ability to find information quickly. The existing "Pocket Guides" provide a good, quick overview of the instrument capabilities, and should be made more prominent. Aside from the current "Pocket Guides," some clear links to existing "how to" documents may be appropriate. Implementation of Instrument Interest groups and User Forums would be a good way to assist astronomers in developing their programs. We are aware that the resources to implement a full-service system are probably too ambitious, but open forums and interest groups could leverage expertise from the general community. Occasional splinter sessions at AAS meetings might be used as well to increase shared experience.

This NHSC will work to support additional visibility of instrument information as well as providing new and innovative ways of providing additional insight. A complete upgrade of the NHSC webpages will start this process over then next several months. We will also work with the NHSC Users Panel to make sure we are continuing to be responsive in this area.

Training of Scientists

Data analysis workshops are extremely important for training and for disseminating information to the community; but the current planning may not include a sufficient number of workshops. The workshop that will take place in early April appears restricted to only two members from the various Key Project teams. The next workshop may not be scheduled until more than a year later. A more frequent schedule, or more inclusive attendance (possibly with several sessions to allow more users to attend) should be implemented if the NHSC perceives adequate community demand and has the required resources. If multiple workshops cannot be supported, alternative forms of training might be explored, e.g., via webcasts or other internet connections. The goal should be to

accommodate all who are interested in attending. Proposal preparation workshops could also be useful.

The NHSC agrees with the spirit and intent of this recommendation. Additional data processing workshops can be supported, and other methods of education of scientists have been considered and being made available as we can. These include online training sessions and related. As we move forward, demand and resources will be balanced to find the best solution for the community. Proposal preparation workshops are planned.

Heterodyne Work

To date, broadband, very-high-resolution, very-high-sensitivity spectroscopy has not been available from a space platform. HIFI spectra will often be very complex, full of emission from unknown species. But they will also be complex because of the double-sideband nature of the instrument. The de-convolution algorithm has worked acceptably with moderately sensitive data. However, there is little community experience with this algorithm. It is unclear how effectively it will work with Herschel data. Various artifacts imposed on the spectra by the system are unlikely to be completely characterized before the performance-verification phase is complete and will further complicate de-convolution. A pipeline may not be able to adequately process this data, whose oddities will not be completely known before deployment. User naïveté might be well addressed through establishment of shared-interest groups able to exchange experience in working with HIFI.

An added concern is that the amplitude calibration scheme, although apparently quite sound, may not converge, based as it is on the spectrum of Uranus and/or Neptune, which might be inadequately characterized in this wavelength region.

Agreed.

Steps Toward Full User Support

At present, NHSC is concentrating on the immediate support for US participants on US-led Herschel key projects. These will be among the first observations to be carried out with Herschel. The experience gained on these early observations will then serve to help US astronomers planning smaller open time observations.

The HSC and NHSC have established a Herschel Interactive Processing Environment (HIPE) for observers to interact with their Herschel data. This will enable users to process data through pipelines without intimate knowledge of Python or Java. The plan is to generate FITS format data products at many levels of the pipeline, to allow users to work with their data with relative ease. NHSC also hopes to aid users with videos including audio commentary from IPAC experts.

New tools being developed for ease of data reduction, like MOPEX for reducing data on PACS, or the standing-wave-reduction tool analyzing HIFI, will also be of significant

help to US observers.

Promoting community use of the Herschel Common Science System (HCSS) will also be important. Motivating its use will help focus NHSC software efforts by reducing the number of community parallel or bypass efforts that need support.

The assignment by NHSC of a liaison scientist to each of the Guaranteed Time Key Project (GTKP) and Open Time Key Project (OTKP) team looks very promising. For smaller, open time programs such liaisons could become established with shared-interest groups. As the time for carrying out these smaller projects approaches in 2010, NHSC staff should examine which of these two alternatives would more effectively serve the community, given realistic manpower constraints.

Careful thought and sufficient resources have gone into user support. Communication with the community is a high NHSC priority that consistently receives attention. Plans for identifying community needs for education, including special topics, should be enhanced where staffing is available. It is relatively easy to support the high-level users, but harder to understand the needs of the confused or inexpert. Assigning liaison scientists to the OTKP (and GTKP if requested) is very efficient. Small groups and individuals could benefit by having a liaison assigned to them simply to reduce the barrier for asking questions, even if the liaison were solely responsible for making the appropriate referrals.

The NHSC will assess having liaisons to small programs. There is experience other institutions will be examined as well. While potentially valuable, the NHSC will have to weight the cost of such a program versus other priorities. This recommendations is a agreed to be good by the NHSC and will ne carefully considered.

Data Processing

Data processing tools will be incomplete in early observations, through no fault of NHSC. NHSC understands the system well enough to support work-arounds to deal with early data processing during the performance verification phase, as needed. Nevertheless, a main worry is that, since data processing tools will be barely ready at launch, users will not have an opportunity to gain proficiency in using these tools and providing NHSC with early feedback, thus delaying useful input to NHSC until months after launch. At that point, NHSC may be flooded with considerably more interaction than the center will be capable of rapidly assimilating ---although, with luck, NHSC staff may by then be well past dealing with performance verification problems and thus ready to turn attention to data processing upgrades.

NHSC agrees – some luck will be needed.

The Anticipated Crush of Proposals

The NHSC staff should prepare itself for what may prove to be an overwhelming crush of

proposals in response to the call for General Observer programs, to be issued early in 2010. The system in place seems well designed to handle individual questions with its Helpdesk, responses to Frequently Asked Questions (FAQ) and its Knowledgebase; but it may need to shore up its service to the community through greater reliance on web-accessed information, rather than providing individual Helpdesk responses within 48 hours. In times of stress, these individual responses could overwhelm the system. Such a self-help mode for users will, however, require further development of the knowledge base now under construction, as well as the FAQ website. Other existing knowledge bases may be helpful particularly for users of HIFI onboard Herschel. In this regard, user support for molecular spectroscopy now offered by ALMA (Splatalogue) should be linked for use by potential users.

The NHSC very much agrees with this assessment. We will work to avoid a crisis by improving online resources as the early mission progresses and other ways of providing detailed knowledge effectively. Much thought has already gone into this. Members of the NHSC have experience with other missions, which will be leveraged toward this end.

We very much appreciate the support of ALMA. We hope to extend this relationship into many other mutually beneficial areas.

Following in-flight performance verification and science demonstration, the attention of NHSC personnel will need to shift from gaining experience with operating Herschel to transferring that knowledge to the US astronomical community.

Agreed.

<u>Funding</u>

The NHSC center is experienced in dealing with funding problems. However, funding levels and pacing depend on NASA Headquarters and thus on NASA's ability to provide funding and providing it on time. Last year a 17% cut in anticipated funding had to be implemented. This most strongly affected the build-up of observer support teams and a planned HIFI team buildup. Fortunately, some compensating benefits have accrued from NHSC's membership in the larger IPAC structure. Flexibility in accommodating to budgetary problems has allowed the available work force to satisfy the most essential needs. Our impression is that NHSC has assembled an experienced team. Morale is high and this helps the staff solve problems that otherwise might remain unattended.

Agreed.