

# Spectral Cube Builder for IRS — SCUBI

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## Abstract

Among the capabilities of SIRTf's IRS spectrograph is a spectral mapping mode, in which one or more of the slits are moved in small steps across a source of extended emission, sequentially mapping out the entire region. The SIRTf Nearby Galaxy Survey (SINGS) makes heavy use of this mapping mode, and will develop a package for the creation of spectral cubes (with axes  $\alpha, \delta, \lambda$ ), and their derivative products, fixed spectral bandpass (e.g. line) maps and one dimensional spectra extracted from arbitrary regions within the map.

## Participants

Those participating in the creation and validation of the SCUBI are:

J.D. Smith	(JDS)
Lee Armus	(LA)
Rob Kennicutt	(RK)
Daniel Dale	(DD)
Tom Jarrett	(TJ)
Helene Roussel	(HR)

## Schedule

- **SMART Overlap**

March 15, 2002

*JDS, RK*

All potential components of SMART which could be shared with SCUBI will be explored for discussion with the SMART team, including:

- Calibration routines and cal-sets.
- Possible overlap with the project manager.

- SCUBI interface with ISAP analysis component of SMART.
- SCUBI interface with SMART de-fringing modules.

- **SMART Team Members in Tucson** March 18-19, 2002  
*JDS, RK*

Initial agreement on areas of SMART–SCUBI overlap.

- **Finalize SINGS Data Product Release Schedule** April 1, 2002  
*LA, RK, JDS*

The final version of the SINGS Data Product Release Schedule will impact this SCUBI development schedule, which should be revised to accommodate changes. Remaining uncertainties include the potential dependence of the 1D spectra released by SINGS on completed spectral cubes — should the release of the first 1D spectra be pushed back to coincide with the first spectral maps?

- **Simulated (SIM) Spectral Map Data I (SL)** April 1, 2002  
*DD, LA, JDS*

Simulated data is critical to the efficient development of SCUBI, but realistic, physical simulations are difficult to produce, and will be built up in multiple phases. As a first pass, low fidelity simulations will be made using laboratory short-low spectra, and assigned fictitious positions in the headers to simulate a SINGS data set for a single map region, including multiple steps in both directions (perpendicular and parallel to the slit). This basic SIM data will test only the raw mechanics of cube-creation.

- **Initial Rough SL Cube from Simulated Data** May 15, 2002  
*JDS*

The initial rough cube will be built from SIM I data, and will not attempt to treat fringes, offer multiple grid samplings, use more intelligent image combination (e.g. drizzle) or deconvolution (e.g. Richardson-Lucy) algorithms, or utilize the error plane all BCDs will contain to properly weight data gathered from different regions of the spectrum, or different pointings of the slit.

- **Sings Review** May 31, 2002?  
*RK, LA, JDS*

Demonstration of the rough cube creation from simulated SL data will include one or more rough maps, and simple 1D extractions.

- **SINGS Science Meeting** June 17-18, 2002  
*SINGS Team*

Cube and map analysis tools required for SINGS-team science projects will be discussed. These tools may or may not be brought up to community-wide release standards, instead remaining internal to the SINGS team.

- **Improved Spatial SIM Data II (all modules)** L-6.5  
*DD, LA, JDS*

These improved simulated data will include both low-res and high-res spectral maps, and will introduce true spatial modulations within the 2D spectra themselves, which, when recombined, should yield spectral maps of known distributions, for the purpose of testing the spatial reconstruction fidelity of the cube builder. These simulations should also have quasi-realistic error planes, and will test SCUBI's weighted combination capabilities.

- **Cubes from All Modules, with Weighting** L-6  
*JDS, LA*

Cubes will be built from SIM II data in all four IRS modules, and will make use of the error plane to properly weight data at a single position on the sky drawn from different parts of the array, and different BCDs. Realistic error planes should be manufactured by the SSC. The potential for direct use of flat-field products for weight generation in the case of error-propagation difficulties in the IRS pipeline will be assessed.

- **Data Format Specification** L-5  
*LA, JDS*

The final format of SINGS release data products, including cubes, maps and 1D extractions, will be specified. All SCUBI-relevant BCD header information will be finalized.

- **Physical SIM Data III (one LR, one HR)** L-4.5  
*DD, HR, JDS, LA*

Physically realistic simulated data for at least one low-res and one high-res module will be based on ISOCAM CVF data cubes, chosen to approximate SINGS data. They will be spatially sampled on a quasi-regular slit-spacing grid with IRS-sized slits, including simulated pointing drifts which accumulate during spectral mapping, reproducing reasonably SINGS-like 2D low- and high-res spectral images.

- **CubeView and CubeProject Internal Preview Release** L-4  
*JDS*

A rough internal release for basic design evaluation of the spectral cube viewer (CubeView) and project manager (CubeProject), which together will comprise the interface elements of SCUBI. CubeView will permit rough map creation and line extraction (similar to that of the ISOCAM CVF tool), and will be based on the TVTools suite developed by JDS. CubeProject will be based on the SCOREX project manager, and will facilitate the organization and inspection of SINGS spectral mapping data sets, eventually serving in a later release as the central interface for driving cube creation.

- **Cubes with Optimal Spatial Combination** L-3  
*JDS*

Cubes will be created from both Physical (SIM III) and Spatial (SIM II) data with tunable spatial grid spacing using one or more dithered image combination and/or reconstruction algorithms.

- **SINGS Spectral Cube Flux Calibration** L-2  
*LA, JDS*

A flux calibration method for IRS data as specified by the SSC should be adapted to SINGS spectral mapping data.
- **Internal SINGS-team SCUBI v0.1 Alpha Release** L-1  
*JDS*

An internal release of SCUBI consisting of the complete package of CubeView and CubeProject coupled to the cube creation back-end.
- **Improved 1D Cube Extractions** L+1  
*JDS*

One dimensional spectral extractions available within CubeView will be enhanced to offer expanding circular extraction apertures, with potential for error-weighting and profile estimation in a generalized 2D optimal extraction algorithm.
- **SCUBI v1.0 Released to SINGS Team** L+3  
*JDS*

This first production release of SCUBI to the SINGS team will be used to validate the initial SINGS quality/strategy assessment data.
- **First Cube Built with Real SINGS Data!** L+6  
*SINGS Team*
- **Higher Order Analysis Tools** L+?  
*JDS, LA*

Tools permitting higher-order analysis, as recommended by the SINGS team. Some analysis tools may couple to the SMART ISAP analysis package.
- **First Release of Cube-Derived SINGS Maps and 1D Spectra** L+12  
*SINGS Team*
- **Application of 2D De-Fringing Tools to SINGS Spectral Cubes** L+12  
*JDS, LA*

A successful 2D de-fringing technique for IRS data will likely arrive only after launch. If it is integrated into a later version of the IRS pipeline at SSC, BCDs re-run through the latest pipeline can be used to re-construct cubes prior to release. If it available only as an interactive user tool, it should be linked into SCUBI directly or through the SMART interface.
- **First Release of Full SINGS Spectral Cubes** L+21  
*SINGS Team*
- **First SCUBI Release to SSC and SIRTf Community** L+21  
*SCUBI Team*

- **Re-release of Spectral Maps and 1D Extractions**

L+?

*SINGS Team*

All cube-derived SINGS release data products will be re-constructed using the most up to date cubes (including de-fringing, if available), and re-released.