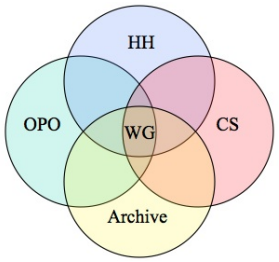
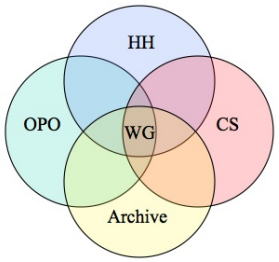


Broadening the Hubble Audience Base

BASIC TENET: "It should be possible to combine the strong public response to the Hubble Heritage images, the extensive educational expertise/infrastructure/audience of OPO, and the potential for citizen science embodied by the new generation of archival products/tools (e.g., galaxy zoo), to engender a new level of interaction between Hubble and the community."

Three pronged approach:

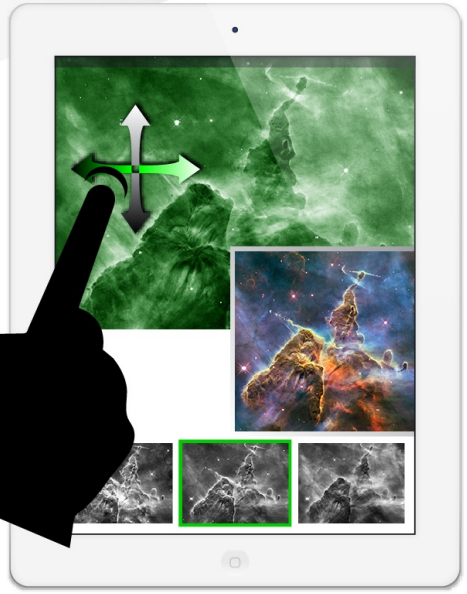
1. Astro Imaging – (Stratis)
2. Hubble Heritage / New Observations– (Zolt)
3. Working Group / Citizen Science – (Brad)



Astro Imaging

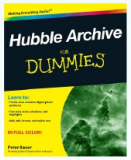
THE ARCHIVE FOR EVERYONE

PUBLIC IMPACT



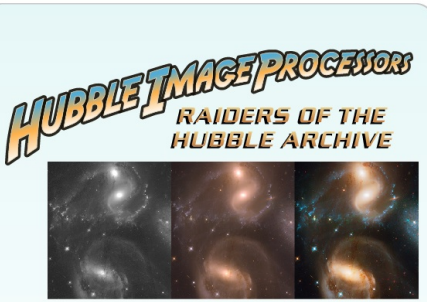
DATA FOR EDUCATION & HOBBYISTS

Baby HLA



How Tos

Curriculum Support Tools



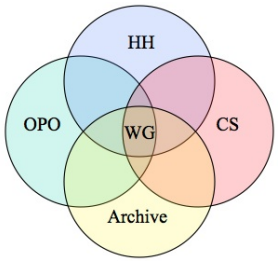
Hubble Legacy Archive (HLA)

Multimission Archive at Space Telescope (MAST)

Novice

Interested & Directed

Expert



Hubble Heritage / New Observations

1. Aesthetic Hubble Images
   Similar to past Heritage observations
   Minimal orbits per target

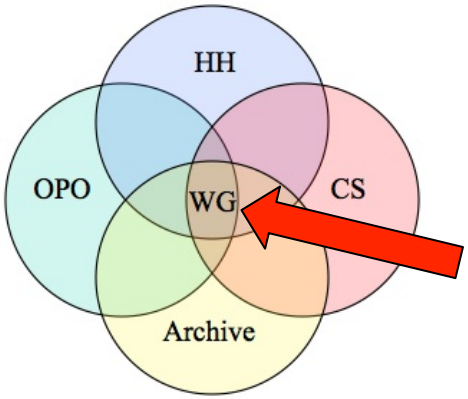
2. Hubble Legacy Image
   Substantial number of orbits for signature Hubble image.
   Science involvement - include in yearly Call for Proposals
   Likely to be large number of science papers (see backup).

3. "Other" Images – Targets of Opportunity (e.g., Mars), Anniversary, etc.

Timeline:

Now:	Define targets/activities for ~15 orbits based on HH list.
In ~3 months:	Devote ~15 orbits this year (probably Hubble Legacy Image) based primarily on outreach
Next Fall:	Meet as group in the fall to select next years targets.

Notes: Always include High Level Science Products (HLSP) in archives at time of release.

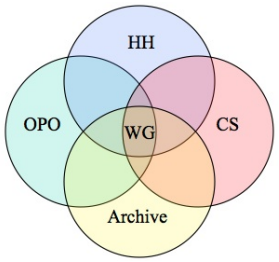


Working Group / Citizen Engagement Initiative

- A multi-division working group (including 3 - 4 members from Archives/ Citizen science, HH, OPO, and other interested staff) meet monthly for next 6 months.

Primary Initiatives:

1. Citizen Science activities (e.g., Zooniverse, planet finding, age dating star clusters, … – see backup)
2. Archive lab exercises (see backup) – Often requested by educators at HLA demos at AAS meetings
3. Jamboree (solicit citizen science projects, EPO grants attached to successful proposers, …)

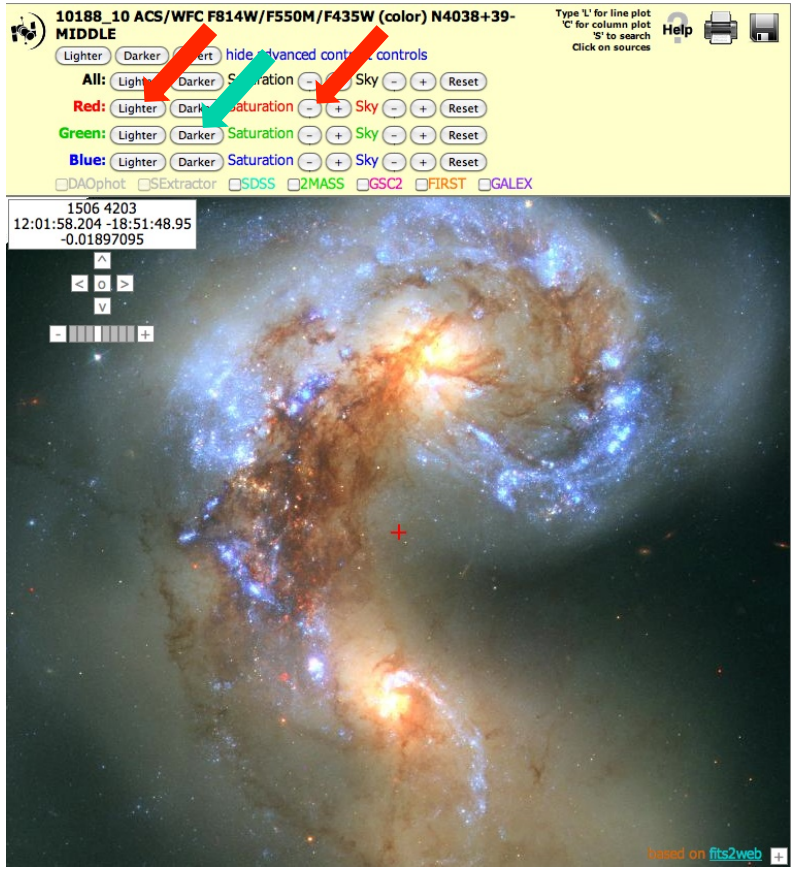


Backup - Broadening the Hubble Audience

(longer version of introductory viewgraph)

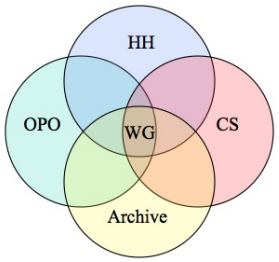
- BASIC TENET: Citizen Science / Amateur Astronomy / Hands-on-Education represents a tremendous, largely untapped resource to engage the community and to engender their continued interest in Hubble (and JWST).

- PARAPHRASE OF STATEMENT FROM DIRECTOR: "It should be possible to combine the strong public response to the Hubble Heritage images, the extensive educational expertise/infrastructure/ audience of OPO, and the potential for citizen science embodied by the new generation of archival products/tools (e.g., galaxy zoo), too engender a new level of interaction between Hubble and the community."



From HLA tutorial on how to make your own color images and submit to Hubble Hidden Treasure contest >>> Demo

http://hlatest.stsci.edu/iotm/number9_advanced_contrast_feb_22_2012.html



Backup: Who is the audience ?

Uninterested Public

OPO, HH

General Public

Interested Public

Politicians

Educators

WG

Students

old

Citizen Science

Amateur Astronomers

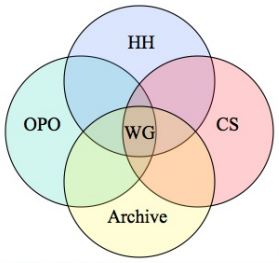
new

Archives

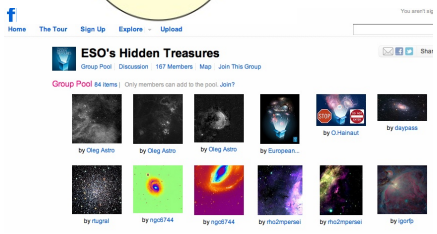
new

old

Research Scientist



Backup: Past/Present/Future ASTRO IMAGING Activities



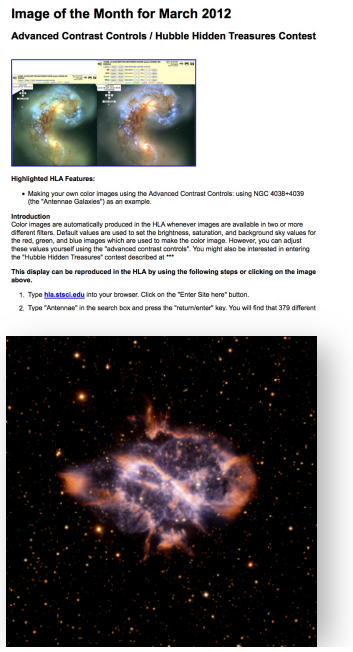


Image of the Month for March 2012

Advanced Contrast Controls / Hubble Hidden Treasures Contest

Highlighted HLA Features:

- Making your own color images using the Advanced Contrast Controls: using NGC 4038+4039 (the "Antennae Galaxies") as an example.

Introduction

Color images are automatically produced in the HLA whenever images are available in two or more different filters. Default values are used to set the brightness, saturation, and background sky values for the red, green, and blue images which are used to make the color image. However, you can adjust these values yourself using the "advanced contrast controls". You might also be interested in entering the "Hubble Hidden Treasures" contest described at ***

This display can be reproduced in the HLA by using the following steps or clicking on the image above.

1. Type hla.stsci.edu into your browser. Click on the "Enter Site here" button.
2. Type "Antennae" in the search box and press the "return/enter" key. You will find that 379 different

ESO's Hidden Treasures (2010?)

⬇

Hubble Hidden Treasures 2012 contest (ESA lead, collaboration with OPO, HH, archives)

⬇

Focal point: Astro imaging website/facebook/ flicker

⬇

In development: "Hubble Astro Imagers Handbook", starting with HLA tutorial and several documents Zolt has authored in past (Zolt, Brad, summer student?)

⬇

Hubble Heritage challenge

⬇

Planetary nebula challenge – "How do astronomers know what elements are present in astronomical objects ? > education activity

(i.e., blue = Oxygen, green = Hydrogen, red = Sulphur")

Hubble Hidden Treasures 2012

minisite text

Title/logo: Help us find Hubble's hidden treasures

What is it? [front page]

Hubble's Hidden Treasures is a competition which invites you to dig into Hubble's archive to find and process beautiful astronomical images.

There are two categories you can enter:

- Finding and processing Hubble observations using a set of simple online tools that anyone can learn;
- Finding and processing Hubble observations using professional tools.

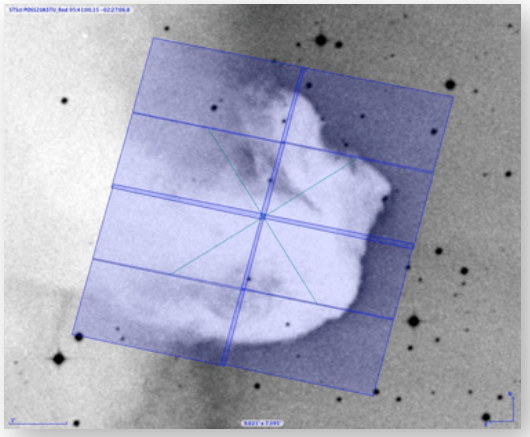
In both cases, you'll be playing with real data from the world's most famous astronomical observatory. You'll be helping to uncover hidden treasures from Hubble's archive for the whole world to enjoy. And you'll be in with a chance of winning one of our great prizes.

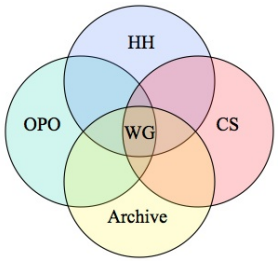
How does it work?

Dig through Hubble's science archive and try to find an amazing image that hasn't yet been published. Process the image, either using the simple online tools provided, or using professional astronomical image processing software. Then submit it to our Flickr group for a chance to win some great prizes [link]. There is no limit to the number of entries per person.

Submit them to our Flickr group for a chance to win some great prizes [link].

This page gives a tutorial [link to tutorial] for how to search the Hubble archive. This page [link to 'What is image processing and how do I do it'] explains what image processing is and how you can do it, both with the simple online tools provided, or, if you want a challenge, using the same software as the professionals do.





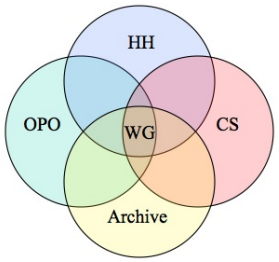
Backup: Citizen Science – Existing efforts

Zooniverse

Carol Christian and Alberto Conti worked closely with the Zooniverse people and COSMOS science team to make Galaxy Zoo happen.

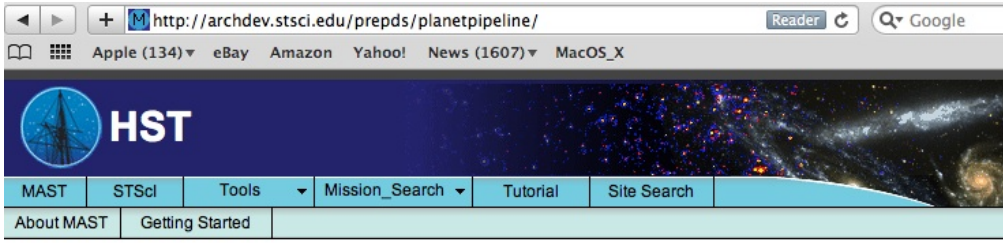
In many cases this is the easiest way to get a project going.

In other cases it might be useful for STScI to get into the game ourselves to provide more flexibility (hookup a basic version of "imexamine" from IRAF to measure profile of objects – e.g., is this object a star or a star cluster?).

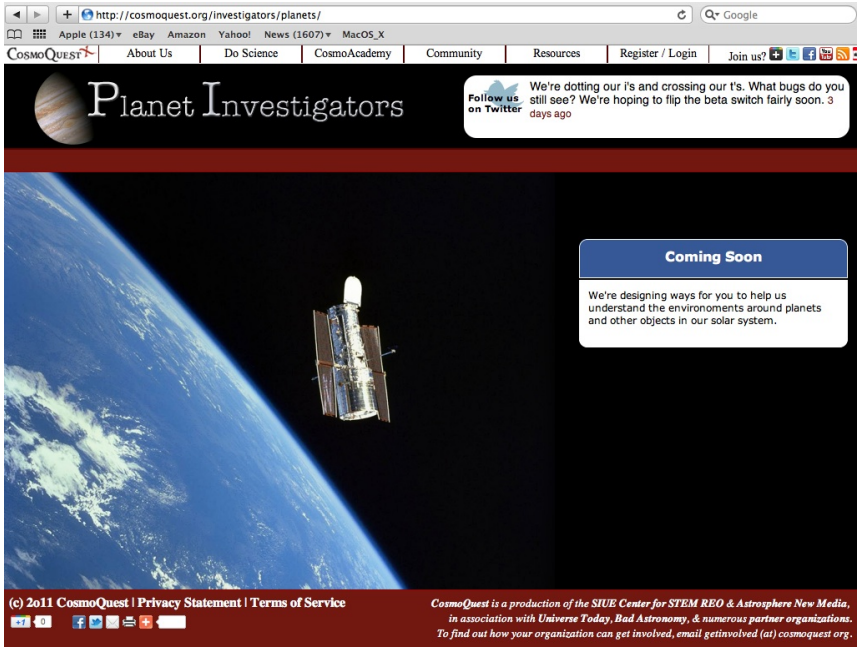


Backup: Citizen Science – Existing efforts

Max Mutchler's archival program (ID 12142) to search their new "Planet Pipeline" images for planetary moons and other debris around planets.

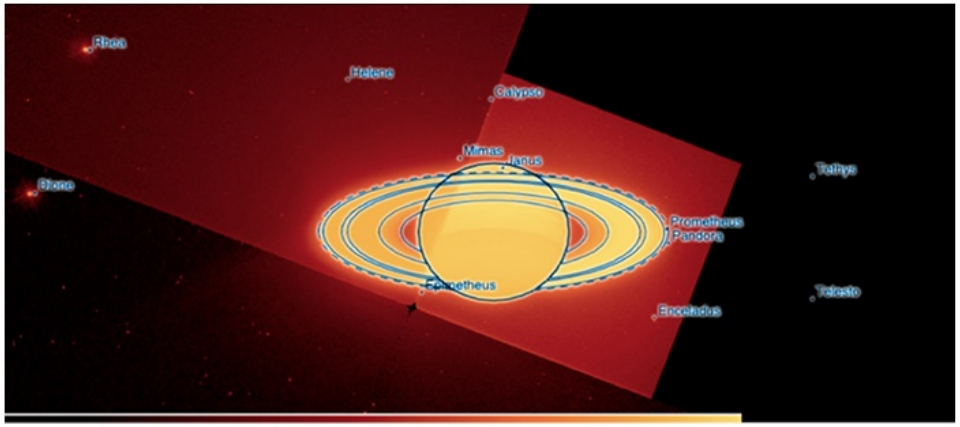


They have partnered with Cosmic Quest to provide the infrastructure for the citizen science component of their project.



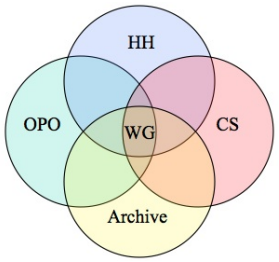
The Planet Pipeline: enabling data mining and citizen science with Hubble images of the Solar System

Max Mutchler, Michael H. Wong, Justin Higgins, Alberto Conti, Susana Deustua, Pamela L. Gay, Daniel Golombek, John Grunsfeld, Sean McKenna



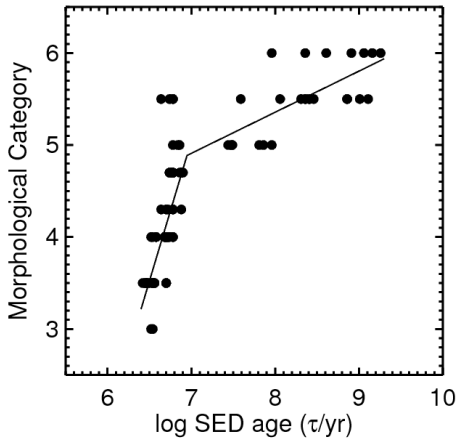
In 15 years of service, the Wide Field Planetary Camera 2 (WFPC2) onboard the Hubble Space Telescope (HST) obtained over 10,000 frames of Solar System data. Since standard data reduction pipelines are typically not optimized for moving- target data, our "planet pipeline" will uniformly reprocess and catalog this WFPC2 image collection to make it more immediately science-ready. Some of our processing steps will utilize citizen scientists t perform visual inspections. Our corresponding database will enable robust queries which are more specific to planetary science, helping archival researchers quickly find and utilize the prepared images within our collection for a wide range of scientific analyses. We welcome suggestions (especially from veteran WFPC2 users) on the optimal treatment and organization of this data collection, and also to identify a broad range of analyses that might only be possible with visual inspections by citizen scientists.

Support for HST/AR program 12142 was provided by NASA through a grant from STScI, which is operated by the Association of Universities for Research in Astronomy, Inc., under NASA contract NAS 5-26555.



Backup: Citizen Science – Potential New Effort

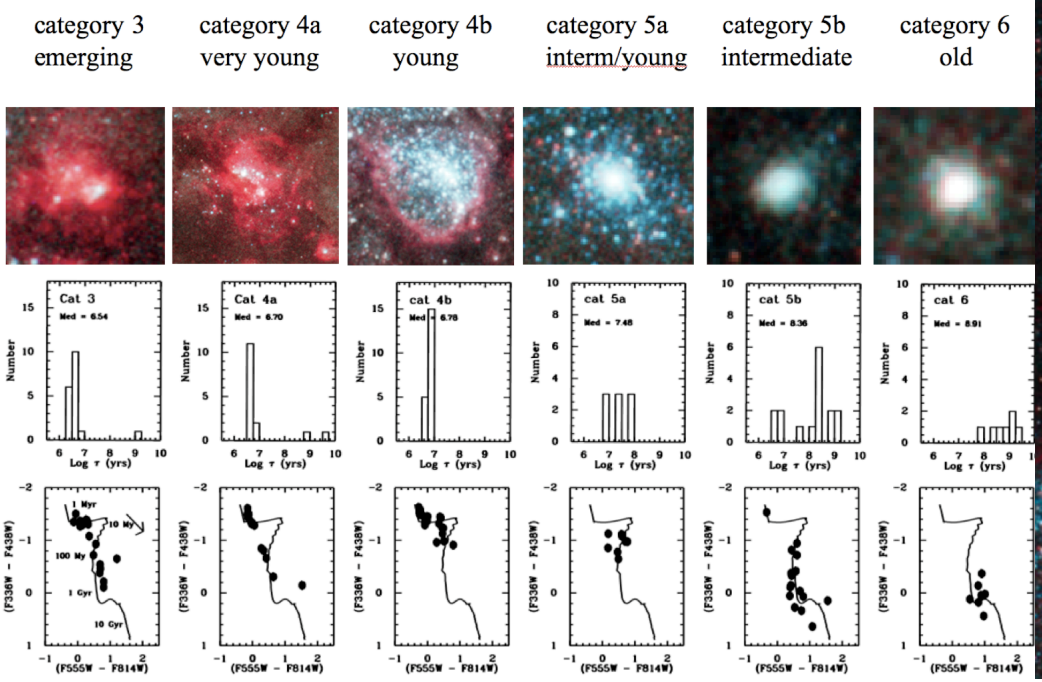
- Brad Whitmore is interested it setting up a Citizen Science project to help him measure the ages of star clusters using techniques developed in a recent paper published in the Astronomical Journal.
- He would use this resource for a number of datasets including the other 6 fields in M83 (ID = 11359), and future Hubble Heritage images.

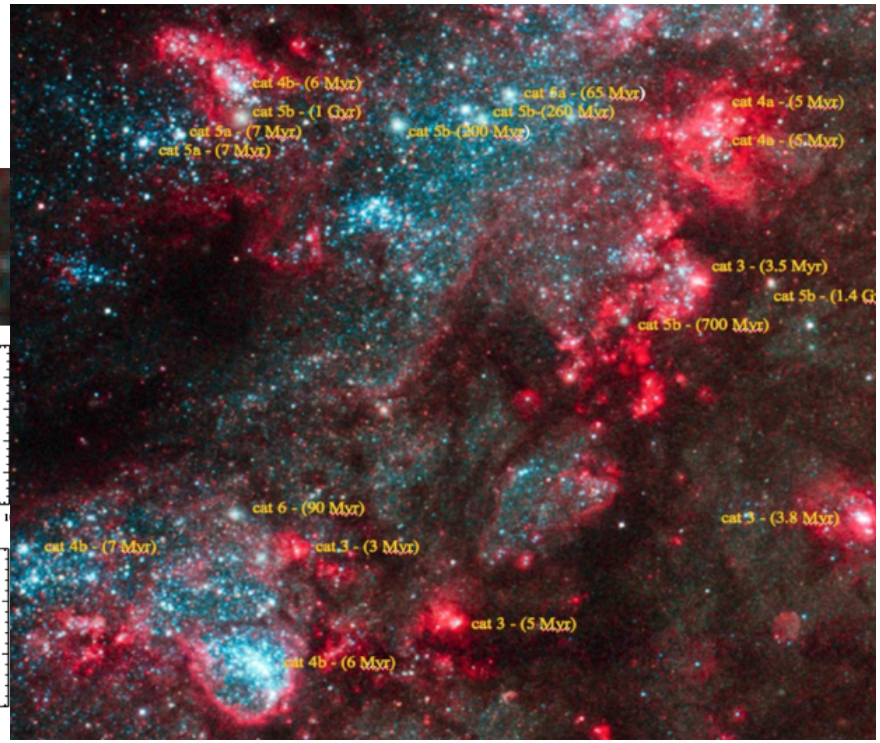


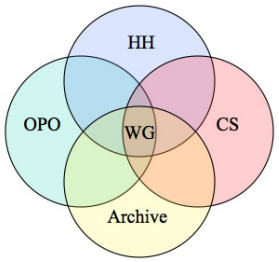
The Astrophysical Journal, 729:78 (14pp), 2011 March 10 doi:10.1088/0004-637X/729/2/78

USING Hα MORPHOLOGY AND SURFACE BRIGHTNESS FLUCTUATIONS TO AGE-DATE STAR CLUSTERS IN M83

Bradley C. Whitmore[1], Rupali Chandar[2], Hwihyun Kim[3], Catherine Kaleida[3], Max Mutchler[1], Matt Stankiewicz[1], Daniela Calzetti[4], Abhijit Saha[5], Robert O'Connell[6], Bruce Balick[7], Howard E. Bond[1], Marcella Carollo[8], Michael J. Disney[9], Michael A. Dopita[10], Jay A. Frogel[11], Donald N. B. Hall[12], Jon A. Holtzman[13], Randy A. Kimble[14], Patrick J. McCarthy[15], Francesco Paresce[16], Joseph I. Silk[17], John T. Trauger[18], Alistair R. Walker[19], Rogier A. Windhorst[3], and Erick T. Young[20]



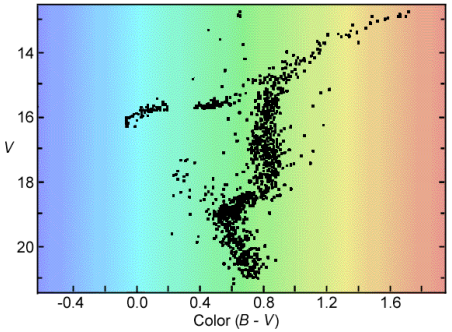




Backup: Archive Lab Exercises

- HLA related materials are often requested by educators at demos at AAS meetings.
- HLA is starting an Educational Resource area: http://hlatest.stsci.edu/hla_edu.html.
- Working Group will facilitate archive/OPO collaborative projects.

Color Magnitude Diagram of M80



Hubble Legacy Archive Educational Materials

• Color Magnitude Diagram

In this exercise students use real Hubble data to create a color magnitude diagram of M80, and then use theoretical isochrones to estimate its age and distance. The student should have some familiarity with stellar magnitudes and Hertzsprung-Russell diagrams, though details are given in the assignment. The full exercise requires knowledge of some form of coding (preferably IDL, to take advantage of the IDL Astronomy Library), but the simplified exercise only requires Microsoft Excel (or something similar). **Simplified Exercise**
Original Exercise

• V838 Monocerotis

In this exercise students use images of V838 Monocerotis taken several months apart to calculate the light echo's apparent rate of expansion. Students require access to software that allows them to view fits files (ex. DS9) **V838 Monocerotis Exercise**

• M87 vs the Antennae

In this exercise students use color-color diagrams and single stellar population models (SSPs) to compare and contrast M87 and the Antennae galaxies. The full exercise is designed to be done using IDL, but it can be altered for lower-level students to only require excel. **M87 Exercise**

• Antennae Galaxies

In this exercise students use Hubble data to construct a color-color diagram of the clusters in the Antennae galaxies. This diagram is used in conjunction with a single stellar population model (SSP) and reddening vectors to identify a method of qualitatively age-dating some of the clusters. This exercise requires an understanding of astronomical magnitude systems (particularly Vegamag vs AB mag) and a basic understanding of extinction. In addition, it requires a good deal of coding (preferably IDL, to take advantage of the IDL Astronomy Library). **Age Dating Exercise**

Background:

A familiar staple of the study of stellar evolution is the Hertzsprung-Russell (H-R) Diagram, like the one above. Developed in the early 1900s, the original H-R diagram plotted stars' spectral type versus their absolute magnitude. Today, diagrams plot stars' B-V color index (observed magnitude in the B band minus magnitude in the V band) versus magnitude. For obvious reasons, this is also known as a color magnitude diagram. H-R diagrams can also be made by plotting effective temperature versus luminosity. These two forms of the H-R diagram are similar in that they can both be used to identify stars of different ages and match observations to theoretical stellar evolution models, however the transformation between the two is not trivial. Because it relies solely on observation, we will focus on the color magnitude diagram (CMD).

A CMD of a single cluster gives a snapshot of that cluster's evolution, with the key features distinguishing groups of different ages. A star's mass governs both its initial position on the CMD and it's evolution. Most stars fall along the very distinct main sequence, where they spend 90% of their lives. This stage is characterized the fusing of hydrogen into helium in the stellar core. More massive stars burn fuel faster, and so exhaust their inner supply of hydrogen before their less-massive neighbors. When this occurs, these stars "turn off" the main sequence, brighten and migrate redwards.

Red giants are characterized by helium burning in the core, surrounded by a hydrogen shell. This helium burns into carbon, which combines with helium to make