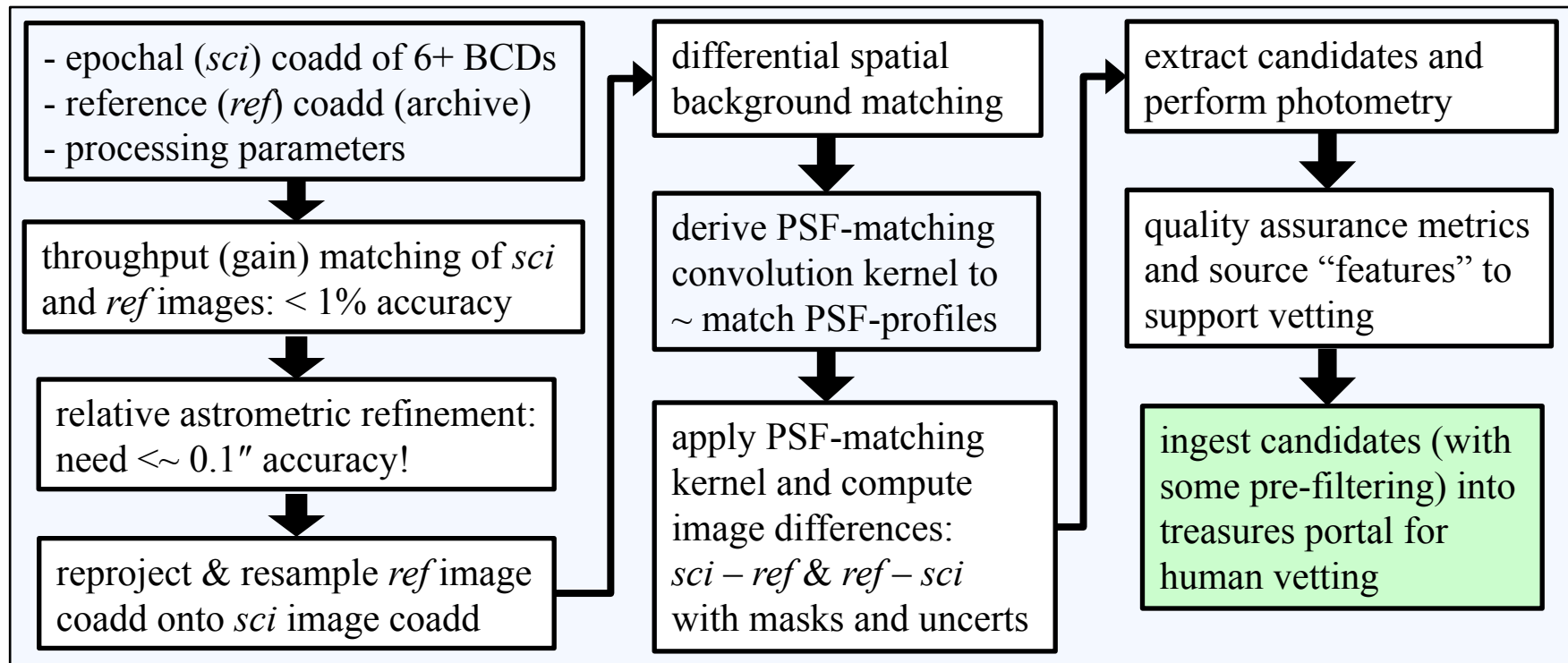# SIDE: SPIRITS (or *Spitzer*) Imaging Differencing & Extraction pipeline

- **Goal of image-differencing:** discover transients by suppressing everything that's static in space & time
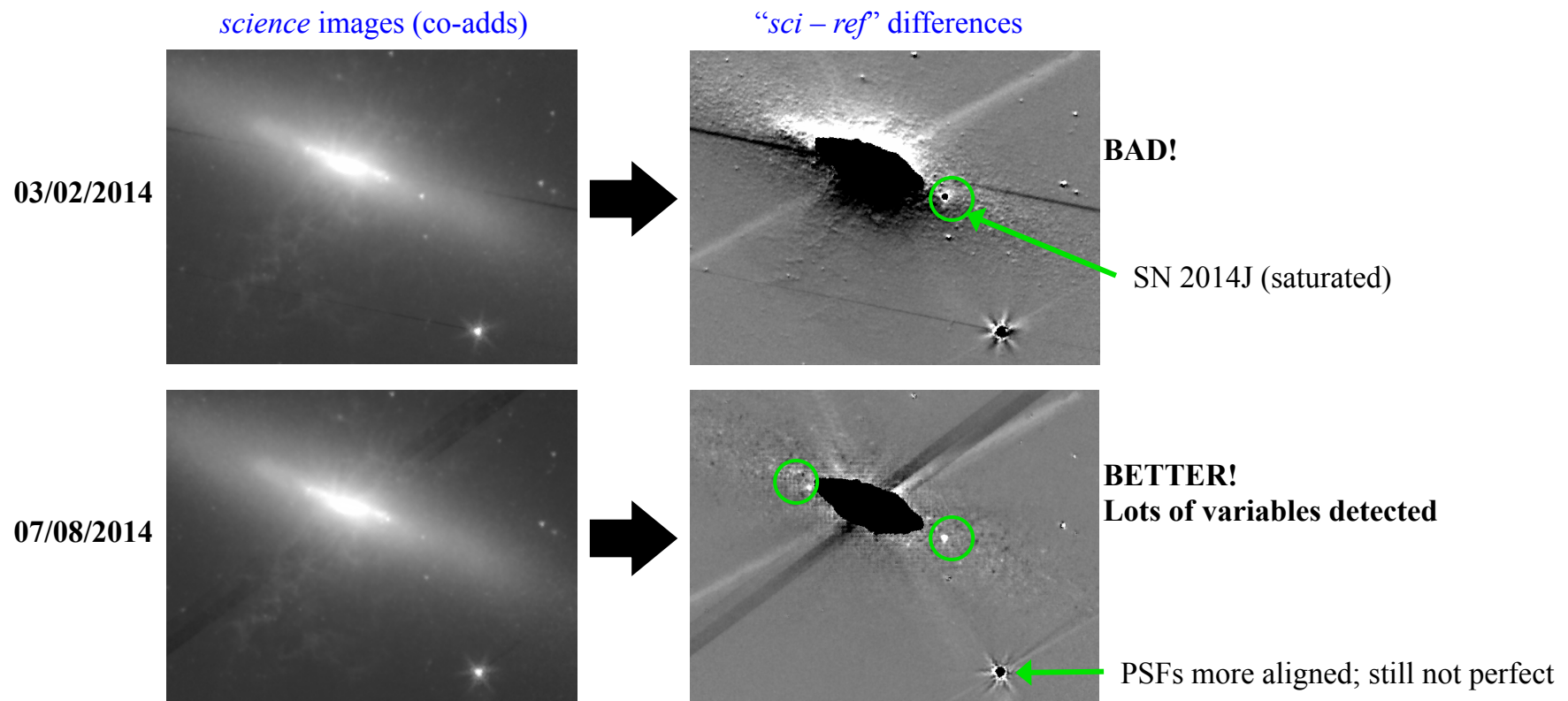- Pipeline adapted from a <u>very early</u> version of the *PTF* pipeline, i.e., before enhanced/tuned for *iPTF*

- epochal (*sci*) coadd of 6+ BCDs
- reference (*ref*) coadd (archive)
- processing parameters

↓

throughput (gain) matching of *sci* and *ref* images: < 1% accuracy

↓

relative astrometric refinement: need <~ 0.1″ accuracy!

↓

reproject & resample *ref* image coadd onto *sci* image coadd

→

differential spatial background matching

↓

derive PSF-matching convolution kernel to ~ match PSF-profiles

↓

apply PSF-matching kernel and compute image differences: *sci − ref* & *ref − sci* with masks and uncerts

→

extract candidates and perform photometry

↓

quality assurance metrics and source "features" to support vetting

↓

ingest candidates (with some pre-filtering) into treasures portal for human vetting

More details in:

http://web.ipac.caltech.edu/staff/fmasci/home/miscscience/ptfide-v4.0.pdf

1

Why so many artifacts?

- Difference-image quality is at the mercy of good astrometric calibration, photometric-gain matching, and PSF-matching between the *science* and *reference* images.
- PSF-matching is severely affected by camera/instrument rotation between epochs – a given for *Spitzer*
  - ➢ particularly challenging for IRAC due to complex asymmetric PSFs and undersampling (less-so in coadds)
- Here's M82 at two epochs:

science images (co-adds)   "*sci – ref*" differences

03/02/2014

BAD!

SN 2014J (saturated)

07/08/2014

BETTER!
Lots of variables detected

PSFs more aligned; still not perfect

Improvements for the near-future

- Minimize occurrence of false-positives. Cannot eradicate completely using automatic filtering
  - ➢ Balance between completeness and tolerable false-positive-rate (or tolerable pain for human vetters!)

- Strategies:
  - ➢ With 2014 epochal images in hand, can now use as *reference* images whose FOV-rotation closely matches new epochal data in 2015.
  - ➢ Perhaps attempt to systematically match FOV-rotations to 2015 data using entire *reference* image library going back to 2003? Systematics between "cold" and "warm" Spitzer?
  - ➢ Refine parameters, filters and extraction thresholds from analyzing 2014 products, or the worst thereof.

- Ideas welcome!