

# **Legacy Surveys with SCUBA-2:**

## **A discussion document for the June 2003 JCMT Board Meeting**

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A major motivation for building SCUBA-2 is to conduct surveys of large areas of sky to great depth. Furthermore, the JCMT's legacy to submillimetre astronomy will most likely be the surveys that SCUBA-2 and HARP-B will carry out in the remainder of this decade. Such surveys will be vital to fully exploit the new generation of interferometers, such as ALMA, and provide essential input for the "Virtual Observatory".

This document lists the strategy issues that might be considered in formulating a plan for SCUBA-2 Legacy Surveys, offers an outline for a proposed SCUBA-2 survey model and a timeline for survey definition. Some possible survey examples are also included in an appendix to give an idea of size-scales and integration times.

### **1. Top-level strategy issues**

The following top-level strategy issues are:

- How can SCUBA-2 surveys be accommodated and organised between the partner countries so as to provide maximum scientific benefit with minimum duplication of effort and overlap?
- Why do we want to do surveys? It is not for a small group of people to "mop up" all the best objects but rather to enable several time-consuming projects to be done efficiently, and/or to produce an early database so astronomers can plan follow-up work (perhaps at multi-wavelengths).
- How would SCUBA-2 survey time be allocated and managed?
- What fraction of SCUBA-2 time should go on surveys?
- Instead of calling the surveys "SCUBA-2 legacy surveys" should they be generic to the telescope i.e. also involve HARP-B?). In addition, there are the SCUBA-2 add-on instruments (FTS and polarimeter) and even the JCMT-SMA link to consider.
- A number of survey programmes already exist or have been planned for other telescopes. Is there a model that can be best adapted to suit SCUBA-2 and the JCMT?
- What will be the interaction between the survey team(s) and the archive centre?
- How do we handle data rights and the dissemination of reduced data?
- Will specific surveys impose additional requirements on the data reduction/pipeline processing software? If the answer to this is yes (which is likely) then this is another reason for considering surveys now.

- Should an "all-sky" survey be a high priority? Does such a survey have real value, for example, to the ALMA consortium?

## **2. A proposed model**

Initial informal discussions have taken place between a small group of astronomers (see appendix 2) as to a possible model for SCUBA-2 legacy surveys (SCULS). The following suggestions have emerged from this small "working group":

- Following confirmation of PPARC and CFI funding now is the appropriate time to start to think seriously about SCUBA-2 legacy surveys. This is particularly timely as the project moves towards PDR for the data reduction/pipeline processing software.

- A general feeling was that a UKIDSS-style survey programme might be most suited to SCUBA-2. UKIDSS is a consortium open to all members of the community to undertake a large legacy programme with WFCAM on UKIRT.

- In UKIDSS the UKIRT Board with the help of external reviewers will oversee survey time. This may be an appropriate model for SCULS.

- Membership of the consortium provides no special data rights to the individuals/institutes. All the data is public to the UK/CA/NL community as soon as it enters the archive. A general release to the world community (e.g. ESO/USA/Japan) could come after 18 months?

- Given the manpower needs of the survey, it should be driven to a "community-manned" model like UKIDSS. The CFHT-LS is not that dissimilar with 6 postdocs doing the majority of the work.

- The amount of time allocated to surveys should be dictated by the feedback from the community and the decision of the Board. Clearly to be worthwhile the surveys need to reach a minimum size - which is probably of order of ~50% of the SCUBA-2 time (10% is too little and 100% is too much).

- Every effort should be made to avoid co-ordinate the proposed surveys within the partner countries.

- One possible way of achieving this would be to encourage joint consortia through an open workshop-style meeting.

- It is suggested that individual surveys will have separate co-ordinators (the UKIDSS approach). A possible way of ensuring joint responsibility between countries is for a survey scientist to oversee (at top-level) the various galactic and extragalactic programmes.

- A basic strategy, outlined below in the timeline and following acceptance of the strategy, would be to construct "strawman" proposals that would be presented to the community through e-mail exploder. The request would be to either sign-up for it, suggest improvements or suggest alternative surveys.

- The deadline for feedback would be late summer - allowing us to hold a survey workshop in September and finalise a proposed set of surveys to go to the Board in November.

### 3. Suggested timeline [Needs revision.]

5 Jun 2003: Discussion of SCUBA-2 Survey Strategy at the JCMT Board Meeting

mid Jun-end Aug: Outline of "strawman" proposals by a small working group (to be chaired by the external project scientist?)

early-Sept: Joint Canadian/UK/Netherlands workshop on SCUBA-2 surveys

Sept-end Oct: Form consortia and write draft proposals

Nov 2003: Present draft results to JCMT Board

### Appendix 1: SCUBA-2 Legacy Survey [SCULS]

Outline of some possible surveys (this is really to get an idea of size-scales, required times etc).

Baseline assumptions (somewhat conservative):

$7.2 \times 7.2$  arcmin field-of-view (so all 4 quadrants operational at both wavelengths)  
850 $\mu$ m - NEFD per pixel (1- $\sigma$ /1-sec) 25mJy - confusion limit 2mJy (=2hrs/5- $\sigma$ )  
450 $\mu$ m - NEFD per pixel (1- $\sigma$ /1-sec) 80mJy - confusion limit 1mJy (=90hrs/5- $\sigma$ )  
50% observing overheads (hopefully, quite pessimistic)

Draft Outline:

#### (i) "Whole-Sky" shallow survey

Area ~20,000 sq. degrees

Depth 30mJy at 850 $\mu$ m (1- $\sigma$ ) [estimated depth at fastest scan rate]

Time required 550hrs (70 shifts)

\* Finding chart for bright objects in the galaxy and the Universe

#### (ii) Star formation in the Galaxy (Gould belt of GMCs)

Area ~25 sq. degree

Depth 2mJy at 850 $\mu$ m (1- $\sigma$ )

Time 150hrs (20 shifts)

\* A survey of central regions of local GMCs for proto-stars and pre-stellar cores.

#### (iii) A Survey of the Galactic Plane

Area >200 sq. degree

Depth 4mJy at 850 $\mu$ m (1- $\sigma$ )

Time 300hrs (38 shifts)

\* GC and inner plane - compliment UKIDSS/GPS and SIRTf/GLIMPSE?

**(iv) Wide-area Extragalactic Survey**

Area 5 sq. degrees

Depth 0.4mJy at 850 $\mu$ m (1- $\sigma$ ) [confusion limit]

Time 760hrs (95 shifts)

\* Clustering and LSS, match to best-studied UKIDSS/DXS+UDS fields

**(v) Ultra-deep 450 $\mu$ m Survey**

Area 0.036 sq. degree (2 fields)

Depth 0.2mJy at 450 $\mu$ m (1- $\sigma$ ) [confusion limit]

Time 900hrs (112 shifts)

\* First view of faint 450 $\mu$ m population in UKIDSS/UDS fields - schedule as symbiote on whole-sky survey to exploit best conditions

**The surveys defined above would take of order a year to complete (assuming only a 50% success rate due to weather).**

**Appendix 2: Working Group**

Ian Smail (Durham)

Mike Fich (Waterloo)

John Richer (Cambridge)

Rob Ivison (UK ATC)

Douglas Scott (UBC)

Walter Gear (UWC)

Doug Johnstone (HIA)

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