

iPTF and ZTF

IPAC Data Systems

George Helou for

Jason Surace, Russ Laher, Frank Masci, Eran Ofek,
David Levitan, Branimir Sesar et al

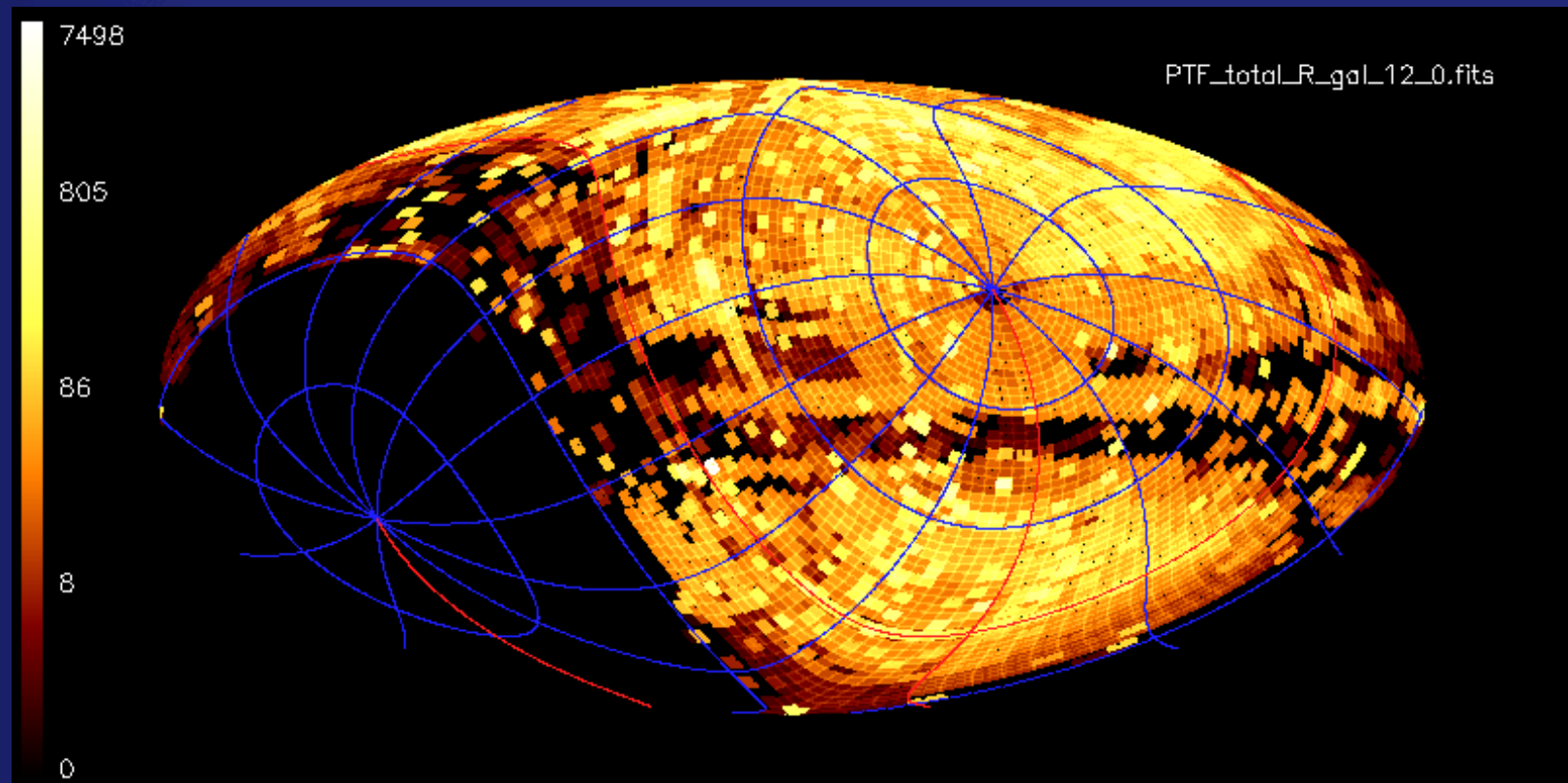
Stockholm, June 5, 2014

OUTLINE

- iPTF Data Reminders
- High-Fidelity Lightcurve Pipeline
- Reference Image and Catalog Pipeline
- Real-Time Processing
- PTF Archive at IRSA (IPAC)
- ZTF Data Processing

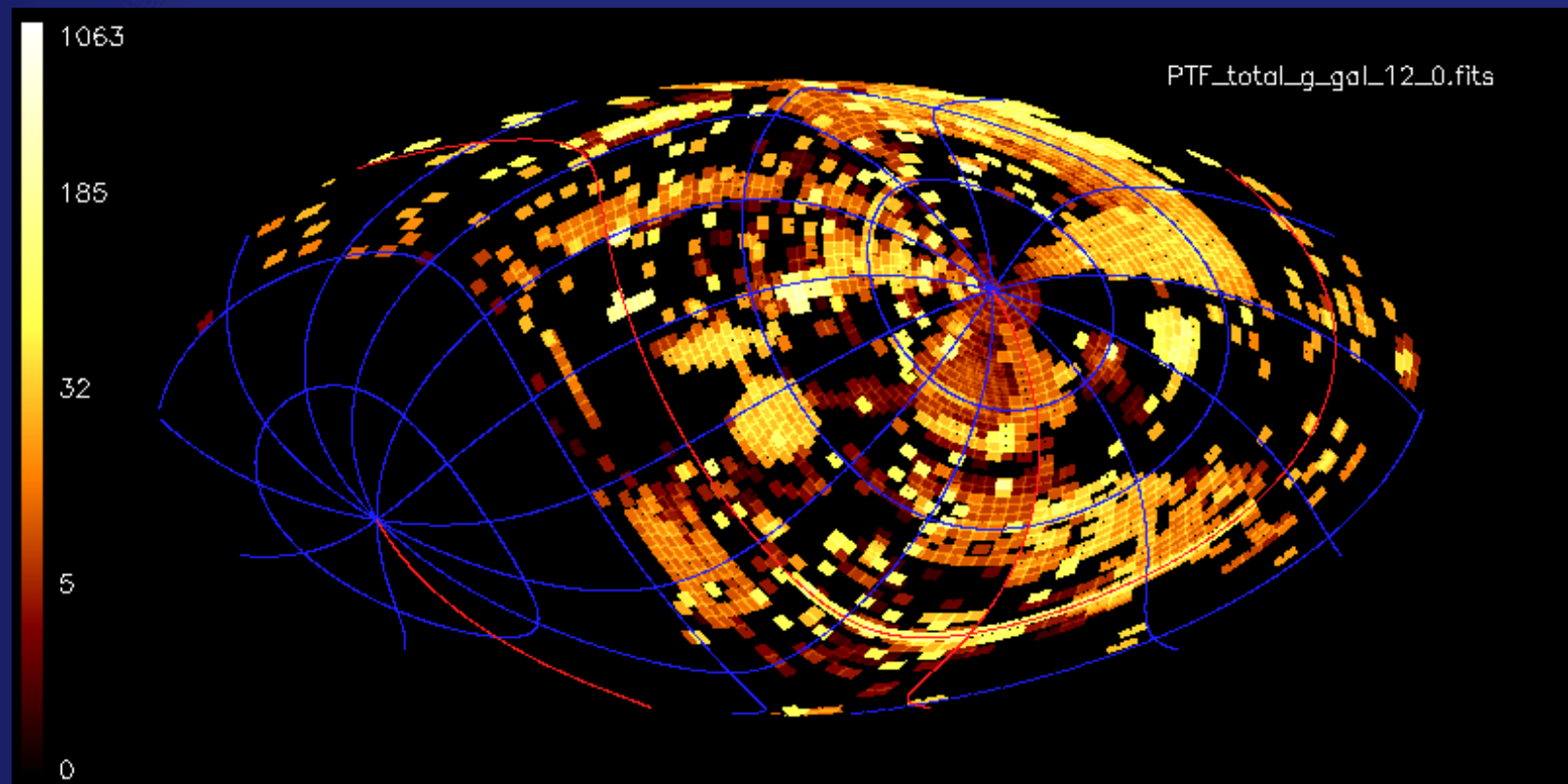
IPAC is the data processing and archiving center for PTF,
iPTF, ZTF

R-band



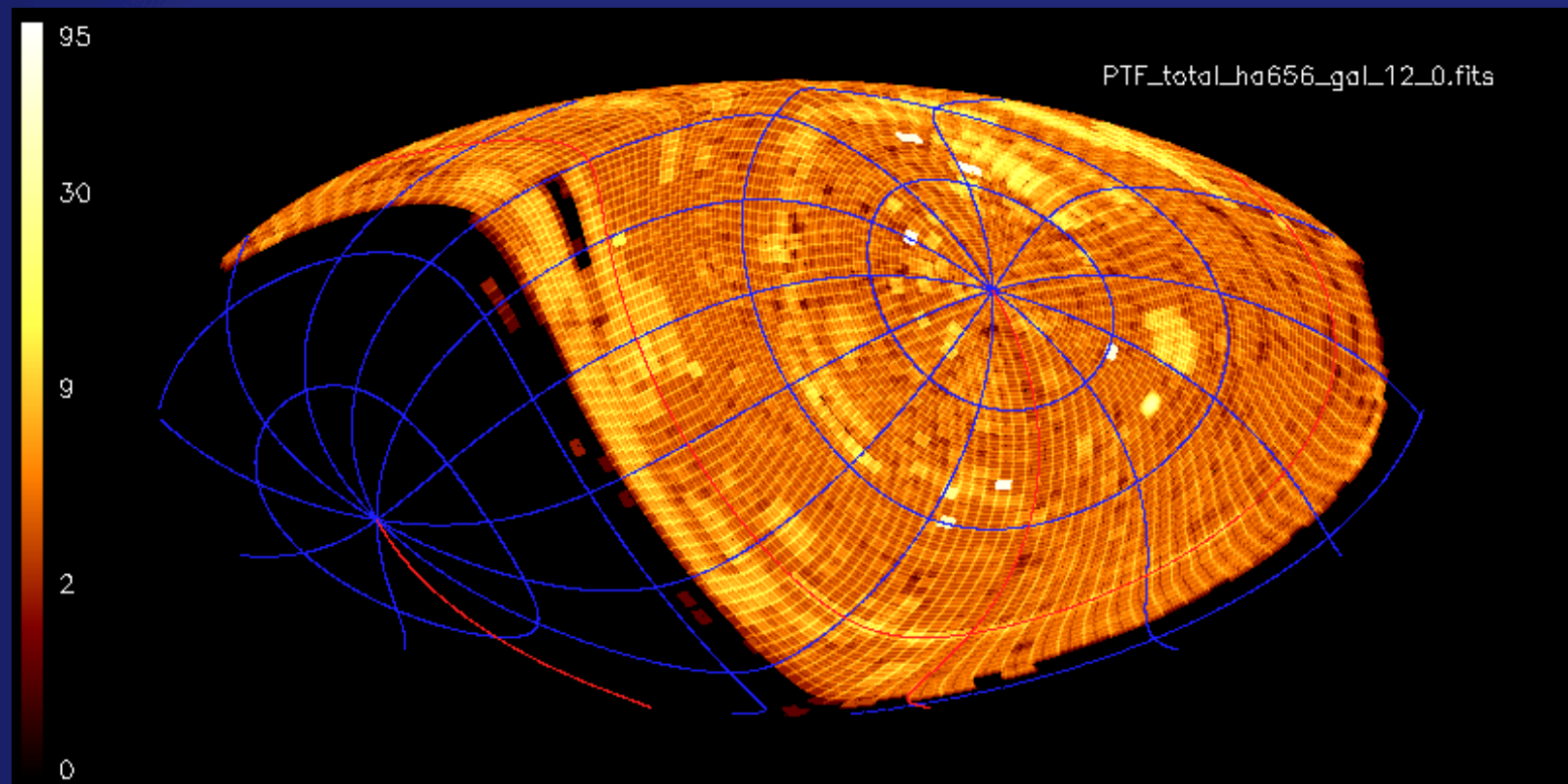
1203 nights, 259401 pointings, 2.9 million images

g-band



223 nights, 40742 pointings, 448k images

H-alpha



100 nights, 13055 pointings, 143k images
Completely unique survey; 2 filters(on and off line)

Some Basic iPTF Stats

- Limiting Magnitude: 20.5 @R, 21.5 @g in one shot.
- Saturation: 14 @R
- Typical Resolution: 2" median (can't get much better)
- Area per shot: 7.7 square degrees
- Shots per night: 150-250 (1000-2000 square degrees)
- Cadence: hours and days
- Astrometric Calibration: 0.25"
- Photometric Calibration: 2-3% absolute, millimag relative
- Turnaround time: image subtraction and transients (20 minutes), high-fidelity reduction (1-2 days), light curves (weeks)
- Products: Images, catalogs (aperture, psf-fit), source association, etc. Deep coadds

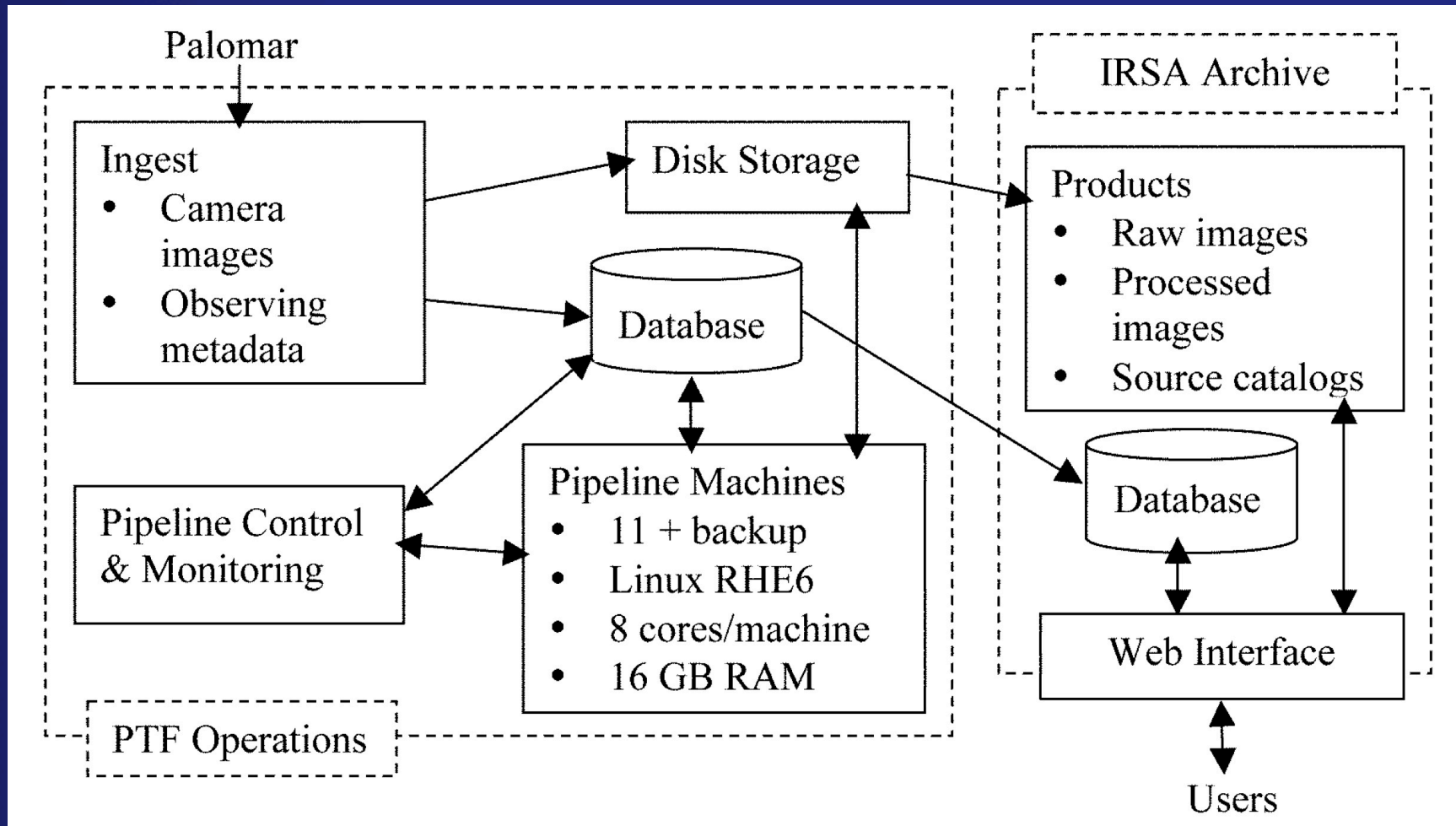
PTF High-Fidelity Lightcurve Pipeline

Laher et al 2014, PASP in press <http://arxiv.org/abs/1404.1953>

- Data streams from Palomar->San Diego->Cahill->Morrisroe.
- At end of night, generates calibration files such as flats, biases, etc
- Reduces science images in standard fashion (trimming, bias subtraction, flat-fielding). Masks, etc. generated.
- Images are calibrated directly against UCAC3 and SDSS, or a nightly calibration (tied to SDSS) used for non-SDSS overlap fields
- Final image data product is a photometrically and astrometrically calibrated CCD image.
- All calibrated sources are extracted and registered in a “sources” database.
- All epochal source detections are merged into a “merged sources” database. More processing yields relative calibration at milli-mag levels
- Data are passed on to IRSA to enable access

PTF High-Fidelity Lightcurve Pipeline

Laher et al 2014, PASP in press <http://arxiv.org/abs/1404.1953>



PTF High-Fide

- Combination of software from community, from pre-existing IPAC pipelines, and newly designed with PTF/iPTF team

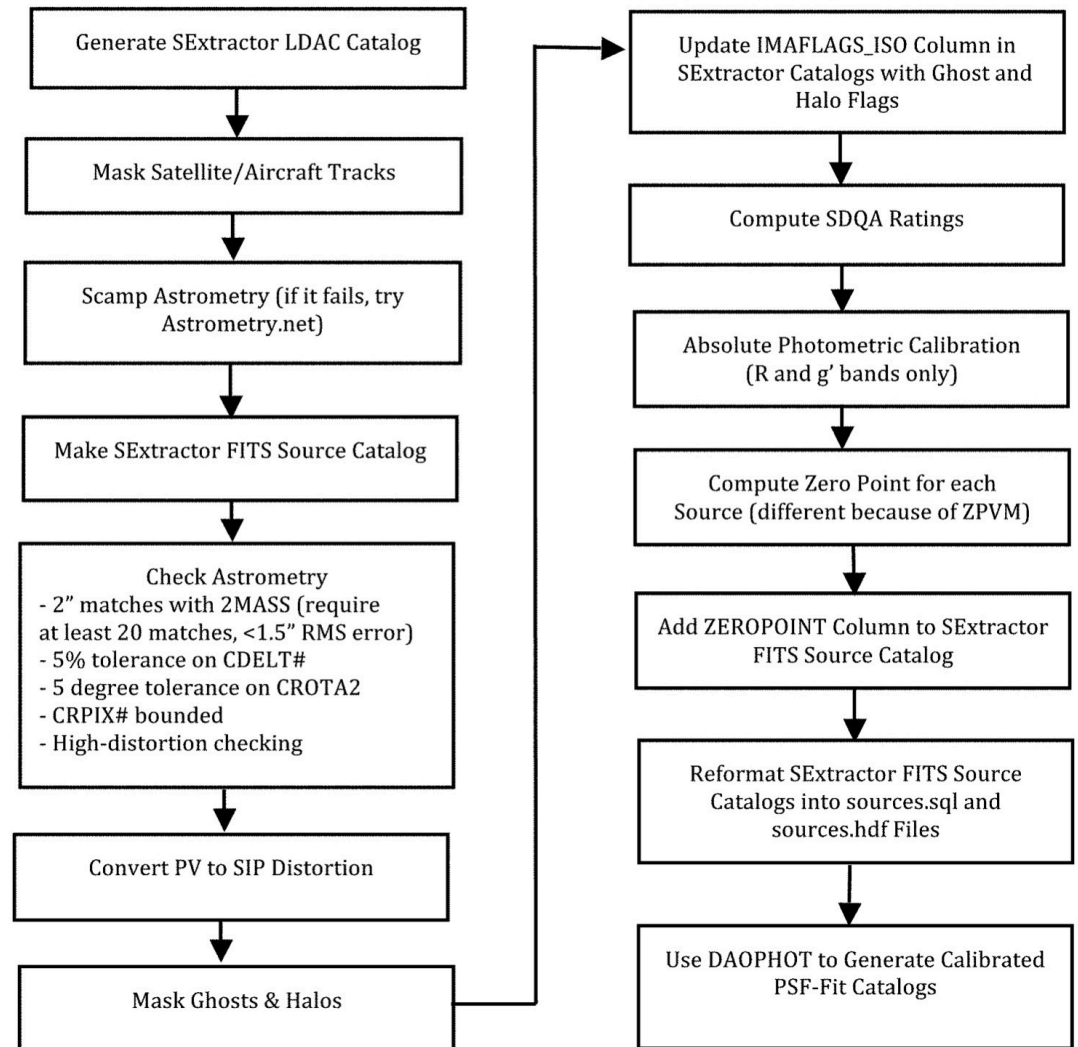


Fig. 7.— Flowchart for the frame-processing pipeline.

PTF High-

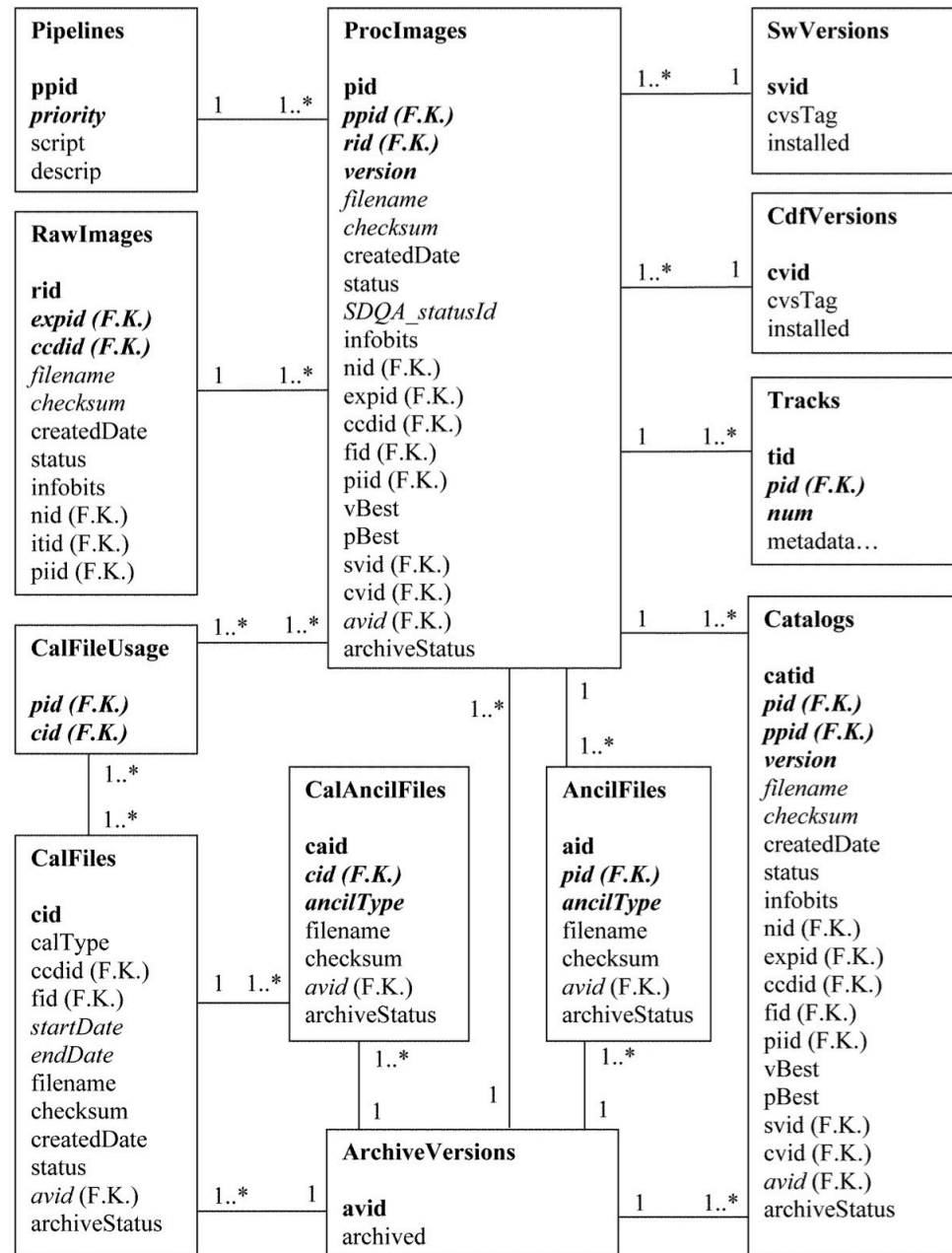
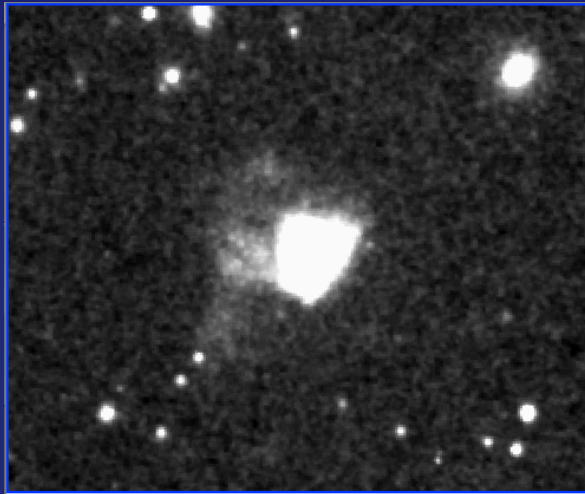


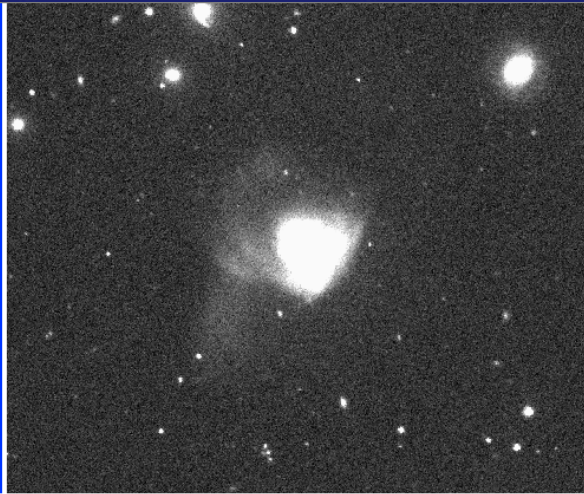
Fig. 4.— IPAC-PTF database-schema design for the pipeline image processing (see §9). The figure nomenclature is explained in the caption of Figure 3.

Image Quality

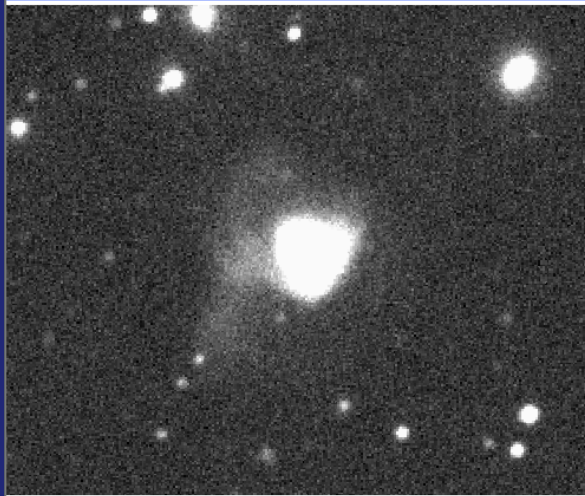
DSS



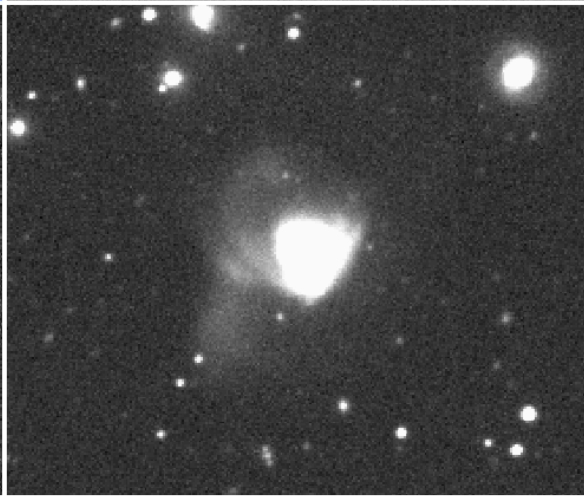
SDSS



Single 60 sec
PTF Exposure



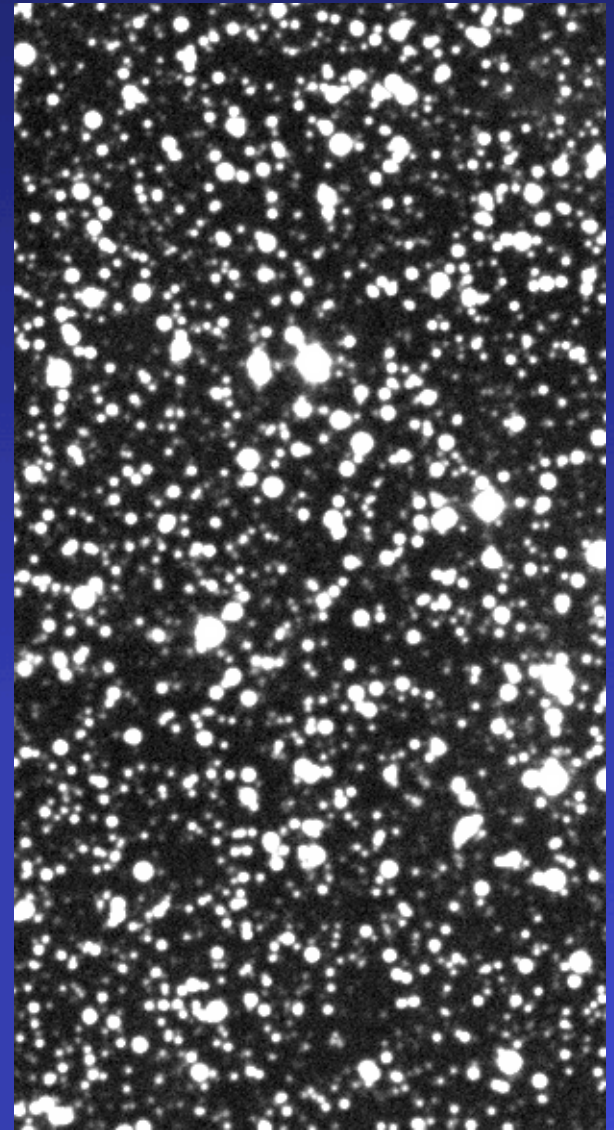
Coadd of 10
PTF Exposures



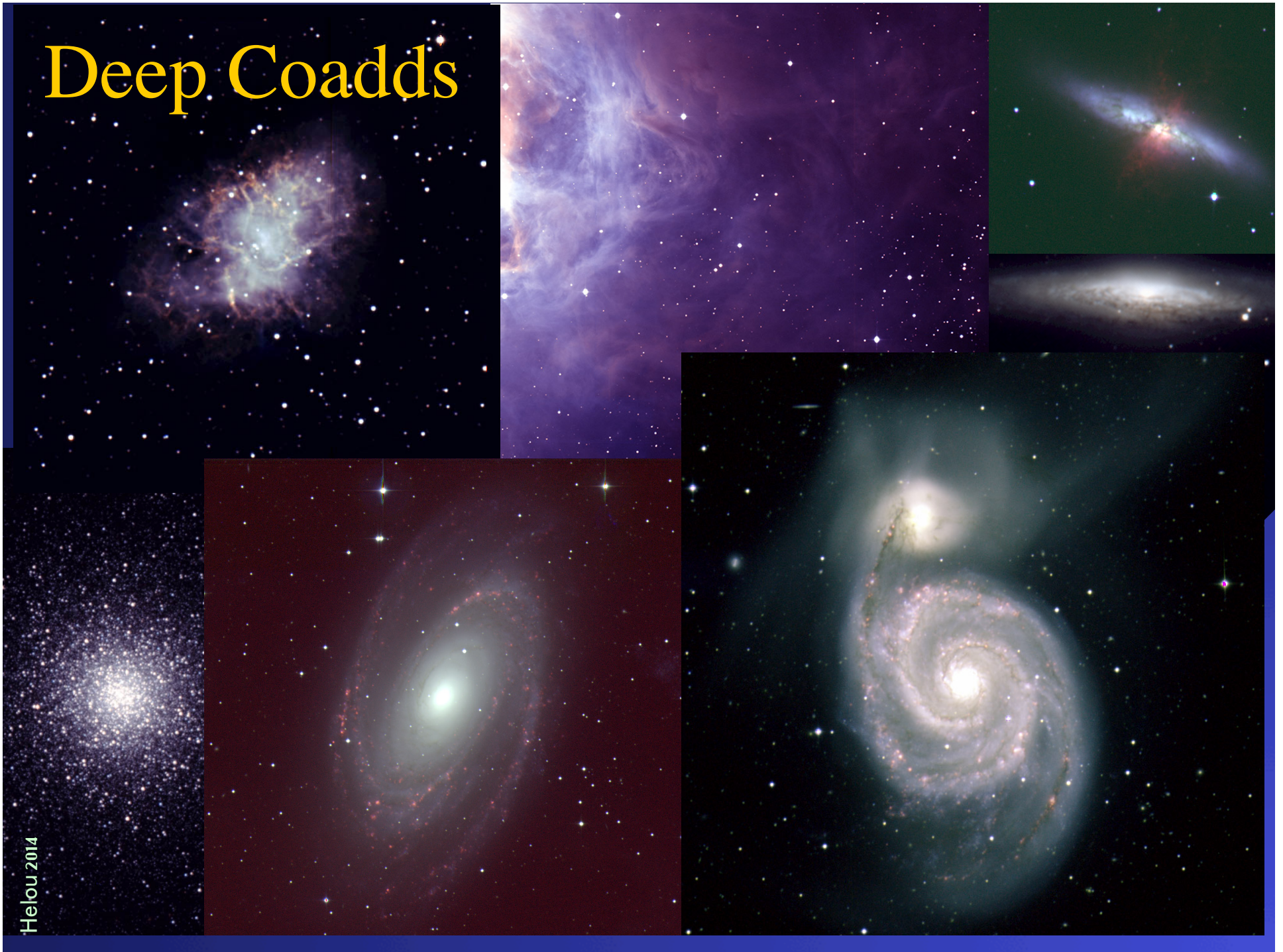
Arp 220. Can you see what's different?

Reference Image and Catalog Pipeline

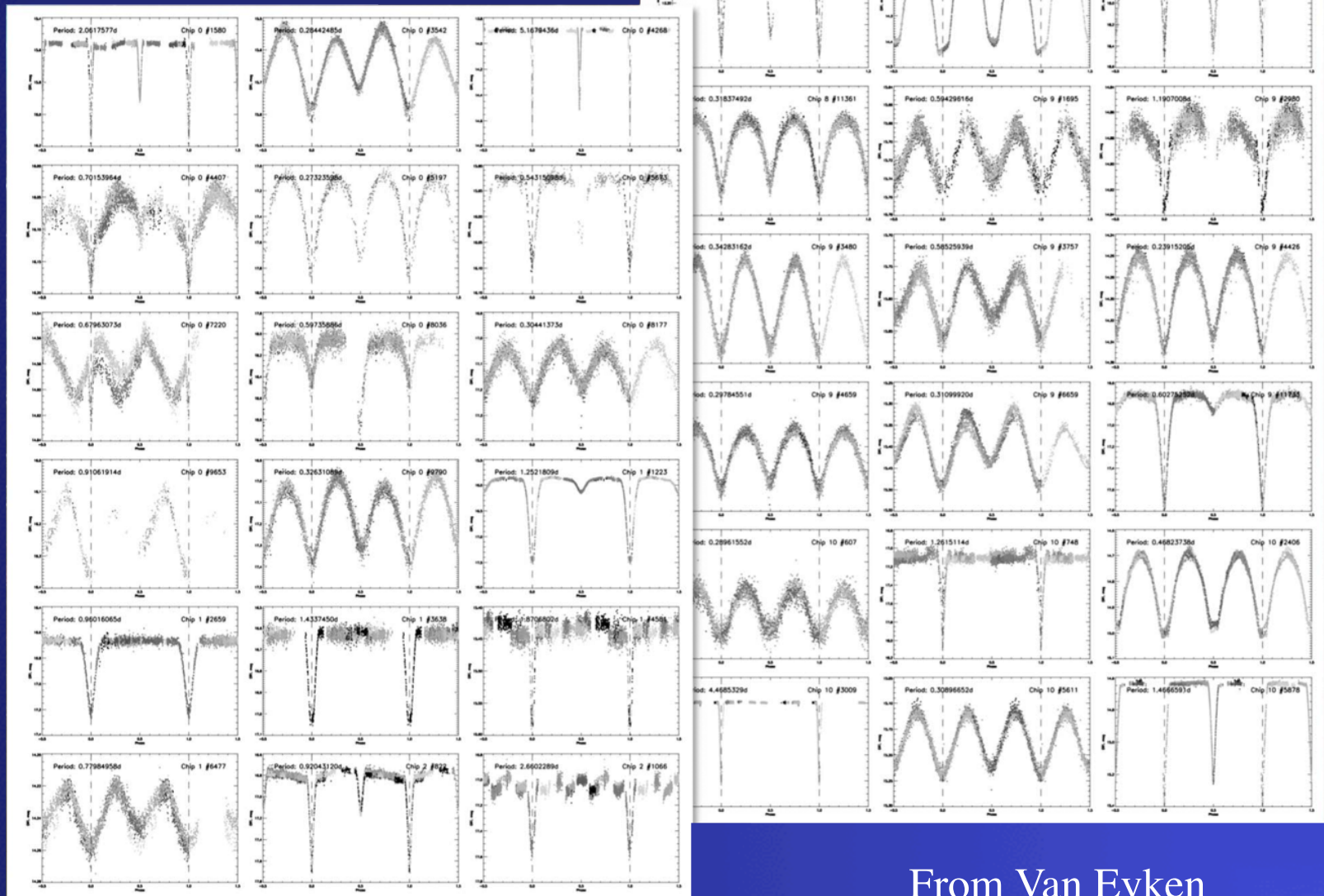
- Deep coaddition of the epochal data, with proper weighting and image selection. Derivation of “reference catalogs”, i.e. stationary sky.
- This drove a lot of development effort for achieving near 100% reliability on the frame-level products.
- Critical for image subtraction and light curve generation
- IPAC products are sufficiently superior to their forerunners that LBL now uses these reference images for the real-time image subtraction pipeline.



Deep Coadds

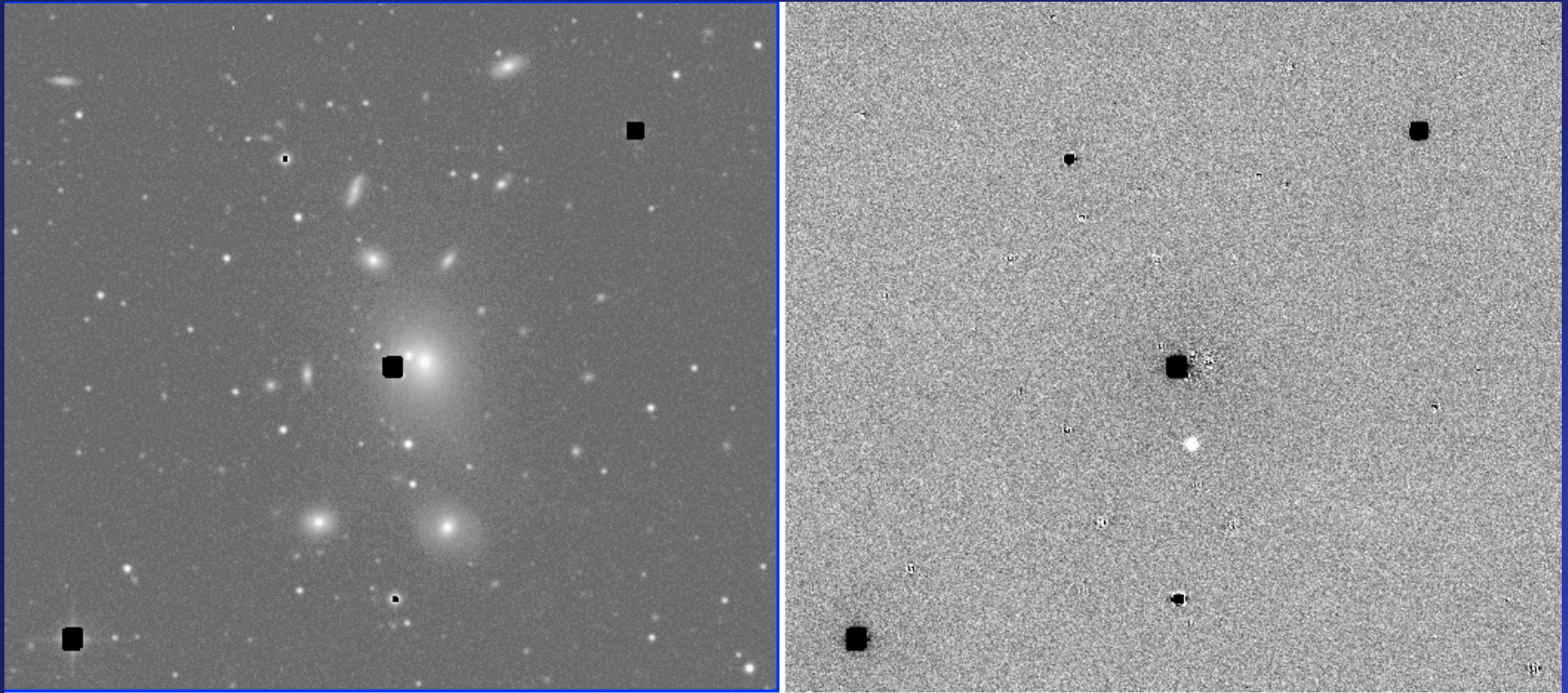


Binary light curves taken from PTF processed images in Orion. Data can be calibrated to near-millimag precision at bright end.



From Van Eyken

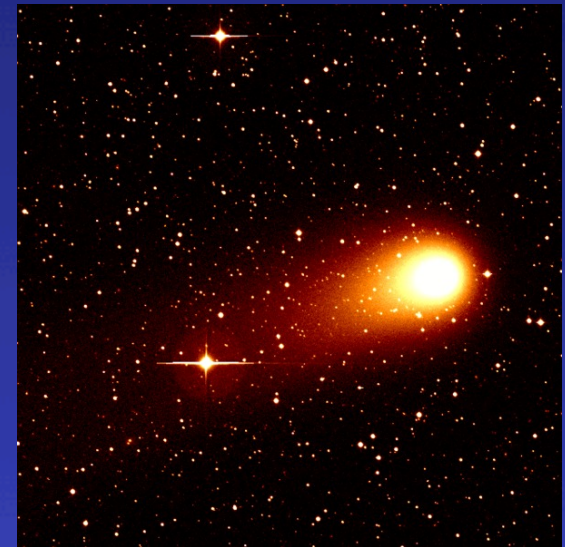
Real-Time Image Subtraction and Transient Detection



- Currently running at NERSC, real-time image subtraction, transient detection, and machine-learning candidate vetting.
- New version developed and running now at IPAC, includes NEO specialized software.
- Real-time alert and delivery system under development for GRBs, with goal of 20-minute turnaround time. Basis for general real-time engine.

Asteroids, NEOs, and Comets

- Cf. earlier talk by Tom Prince
- Stable system in place to find nearby, fast moving objects (arcseconds per minute).
- New products locate streaks, based on difference imaging, tracklet construction software, and now machine-learning based candidate vetting.
- Feeds objects to minor planet center.



Comet Garradd

PTF Archive at IRSA

The Palomar Transient Factory - Search by Position

http://kanaloe.ipac.caltech.edu/applications/ptf/#id=Hydra_ptf_ptf_11&DoSearch=true&intersect=CENTER&mcentr

Wikipedia MSNBC Salon IDLAstro ADS Spitzer Sci Life News Fitbit

IRSA NASA / IPAC Infrared Science Archive

IRSA Mission Archive Search Related Data Archives Tools & Services Help

Searches History Preferences Help Catalogs Plot Layers Background Monitor

Search by Position m1; Type=CENTER

Level 1 Data

Prepare Download 1 of 1 (1 - 41 of 41) as Text Save Add filters

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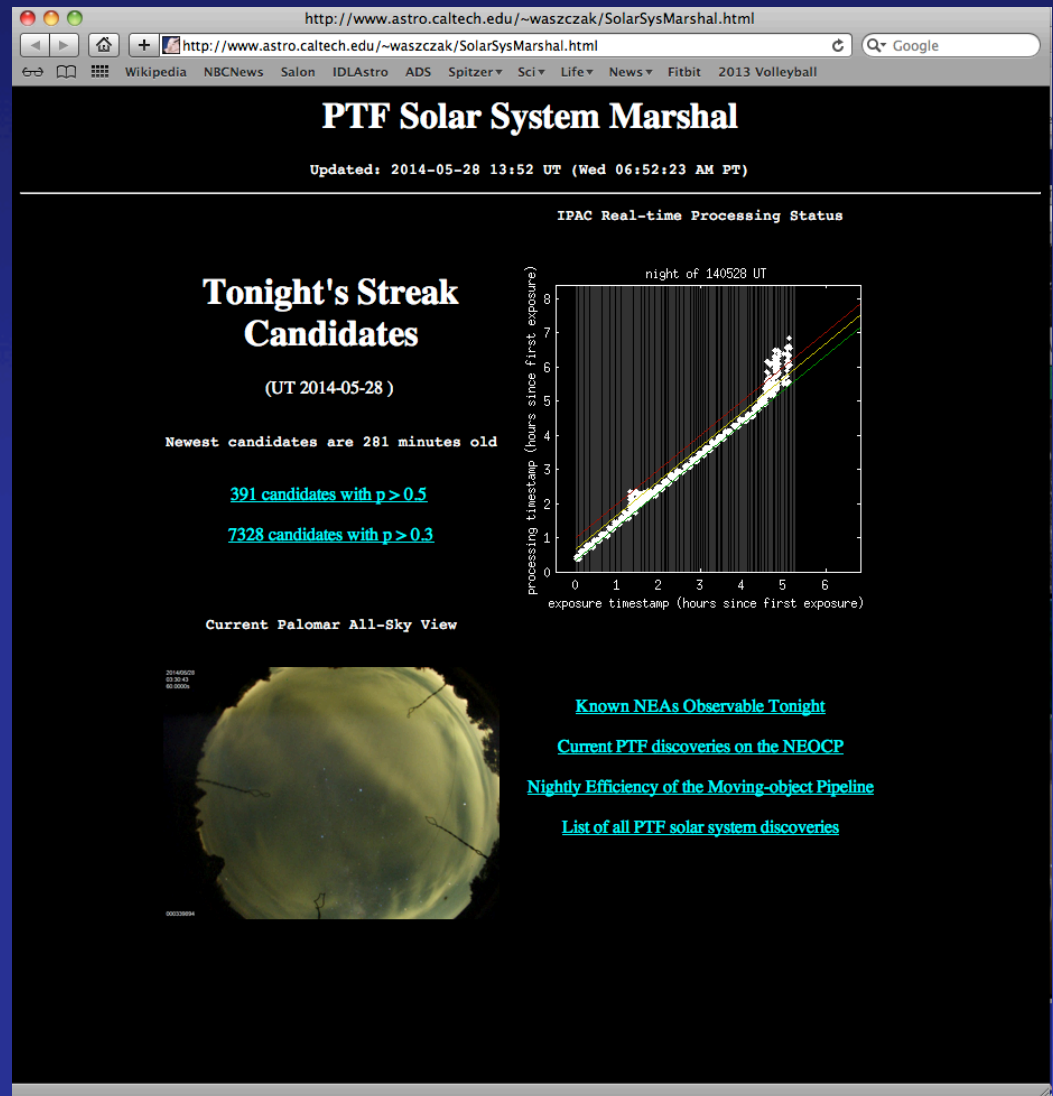
Display a menu

L1 Image Coverage

PTF Level 1 Image 1/xx

Data products can be searched and retrieved via sophisticated GUI tools and also through an application program interface that allows integration of the archive into other, 3rd party software.

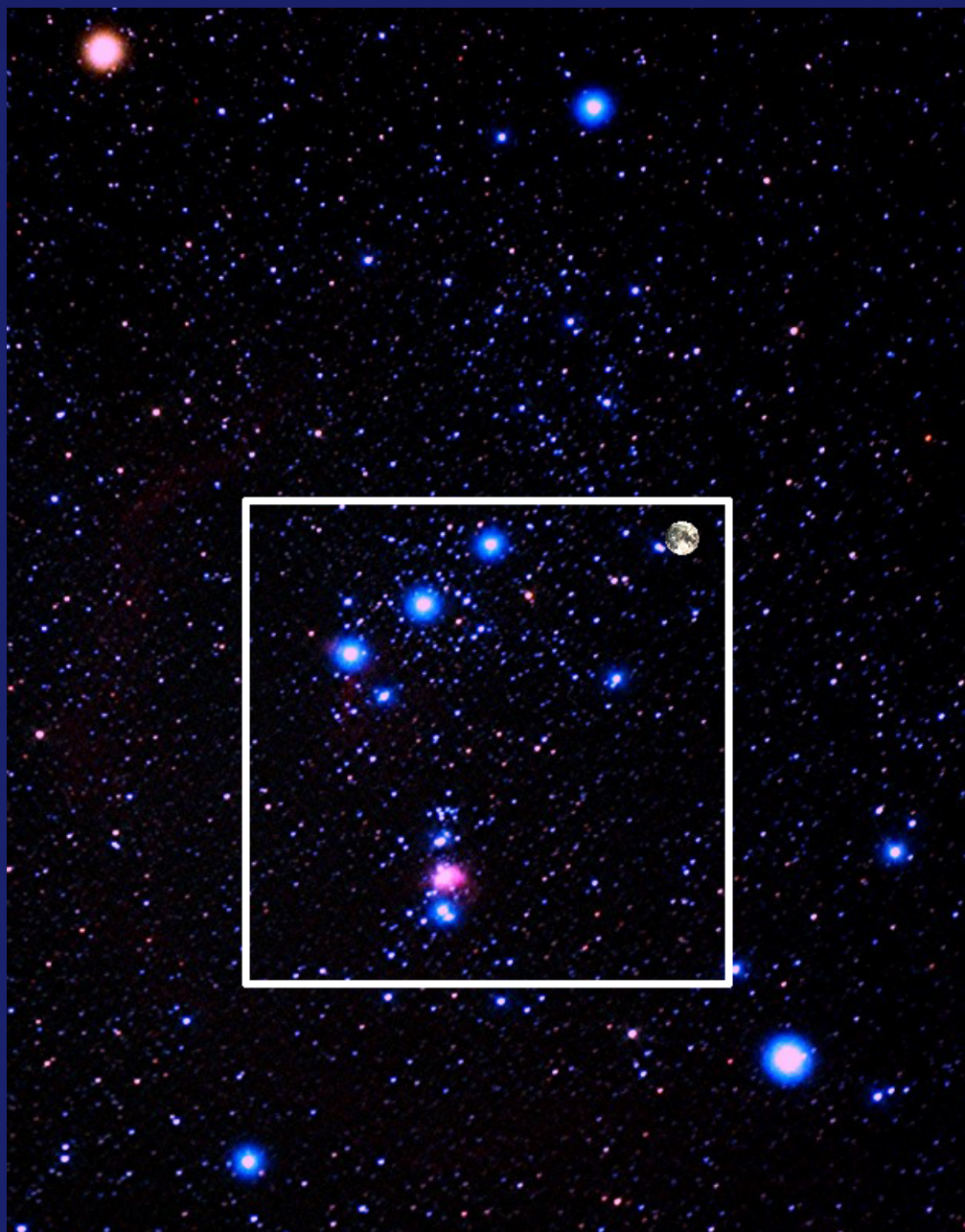
There are also three “marshals” resident at Caltech (extragalactic, galactic, and solar system), which are essentially science portals, and similar to the “brokers” envisaged for LSST.



Prototype solar system marshal under development by Adam Waszczak.

ZTF is very similar, but a

*whole lot
more of it.*



For illustration,
here's Orion.

The white box is the
ZTF imaging area.

The moon is in the
upper right corner
of the white box.

Planning for ZTF Data Processing (1)

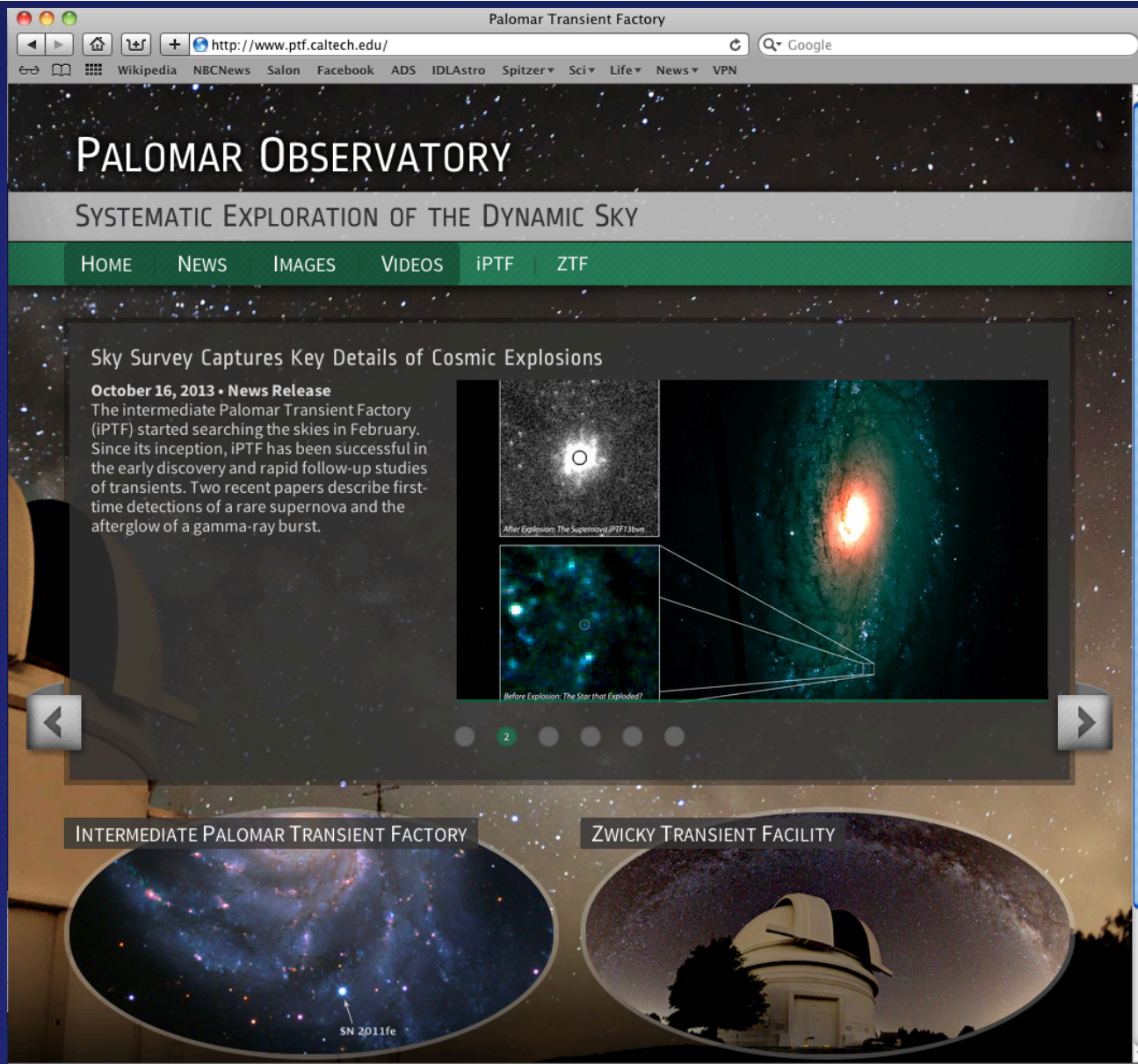
- All software components carried over from iPTF, which is really the prototype system.
 - Real-time & photometric pipelines, calibration, source extraction, deep co-adding, archiving, etc
- Significant software work needed to adapt image algorithms to new, larger format detectors
- Significant effort also needed for testing, tuning, validation with real data
- Primary technical challenge is data I/O (throughput) with more than an order of magnitude increase in data flow.

Planning for ZTF Data Processing (2)

- Scale-up required is estimated at x15
 - 0.5-1 PB/year of processed data products.
 - Storage needs scale by same factor
- Baseline drone farm of 128 computers projected for steady-state dataflow, vs 11 for iPTF
 - Smaller drone farm for ad-hoc science processing.
- Currently working on network engineering, finalization of software components, and development of external data interfaces.

FINIS

IPAC is the data processing and archiving center for PTF,
iPTF, ZTF



We have also built this top-level web page for public consumption.

ASTROPHYSICS LIBRARY
CALIFORNIA INSTITUTE OF TECHNOLOGY

CATALOGUE
OF
SELECTED COMPACT GALAXIES
AND OF
POST-ERUPTIVE GALAXIES

prepared by
F. Zwicky
California Institute of Technology
Carnegie Institution of Washington
with the collaboration of
Margrit A. Zwicky

Objects HADES in the centers of compact clusters of galaxies

It may be conjectured that very compact galaxies may ultimately collapse into configurations of the type of objects HADES ΩH , thereby losing most of their effective

a. Dwarf, Pygmy and Gnome Galaxies

* The use of directed intuition is one of the various procedures of the Morphological Approach to Thought and Action that I have developed during the past few decades and which has been more fully applied in the books listed in the appended bibliography.

A Reminder to the High Priests of American Astronomy
and to their Sycophants

"The scholar's mission requires the study and examination of unpopular ideas, of ideas considered abhorrent and even dangerous.

"Timidity must not lead the scholar to stand silent when he ought to speak.

"In matters of conscience and when he has the truth to proclaim the scholar has no obligation to be silent in the face of popular disapproval.

Dear Dr. Zwicky:

We sincerely regret our inability to publish the enclosed communication, COMPACT GALAXIES, which was submitted as a Letter to the Astrophysical Journal. Communications of this character are outside the scope of this Journal.

Yours sincerely,

S. Chandrasekhar
S. Chandrasekhar - also
Managing Editor

The Venerable Palomar 48-inch Telescope



* Do NOT smoke in the dome, unless you are a sexier version of Edwin Hubble!