



# Making Images Smart:

## Virtual Astronomy Multimedia Project

### Astronomy Visualization Metadata

Robert Hurt, Spitzer Science Center  
Lars Lindberg Christensen, ESO  
and the VAMP team

AAS Jan '10  
Washington DC





**January 5**  
**Epillon Aurigae**  
**Puzzle Pieces**  
**Snap Into Place**

The image was taken as part of the Spitzer Legacy program known as SAGE-SMC: Surveying the Agents of Galaxy Evolution in the Tidally-Stripped, Low Metallicity Small Magellanic Cloud.






The infrared portrait of the Small Magellanic Cloud, taken by NASA's Spitzer Space Telescope, reveals the stars and dust in this galaxy as never seen before. The Small Magellanic Cloud is a nearby satellite galaxy to our Milky Way galaxy, approximately 200,000 light-years away.

The image shows the main body of the Small Magellanic Cloud, which is comprised of the "bar" on the left and a "wing" extending to the right. The bar contains both old stars (in blue) and young stars lighting up their natal dust (green/red). The wing mainly contains young stars. In addition, the image contains a galactic globular cluster in the lower left (blue cluster of stars) and emission from dust in our own galaxy (green in the upper right and lower right corners).

The data in this image are being used by astronomers to study the lifecycle of dust in the entire galaxy: from the formation in stellar atmospheres, to the reservoir containing the present day interstellar medium, and the dust consumed in forming new stars. The dust being formed in old, evolved stars (blue stars with a red tinge) is measured using mid-infrared wavelengths. The present day interstellar dust is weighed by measuring the intensity and color of emission at longer infrared wavelengths. The rate at which the raw material is being consumed is determined by studying ionized gas regions and the younger stars (yellow/red extended regions). The Small Magellanic Cloud, and its companion galaxy the Large Magellanic Cloud, are the two galaxies where this type of study is possible, and the research could not be done without Spitzer.

This image was captured by Spitzer's infrared array camera and multiband imaging photometer (blue is 3.6-micron light; green is 8.0 microns; and red is combination of 24-, 70- and 160-micron light). The blue color mainly traces old stars. The green color traces emission from organic dust grains (mainly polycyclic aromatic hydrocarbons). The red traces emission from larger, cooler dust grains.

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ShareThis 



Large • jpg 7801x7021 41.1 MB

## Color Mapping

<u>Band</u>	<u>Wavelength</u>	<u>Telescope</u>
Infrared	3.6 $\mu\text{m}$	Spitzer IRAC
Infrared	4.5 $\mu\text{m}$	Spitzer IRAC
Infrared	8.0 $\mu\text{m}$	Spitzer IRAC
Infrared	24.0 $\mu\text{m}$	Spitzer MIPS
Infrared	70.0 $\mu\text{m}$	Spitzer MIPS
Infrared	160.0 $\mu\text{m}$	Spitzer MIPS

[Information on Color Mapping](#)

## About the Image

### Date

2010-01-05

### ID

ssc2010-02a1

### Type

Observation

### Credit

NASA/JPL-Caltech/STScI

## About the Object

### Name

SMC, Small Magellanic Cloud, NGC 292

### Type

Galaxy: Type: Barred

Galaxy: Size: Dwarf

Nebula: Type: Star Formation

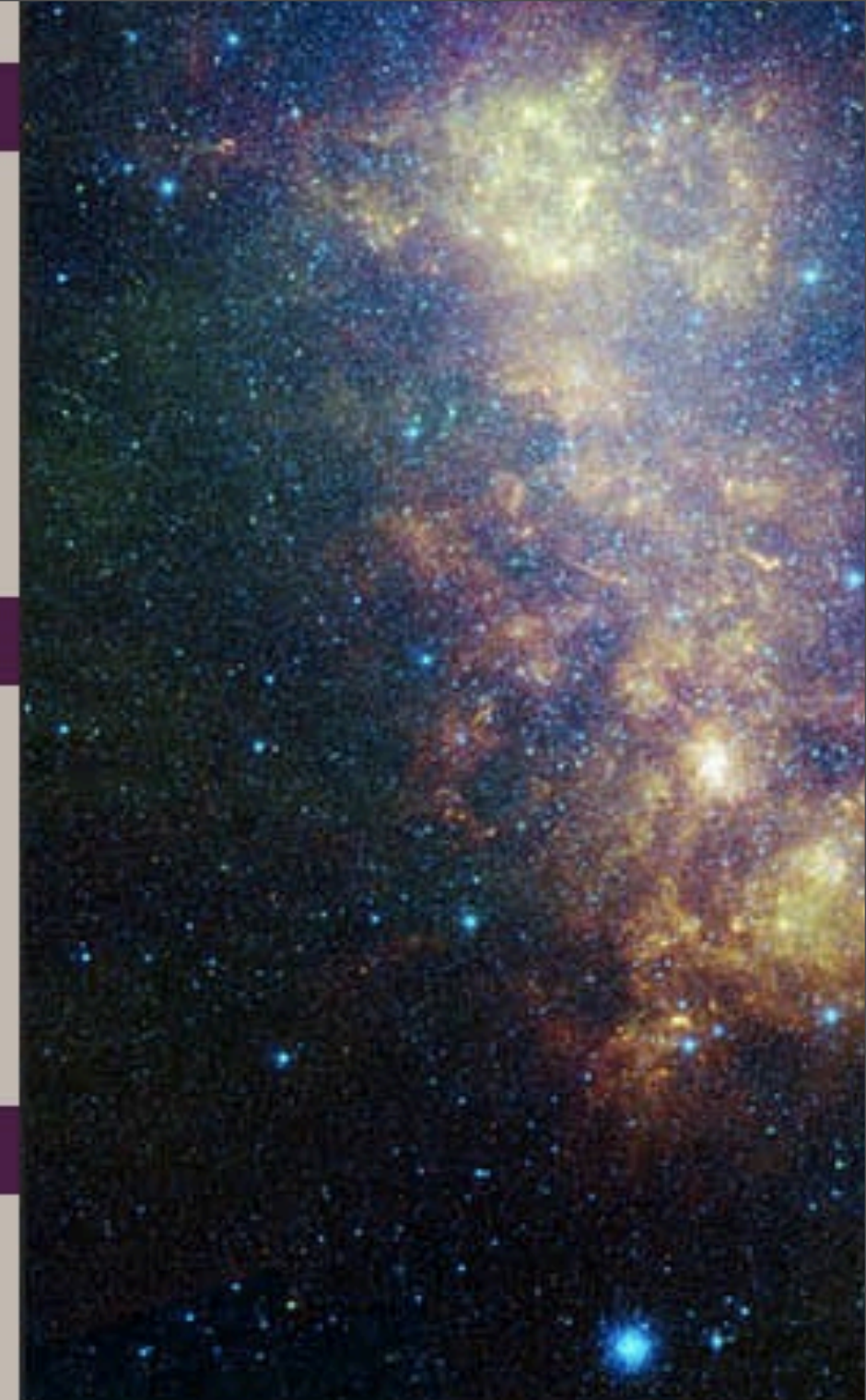
### Distance

197,000 Lightyears

## Recent News



- [Galaxy Exposes Its Dusty Inner Workings in New Spitzer Image](#)




The infrared portrait of the Small Magellanic Cloud reveals the stars and dust in this galaxy as nearby satellite galaxy to our Milky Way galaxy.

The image shows the main body of the Small Magellanic Cloud on the left and a "wing" extending to the right. The stars lighting up their natal dust (green/red) in the image contains a galactic globular cluster.



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[Home](#) > [Images](#) > **Little Galaxy Explored**

 [View Full Screen](#)

**01.05.10**

**Little Galaxy Explored**

### Download Image

**Tiny** • .jpg 589x530 130.3 KB

**Small** • .jpg 960x864 323.6 KB

**Medium** • .jpg 1500x1350 712.8 KB

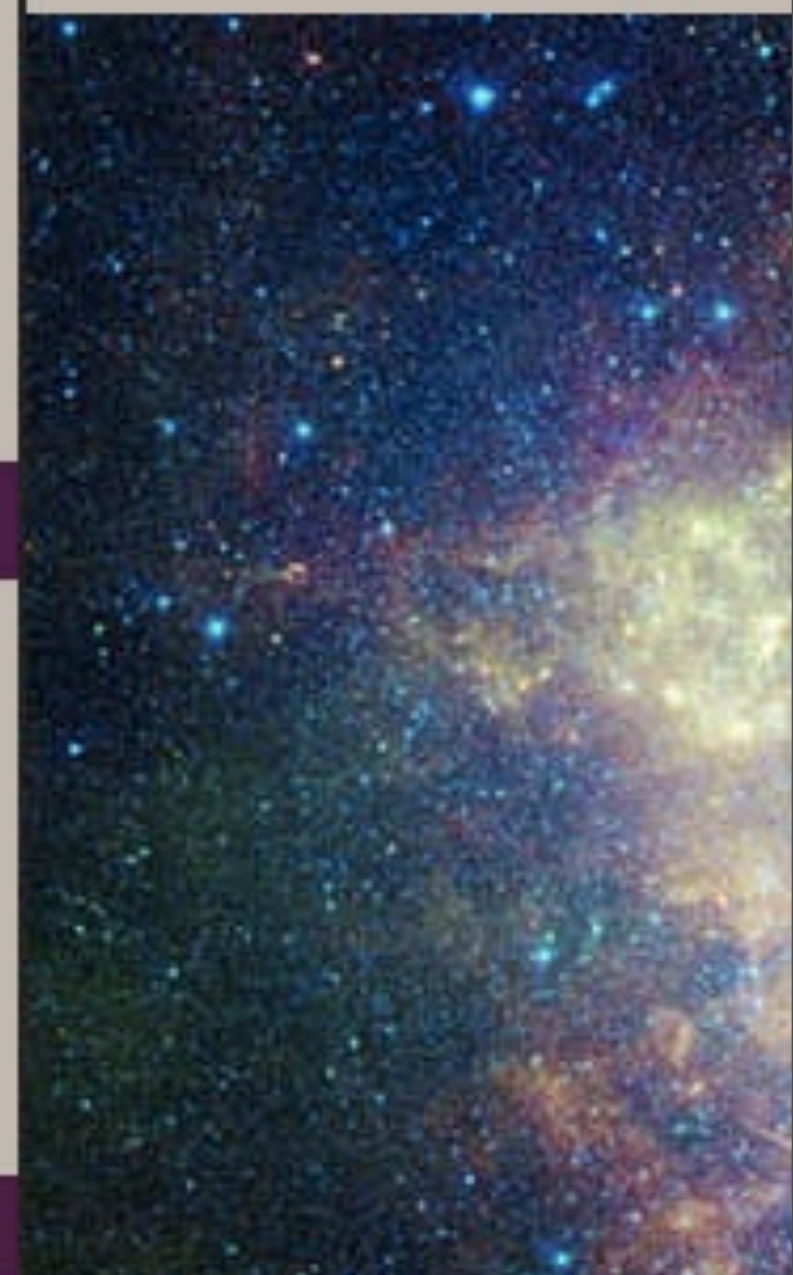
**Large** • .jpg 7801x7021 41.1 MB

### Color Mapping


<u>Band</u>	<u>Wavelength</u>	<u>Telescope</u>
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Infrared	4.5 $\mu\text{m}$	Spitzer IRAC
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01.05.10

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### Image Components



Image  
Little Galaxy  
Explored  
ssc2010-02a

### Latest Images



January 5  
Dusty, Little  
Galaxy



January 5  
Little Galaxy with  
a Tail



January 5  
Mystery of the  
Fading Star



January 5  
Little Galaxy  
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Image  
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ssc2010-02a

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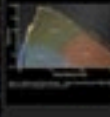
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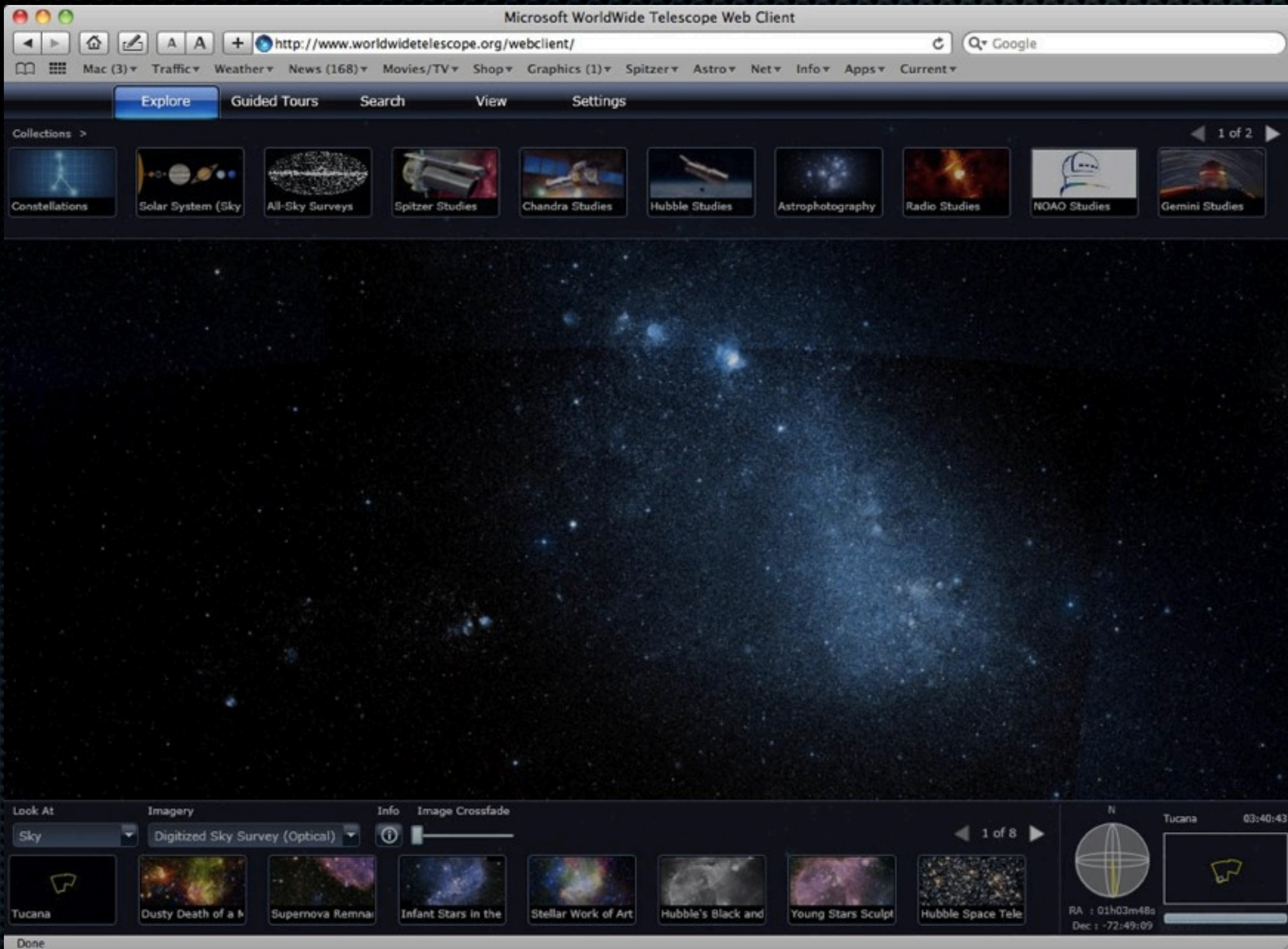
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Microsoft WorldWide Telescope Web Client

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🏠 📄 Ⓐ Ⓐ + 🔍

http://www.worldwidetelescope.org/webclient/ 🔁

🔍 Google

Mac (3) ▾ Traffic ▾ Weather ▾ News (168) ▾ Movies/TV ▾ Shop ▾ Graphics (1) ▾ Spitzer ▾ Astro ▾ Net ▾ Info ▾ Apps ▾ Current ▾

Explore Guided Tours Search View Settings

Collections > 

1 of 2

Constellations

Solar System (Sky)

All-Sky Surveys

Spitzer Studies

Chandra Studies

Hubble Studies

Astrophotography

Radio Studies

NOAO Studies

Gemini Studies

Look At Sky Imagery Digitized Sky Survey (Optical) Info Image Crossfade

Tucana

Dusty Death of a Star

Supernova Remnant

Infant Stars in the

Stellar Work of Art

Hubble's Black and White

Young Stars Sculpting

Hubble Space Telescope

1 of 8

N

RA : 01h03m48s  
Dec : -72:49:09

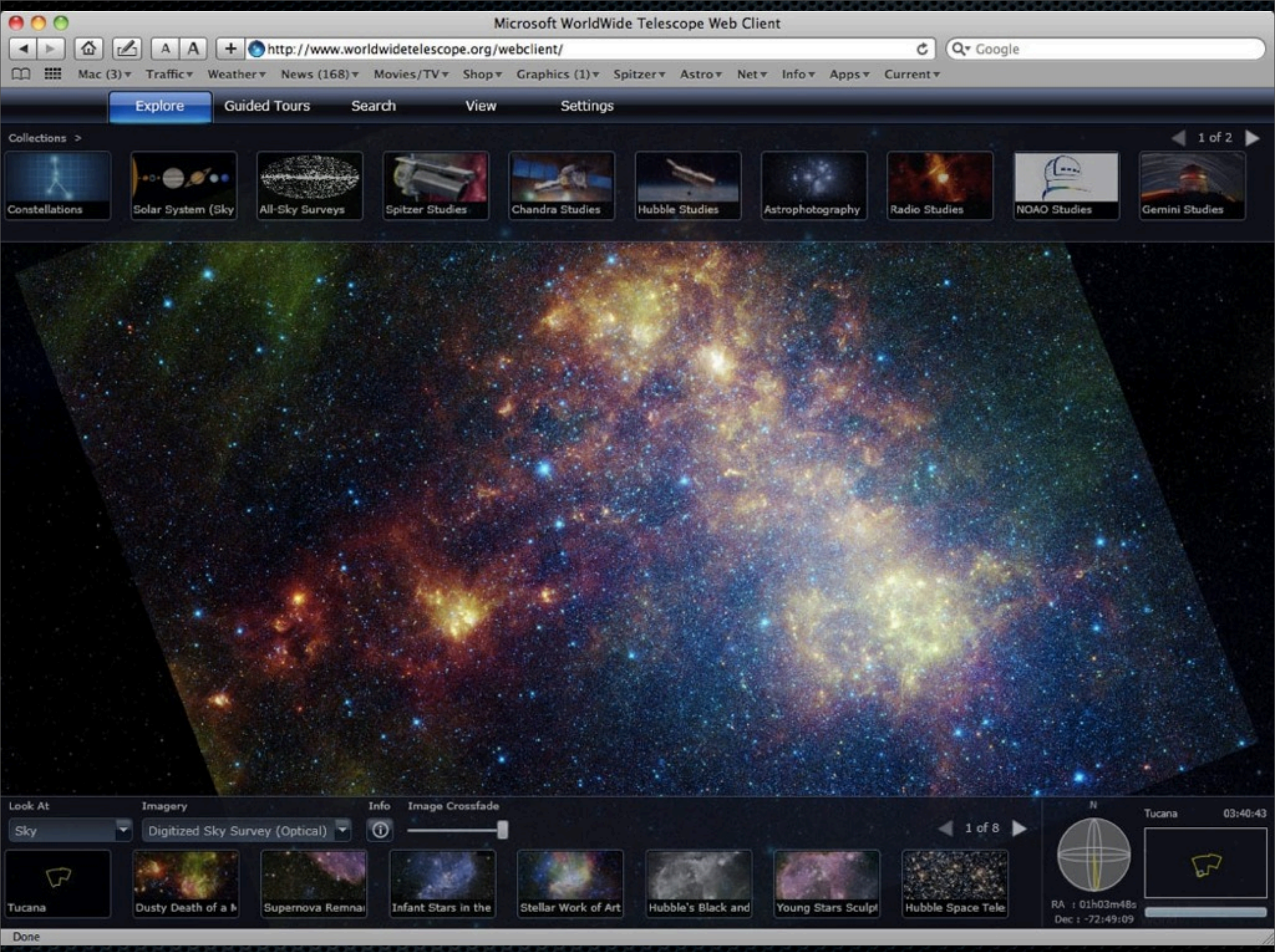
Tucana

03:40:43

Done

Friday, January 8, 2010









That is the vision of VAMP



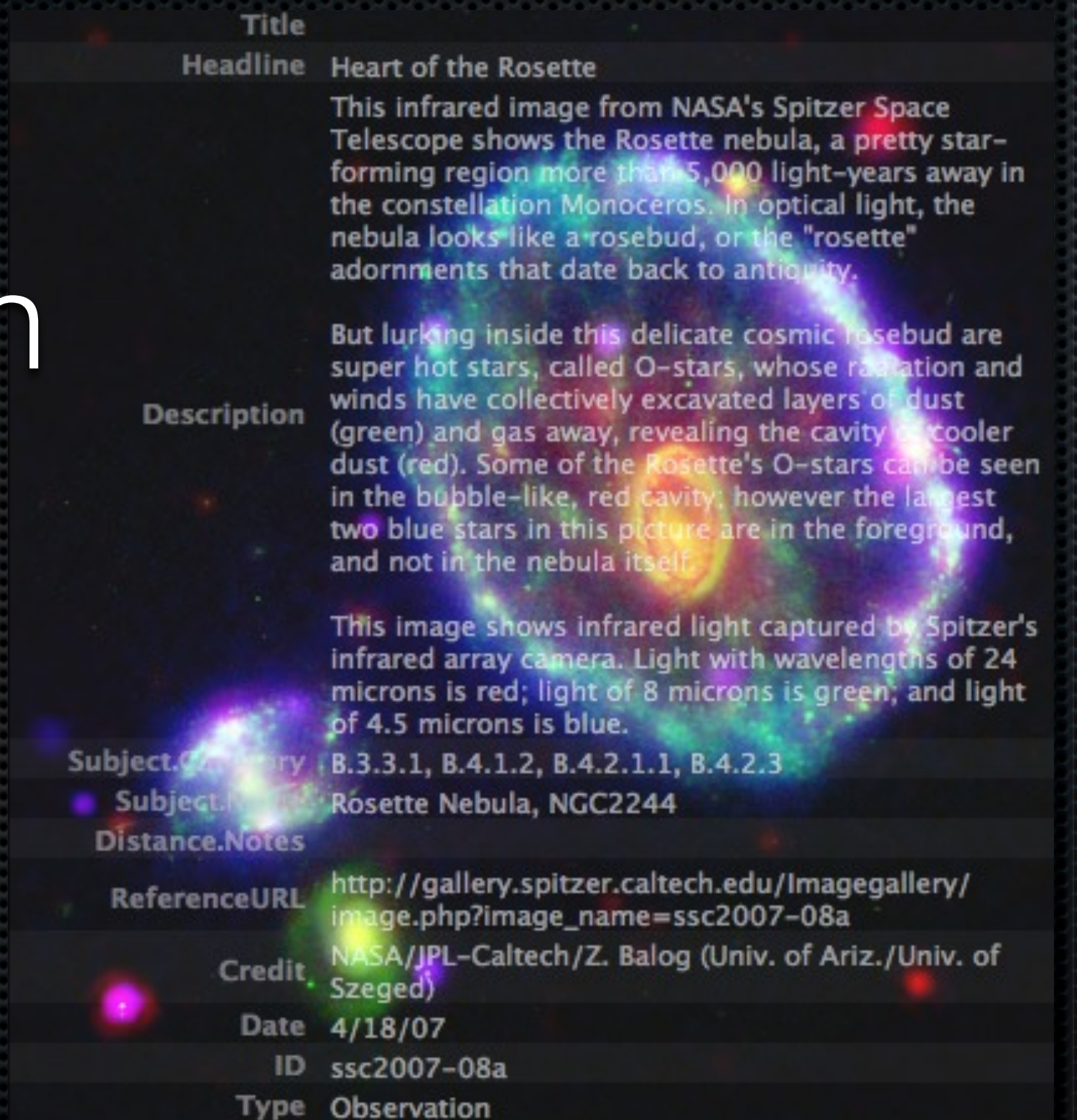


That is the vision of VAMP  
You can do it TODAY!



# Astronomy Visualization Metadata

Data fully  
characterizing the  
image resource

The background of the slide is a vibrant, multi-colored image of the Rosette Nebula, also known as NGC 2244. The nebula is a complex of glowing gas and dust, with a central cavity. The colors represent different wavelengths of infrared light: red for 24 microns, green for 8 microns, and blue for 4.5 microns. The central cavity is a bright red, and the surrounding gas is a mix of green and blue. The overall shape is somewhat circular with a complex, irregular edge.

Title	
Headline	Heart of the Rosette
Description	This infrared image from NASA's Spitzer Space Telescope shows the Rosette nebula, a pretty star-forming region more than 5,000 light-years away in the constellation Monoceros. In optical light, the nebula looks like a rosebud, or the "rosette" adornments that date back to antiquity.
	But lurking inside this delicate cosmic rosebud are super hot stars, called O-stars, whose radiation and winds have collectively excavated layers of dust (green) and gas away, revealing the cavity of cooler dust (red). Some of the Rosette's O-stars can be seen in the bubble-like, red cavity; however the largest two blue stars in this picture are in the foreground, and not in the nebula itself.
	This image shows infrared light captured by Spitzer's infrared array camera. Light with wavelengths of 24 microns is red; light of 8 microns is green; and light of 4.5 microns is blue.
Subject.Category	B.3.3.1, B.4.1.2, B.4.2.1.1, B.4.2.3
Subject.Name	Rosette Nebula, NGC2244
Distance.Notes	
ReferenceURL	<a href="http://gallery.spitzer.caltech.edu/Imagegallery/image.php?image_name=ssc2007-08a">http://gallery.spitzer.caltech.edu/Imagegallery/image.php?image_name=ssc2007-08a</a>
Credit	NASA/JPL-Caltech/Z. Balog (Univ. of Ariz./Univ. of Szeged)
Date	4/18/07
ID	ssc2007-08a
Type	Observation



# Elements of AVM



# Elements of AVM

- ✧ Metadata Schema



# Elements of AVM

- ✦ Metadata Schema
- ✦ Outreach-Oriented Subject Taxonomy



# Elements of AVM

- ✧ Metadata Schema
- ✧ Outreach-Oriented Subject Taxonomy
- ✧ Interactive Tagging Tools



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- ✧ Outreach-Oriented Subject Taxonomy
- ✧ Interactive Tagging Tools
- ✧ WCS Recovery Utilities
- ✧ Web and Scripting Resources
- ✧ Growing User's Community
- ✧ Online Registry/Archive



# Metadata Schema

## 3.1 Creator Metadata

<b>Creator</b>	<u>string</u>	Spitzer Science Center
<b>CreatorURL</b>	URL	<a href="http://www.spitzer.caltech.edu">http://www.spitzer.caltech.edu</a>
<b>Contact.Name</b>	<u>string</u> , list	R. Hurt
<b>Contact.Email</b>	<u>string</u> , list	example@ipac.caltech.edu
<b>Contact.Telephone</b>	<u>string</u> , list	555-555-5555
<b>Contact.Address</b>	<u>string</u>	1200 E. California Blvd.
<b>Contact.City</b>	<u>string</u>	Pasadena
<b>Contact.StateProvince</b>	<u>string</u>	California
<b>Contact.PostalCode</b>	<u>string</u>	91125
<b>Contact.Country</b>	<u>string</u>	USA
<b>Rights</b>	<u>string</u>	Public Domain



# Metadata Schema

3.2 Content Metadata		
Title	<u>string</u>	M 82
Headline	<u>string</u>	The galaxy M82 is seen across the spectrum from X-rays to infrared light. This combined view is from NASA's Chandra, Hubble, and Spitzer telescopes.
Description	<u>string</u>	NASA's Spitzer, Hubble, and Chandra space observatories teamed up to create this multi-wavelength, false-colored view of the M82 galaxy. <u>High energy</u> particles appear as blue, stars as green, dust as red.
Subject.Category	<u>string-CV</u> , list	C.5.1.6; <u>C.5.3.3</u>
Subject.Name	<u>string</u> , list	M 82; Messier 82; NGC 3034; Cigar Galaxy
Distance	<u>float</u> , list(2)	11700000; 0.000677
Distance.Notes	<u>string</u>	<u>light</u> years from PI; redshift from NED
ReferenceURL	URL	<a href="http://gallery.spitzer.caltech.edu/Imagegallery/image.php?image_name=sig06-010">http://gallery.spitzer.caltech.edu/Imagegallery/image.php?image_name=sig06-010</a>
Credit	<u>string</u>	NASA/JPL-Caltech/STScI/CXC/UofA/ESA/AURA/JHU
Date	<u>date</u>	2007-04-24
ID	<u>string</u>	<u>sig06-010</u>
Type	<u>string-CV</u>	Observation
Image.ProductQuality	<u>string-CV</u>	Good



# Metadata Schema

## 3.3 Observation Metadata

Facility	<u>string</u> , list(s)	Chandra; Hubble; Hubble; Spitzer
Instrument	<u>string</u> , list(s)	ACIS; ACS; ACS; IRAC
Spectral.ColorAssignment	<u>string</u> -CV, list(s)	Blue; Green; Orange; Red
Spectral.Band	<u>string</u> -CV, list(s)	X-ray; Optical; Optical; Infrared
Spectral.Bandpass	<u>string</u> , list(s)	-;B;R;mid-infrared
Spectral.CentralWavelength	<u>float</u> , list(s)	0.5;440;700;8000
Spectral.Notes	<u>string</u>	X-ray bandpass wavelengths are approximate
Temporal.StartTime	<u>date</u> , list(s)	-; 2005-02-05; 2005-02-05; 2004-07-03T12:00
Temporal.IntegrationTime	<u>float</u> , list(s)	-; -; -; 240
DatasetID	<u>string</u> , list(s)	a1;a2;a3;a4



# Metadata Schema

3.4 Coordinate Metadata		
Spatial.CoordinateFrame	string-CV	ICRS
Spatial.Equinox	string	2000
Spatial.ReferenceValue	float, list(2)	149.11051168; 69.7053749827
Spatial.ReferenceDimension	float, list(2)	4299; 3490
Spatial.ReferencePixel	float, list(2)	922.146820068; 1153.85690308
Spatial.Scale	float, list(2)	-4.1635027032331E-05; 4.1635027032331E-05
Spatial.Rotation	float	49.93606563
Spatial.CoordsystemProjection	string-CV	TAN
Spatial.Quality	string-CV	Full
Spatial.Notes	string	FOV: 10.74 x 8.72 arcminutes; Ref coordinate: 9h56m26.52s 69d42m19.35s; derived from astrometry.net file sig06-010.fits
Spatial.FITSheader	string	CRVAL1 = 6.3856 CRVAL2 = 64.1784 RADESYS = 'ICRS' EQUINOX = 2000. CTYPE1 = 'RA---TAN' CTYPE2 = 'DEC--TAN' CRPIX1 = 214. CRPIX2 = 138.
Spatial.CDMatrix (deprecated)	float, list(4)	



# Metadata Schema

## 3.5 Publisher Metadata

<b>Publisher</b>	<u>string</u>	Spitzer Space Telescope
<b>PublisherID</b>	<u>string</u>	<u>vamp://spitzer</u>
<b>ResourceID</b>	<u>string</u>	<u>sig05-010_jpg_sm</u>
<b>ResourceURL</b>	URL	<a href="http://ipac.jpl.nasa.gov/media_images/sig06-010.tif">http://ipac.jpl.nasa.gov/media_images/sig06-010.tif</a>
<b>RelatedResources</b>	<u>list</u>	<u>vamp://spitzer/sig05-010</u> ; <u>vamp://spitzer/sig05-010</u>
<b>MetadataDate</b>	<u>date</u>	2008-05-09
<b>MetadataVersion</b>	<u>string</u>	1.1



# Subject Taxonomy

- 3. Star
    - 3.1. [Evolutionary Stage]
      - 3.1.1. Protostar
      - 3.1.2. Young Stellar Object
      - 3.1.3. Main Sequence
      - 3.1.4. Red Giant
      - 3.1.5. Red Supergiant
      - 3.1.6. Blue Supergiant
      - 3.1.7. White Dwarf
      - 3.1.8. Supernova
      - 3.1.9. Neutron Star
        - 3.1.9.1. Pulsar
        - 3.1.9.2. Magnetar
      - 3.1.10. Black Hole
    - 3.2. [Type]
      - 3.2.1. Variable
        - 3.2.1.1. Pulsating
        - 3.2.1.2. Irregular
        - 3.2.1.3. Eclipsing
        - 3.2.1.4. Flare Star
        - 3.2.1.5. Nova
      - 3.2.2. Carbon
      - 3.2.3. Brown Dwarf
      - 3.2.4. Wolf-Rayet
      - 3.2.5. Blue Straggler
      - 3.2.6. Exotic
        - 3.2.6.1. X-Ray Binary
    - 3.3. [Spectral Type]
      - 3.3.1. O
      - 3.3.2. B
      - 3.3.3. A
      - 3.3.4. F
      - 3.3.5. G
      - 3.3.6. K
      - 3.3.7. M
      - 3.3.8. L
      - 3.3.9. T
    - 3.4. [Population]
      - 3.4.1. I
      - 3.4.2. II
      - 3.4.3. III
    - 3.5. [Feature]
      - 3.5.1. Photosphere
        - 3.5.1.1. Granulation
        - 3.5.1.2. Sunspot
      - 3.5.2. Chromosphere
        - 3.5.2.1. Flare
        - 3.5.2.2. Facula
      - 3.5.3. Corona
        - 3.5.3.1. Prominence
  - 3.6. [Grouping]
    - 3.6.1. Binary
    - 3.6.2. Triple
    - 3.6.3. Multiple
    - 3.6.4. Cluster
      - 3.6.4.1. Open
      - 3.6.4.2. Globular
  - 3.7. Circumstellar Material
    - 3.7.1. Planetary System
    - 3.7.2. Disk
      - 3.7.2.1. Protoplanetary
      - 3.7.2.2. Accretion
      - 3.7.2.3. Debris
    - 3.7.3. Outflow
      - 3.7.3.1. Solar Wind
      - 3.7.3.2. Coronal Mass Ejection
4. Nebula
  - 4.1. [Type]
    - 4.1.1. Interstellar Medium
    - 4.1.2. Star Formation
    - 4.1.3. Planetary
    - 4.1.4. Supernova Remnant
    - 4.1.5. Jet
  - 4.2. [Appearance]
    - 4.2.1. Emission
      - 4.2.1.1. H II Region
    - 4.2.2. Reflection
      - 4.2.2.1. Light Echo
    - 4.2.3. Dark
      - 4.2.3.1. Molecular Cloud
      - 4.2.3.2. Bok Globule
      - 4.2.3.3. Proplyd
5. Galaxy
  - 5.1. [Type]
    - 5.1.1. Spiral
    - 5.1.2. Barred
    - 5.1.3. Lenticular
    - 5.1.4. Elliptical
    - 5.1.5. Ring
    - 5.1.6. Irregular
    - 5.1.7. Interacting
    - 5.1.8. Gravitationally Lensed
  - 5.2. [Size]
    - 5.2.1. Giant
    - 5.2.2. Dwarf



# Interactive Tagging Tools

- ✦ Photoshop XMP Panels
  - ✦ Elements
  - ✦ CS1-CS3, and now CS4 compatible versions
- ✦ FITS Liberator Plugin for Photoshop
- ✦ Web-based AVM form (customizable for local needs)



# WCS Recovery Tools

- ✧ WorldWide Telescope
- ✧ Pinpoint WCS



# Web & Scripting Resources

- ✧ EXIFTool extensions
- ✧ Python command line
- ✧ PHP



# Growing User Community

- ✦ Spitzer Website
- ✦ Chandra Image Gallery
- ✦ ESO image/video/news archives (fully in Q1 2010)
- ✦ Soon: ESA Hubble website



# Online Registry/Archive

- ✦ IRSA VAMP Archive in development



# What is next?

- ✦ Expanding AVM to encompass video, podcasts, news
- ✦ Expand AVM taxonomy beyond “objects”
- ✦ Add more image libraries
- ✦ Reach out to amateur community
- ✦ WWT “tuning” (tagging pipeline, cross-linking both ways)
- ✦ Connecting ESO press releases/images/videos with the science papers
- ✦ Describe the tagging flow
- ✦ And???