# Building Image Mosaics With The Montage Image Mosaic Engine
## *http://montage.ipac.caltech.edu*

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*GRITS, May 14, 2009*

# History of Montage

| The Guilty: Contributors to Montage | |
| --- | --- |
| John Good<br>Anastasia Laity<br>Bruce Berriman | IPAC |
| Joseph Jacob | JPL |
| Daniel S. Katz | JPL/CCT |
| Tom Prince (PI)<br>Roy Williams | CACR, Caltech |
| Ewa Deelman<br>Gurmeet Singh<br>Mei-Hu Su | ISI, USC |

❖ Funded 2002-2005 by *NASA Earth Sciences Technology Office Compute Technologies Program*

  ❖ Deliverables completed - Feb 2005

  ❖ IPAC contribution to the National Virtual Observatory

  ❖ Maintained at IPAC

❖ Current release, version 3.0, available for download at http://montage.ipac.caltech.edu

  ❖ Over 2,500 downloads

❖ Operational on-request service - Sep 2007

  ❖ http://hachi.ipac.caltech.edu 8080/montage

  ❖ Uses NVO request management system developed at IPAC

# Why Do Scientists Need To Create Mosaics?

Two epochs:
Jul/Aug 05 & Oct/Nov 05

| Instrument | Bands (μm) | Field-of-View (arcmin) |
|---|---|---|
| IRAC | 3.6, 4.5, 5.8, 8.0 | 5.2. x 5.2 |
| MIPS | 24 | 5.4 x 5.4 |
| | 70 | 5.25  x 2.6 |
| | 160 | 0.5 x 0.5 |



3.6 μm

8.0 μm
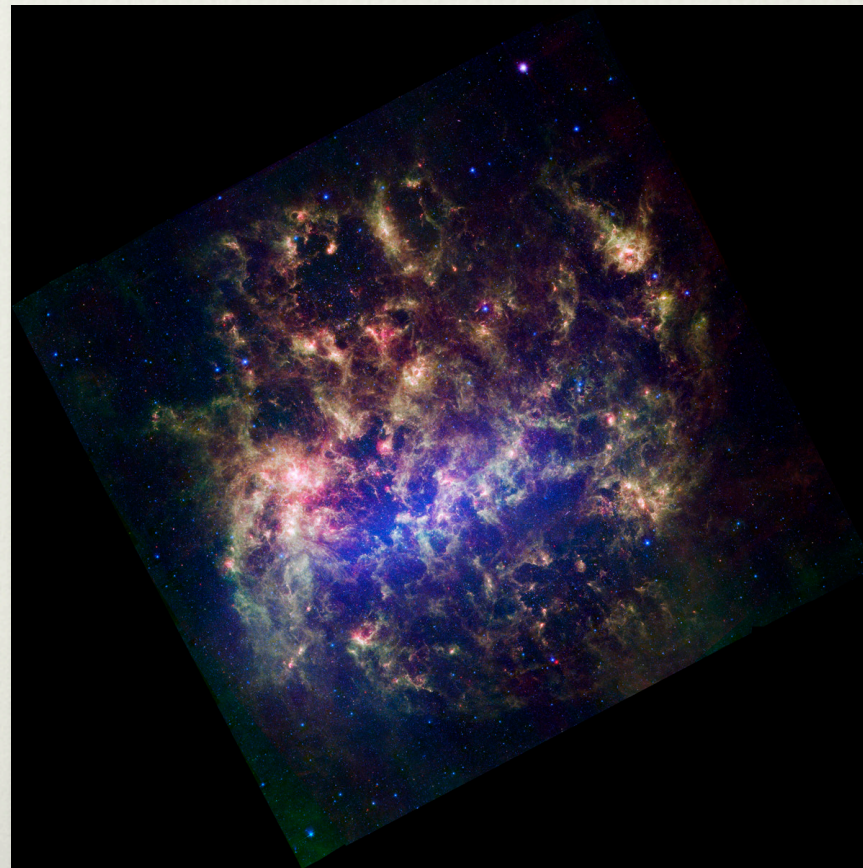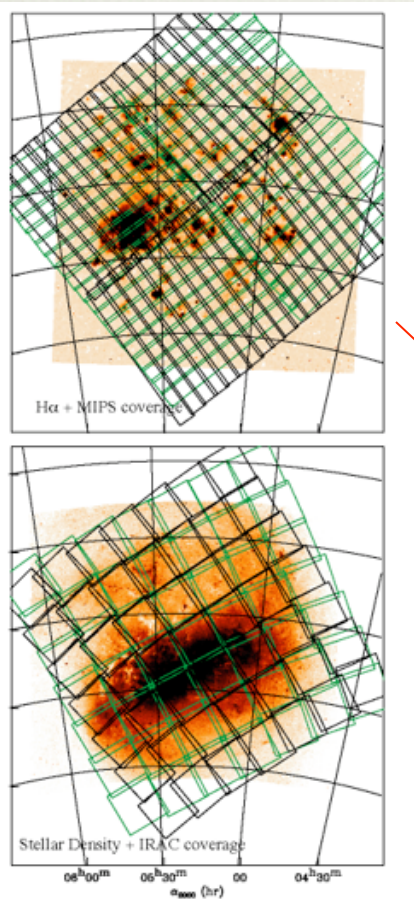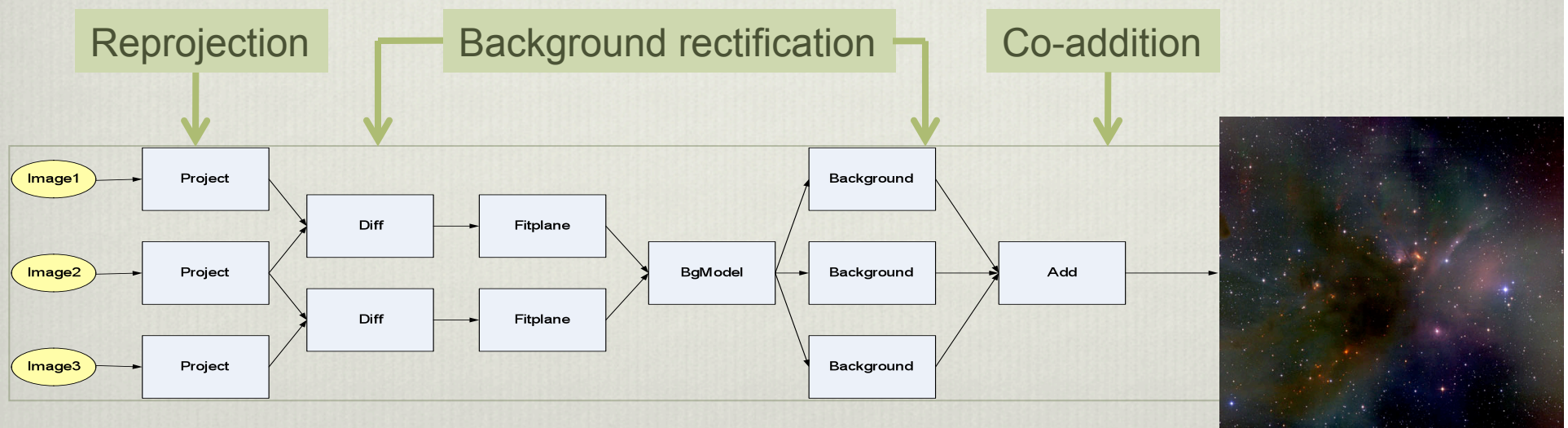
24 μm

# What Is Montage?

## Toolkit for assembling FITS images into science-grade mosaics

❖ Uses algorithms that preserves spatial and calibration fidelity of input images

❖ Supports all projections and coordinate systems in use in astronomy.

❖ Modular design that is highly scalable

❖ ANSI-C code (300 MB) runs on all common *nix platforms – desktops, clusters, grids and supercomputers.

❖ Ancillary tools for managing and manipulating images

❖ Processes 40 million 2MASS pixels in 32 min on 128 nodes of 1.2 GHz Linux cluster

**Montage processing flow**

| Reprojection | Background rectification | Co-addition |

```
Image1 → Project
Image2 → Project → Diff → Fitplane
Image3 → Project → Diff → Fitplane → BgModel → Background → Add
                                              → Background
                                              → Background
```

# How Is It Used?

- ❖ Support Science Analysis

- ❖ Support Production of Data Sets, Data Products and Preview Products
  - ❖ Incorporate into Workflows and Pipelines
  - ❖ SWIRE, GLIMPSE, IPHAS, …

- ❖ Quality Assurance of data products
  - ❖ Cosmic Evolution Survey validated maps derived from HST ACS data

- ❖ Support on-line access to data

- ❖ E/PO Products
  - ❖ All-sky 3-color 2MASS mosaic delivered to World Wide Telescope (WWT)

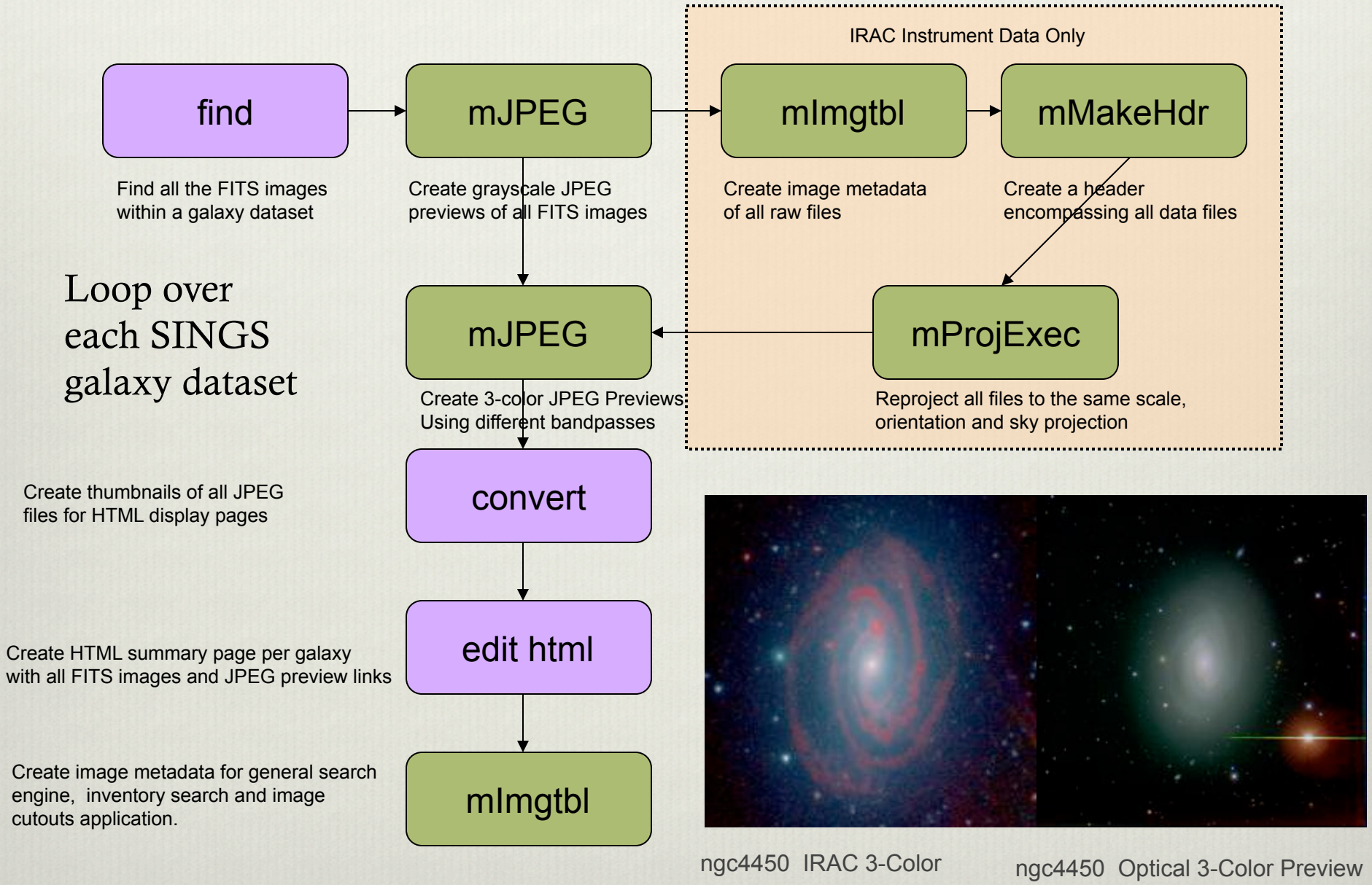- ❖ Development of Cyber Infrastructure
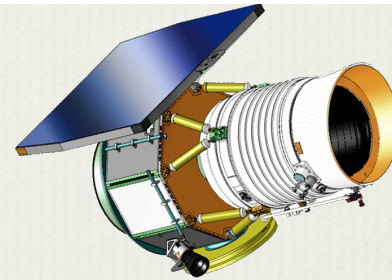
So easy an astronomer can use it!



```bash
#!/bin/bash
# Pleiades Image creation BASH script.
# Inseok Song, 2007
for bands in DSS2B DSS2R DSS2IR; do echo Processing ${bands};
mkdir $bands;
cd $bands;
mkdir raw projected;
cd raw;
mArchiveList dss ${bands} "56.5 23.75" 3 3 remote.tbl;
mArchiveExec remote.tbl;
cd .. ;
mImgtbl raw rimages.tbl ;
mProjExec -p raw rimages.tbl ../pleiades.hdr projected stats.tbl ;
mImgtbl projected pimages.tbl ;
mAdd -p projected pimages.tbl ../pleiades.hdr ${bands}.fits ;
cd .. ;
done

mJPEG -blue DSS2B/DSS2B.fits -1s 99.999% gaussian-log \
      -green DSS2R/DSS2R.fits -1s 99.999% gaussian-log \
      -red DSS2IR/DSS2IR.fits -1s 99.999% gaussian-log \
      -out DSS2_BRIR.jpg
```
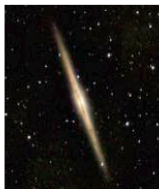
# SINGS Three-Color Image Preview Generation

**find**

Find all the FITS images within a galaxy dataset

**mJPEG**

Create grayscale JPEG previews of all FITS images

IRAC Instrument Data Only

**mImgtbl**

Create image metadata of all raw files

**mMakeHdr**

Create a header encompassing all data files

Loop over each SINGS galaxy dataset

**mJPEG**

Create 3-color JPEG Previews Using different bandpasses

**mProjExec**

Reproject all files to the same scale, orientation and sky projection

Create thumbnails of all JPEG files for HTML display pages

**convert**

**edit html**

Create HTML summary page per galaxy with all FITS images and JPEG preview links

Create image metadata for general search engine, inventory search and image cutouts application.

**mImgtbl**

ngc4450  IRAC 3-Color

ngc4450  Optical 3-Color Preview

# Montage Supports WISE

## 2MASS Image Services

This suite of services provides access to and information about the 2MASS Atlas and Quicklook Images. Atlas and Quicklook Images delivered by these services are in FITS format and contain full WCS information in their headers. Atlas Images contain photometric zero point information in their headers and are suitable for quantitative photometric measurements. Quicklook Images are restored from lossy-compressed versions of the Atlas Images and may be used for position measurements, finding charts and visual inspection of the near-infrared sky.

Only Atlas Images should be used for quantitative photometric measurements because of the information lost during the Quicklook compression process.

### Interactive Image Service

This service enables rapid interactive viewing and retrieval of single 2MASS Image Sets (J, H and K$_s$) covering a specified point or object. This is useful for fast examination of individual sources and/or small fields.

- Interactive Service Start
- More Information

### Image Inventory Service

This service provides a listing of all 2MASS Images and their metadata that cover a point or region on the sky. It is useful for determining if a position is covered by more than one image, as is the case in Tile overlap regions, and for selectively finding and retrieving images that cover a broader region.

- Inventory Service Start
- More Information

### Batch Image Service

This service retrieves sets of all 2MASS Images that cover a specified large region, sets of Images that cover an input list of sky positions, or sets of Images that match an input list of image descriptors. This is useful for retrieving large numbers of images to construct large area image mosaics, and for generating finding charts for large numbers of targets.
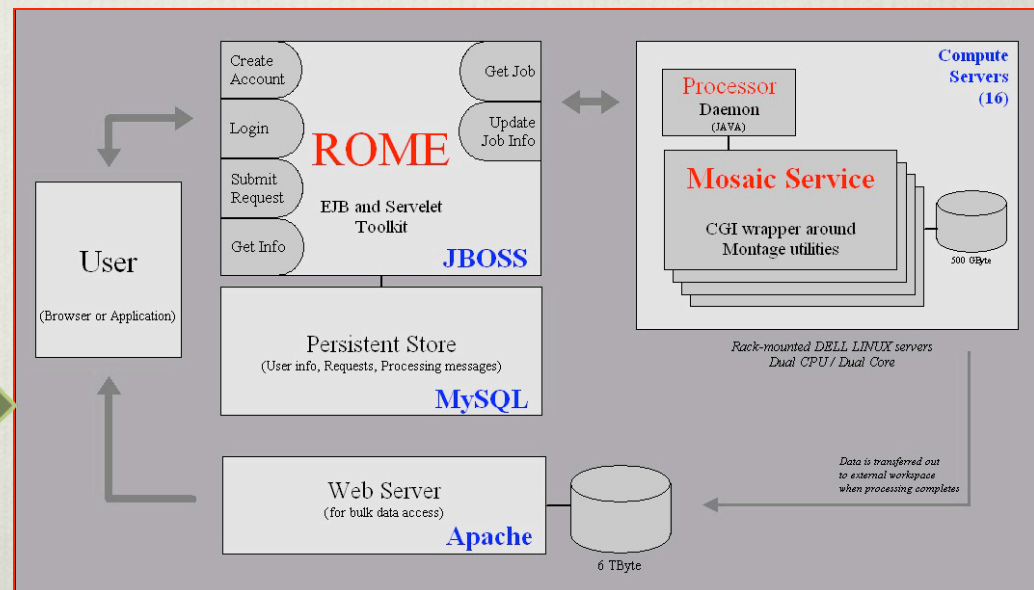
- Batch Service Start
- More Information

*Sky Coverage of the 2MASS Full Survey Images*
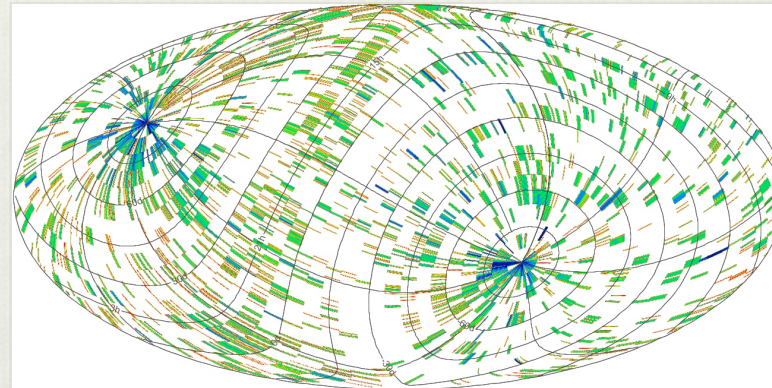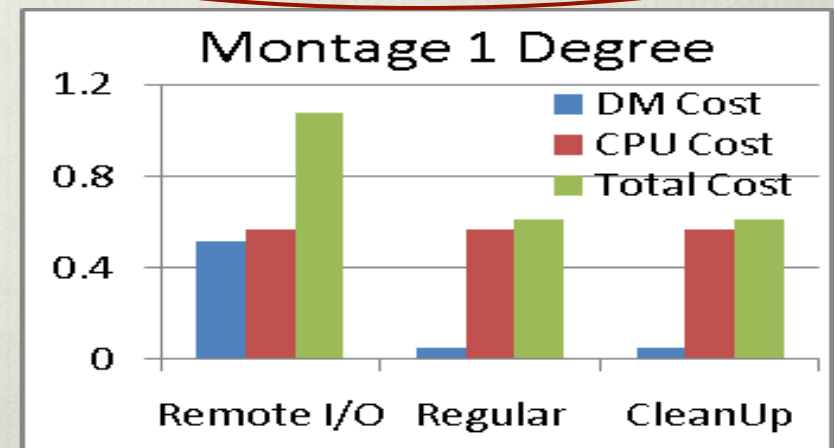
Derive cumulative sky coverage of WISE images during

On-request re-sampling and re-projection of images

# Development of Cyber Infrastructure

❖ Task scheduling in distributed environments (performance focused)

❖ Designing job schedulers for the grid

❖ Designing fault tolerance techniques for job schedulers

❖ Exploring issues of data provenance in scientific workflows

❖ Exploring the cost of scientific applications running on Clouds

❖ Developing high-performance workflow restructuring techniques

❖ Developing application performance frameworks

❖ Developing workflow orchestration techniques

Cost with 128 processors on Amazon EC2 cloud

https://wwws-usa1.givex.com/cws/montage/consumer/main/home.py