

Hanny's Voorwerp
and the rise of
the digital amateur
astronomer

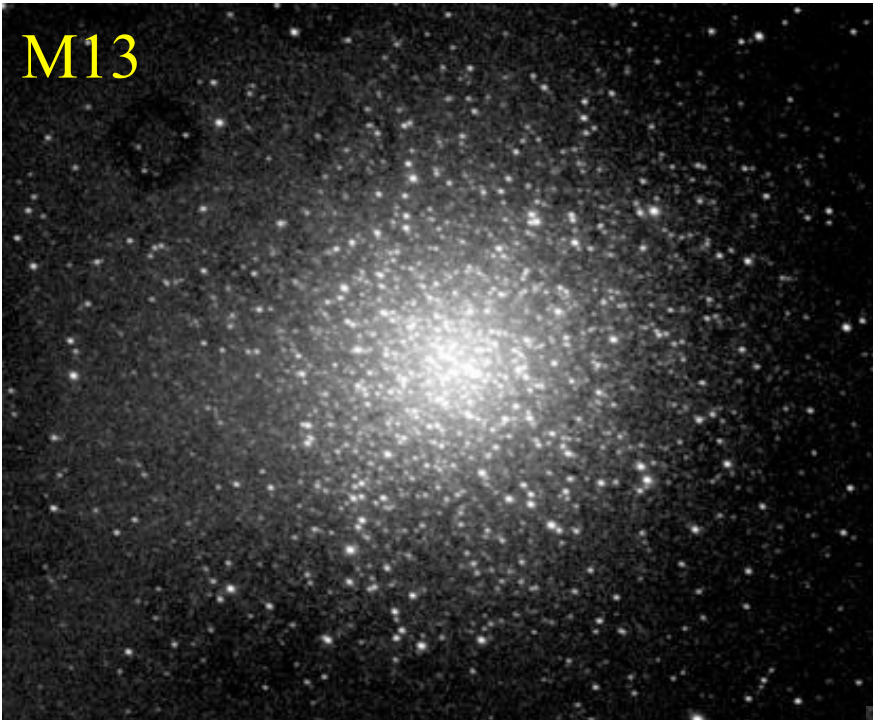
The revolutions

- Telescope control and tracking
- Solid-state digital imagers
- Image-processing software
- Online data compilations
- Fast networks and Web 1.0 and 2.0
- This isn't necessarily what amateur astronomy is *all* about, but sure is cool for those who want to go this way

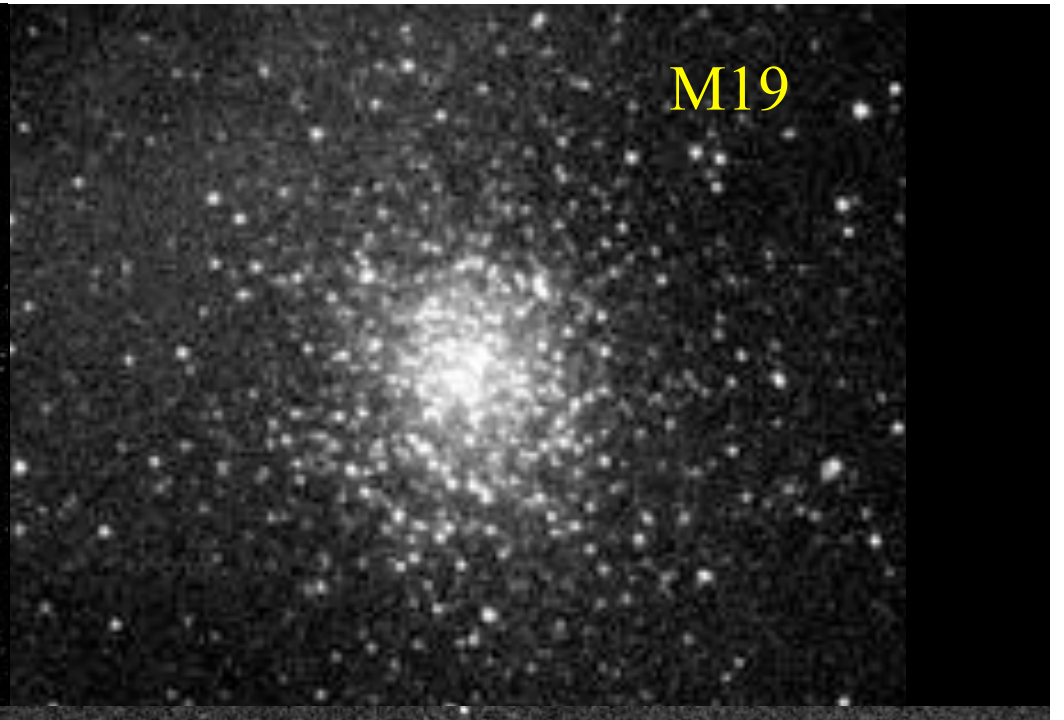
Digital detectors: really sensitive and stable



M13



M19



M28



M55

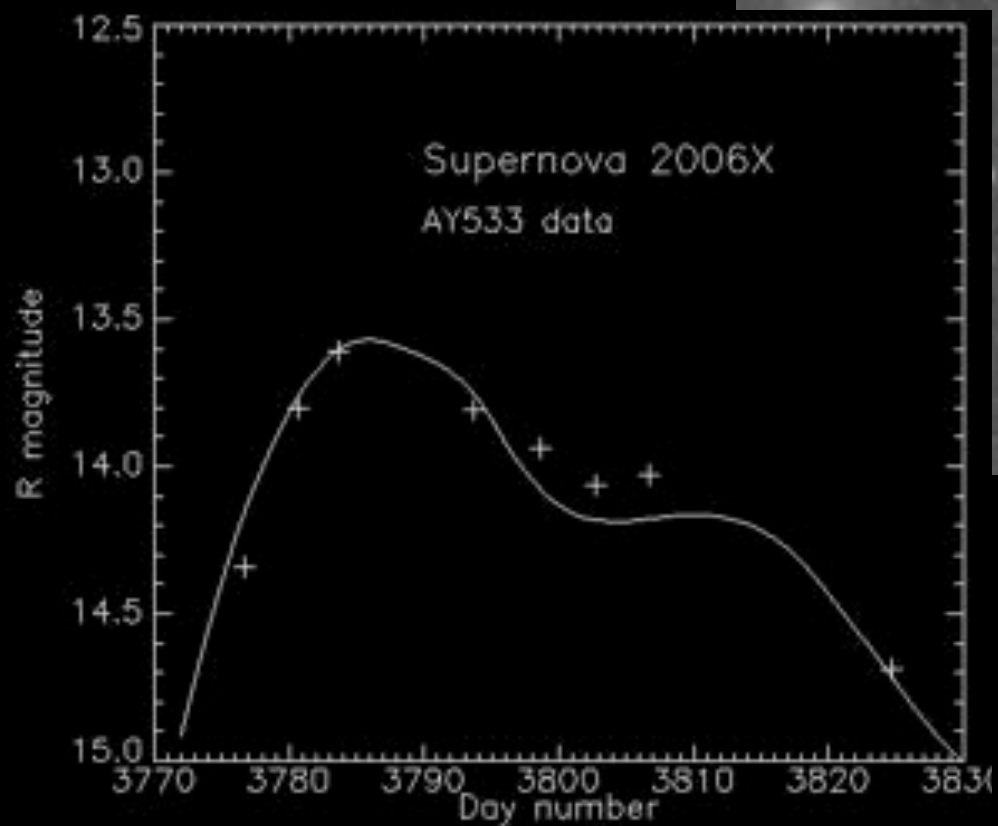
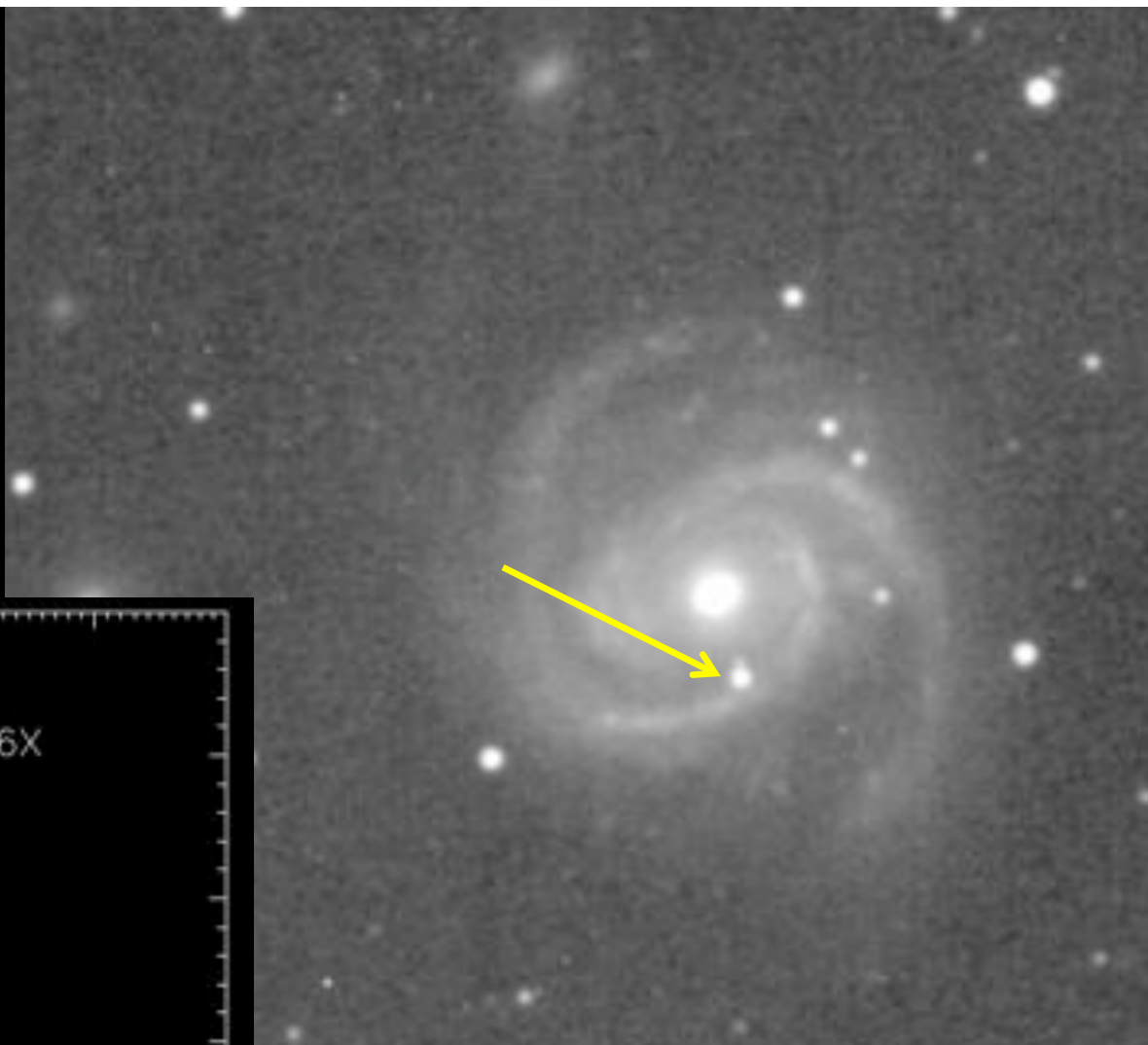


These on a night when only five stars were visible...

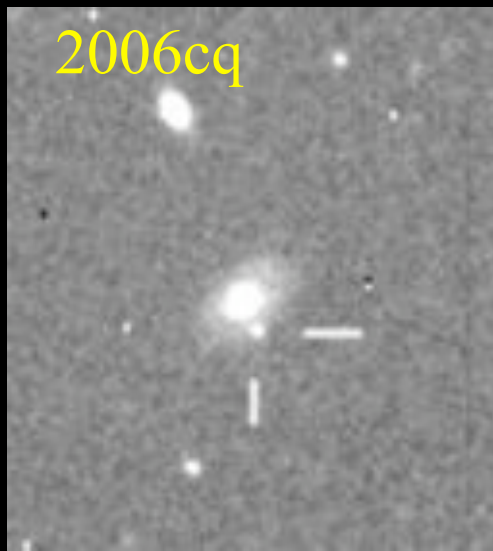
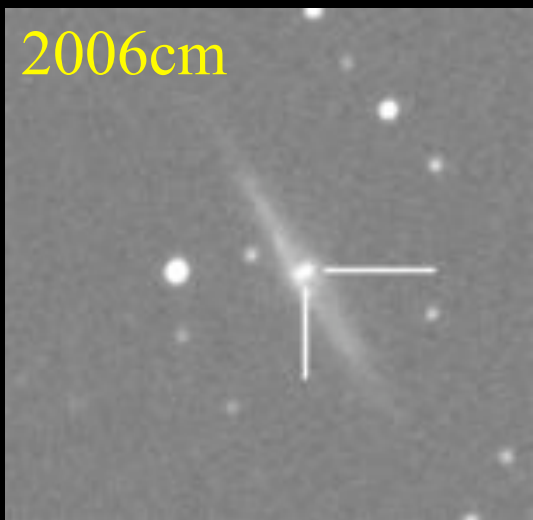
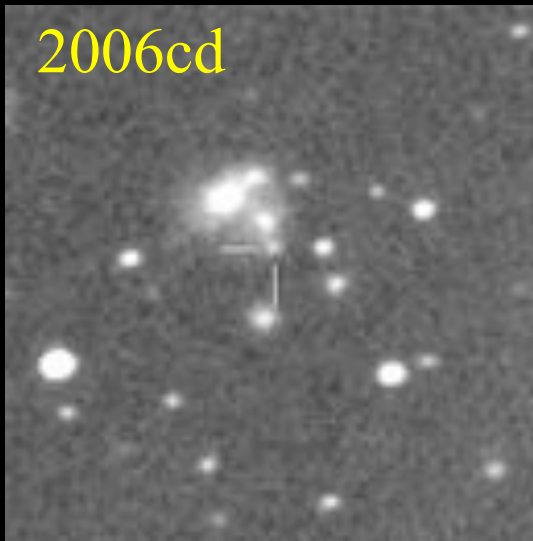
Difficult visual targets
become easy even from
light-polluted areas



Follow exploding
supernovae...



Puckett Observatory (North Georgia) international SN search

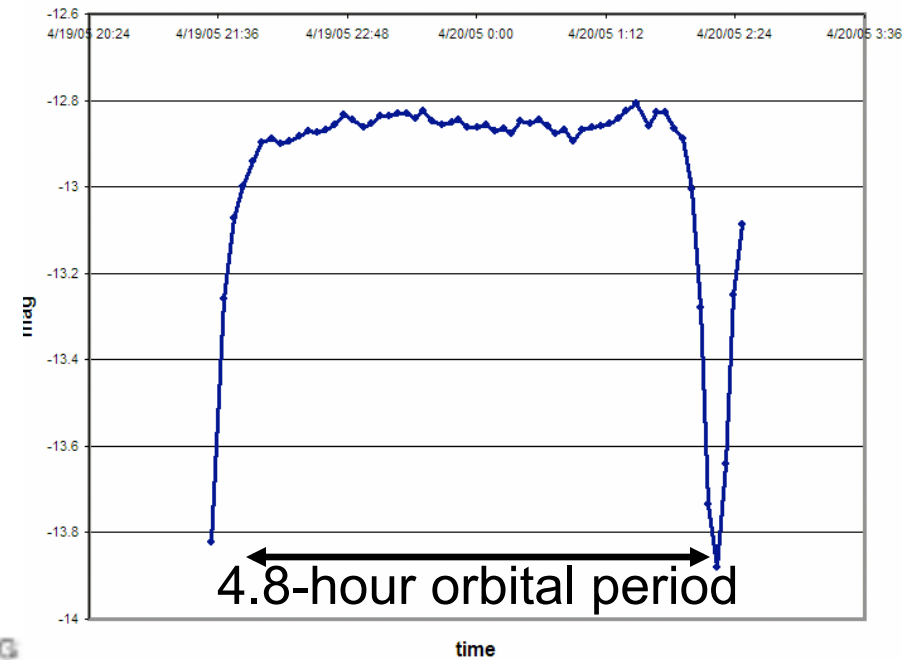


(courtesy Tim Puckett)

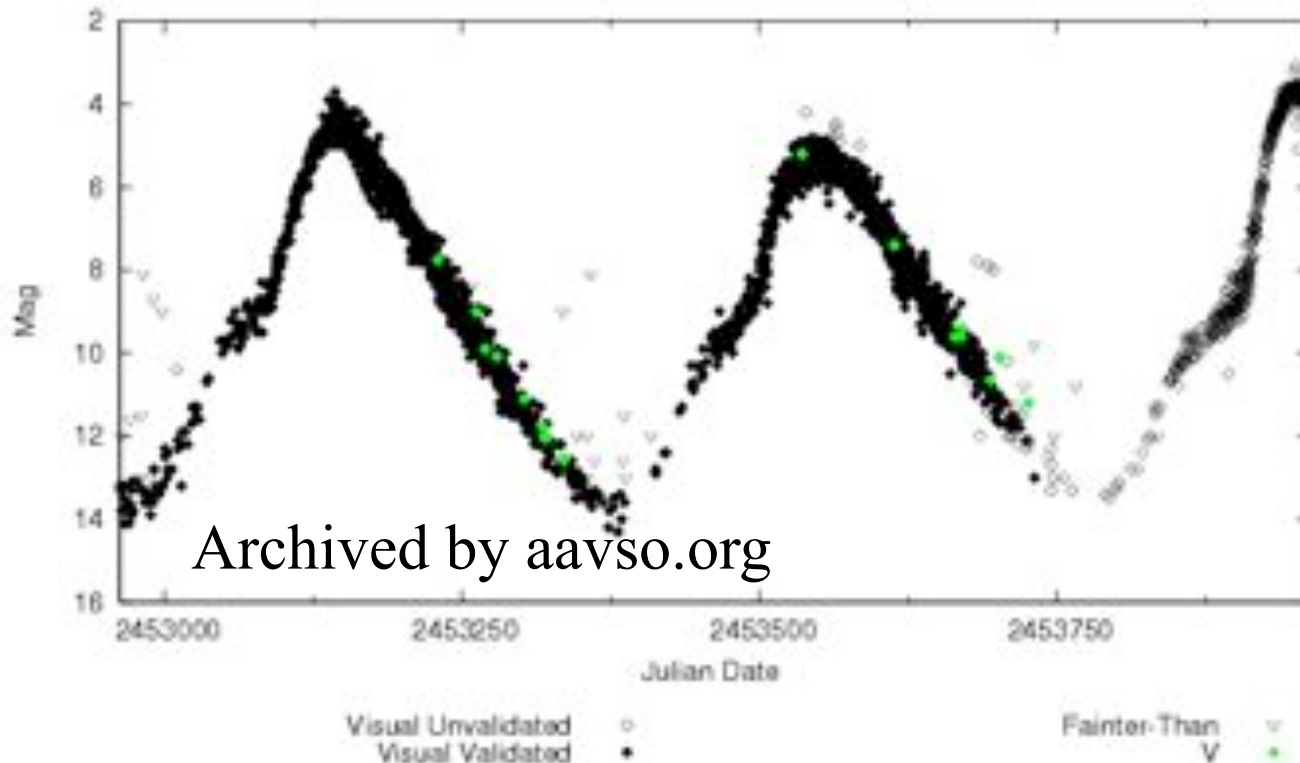
Track variable stars – build on the AAVSO (et al.) history spanning a century, now with new reach and precision. Pulsating white dwarfs changing pitch as they cool, Cepheid variables, eclipsing binary stars which transfer mass, dwarf novae, flaring red dwarfs, spotted stars...

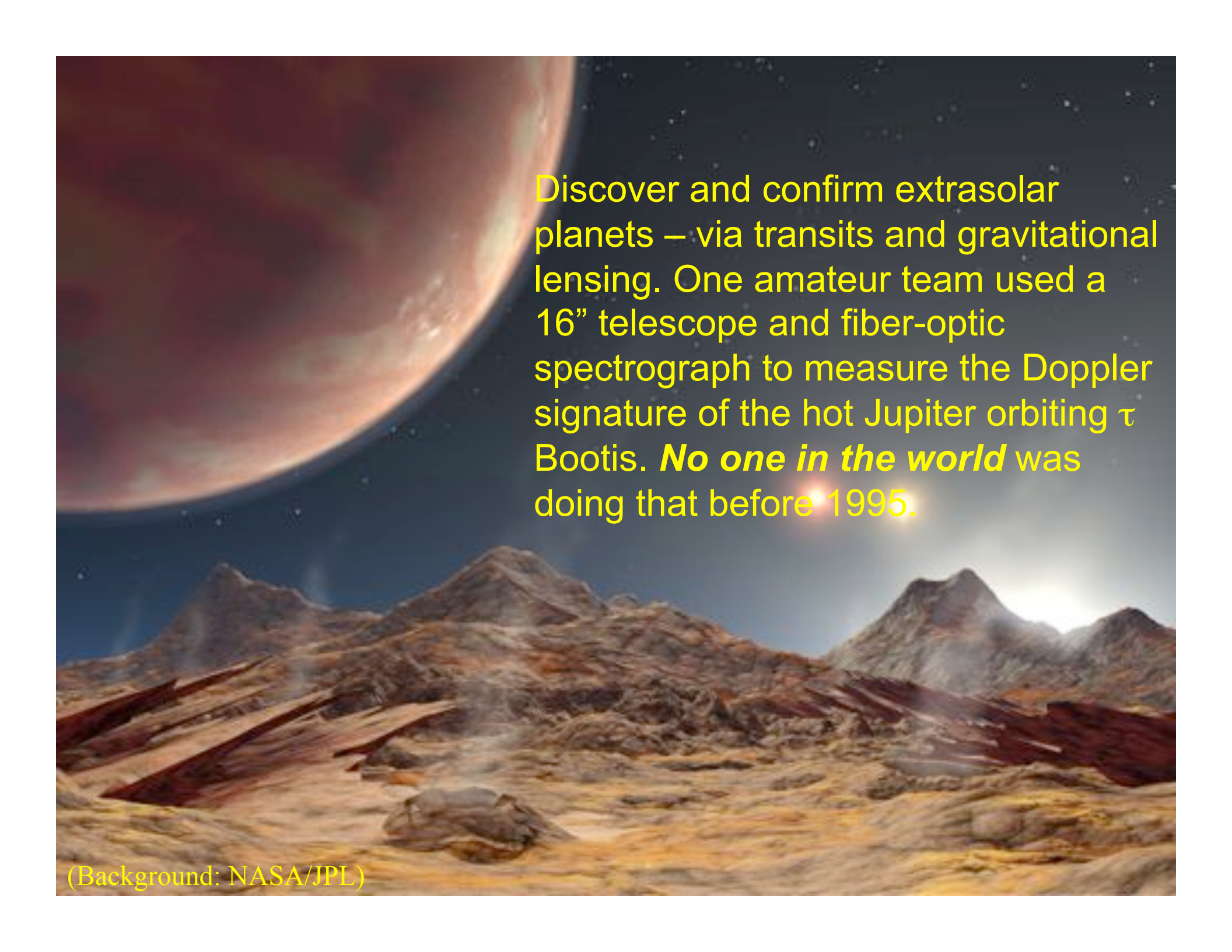
Example: citizensky.org is tracking the 27-year eclipsing binary ϵ Aurigae, whose cooler member is verrrry strange and too bright for observatory instruments.

UX Ursae Majoris
Cataclysmic eclipsing binary
White dwarf+red dwarf
(Brandon Atkins, UA undergrad)



AAVSO DATA FOR CHI CYG - WWW.AAVSO.ORG



A composite image featuring a large, reddish planet in the upper left, a rocky landscape with mountains in the foreground, and a bright star in the sky.

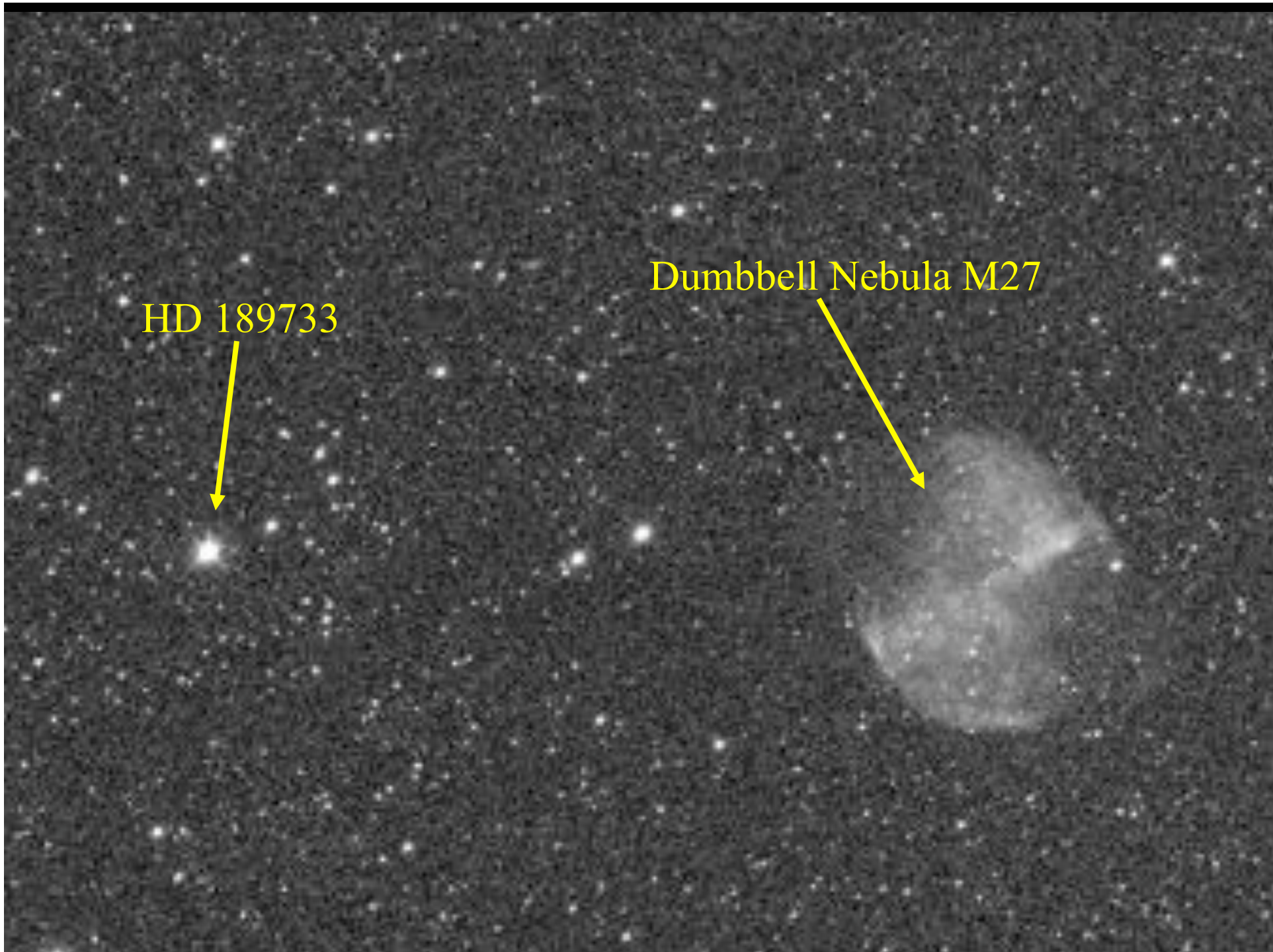
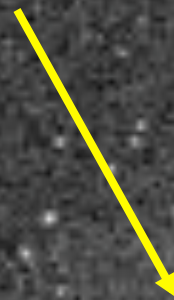
Discover and confirm extrasolar planets – via transits and gravitational lensing. One amateur team used a 16" telescope and fiber-optic spectrograph to measure the Doppler signature of the hot Jupiter orbiting τ Bootis. ***No one in the world*** was doing that before 1995.

(Background: NASA/JPL)

HD 189733

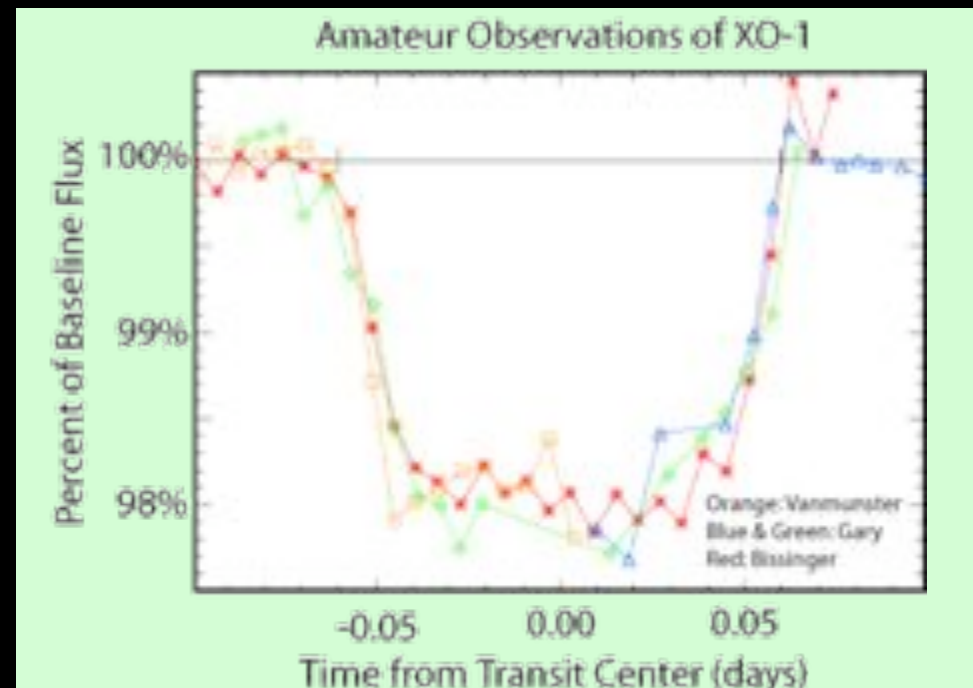
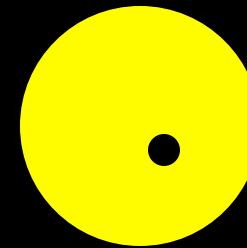
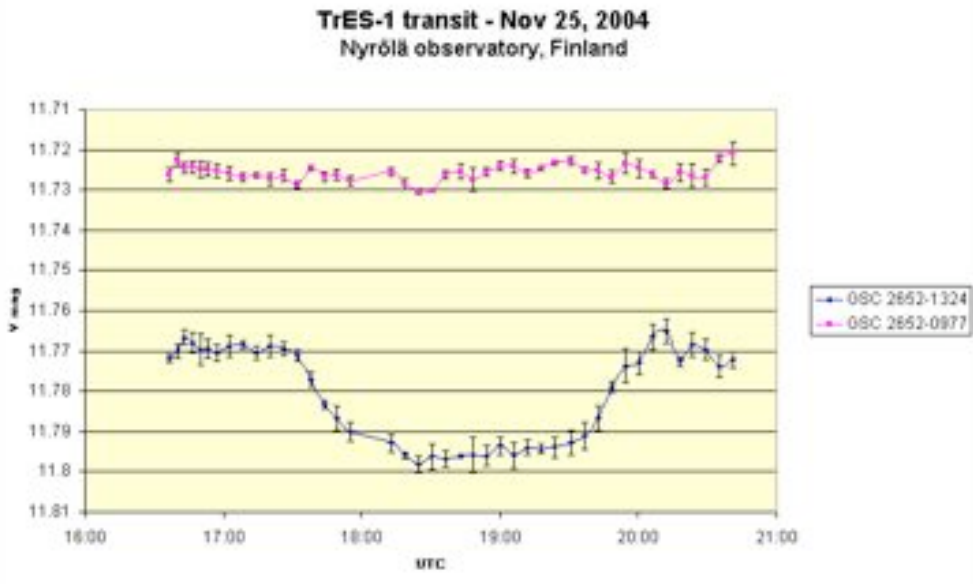


Dumbbell Nebula M27



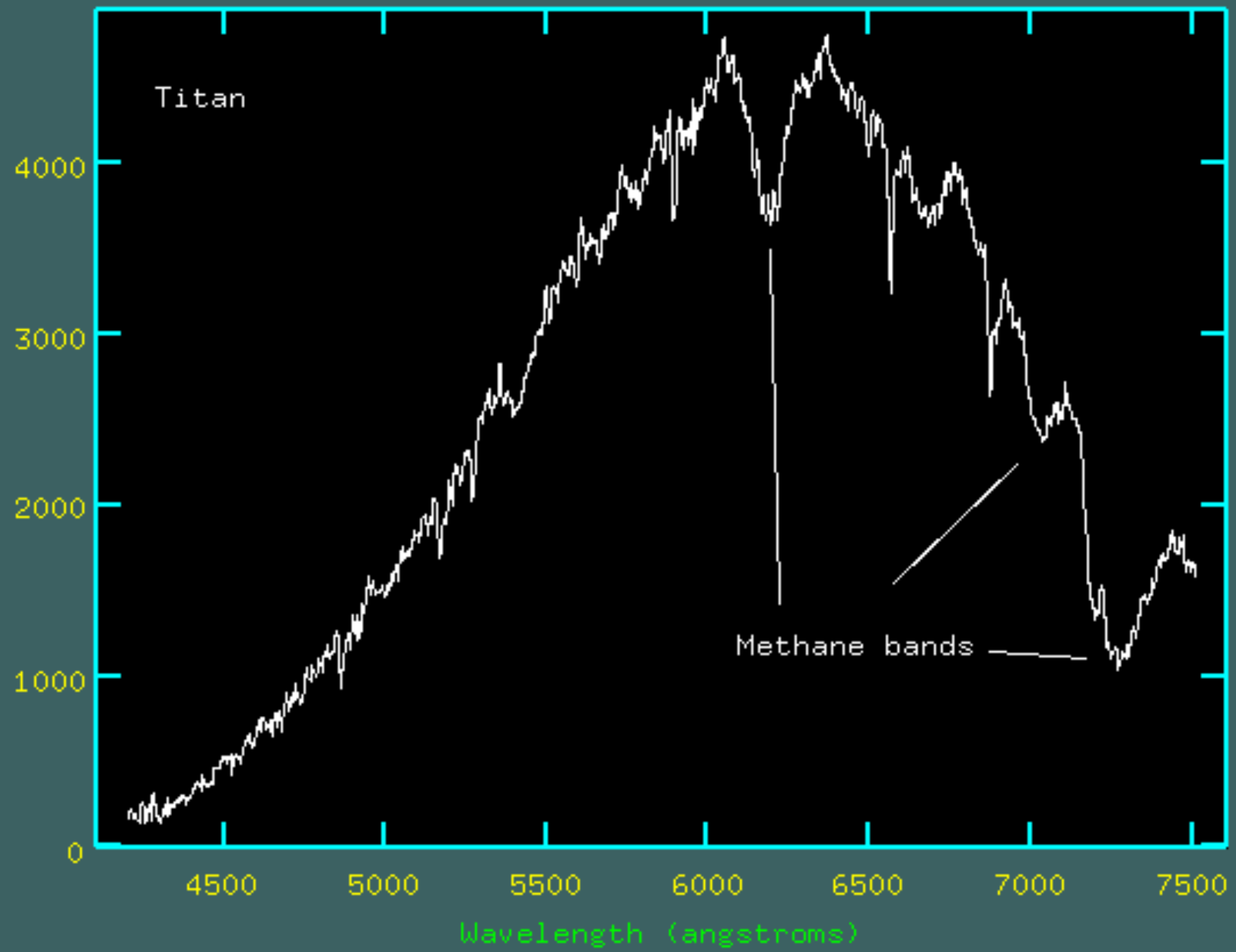
TrES-1 (Arto Oksanen)

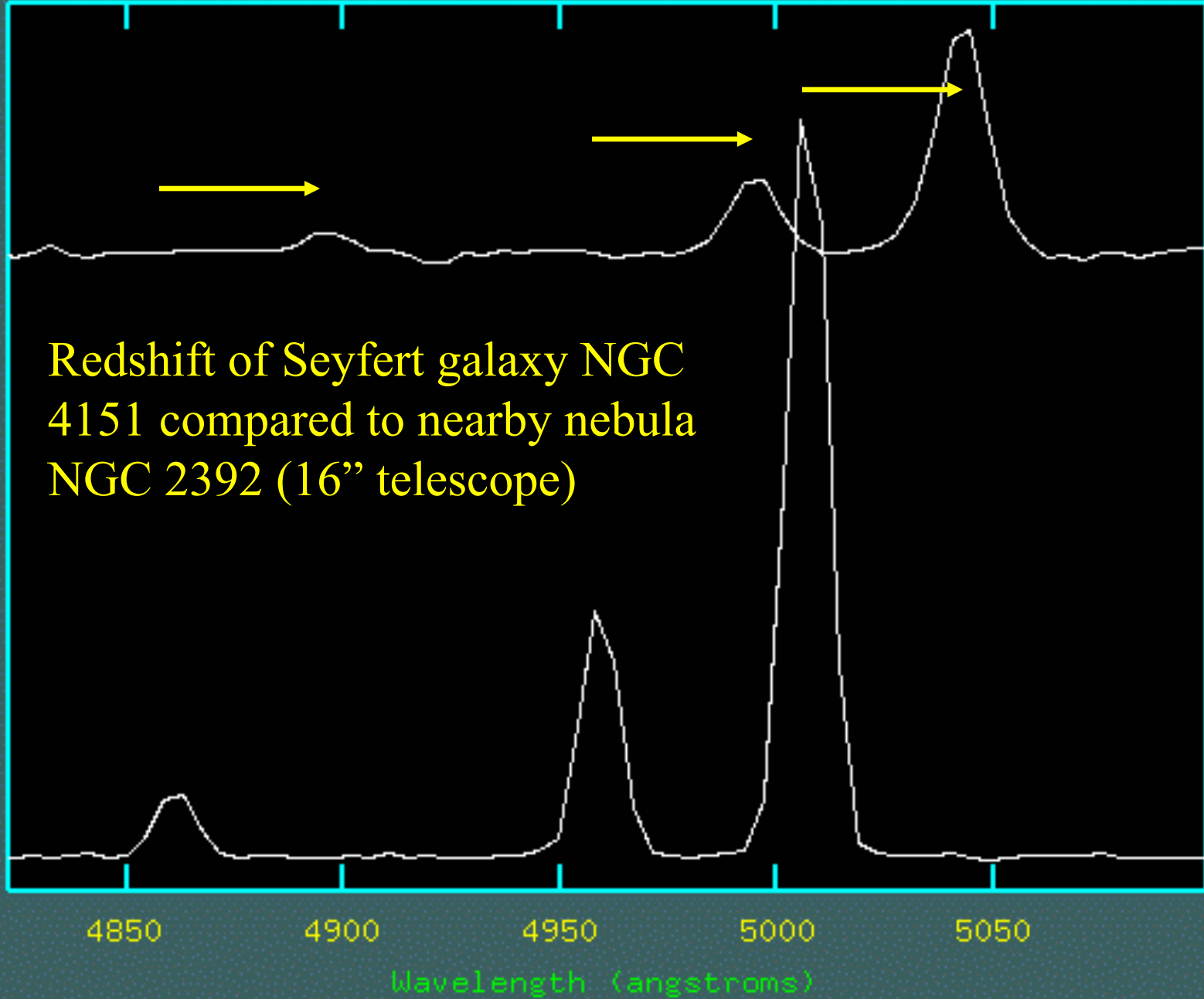
Transit variations



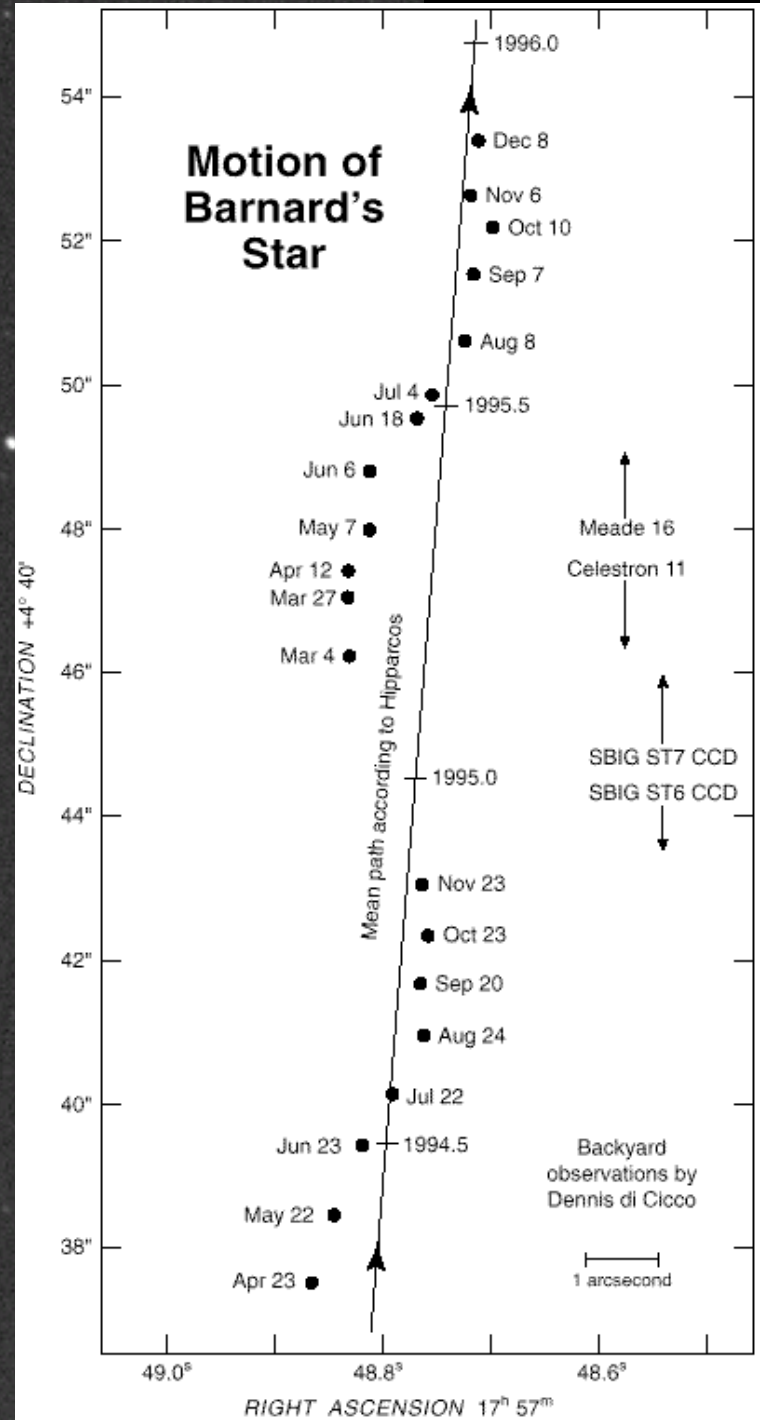
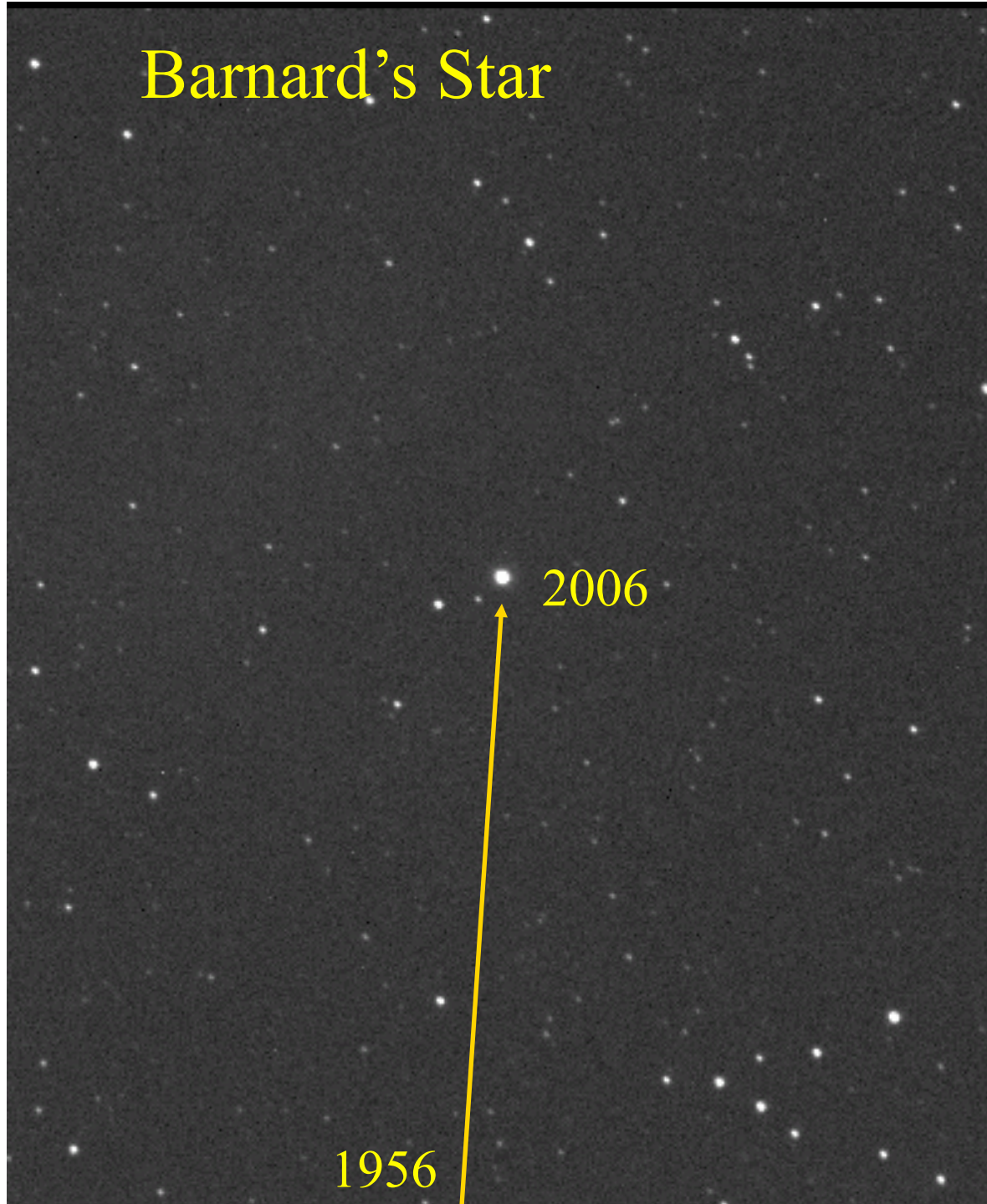
(Figure: McCullough et al. ApJ 2006)

[titandisp]: Titan 5m 300, ap:1 beam:1

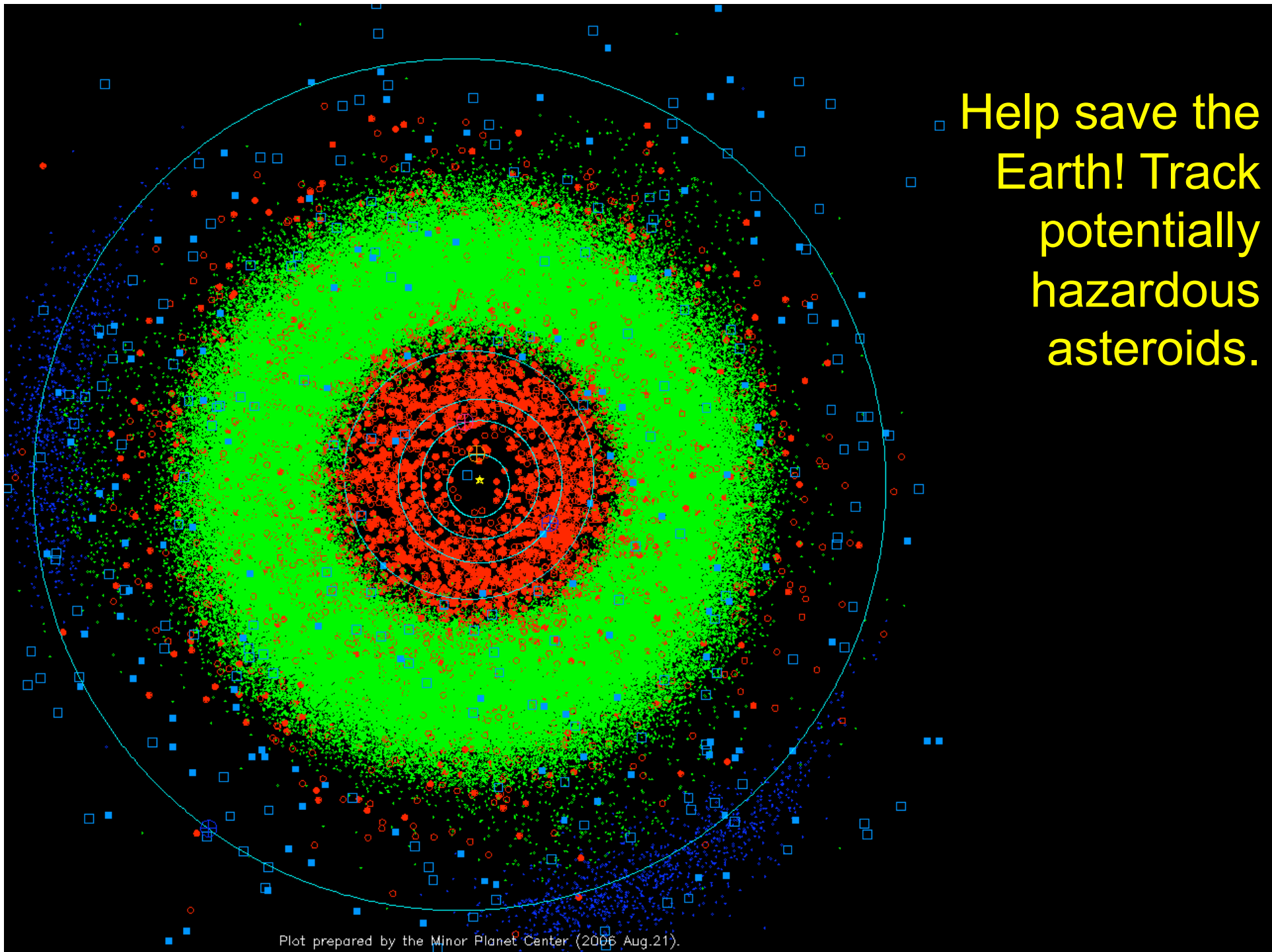




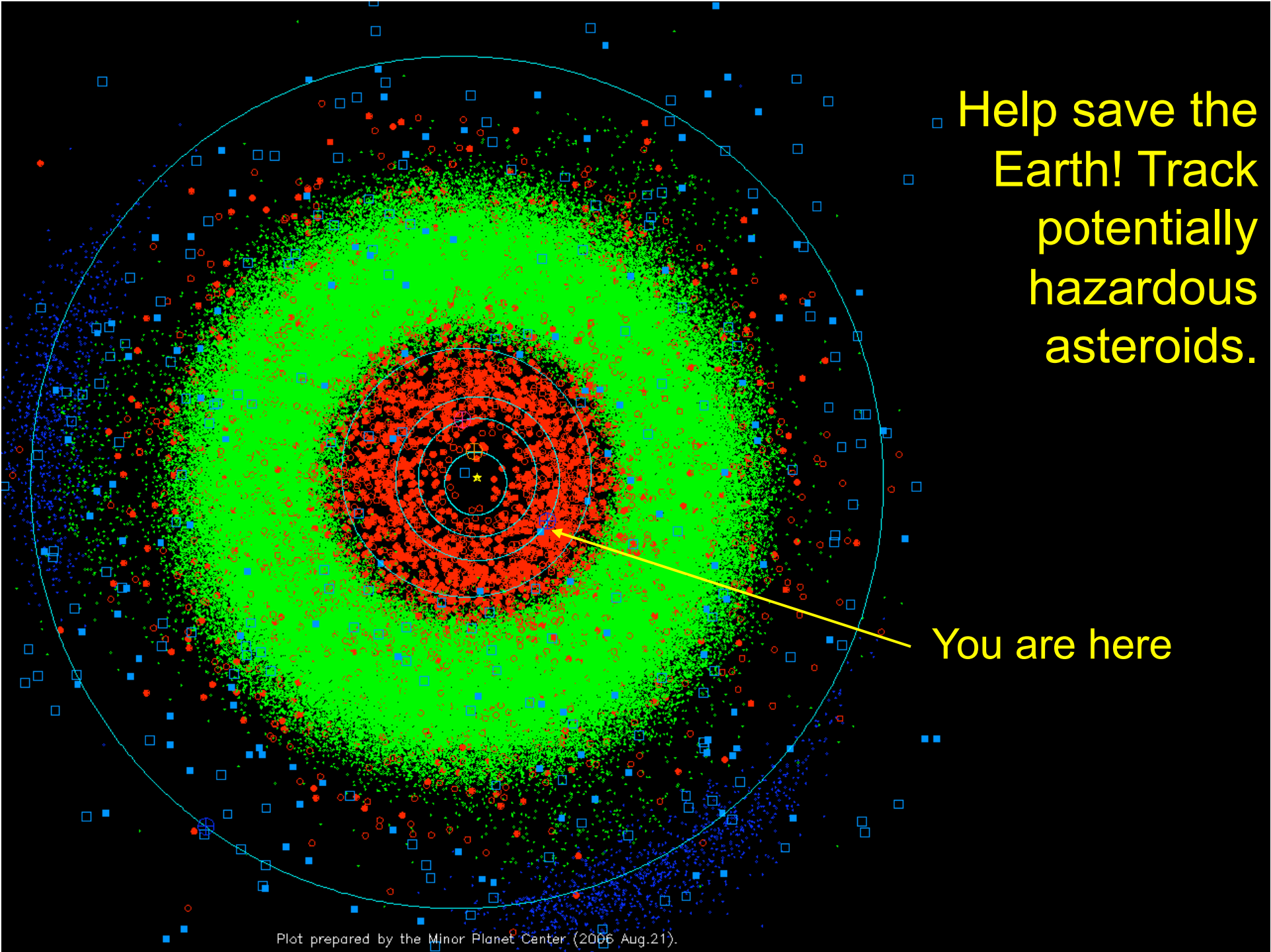
Barnard's Star



Help save the Earth! Track potentially hazardous asteroids.



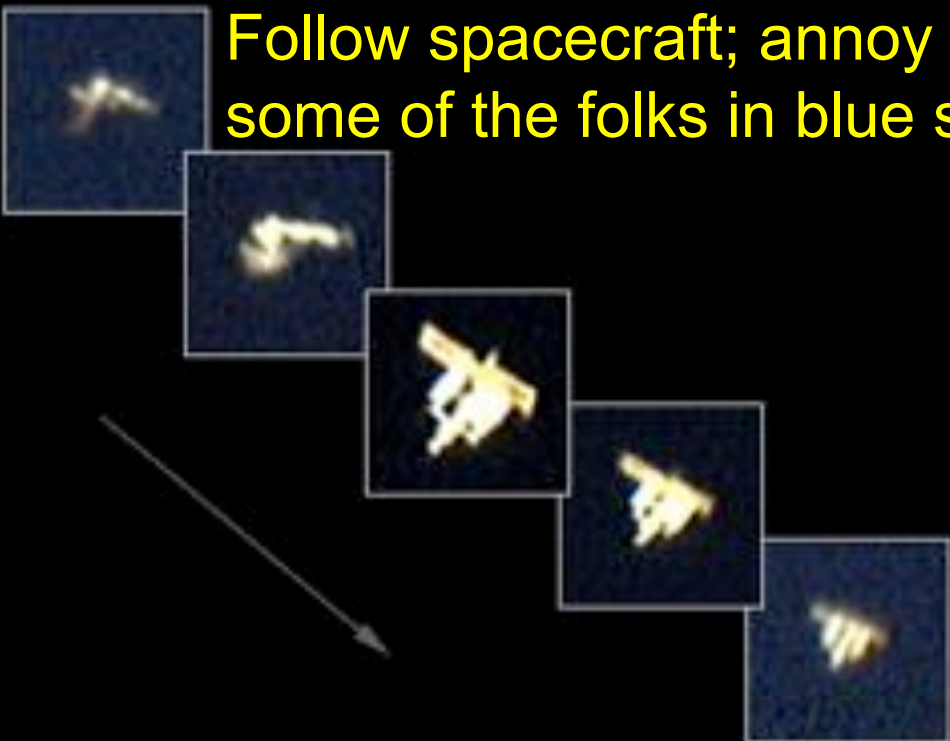
Help save the Earth! Track potentially hazardous asteroids.



You are here

Plot prepared by the Minor Planet Center (2006 Aug.21).

Follow spacecraft; annoy some of the folks in blue suits



International Space Station ISS

31.03.2003 / 19:07 UT - 19:13 UT

8" SCT & ToUCam Pro Web Cam

Frank Brandl

International Space Station with Atlantis STS-112

10/14/2002 8:55pm PST

Bellevue, WA

Meade LX90 prime focus Vesta Pro SC

Shutter: 1/500th second

Gain: 45% Brightness: 50%

Angle: 83 degrees

Distance: 250 Miles

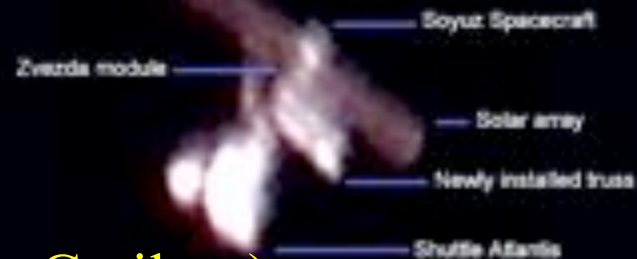
Speed: 17,500 mph

tegwilym@attix.com

Models from Philip Meading's sim/0204



International Space Station, 8 June 2001, 21:57 UT.
Celestron Ultima 9.25, Philips Vesta Pro webcam. David Cash.

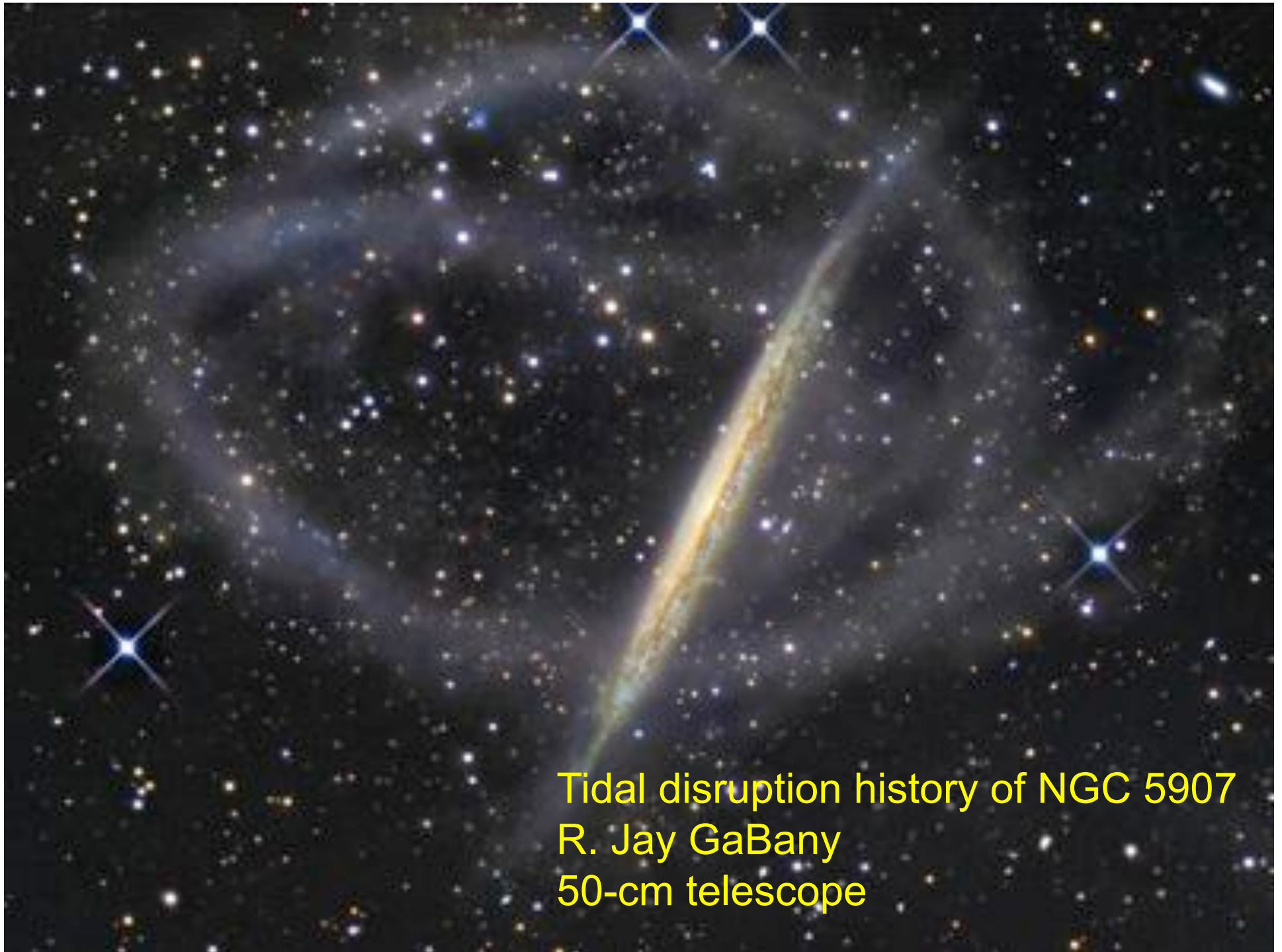


(Tom Gwilym)

International Space Station Dec 27, 2008

(Ralf Vandebergh, NL)
25-cm reflector





Tidal disruption history of NGC 5907
R. Jay GaBany
50-cm telescope

High-speed planetary imaging

Webcams rule!

Lots of short exposures catch a few moments of calm air

Image registration and stacking

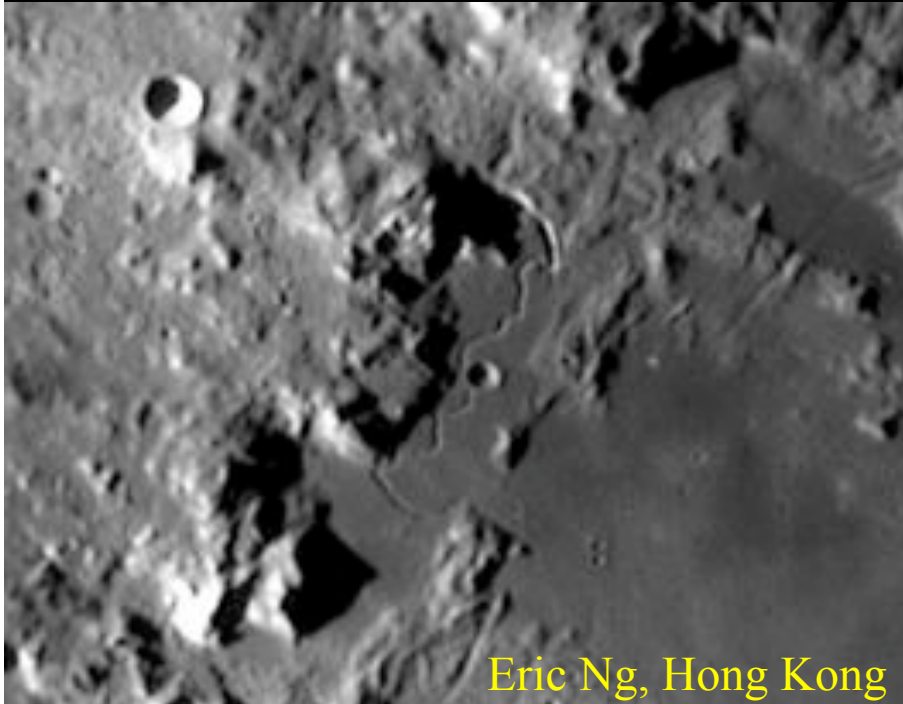
Sharpening: filters, wavelets...



Donald Parker/Sky and Telescope



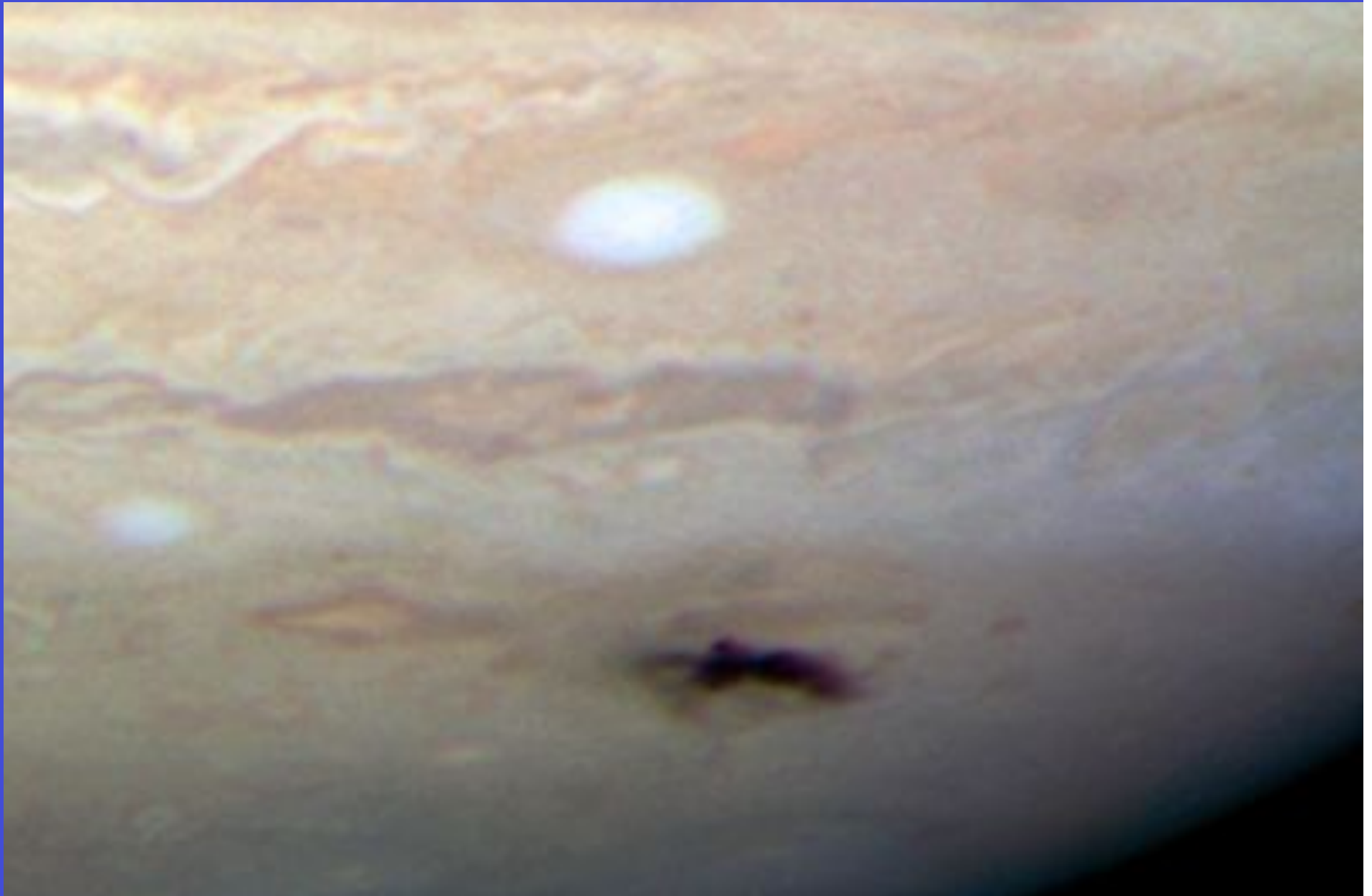
Wes Higgins, Oklahoma



Eric Ng, Hong Kong



Mike Salway, Australia



Anthony Wesley's "Bird Strike" impact spot,
HST WFC3, 23 July 2009

Open-source image processing

- Telescopic data – Hubble, ground-based
- Mars Exploration Rovers Spirit and Opportunity (help the rover drivers!)
- Cassini/Huygens at Saturn
- Phoenix team shout-out
- Archives – planetary dumpster diving

Process data from Hubble, La Palma, Mauna Kea...
FITS format and the FITS Liberator Photoshop plugin

FITS = Flexible Image Transport System. Internationally standardized binary format for multidimensional arrays and header (meta)data, dating to 1978. The standard for archiving from all NASA astronomy missions, all major ground-based observatories, can be written by amateur CCD software. Crack this format and you have the riches of Hubble, La Palma, ESO, GALEX, Chandra... at your fingertips.

30 Doradus
HST WFPC2

James Long
25 July 2005

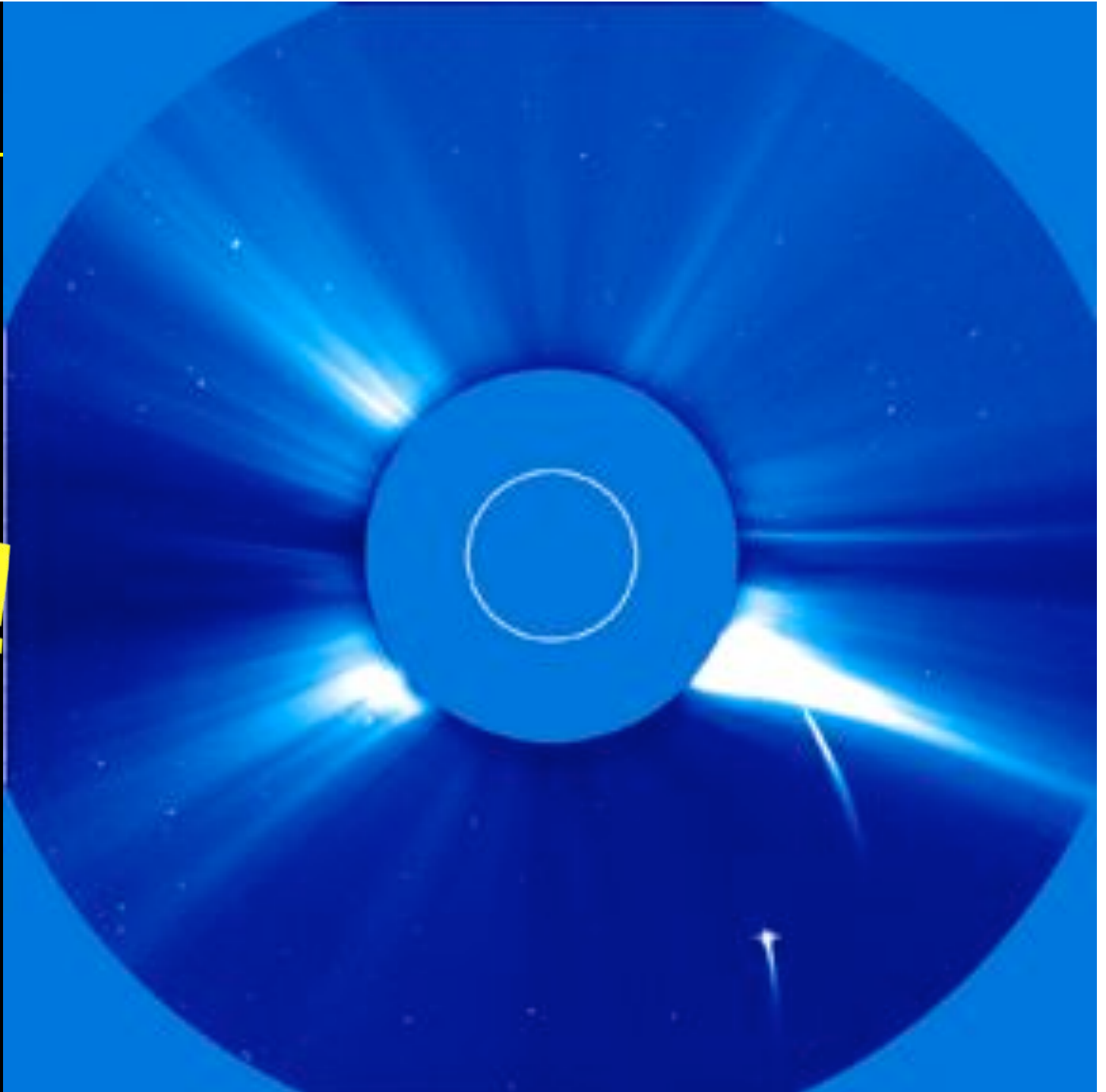


Shadow transit of Despina over Neptune – found in Voyager 2 data 20 years later by amateur and philosopher Ted Stryk



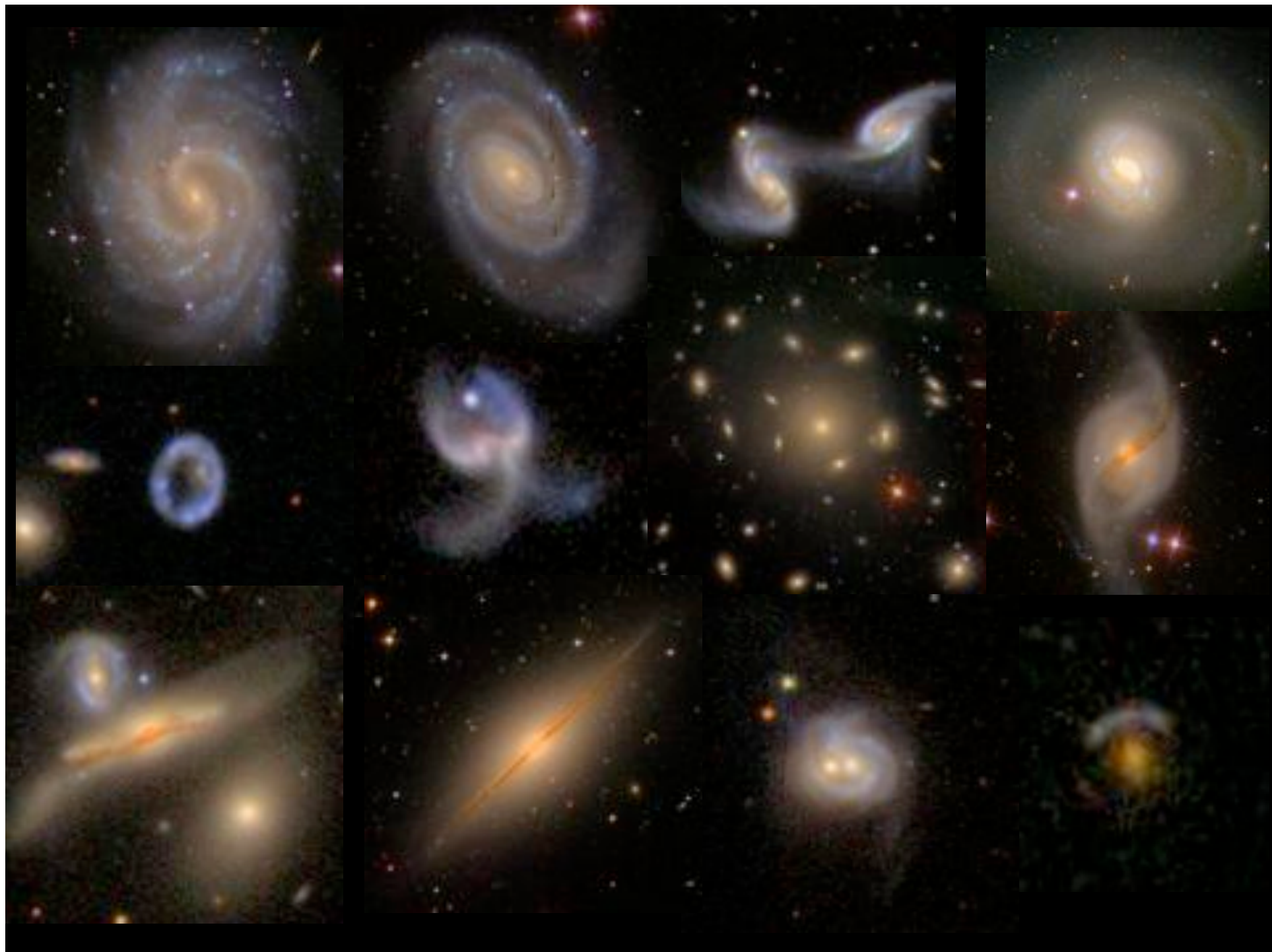
SOHO comets –
1674 and
counting. Now
twin STEREO
spacecraft have
taken over

IN 3D!



Discover quasars by the thousands by collating sources in existing optical/radio/X-ray survey data. For extra credit, publish before some professional observing teams. (Eric Flesch, quasars.org)

```
000000.0-000158 Q 18.1 19.4 p - - Q 2357-003A 1.560
000000.6+321230 R 12.2 16.0 p 2 2 0 92 0 8 NVSS J000000.1+321233 4
000000.6-200446 R (20.7)22.5 x 1 6 36 0 58 NVSS J000000.2-200448 4
000000.9-200447 X 18.7 20.3 pv 1 1 3 64 0 33 1RXS J000000.9-200444 157
000001.0+012416 R 20.3(22.3) 1 x 0 96 4 0 FIRSTJ000001.0+012415 1
000001.3-063114 R 18.6 21.1 1 1 0 95 0 5 NVSS J000001.4-063113 3
000001.3-020200 QR 19.7 21.0 p - - FIRST J000000-0202 61 12 11 16 1.356
000001.4-303627 Q 19.0 19.9 p - 2 2QZ J000001.3-303627 1.143
000001.5+321247 X 19.1(21.8)p - x 14 32 3 51 1RXS J000001.3+321247 120
000001.6-092940 GR 17.3 19.8 p 1 1 SDSS J000001.5-092940 2 98 0 0 0.191
000002.0-152435 R 16.7 19.1 p 1 1 2 91 0 7 NVSS J000001.9-152435 10
000002.1+155254 GR 11.1 11.4 p 1 1 CGCG 456-13 0 65 2 33 0.020 NVSS 3
000002.2-093136 GR 19.2 22.9 1 2 SDSS J000002.1-093136 0 99 0 1 0.466
```





The ancestral pub
of Galaxy Zoo

Zookeeper Chris
and the
astronomers of
the Round Table



GALAXY ZOO.org

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Galaxy Analysis

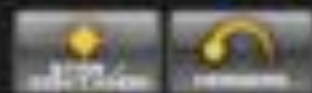
Welcome to Galaxy Zoo's view of the Universe. If you're here you should already have seen the [Tutorial](#), but feel free to go and remind yourself. There's no need to agonise for too long over any one image, just make your best guess in each case.



Show Grid Overlay on the next Image

Galaxy Ref:
586010680371851294

Choose the Galaxy Profile
by clicking the buttons
below



0.014% of Zoo volunteers*

*and a few Zookeepers



Galaxy Zoo's greatest hits so far

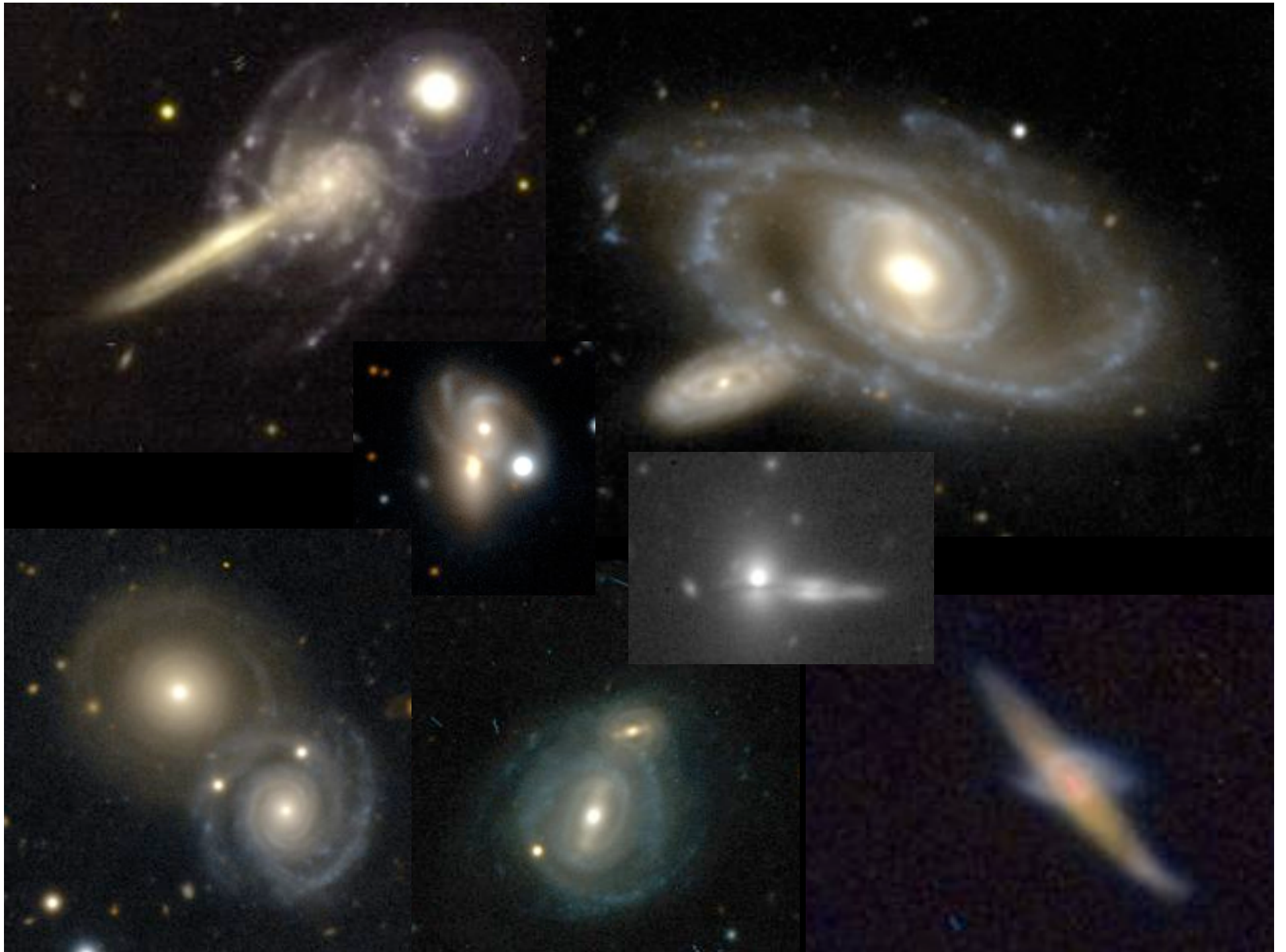
- Blue ellipticals
- Red spirals
- Brains are biased, not galaxies
- Correlation of galaxy spins and history
- Green peas (participant-initiated!)
- Hanny's Voorwerp (participant discovery)
- Dust statistics (forum science)



Holwerda et al. 2009













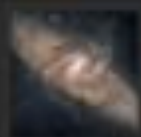
Deep





Hello **NGC3314**

March 26, 2008, 03:38:14 AM



Show unread posts since last visit.
Show new replies to your posts.
Total time logged in: 8 days, 19 hours and 59 minutes.

News: New Galaxy Zoo Forum is launched! (Note: this requires a separate registration)

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Galaxy Zoo Forum > The objects > Weird and wonderful (Moderators: Alice, Edd, StuartA, bamford) > The Hanny's Voorwerp.

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Author

Topic: The Hanny's Voorwerp. (Read 6426 times)

Hanny

Hero Member
★★★★★
Posts: 7205



"Voorwerp kid"



The Hanny's Voorwerp.

« on: August 13, 2007, 06:16:40 AM »

[Quote](#)

What's the blue stuff below?

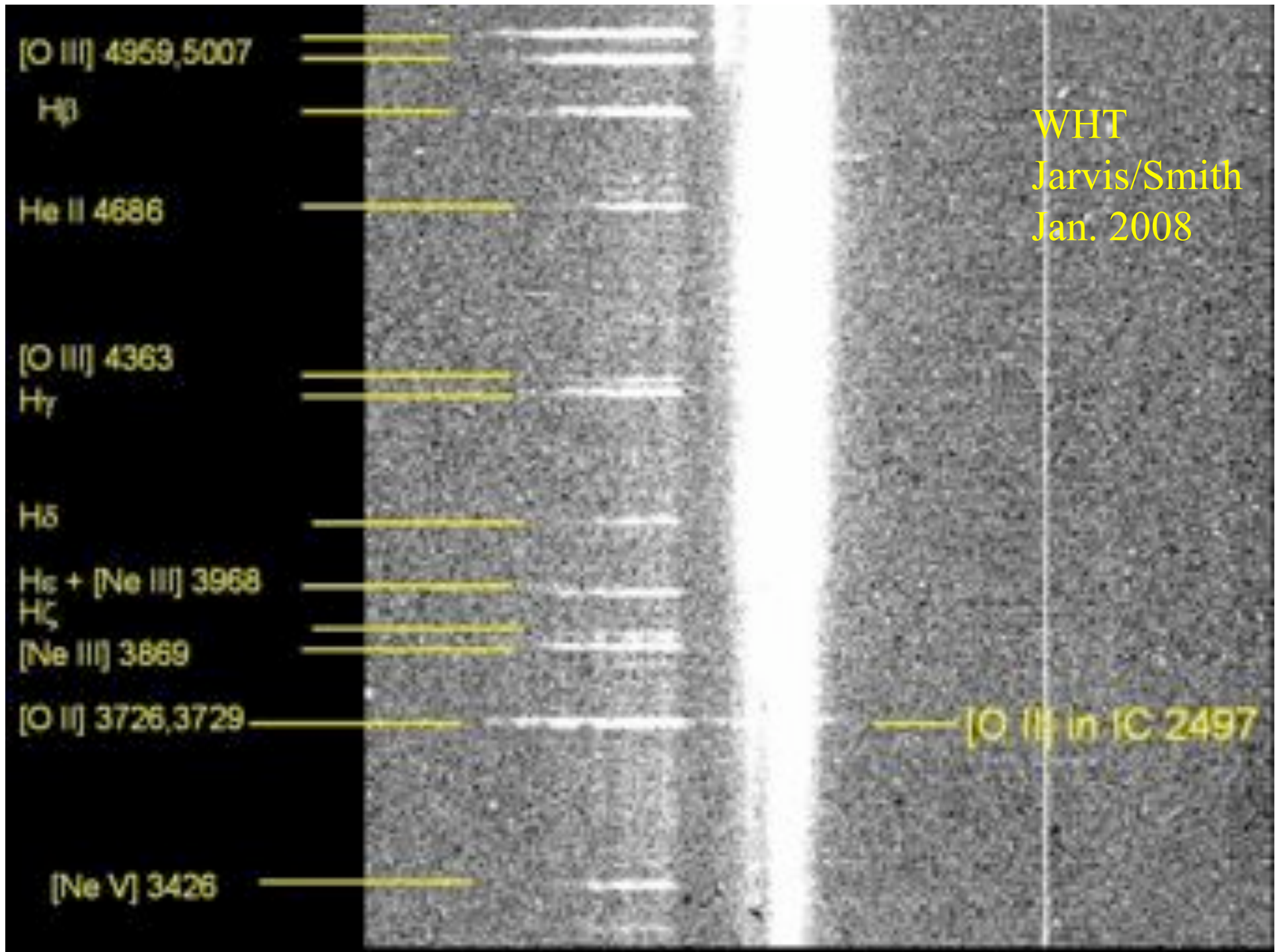
Anyone?

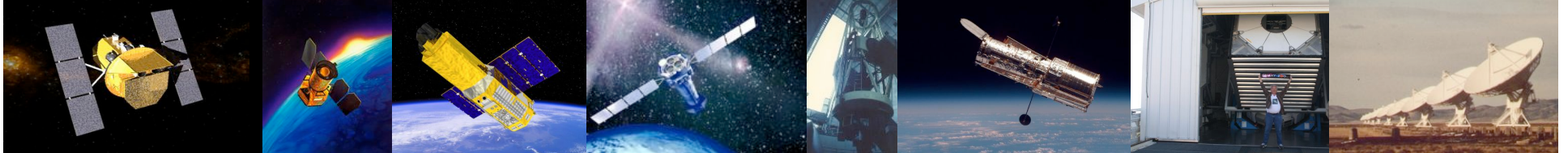
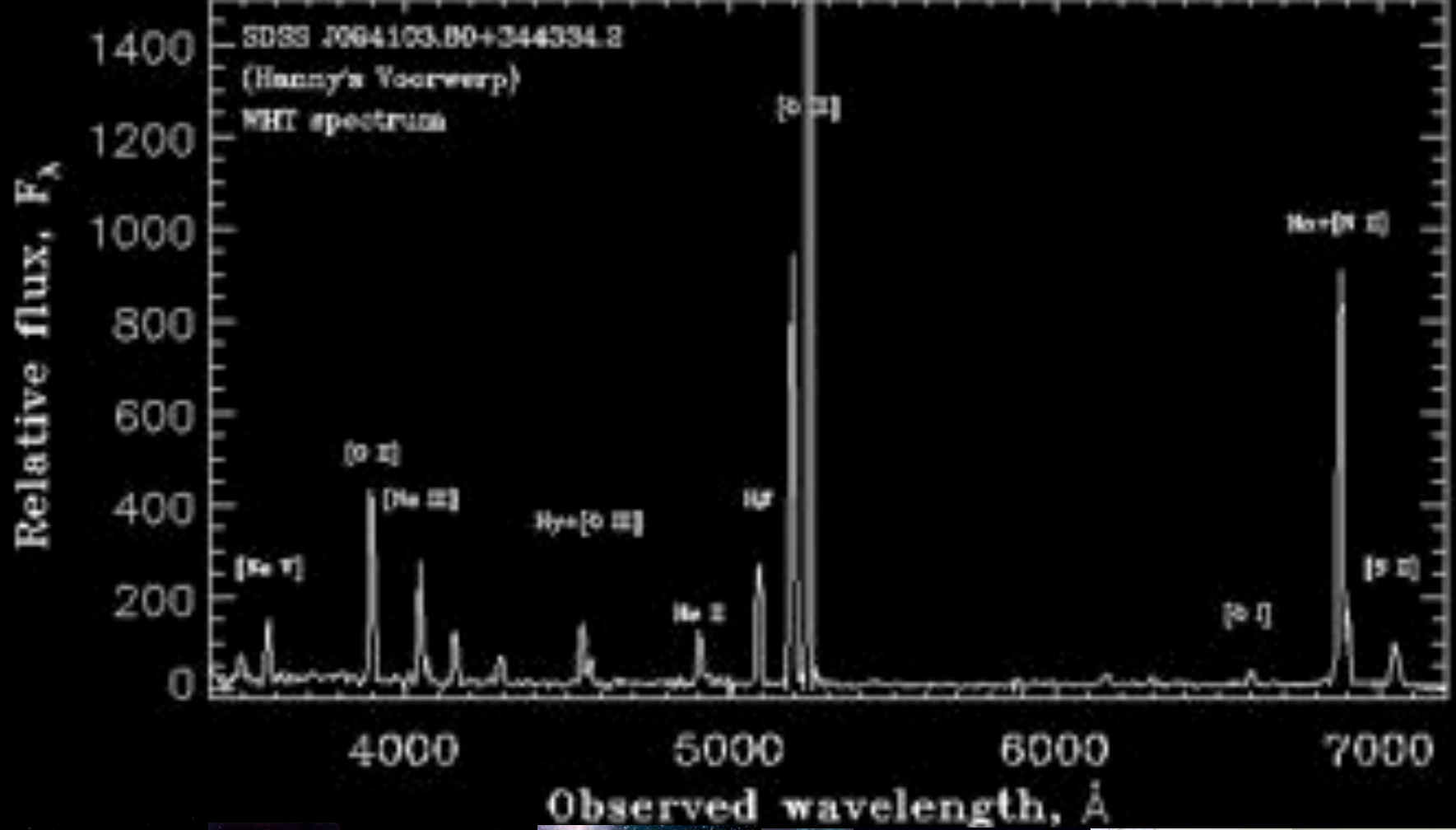
<http://cas.sdss.org/astro/en/tools/chart/chart.asp?ra=145.2671505&dec=34.73290502>





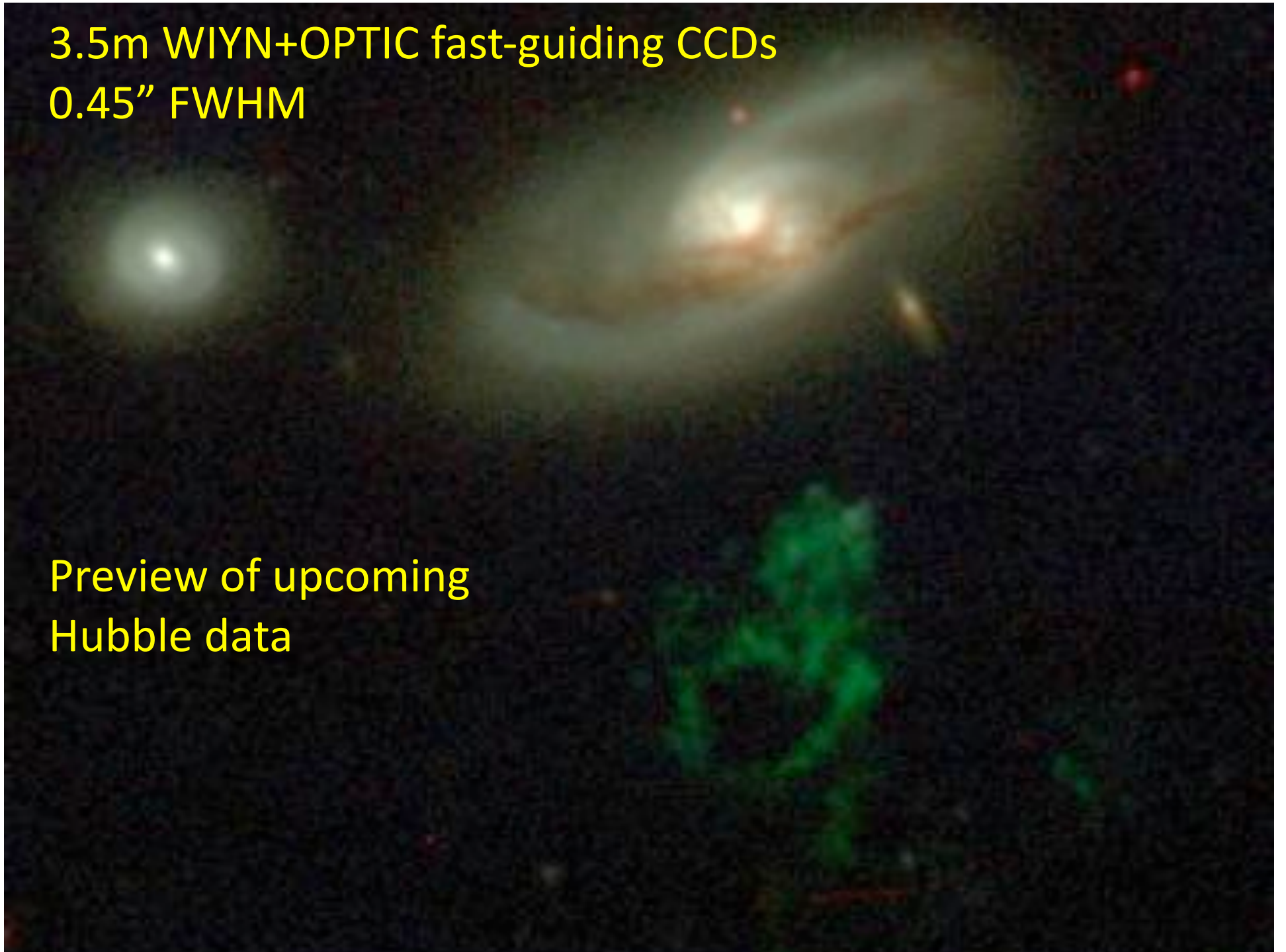
SARA remote 0.9m
BVR

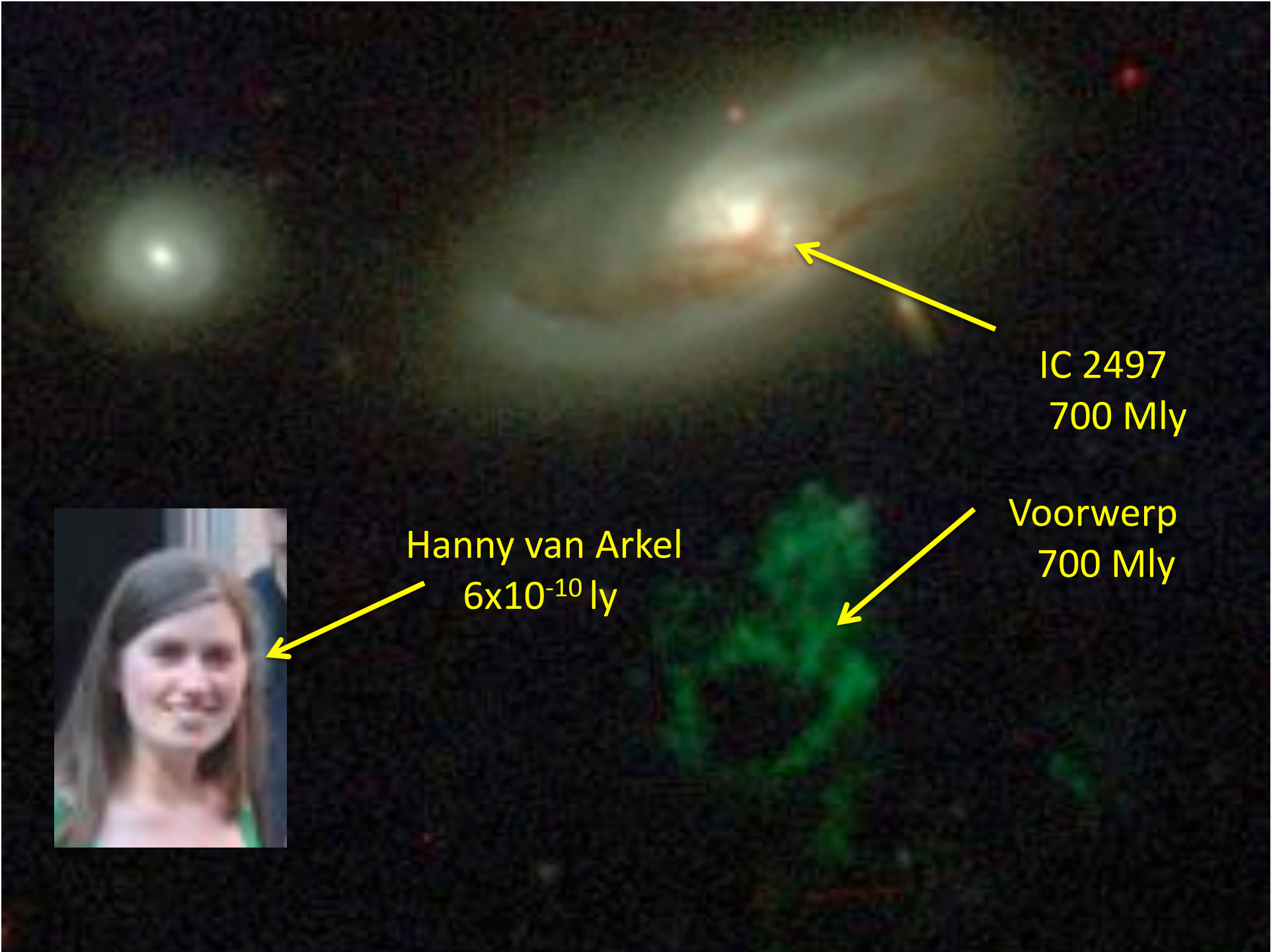




3.5m WIYN+OPTIC fast-guiding CCDs
0.45" FWHM

Preview of upcoming
Hubble data

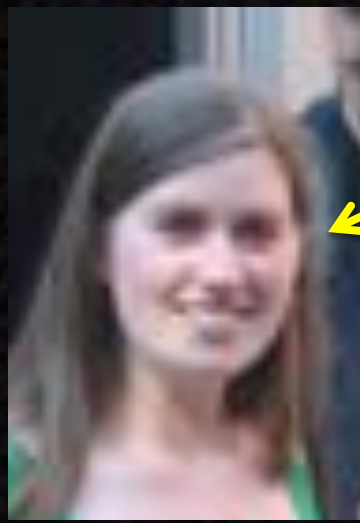


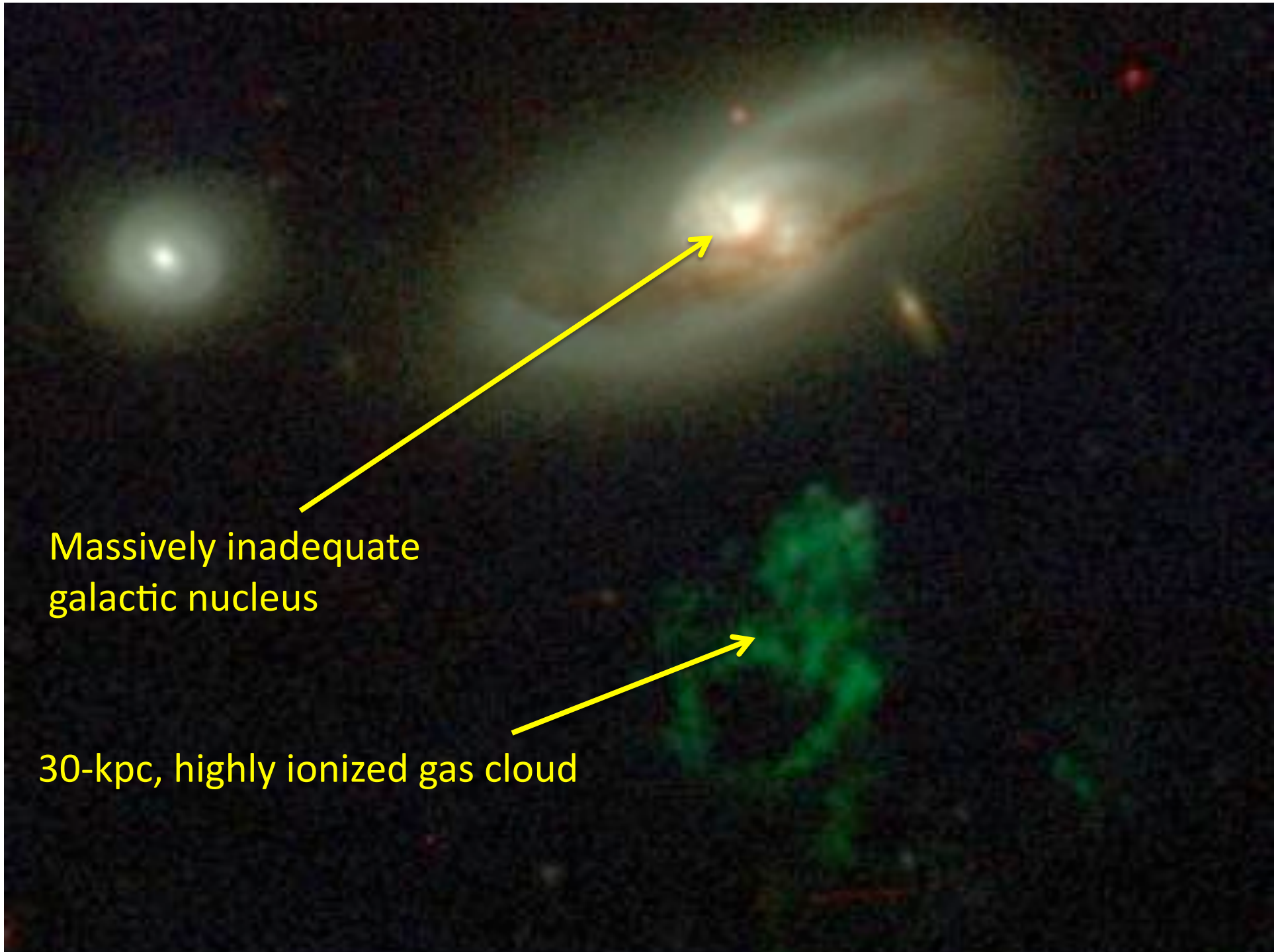


IC 2497
700 Mly

Voorwerp
700 Mly

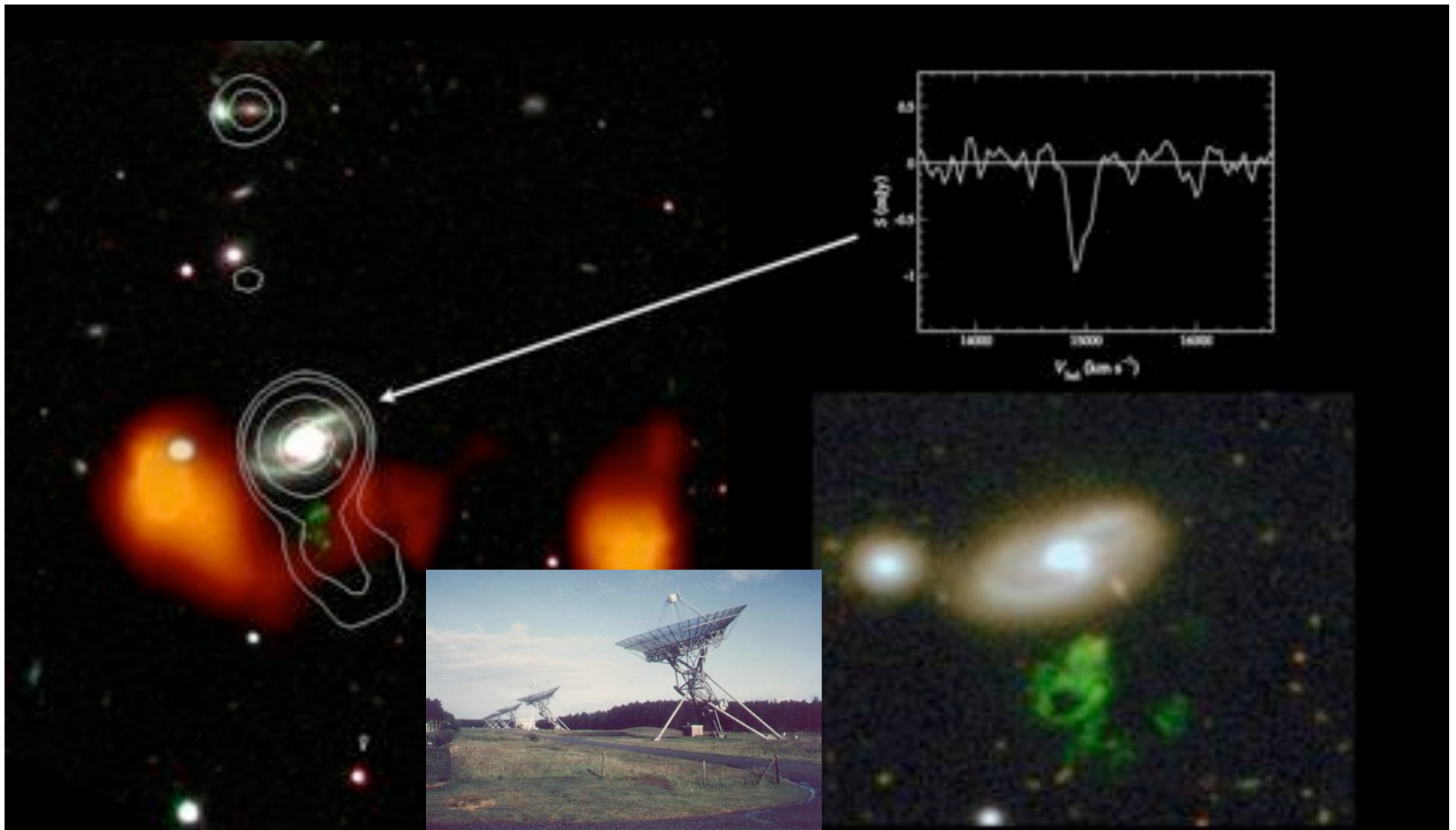
Hanny van Arkel
 6×10^{-10} ly





Massively inadequate
galactic nucleus

30-kpc, highly ionized gas cloud



WSRT results (Garrett et al. 2009): $5 \times 10^9 M_{\odot}$ H I arc (Voorwerp is an ionized part)
 relic of interaction?

Possible jet or outflow in this direction (clearing a path for radiation?)

H I absorption at core (which is a weak VLBI source): obscuration may be high

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updated 11:18 a.m. EDT, Thu August 7, 2008

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Armchair astronomer finds 'cosmic ghost'

Harry van Arkel was poring over photos of galaxies on the Internet last August when she stumbled across a strange object: a bright, gaseous mass with a gaping hole in its middle. Van Arkel is a schoolteacher in the Netherlands, not an astrophysicist. But her find — what some are calling a "cosmic ghost" — has captivated astronomers. [Full story](#)

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1:05



AC 300: The Shot
1:25

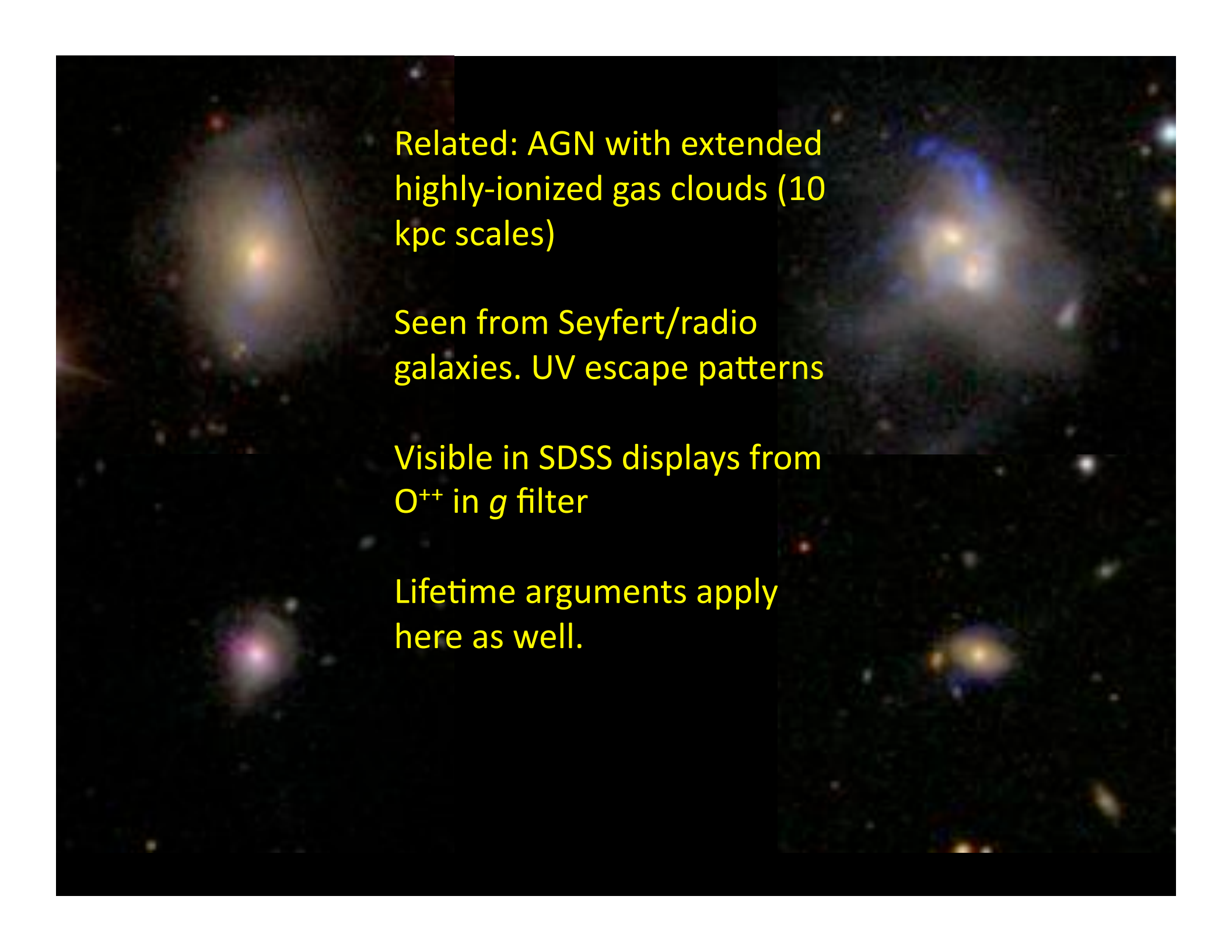


Las Vegas judge faces disciplinary hearing
LIVE

[LIVE: Today on iReport.com](#)


In progress from Bill's den: Dead Quasar Survey





Related: AGN with extended
highly-ionized gas clouds (10
kpc scales)

Seen from Seyfert/radio
galaxies. UV escape patterns

Visible in SDSS displays from
 O^{++} in g filter

Lifetime arguments apply
here as well.

Zooites can look for these!

- Finds from forum (recovered known ones)
- Specific call for more on forum/blog
- Targeted hunt: examine everything from Veron-Cetty/Veron AGN catalog at $z < 0.1$, everything with ~appropriate line ratios from SDSS. 16,000 galaxies, >10 views each. At least 3 people looked at all of them within a month! >100 candidates for spectroscopy.

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You Want to Play With Moon Craters?

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Nam egestas. Cras accumsan nibh vitae nibh. Nunc eget ipsum. Sed quis odio id ne, scelerisque elementum. Morbi euismod, massa sed porta tempor, arcu est venenatis.

MOON ZOO

Launch

This is MoonZoo

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Proin imperdiet, eros ac fermentum accumsan, odio odio dictum enim, id tincidunt enim tellus nec tortor. Nunc dictum ante non leo. Aliquam ipsum nibh, ultrices dignissim, ornare vel, rutrum id, lectus. Maecenas at metus. Quisque vulputate, purus vitae vulputate accumsan, augue diam porttitor massa, vel accumsan nisi arcu eget nisi. Donec posuere rutrum dul. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas.

Latest Moon Blogs

Lorem ipsum dolor sit amet, consectetur

Adipiscing elit. Proin imperdiet, eros ac fermentum accumsan, odio odio dictum. [MORE >](#)

Tincidunt enim tellus nec tortor.

Nunc dictum ante non leo. Aliquam ipsum nibh, ultrices dignissim, ornare vel, rutrum id, lectus. [MORE >](#)

Maecenas at metus. Quisque vulputate

Purus vitae vulputate accumsan, augue diam porttitor massa, vel accumsan nisi arcu eget nisi. Donec posuere rutrum dul. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas.

Play With Craters

Launch

[MORE INFO](#)



Apollo Search

Launch

[MORE INFO](#)

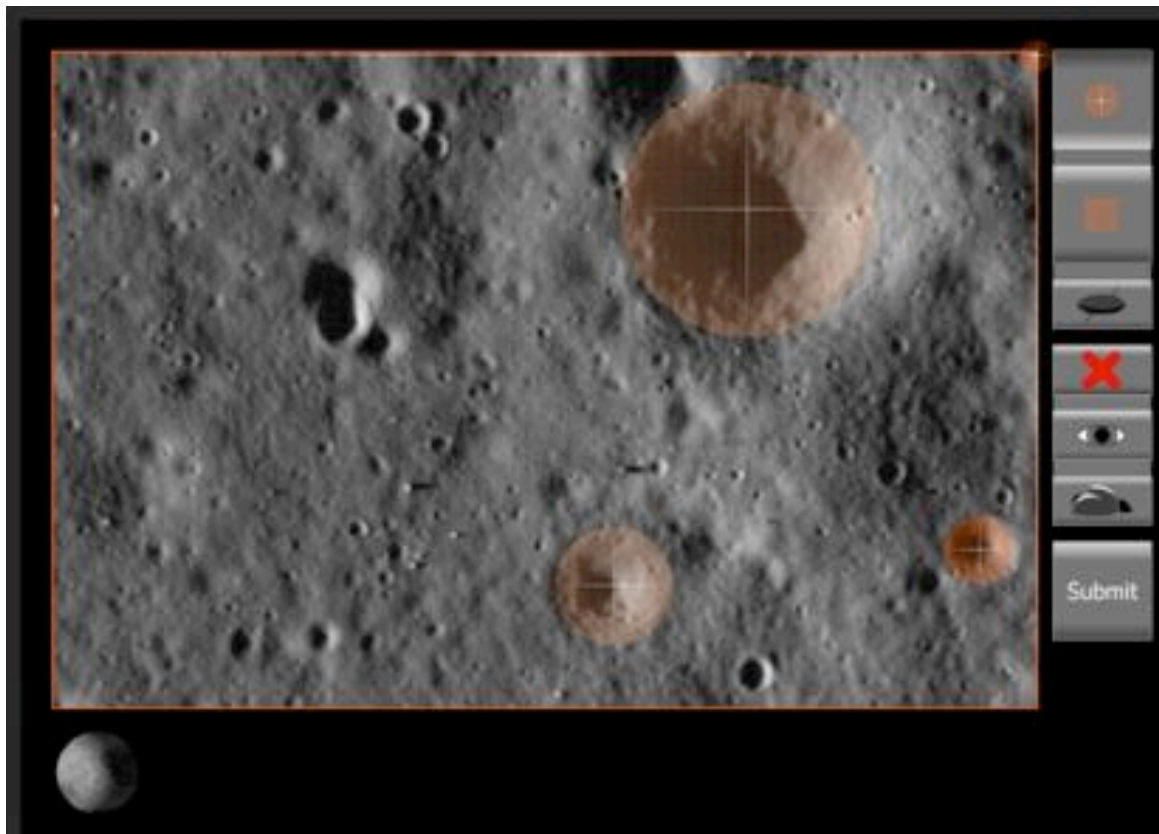


Boulder Wars

Launch

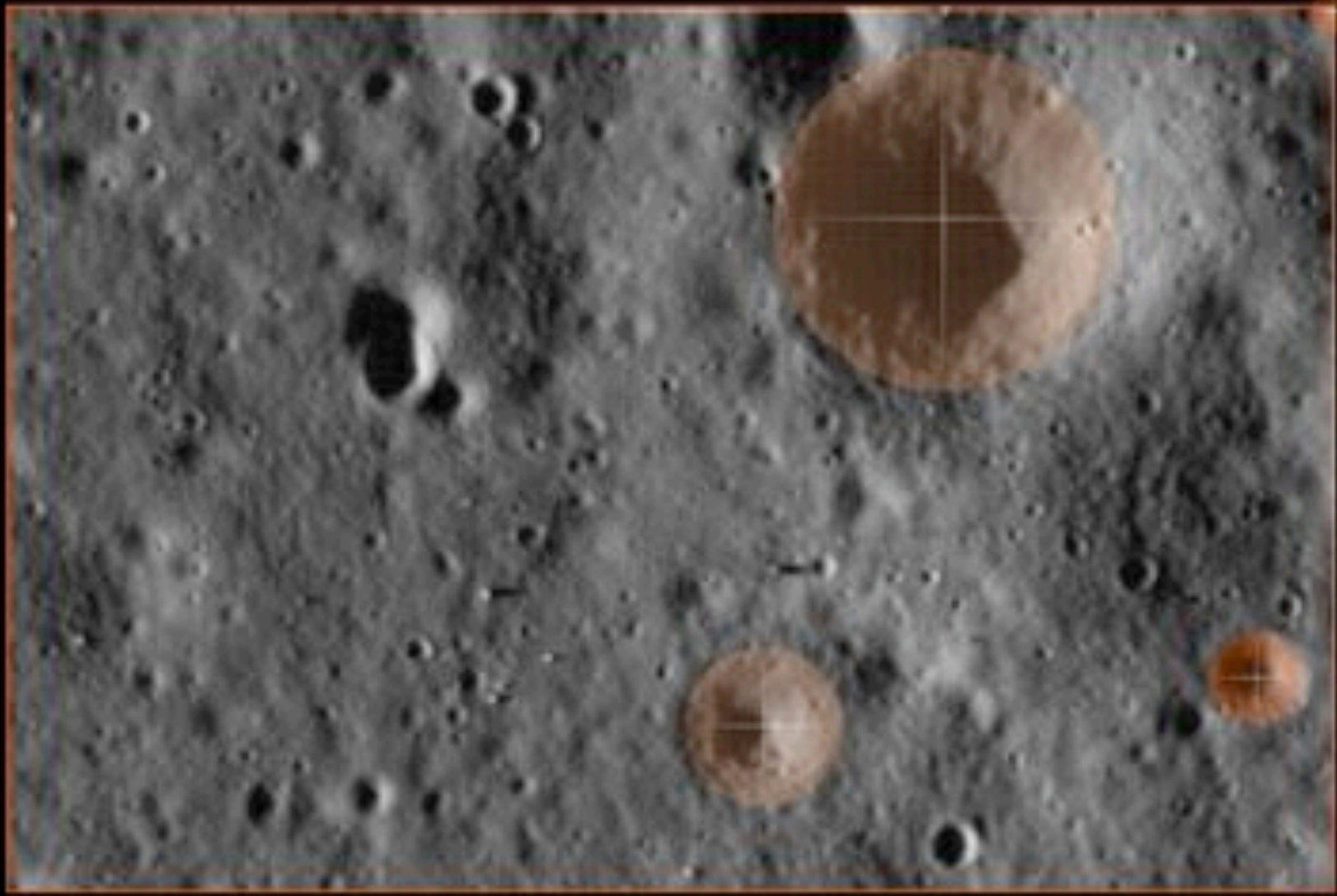
[MORE INFO](#)





Instructions

- To annotate craters: Select the circular crater tool, move to the centre of the crater, then click and drag out to the size of the crater. Click the crater tool again or press escape to stop placing craters.
- To annotate areas of interest: Select the square tool, move to one edge of the area and click and drag over the area. Choose a type of area from the menu that appears. Click the area tool again or press escape to cancel placing an area.
- To edit an annotation: Click and drag to move it, or click and drag a handle to scale or rotate it. Use the cursor keys to make fine adjustments to an annotation's position.
- To show or hide all annotations, click the top eye button. This button will show all annotations if any are hidden.
- To delete an annotation, click the red X button, or press the backspace key.
- To show or hide the selected annotation, press the bottom eye button.
- To mark a crater as bouldered, select the annotation and click the boulder button. A mark will appear on any crater annotations marked as bouldered.
- Once you're done, click the Submit button. If you're happy with all of your annotations, confirm by clicking the green tick button.



A vertical toolbar with several interactive elements:

- A button with a small orange plus sign (+).
- A button with a small orange square.
- A button with a small black oval.
- A button with a red 'X' symbol.
- A button with a small black circle and a white dot inside.
- A button with a small black arc.
- A button labeled "Submit".



ZOO niverse



The limits are no longer in hardware, nor software, but in wetware. This is just as true for professionals...



It's a big Universe out there!



It's a big Universe out there!

....but all together we can grok more of it.





It's a big Universe out there!

....but all together we can grok more of it.

www.galaxyzoo.org



Special thanks to:

Ian Mclenahan - Michael Forrest

Scott Schell - Chris Dackombe

Henri Kerko - Stuart Simpson

Lea Lindstrom - Pierre Rhéaume

Jason M George - T.C. Johnston

plus 250,000 others

Where can I start?

- www.stsci.edu
- SOHO data: <http://sohowww.nascom.nasa.gov/data/>
- skyview.gsfc.nasa.gov
- Minor Planet Center: <http://cfa-www.harvard.edu/iau/mpc.html>
- www.sbig.com
- registax.astronomy.net
- quasars.org
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