1. INTRODUCTION

1.1 Purpose of this Document

The purpose of this document is to review the current status of SPIRE AOT development, and to highlight issues that have been raised by the AOT team that require higher level advice from within SPIRE on certain aspects of policy. We also review the principles on which we have designed the current AOTs.

The document takes as its input the technical notes generated by the PHOT and SPEC AOT groups, and written by M. Fox and M. Sauvage respectively. These documents should be read with this document for full coverage of the current AOT status.

1.2 What Needs to be Done Next

As can be seen in the Fox and Sauvage documents, much progress has been made in the development of AOT decision trees. However, several issues remain open and cannot be acted on until further decisions are made about SPIRE policies in some areas. The current document aims to encourage input on these issues from the wider SPIRE community. Decisions on these open issues should be made at or before the forthcoming consortium meeting. I do not think any of these issues will have a major effect on the ongoing SPOT/AOT design process underway between the SPIRE ICC and ESA. However, it is important that any such effects been identified soon.

2. GENERAL PRINCIPLES OF AOT DESIGN

The general principle we have taken with the AOT design is to protect the user from as many technical implementation details as possible. Our aim is to avoid the technical overload that was so prevalent with ISO, and at the same time to allow us to optimise the observing mode for any given observation in the light of improved knowledge about the satellite and instrument performance after the programme has been input. This is most apparent with the PHOT AOTs where the details of point source and mapping implementation can vary. This 'hands off' approach was adopted on the advice of various members of the ICC. It could still be changed, but we feel there is much to recommend it – simplicity for observers, a more limited number of observing modes to calibrate and test, simplicity of reduction and analysis etc..

3. AOT DESIGN STATUS

Decision trees and descriptions of what is needed for the AOTs have been prepared for both PHOT and SPEC AOTs. Some refinement of these is still needed but much of the basic work is done. Descriptions of what needs to be presented to the user in SPOT have also been prepared, though these are in some cases rudimentary and need to be expanded. The basic outline of what logic is needed within CUS to provide integration time estimates has been prepared.

4. OPEN ISSUES IN CURRENT AOT DESIGNS

4.1 Open Issues from PHOT

- Point source observing modes

At present the AOT allows the observer to select between a single point chop and a 7 point jiggle. The assumption is that the observer will know if his source position is accurate to a few arcseconds or not. However, there is a worry that the far-IR position, relevant to Herschel, and whatever waveband is being used to provide an accurate position might differ by such an amount. There is thus an argument that a 7 point should always be used, no matter what. There would be little cost in observing time by using 7 point rather than single point, but the reduction and analysis would be somewhat more complicated.

If we continue to offer a single point chopped mode, we must emphasise the need for accurate target astrometry in the documentation.

- Chopping parameters

The current assumption is that the chop throw, frequency and angle should be fixed (nominally 126", 2 Hz, and parallel to the y-axis). There may be circumstances where these are not optimal for a proposal – one GT observer has already asked about the possibility of chopping perpendicular to the y axis. Should we allow some alternatives to these fixed parameters? If so, should this only be offered in an 'expert' mode? What support implications would there be in allowing alternatives to the standard chop parameters, and do we have the resources to cope with any additional needs?

- Methods of mapping large areas

For any mapping projects larger than a single jiggle map (4'x4') two observing modes can be used – raster map or scan map. As things currently stand, we are implementing a hard divide between observing these modes at a fixed map size – raster for areas smaller than 40'x40', scan maps for anything larger. The observer than enters the appropriate parameters for the mode selected. Are we happy with this approach? Under what circumstances would the area divide, currently 40'x40', change? What plans should we make for observers affected by any such change?

- Roll angle constraints

Only the central circular area of a given map can be guaranteed without additional constraints being placed on when an observation can be made. We currently envisage allowing observers to add roll angle constraints if they need to cover a particular area of the sky. This would limit the dates on which their observations can be made. Appropriate comments concerning this will need to be made in the documentation.

- Parallel Mode

The possibility of observing with PACS and SPIRE in parallel might be able to boost the efficiency of the observatory. However, the telemetry data rate is not sufficient to have both instruments running together with both operating fully. Some parts of SPIRE will thus have to be turned off in parallel mode. There are a range of possibilities for which parts of SPIRE to turn off, and the best choice will likely vary from one scientific programme to another. Furthermore, we still do not know if parallel mode will be rendered unworkable by the BSM affecting PACS, or what compromises there might be needed on scanning speed to ensure good data from both instruments. There are also practical problems with parallel mode in that the two instruments are offset in the focal plane. It will thus only be workable for very large area surveys.

If this mode is to be offered generally, how are we to decide which parts of SPIRE to turn off? If there turn out to be problems with BSM crosstalk to PACS (when will this be determined?), what can we do for affected programmes?

All these considerations and uncertainties suggest that parallel mode should be an expert only mode at the very least, and might indicate that it should be something given low priority for now. It could be argued that it is too complex a mode to be offered at all. What are the opinions of the broader SPIRE community on this?

4.2 Open Issues from SPEC

Several open questions were identified by the SPEC AOT team.

- How many spectral resolutions to offer?

At the moment only two spectral resolutions are envisaged for SPEC: high (R=1000) and low (R=40). Is there a case for an intermediate resolution setting? The scientific case for this would be a blind search for features that could then be followed up with HIFI. Is this a mode that is likely to have significant demand? If so the width of such features needs to be considered so that an appropriate spectral resolution can be adopted.

- Can a spectrum be obtained in less than 3 minutes?

For imaging spectroscopy to cover a large area the limiting factor is the time taken for a single spectrum to complete. As things stand this takes 3 minutes per position, so that a filled field of view takes more than 3 hours to complete. Faster spectra can in principle be obtained by using scanning mode, but this may compromise the quality of the data.

- How useful is LR mode?

The utility of the low resolution mode, when compared to the still lower resolution but much higher sensitivity of SPIRE PHOT, was questioned.

- Modes for mapping with the FTS

While mapping with the FTS is unlikely to be offered there was some discussion of the practicalities of such observations, and the possibilities for their implementation were considered. Is this a mode we would like to see offered, and if so, what additional resources would be needed to provide it?

5. WHERE DO WE GO FROM HERE?

Clearly the AOT trees and descriptions need to go through another iteration of refinement and for any answers to the open questions in section 4 to be included.

What needs to be done beyond that?

Clearly the AOT entry needs to be implemented in SPOT. I believe this is an ESA task. We need to know what ESA needs from us to move forward with this development. A list of deliverables from them would be very helpful. The implementation will then need to be tested by potential users – the ICC teams will be ideal for this.

The output format from SPOT will define building blocks for CUS. It is unclear how well defined the SPOT output is at the moment, or whether something more complex than a simple matrix matching SPOT parameters to CUS building blocks will be needed. The AOT output also provides a description of the observation that will need to be included in the eventual data products so as to define what data reduction steps needs to be applied to the data.

The interface between the ICC and ESA will be essential for this next stage of AOT development.

6. CONCLUSIONS

The initial stages of AOT development are essentially complete. We must now move into a refinement stage where the decision trees and SPOT interface is improved and clarified, and where open issues are resolved.

The next stages of AOT development will include implementation of these decision trees into SPOT and their testing, and the use of SPOT output to define CUS commands and data reduction steps.

These are the next stages of AOT development for the ICC.