

The Zwicky Transient Facility (ZTF)

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on behalf of the ZTF collaboration



Overview

Why ZTF?

(“unfair advantages”)

Science Opportunities with ZTF

Brief status update

Survey differences from iPTF

ZTF adds technical advances to PTF's strengths.

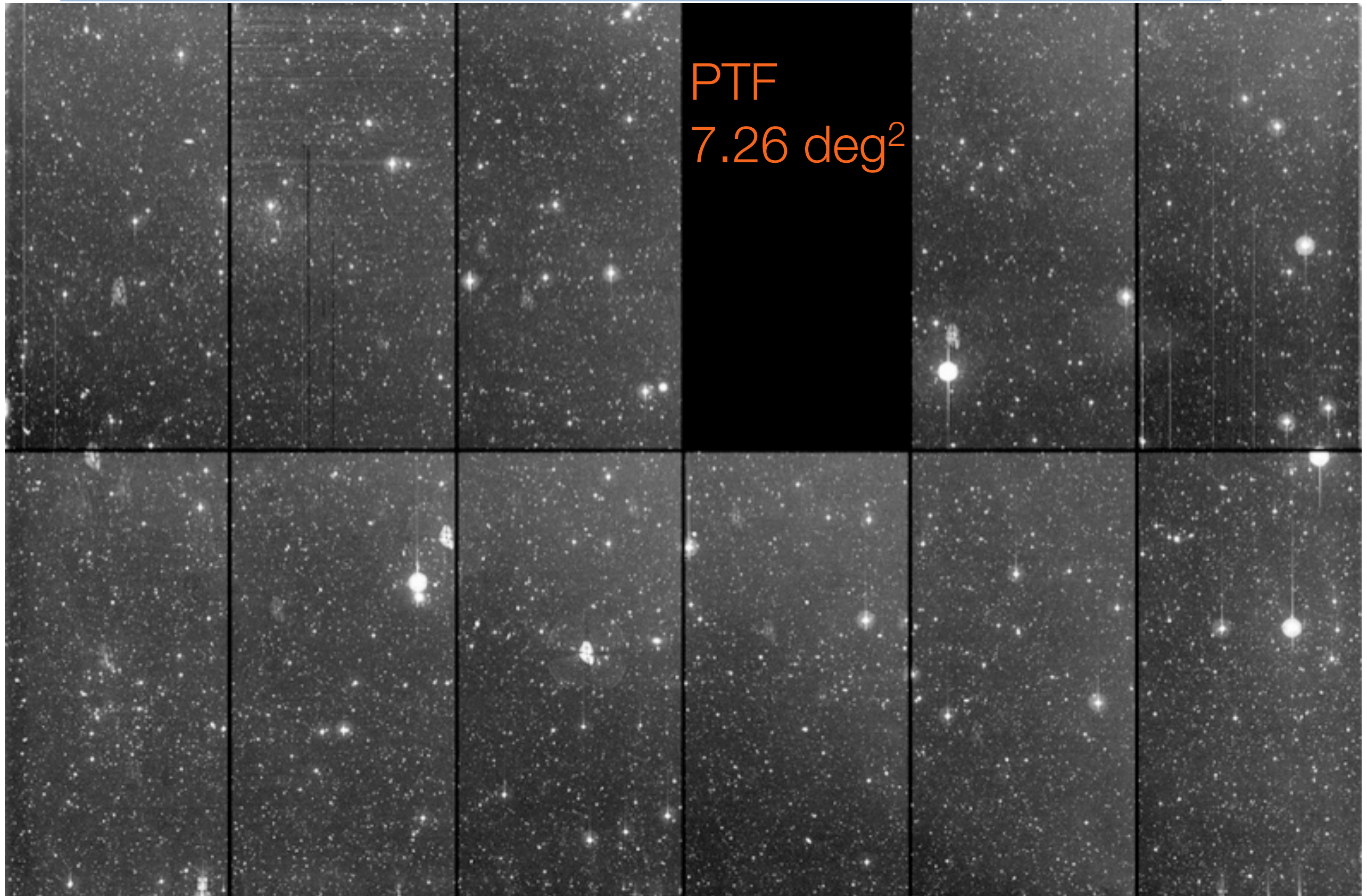


Survey telescope with dedicated followup network \Rightarrow P48 + P60

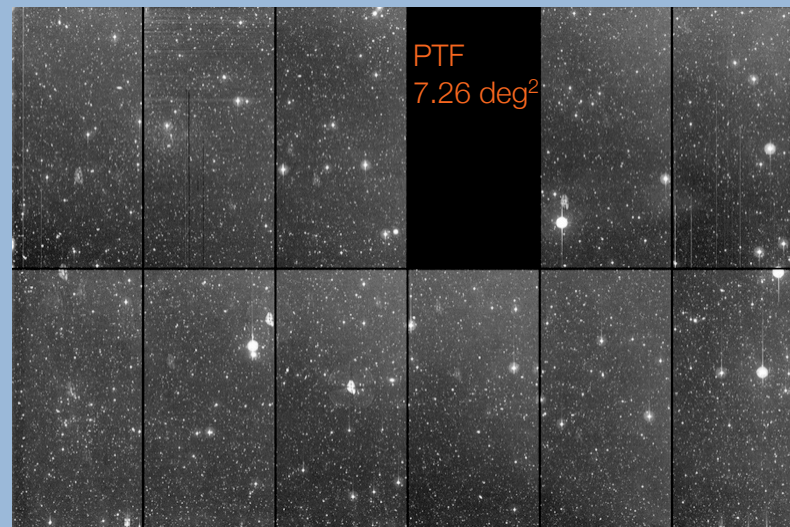
Maintain cadence by limiting filter set \Rightarrow Mould R, SDSS g'

Don't outrun the followup! \Rightarrow limiting magnitude of ~ 20.5

A new camera filling the P48 focal plane will enable a high-cadence survey.

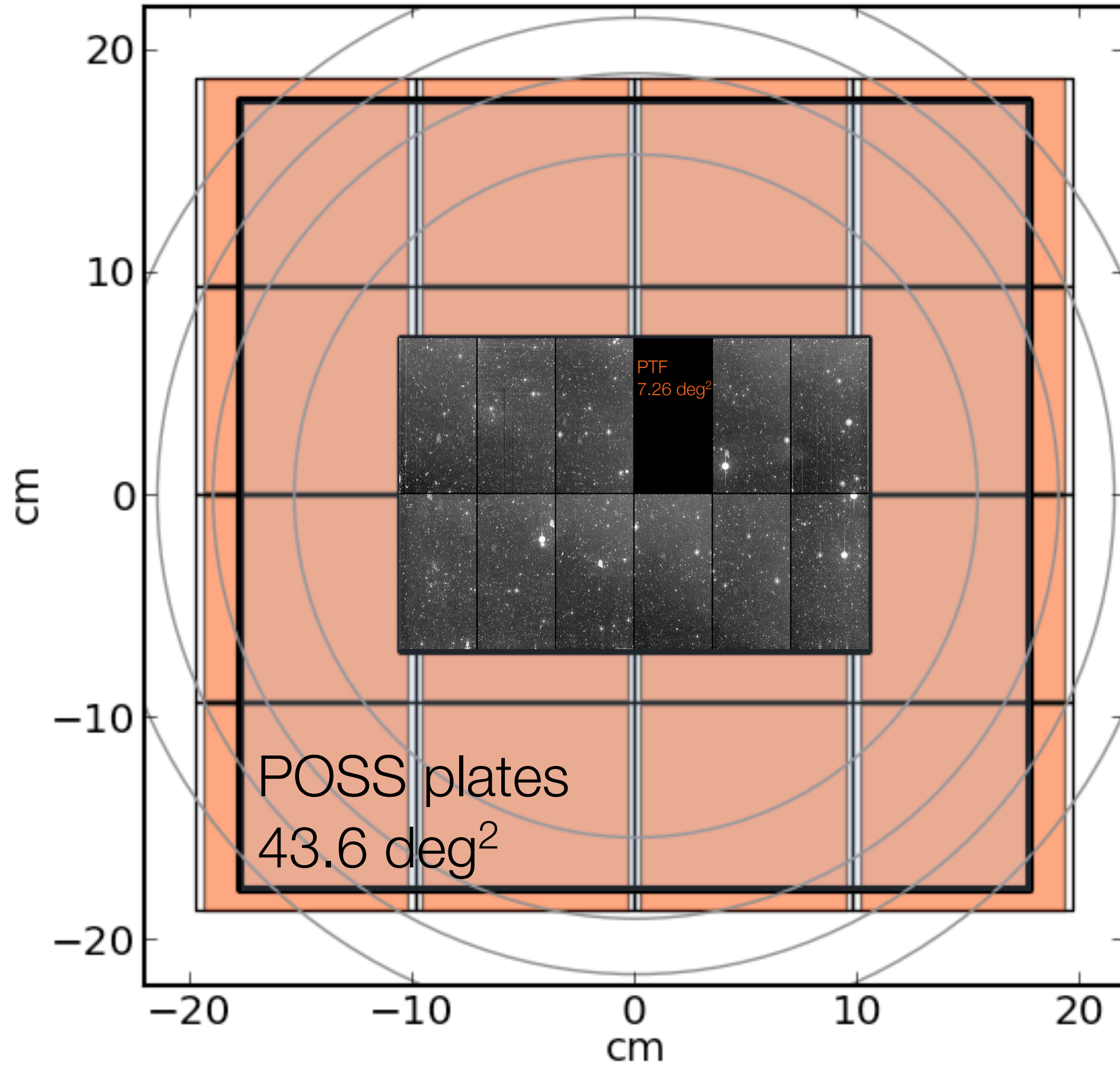


A new camera filling the P48 focal plane will enable a high-cadence survey.

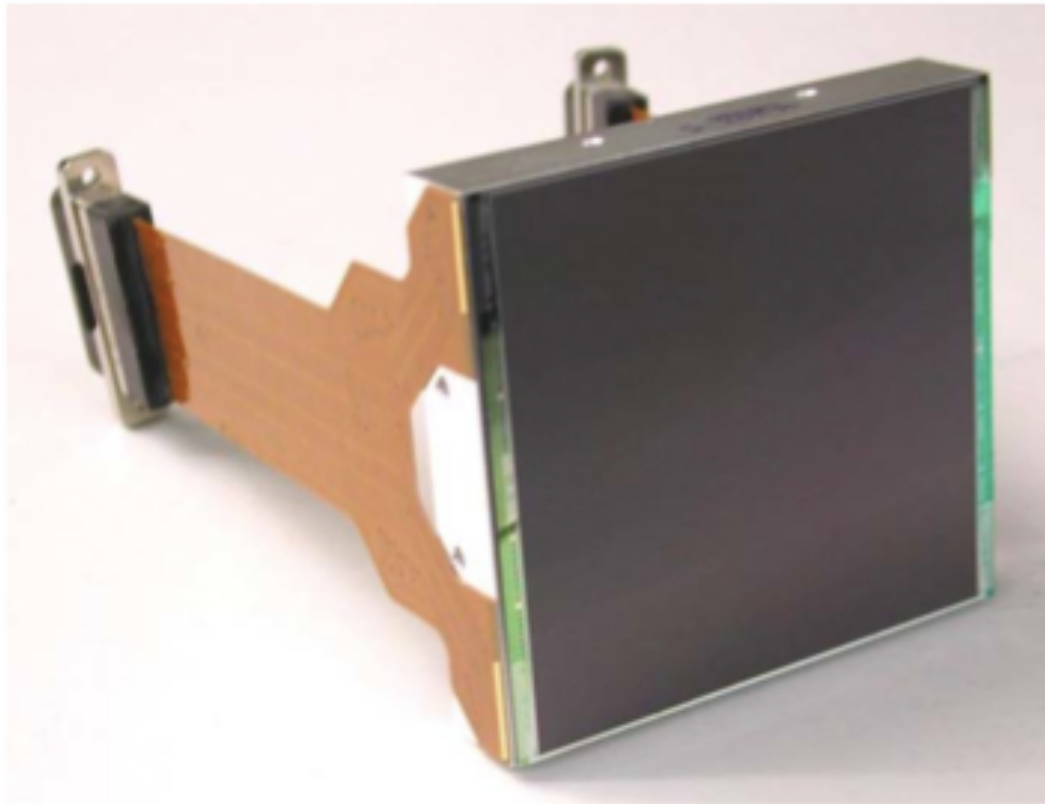


POSS plates
43.6 deg²

A new camera filling the P48 focal plane will enable a high-cadence survey.



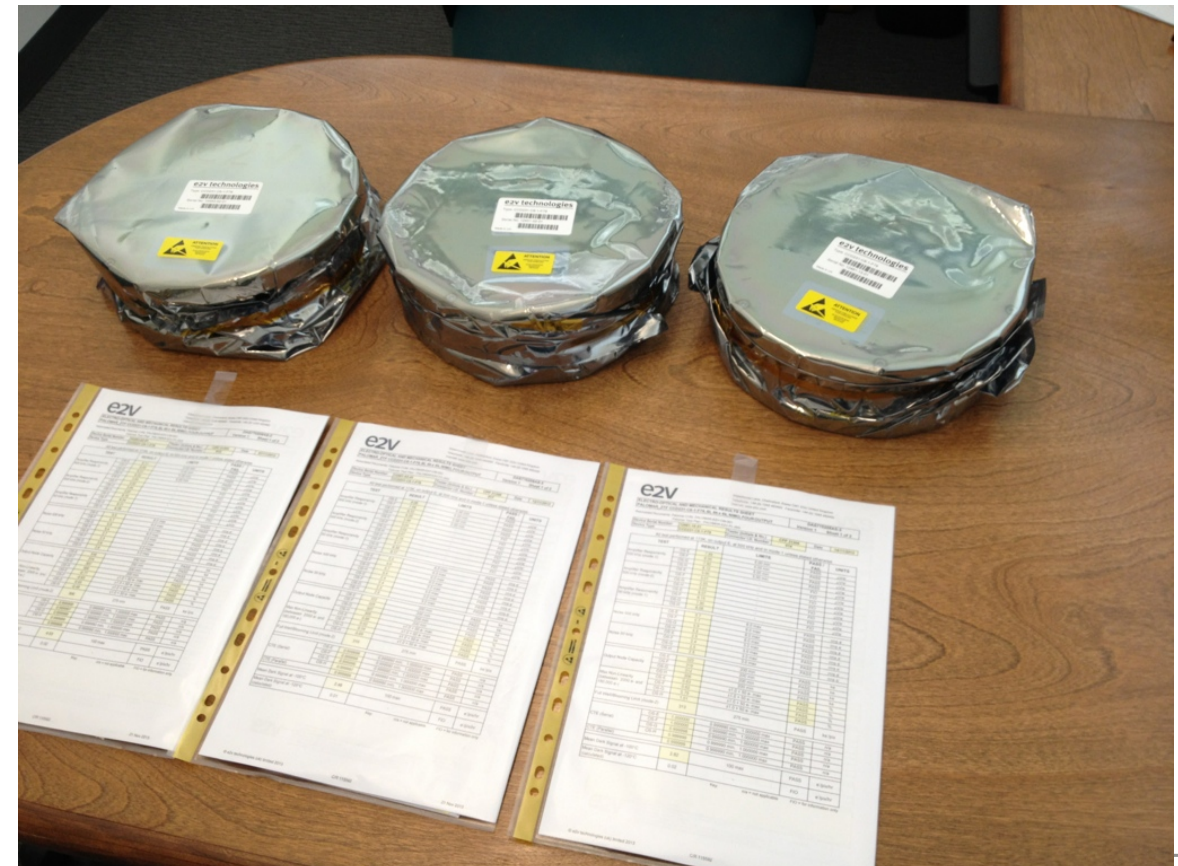
Affordable wafer-scale CCDs make ZTF possible.



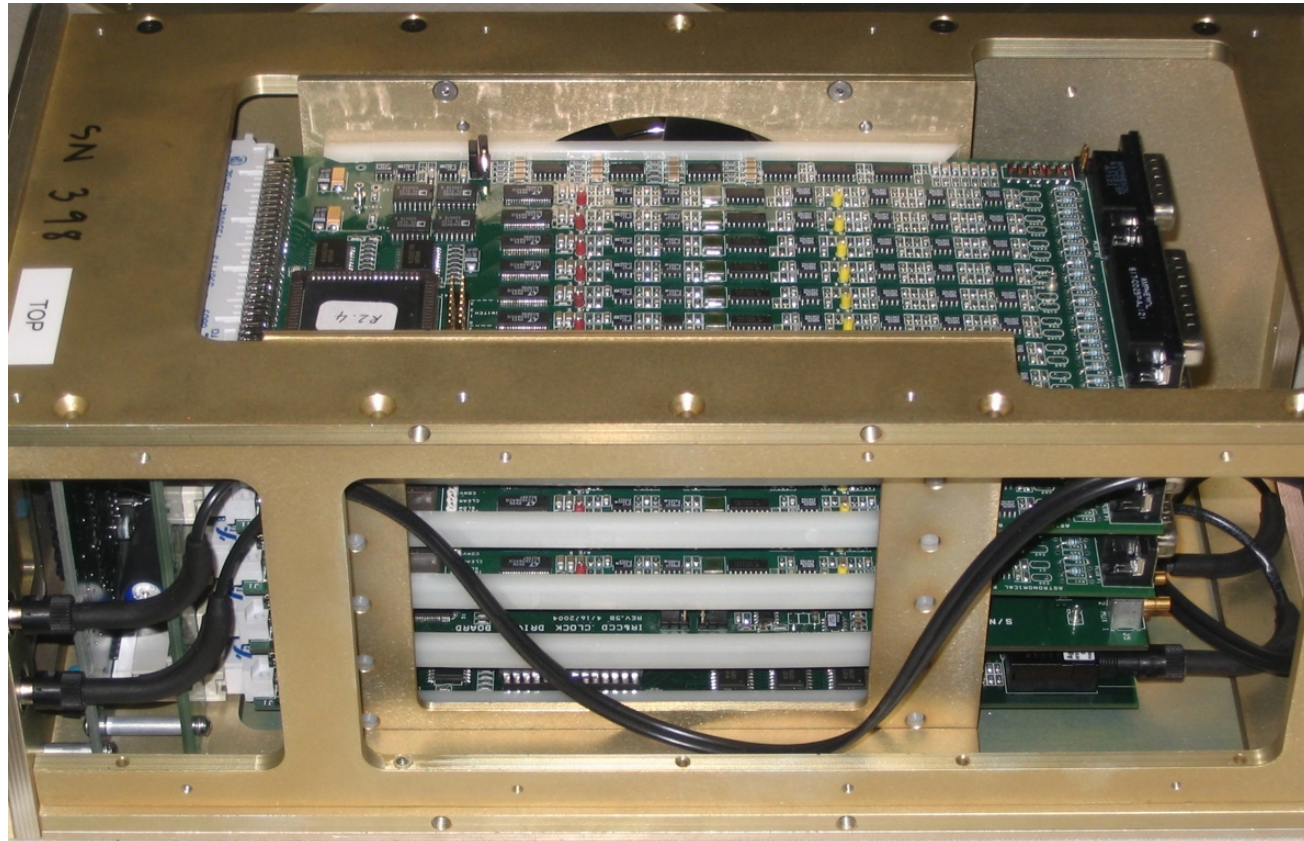
[CCD231-84 is illustrated here; CCD231-C6 is similar]

e2v	
dimension	9.2 x 9.2 cm
pixels	6.1k x 6.1k
pixel size	15 micron
pixel scale	1"/pixel
outputs	4

5 CCDs fabricated and delivered!



Moore's Law reduces overhead.



PTF

2000-era Leach Gen-II controller
36 second readout of 96 Mpx



ZTF

2014-era (e.g., STA Archon)
10 second readout of 576 Mpx

“Volumetric survey speed” is a useful figure of merit.

Volumetric survey speed:

Spatial volume within which a transient of fixed absolute magnitude (-19) can be detected, divided by exposure + overhead time

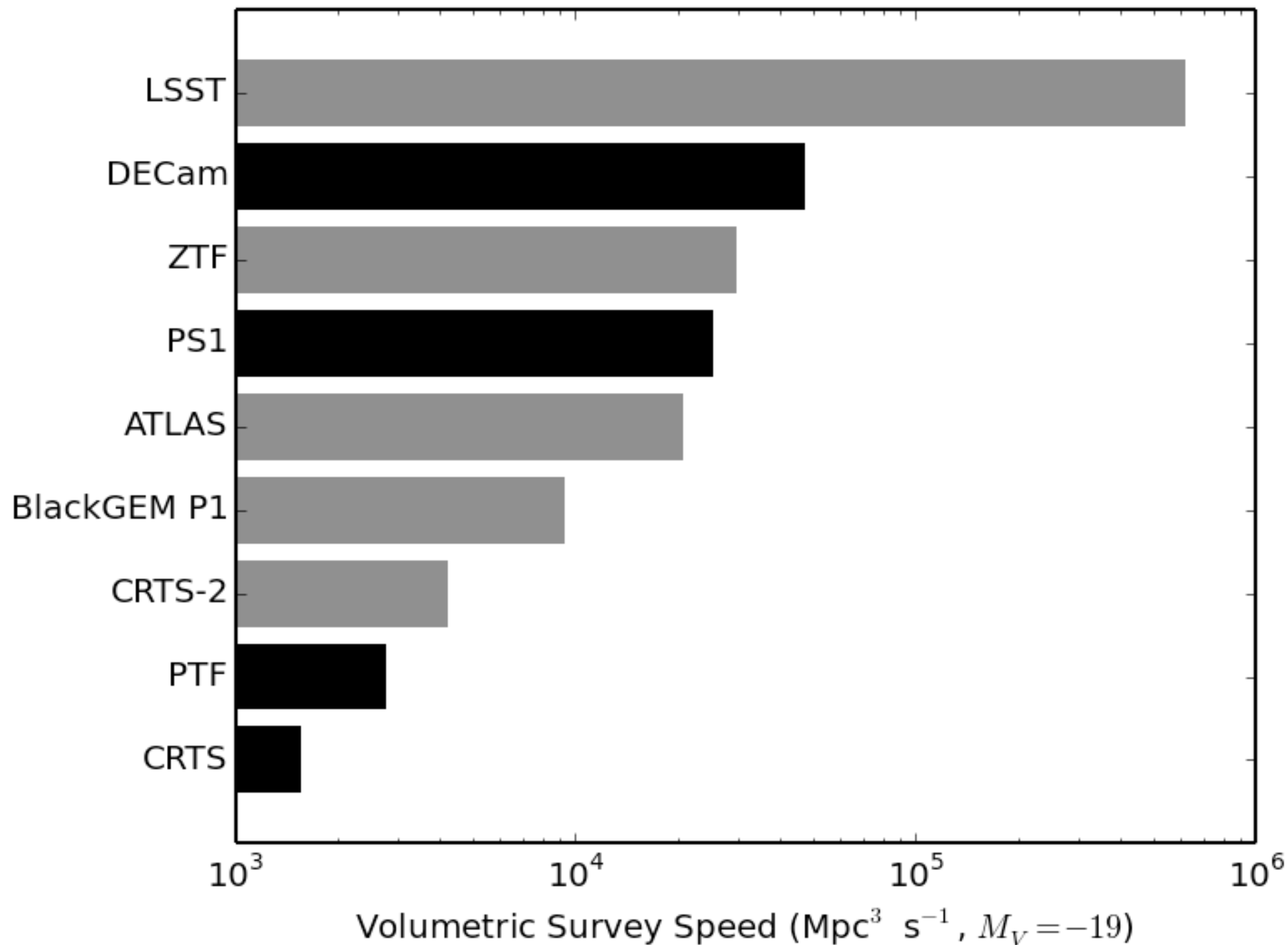
roughly proportional to transient detection rate

(cadence should be matched to intrinsic timescale;
need enough sky)

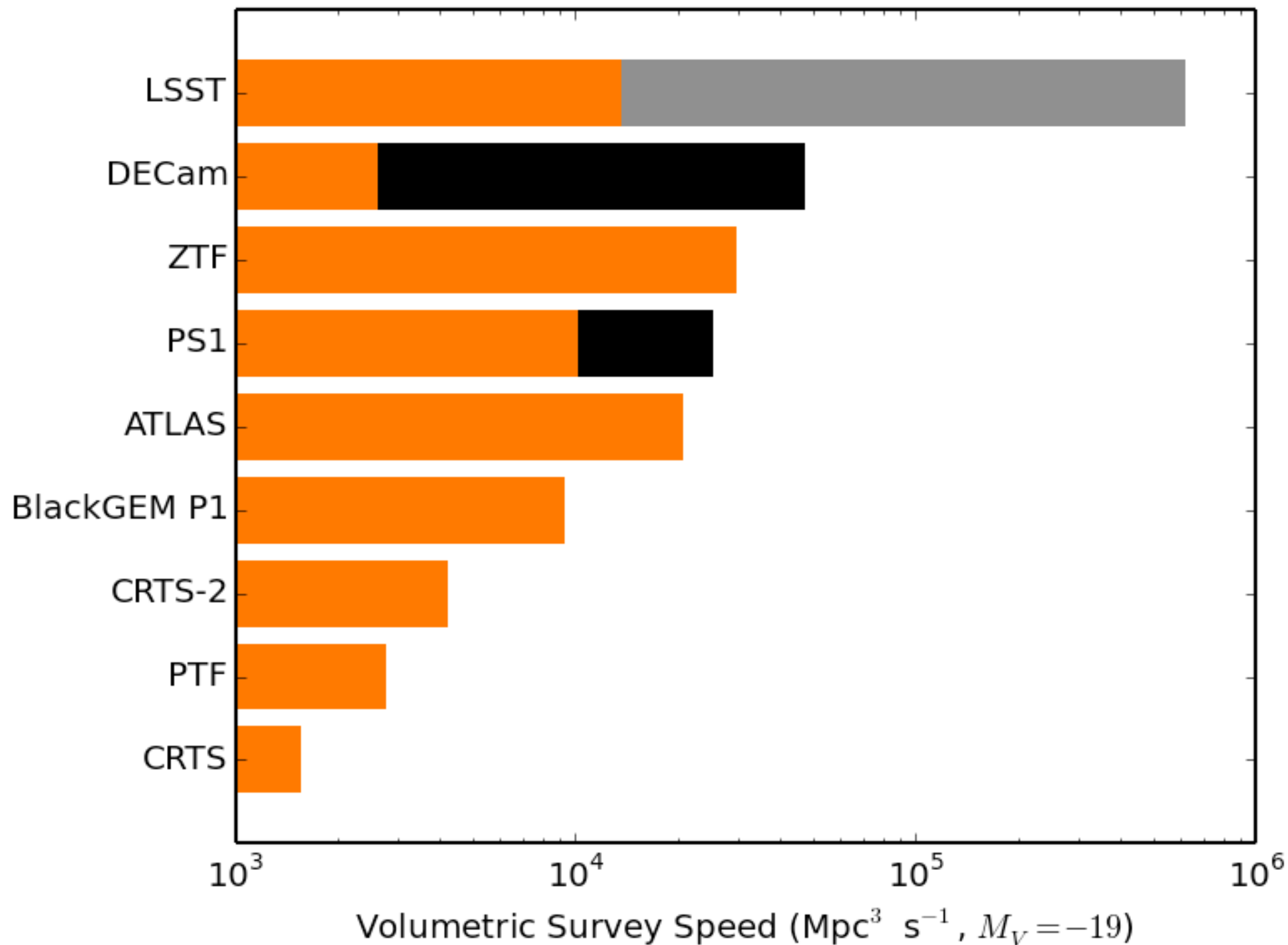
includes field of view, limiting magnitude (thus aperture, image quality, sky background, throughputs), readout & slew overheads

length of overhead implies optimal exposure time

ZTF will have world-leading speed in finding spectroscopically-accessible transients.



ZTF will have world-leading speed in finding spectroscopically-accessible transients.



ZTF will survey an order of magnitude faster than PTF.

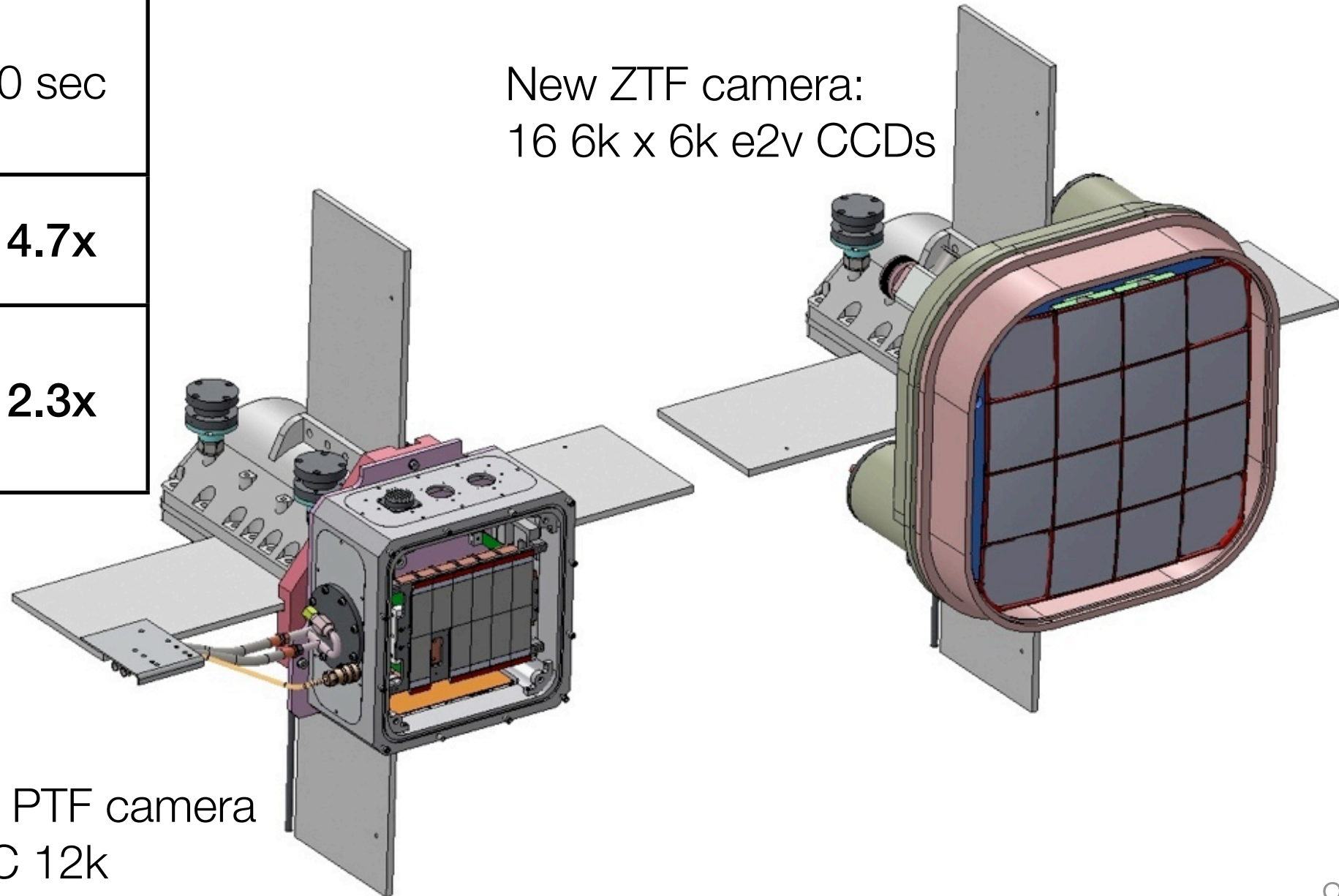
	PTF	ZTF
Active Area	7.26 deg ²	47 deg ²
Overhead Time	46 sec	<15 sec
Optimal Exposure Time	60 sec	30 sec
Relative Areal Survey Rate	1x	14.7x
Relative Volumetric Survey Rate	1x	12.3x

3800 deg²/hour

⇒ 3π survey in 8 hours,

> 250 observations/field/year
for uniform survey

New ZTF camera:
16 6k x 6k e2v CCDs

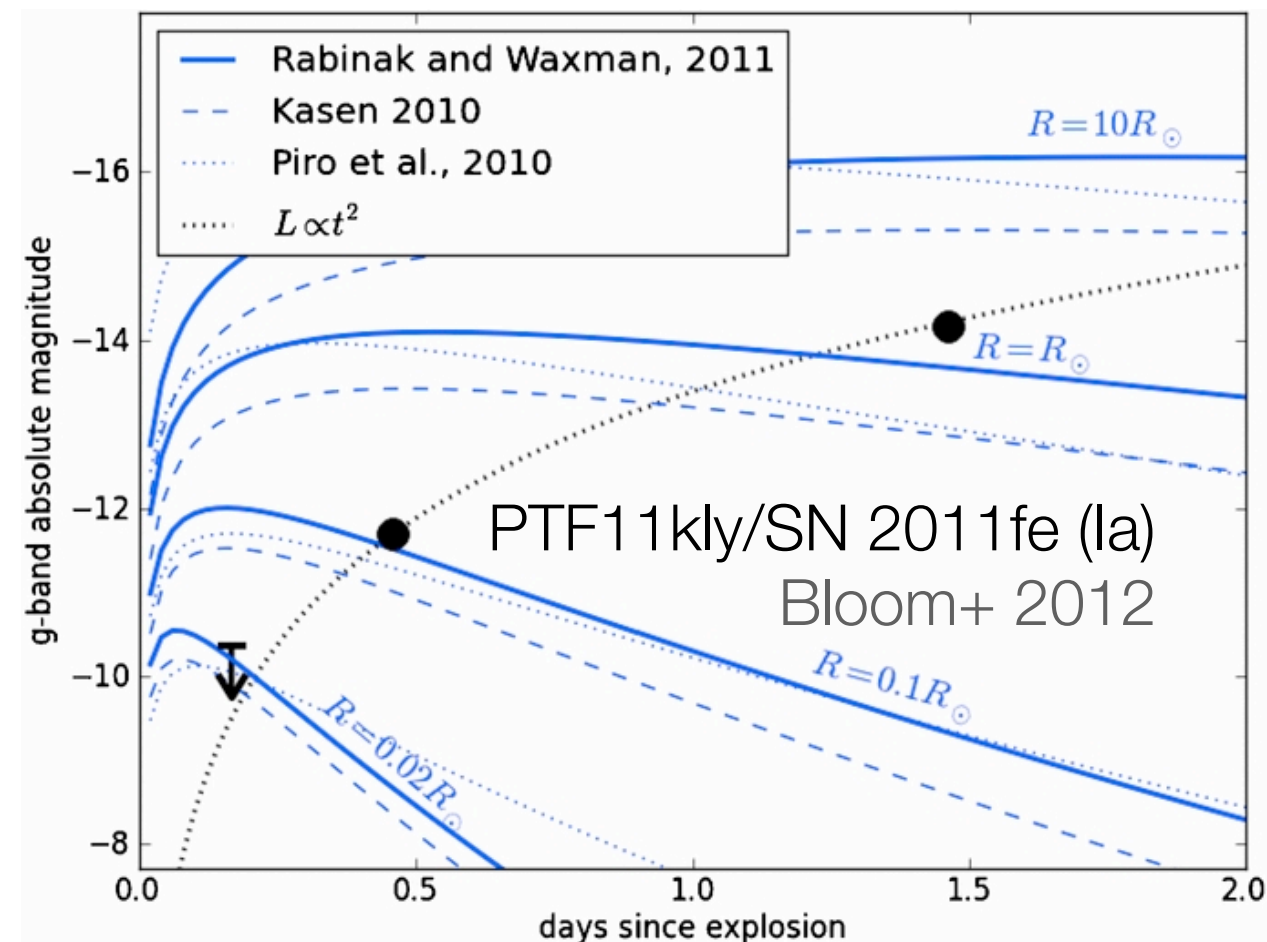


Existing PTF camera
MOSAIC 12k

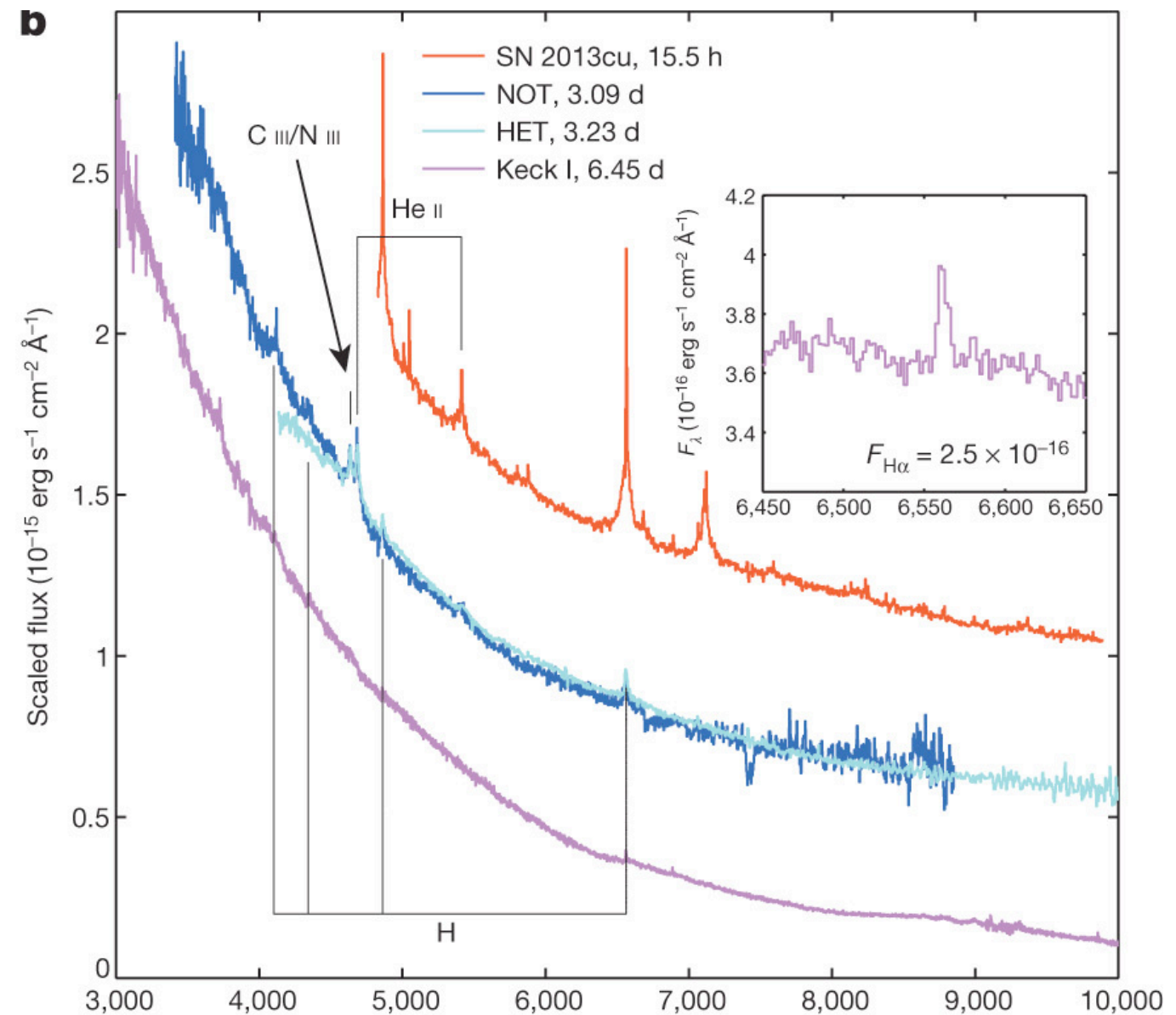
Early observations of young SNe test progenitor physics.

understand physics of shock breakout & shock heating;
observe progenitor wind

measure progenitor radius and
distinguish progenitors

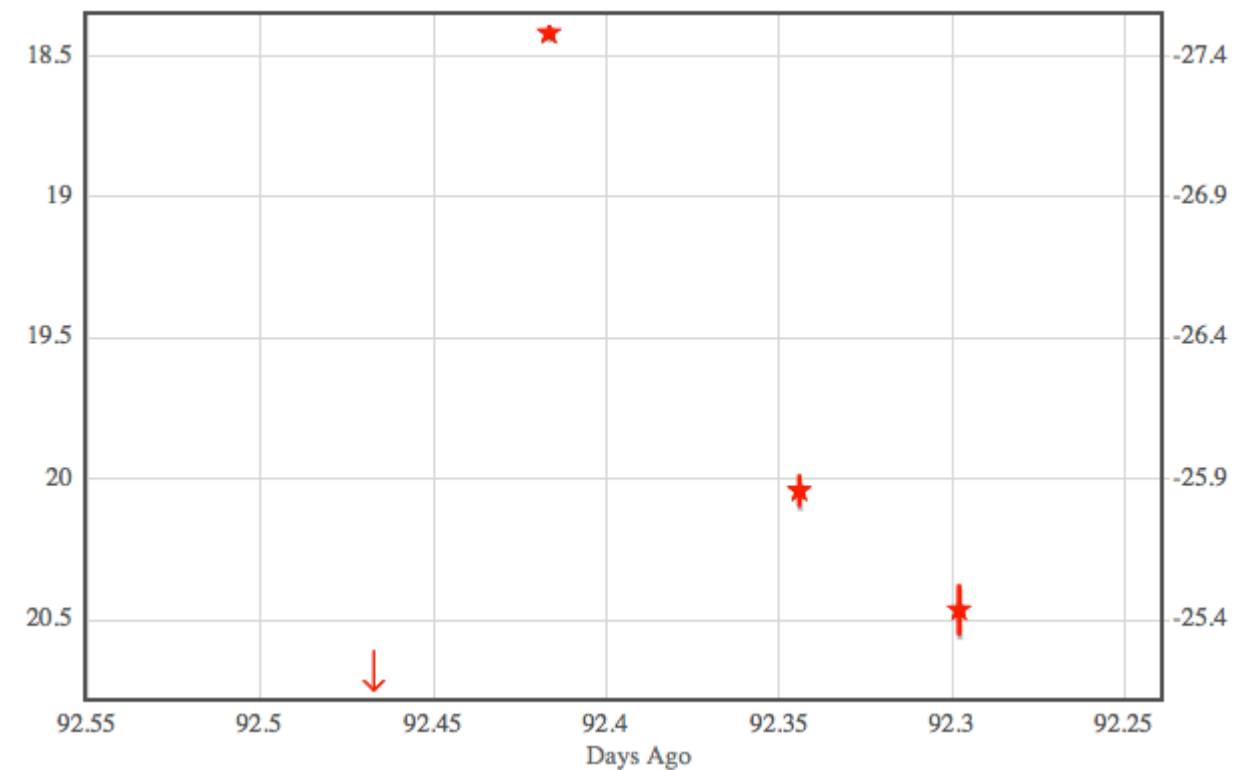
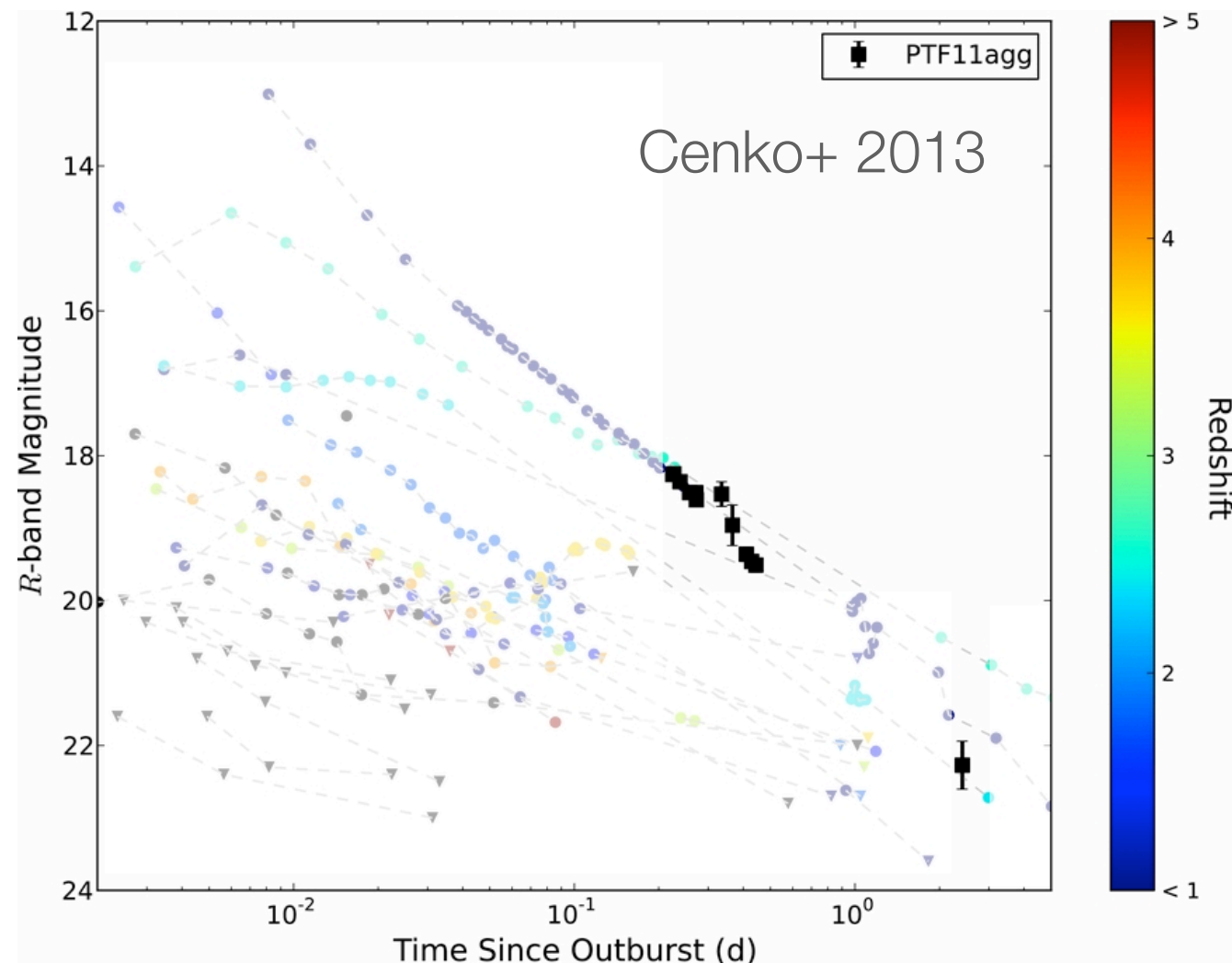


iPTF13ast/SN2013cu (IIb)
Gal-Yam+ 2014



**ZTF will discover a supernova
< 24 hours old every night**

(Sub)relativistic explosions may produce rare fast transients.



untriggered
GRB afterglow?

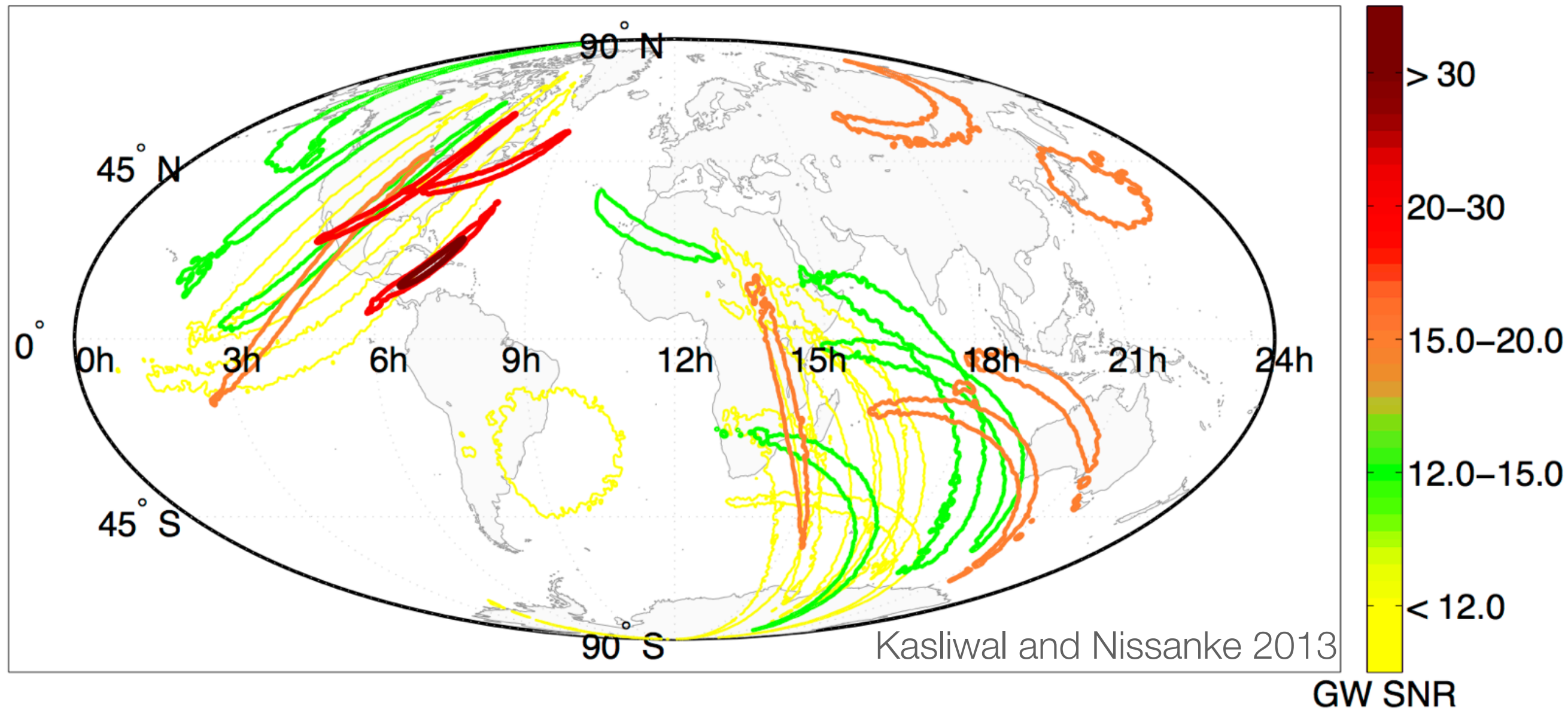
dirty fireball?

ZTF will:

**Discover 5 GRB orphan
afterglows each year**

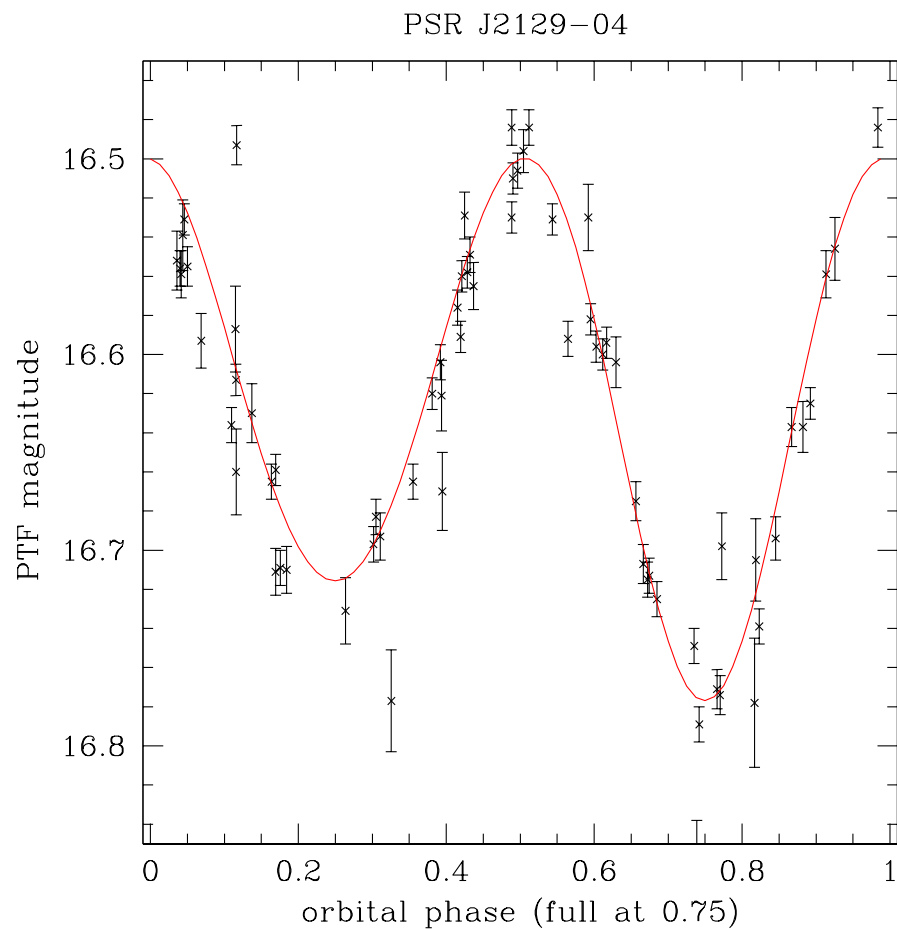
**Discover >20 PTF11agg-like
dirty fireballs each year**

EM counterparts to GW sources will reveal key physics.

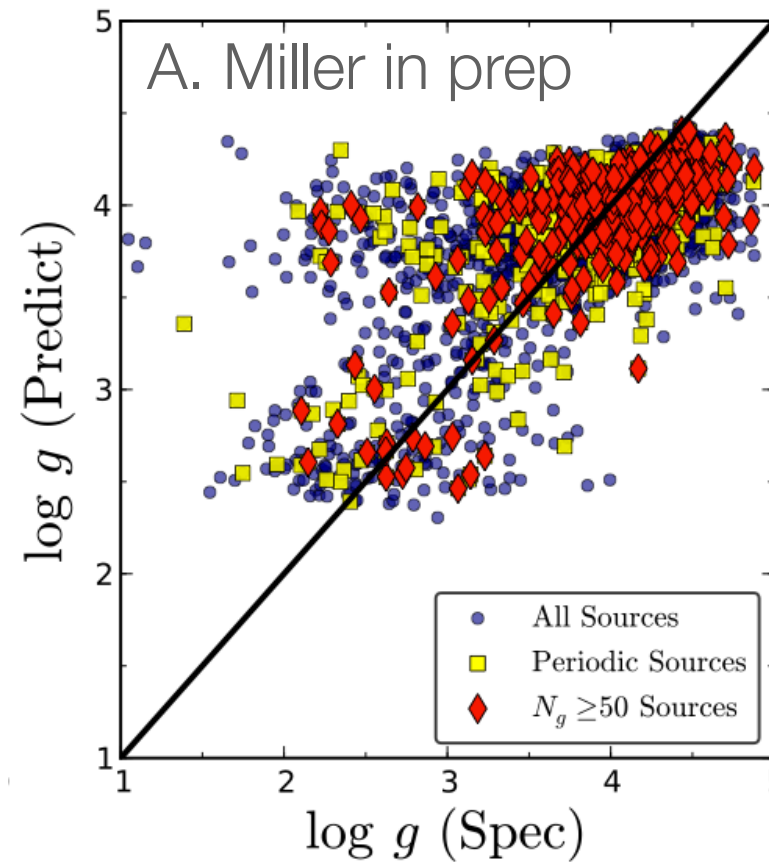


ZTF is well-positioned to
search for GW counterparts

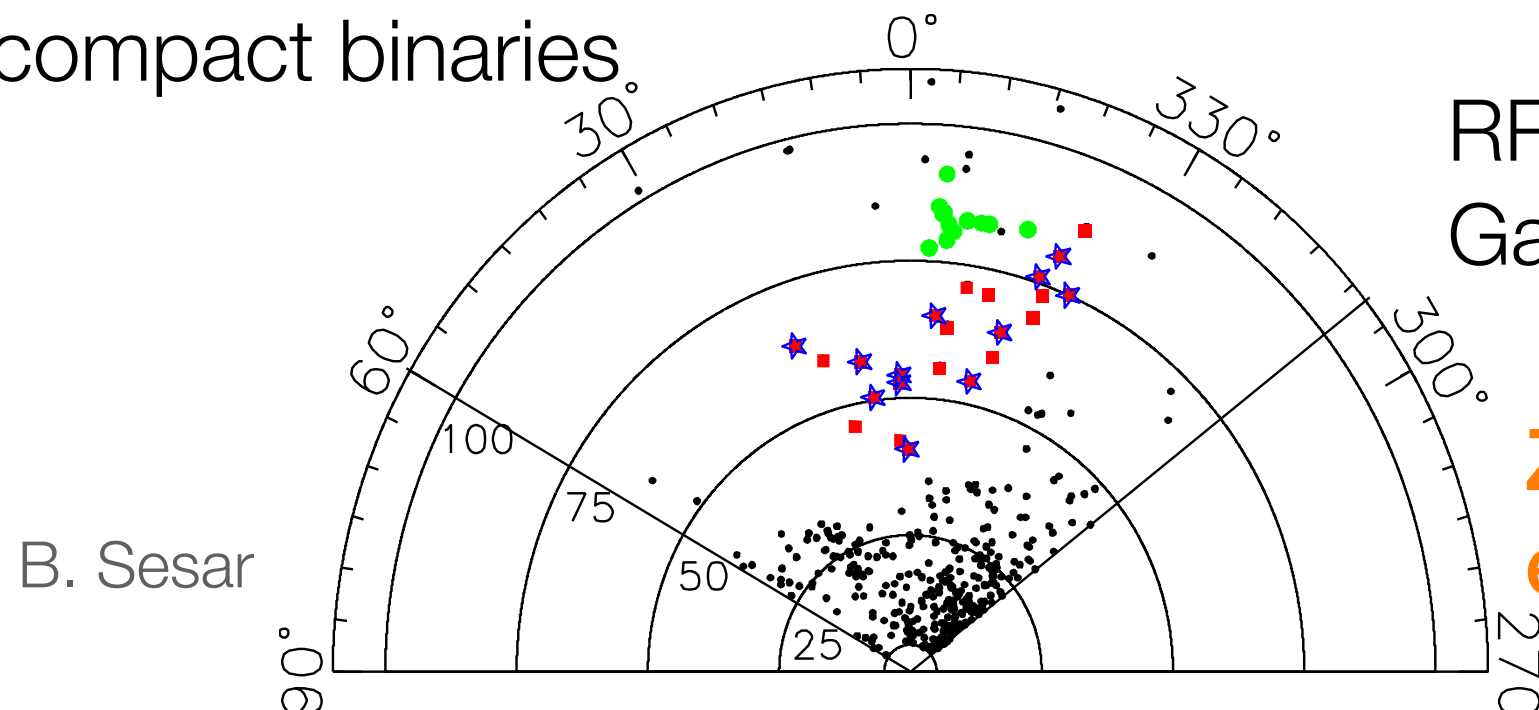
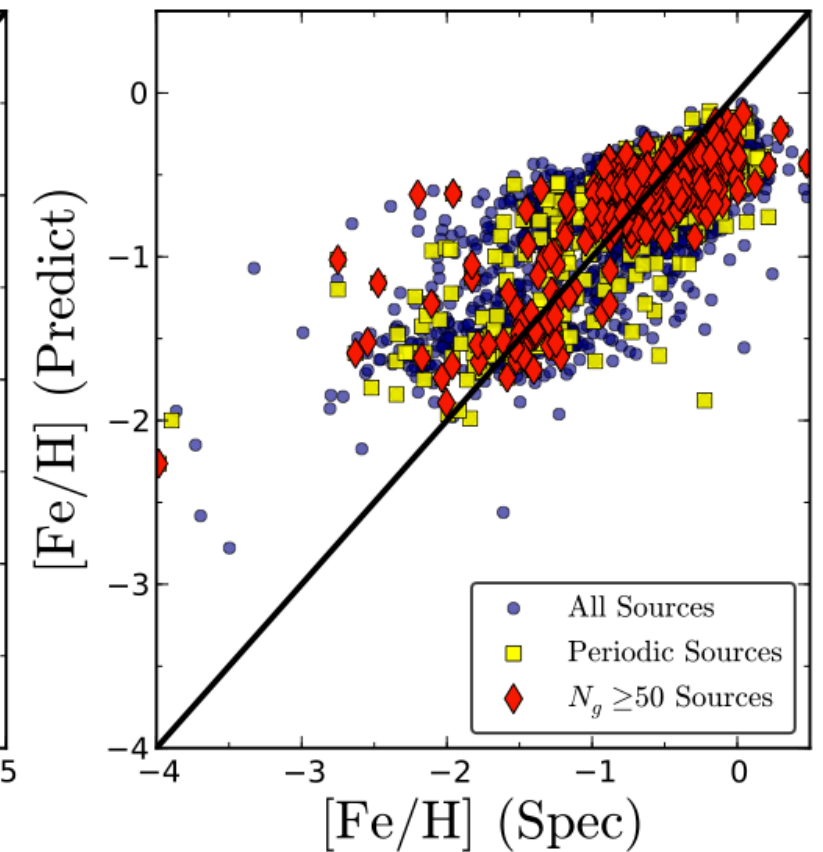
Photometric variable catalogs enable great science.



identification of
compact binaries

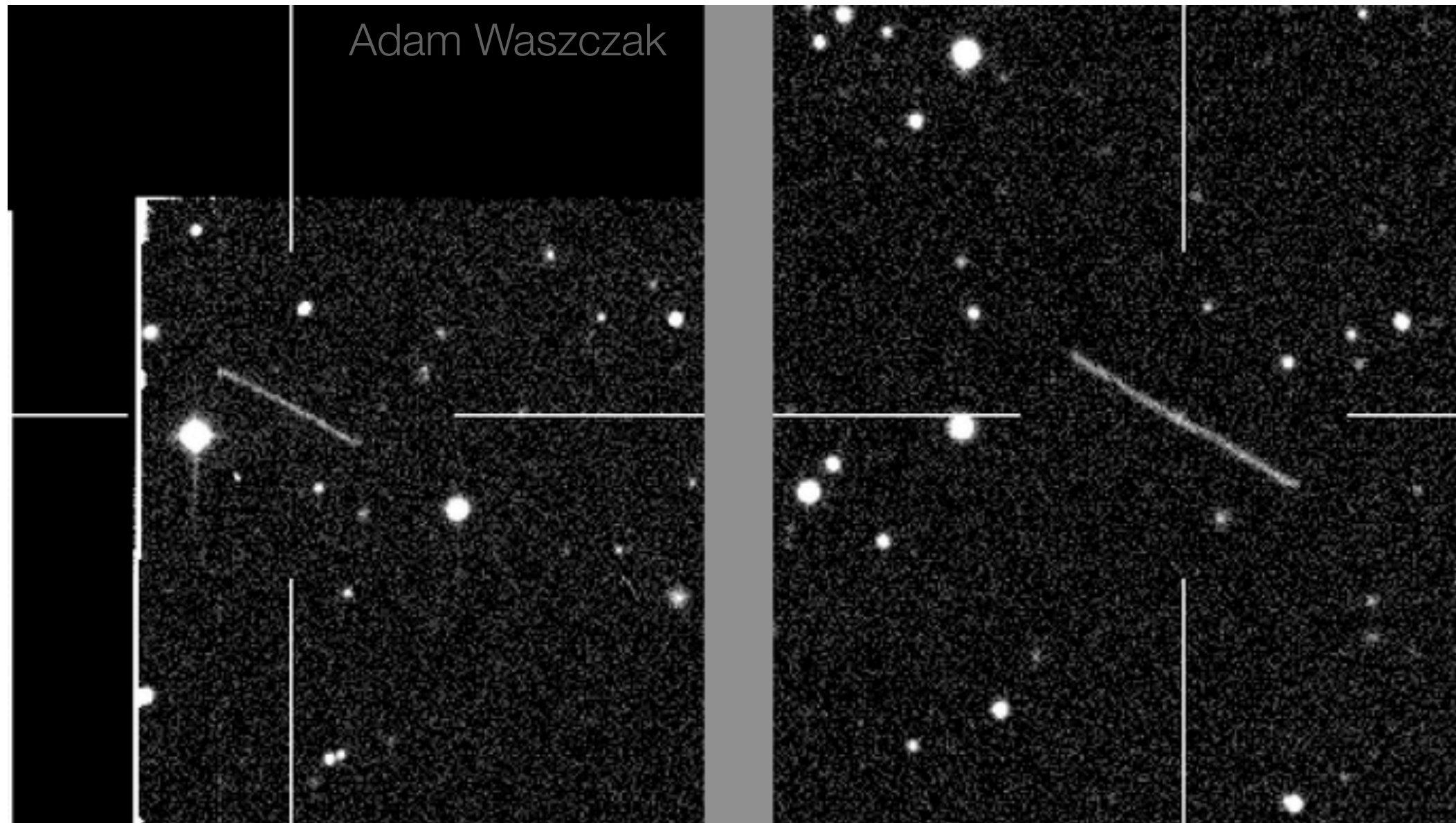


variability predicts stellar parameters



**ZTF will obtain >250 epochs
each year over 3 pi**

Near Earth Asteroids pose a threat and an opportunity.



iPTF-discovered NEA 2014 JG55

Passed 1/4 of a lunar distance from Earth!

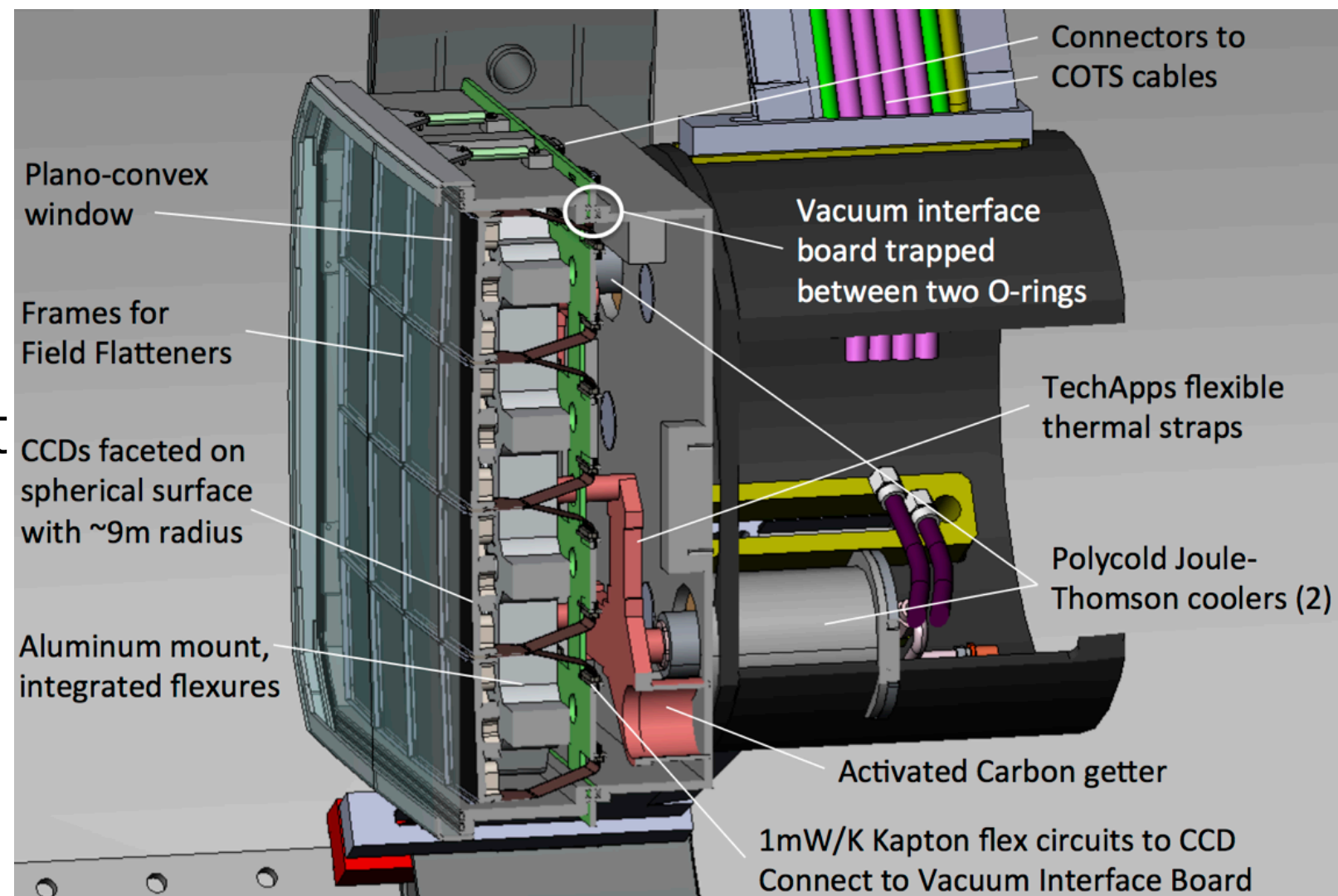
ZTF can perform the most sensitive search for streaking NEAs.

ZTF hardware is coming soon.

Near final optical & cryostat design
expect to begin fabrication & optics
procurements soon

5 CCDs in hand;
lab controller testing soon

But lots of remaining work:
camera integration & test
telescope upgrades
commissioning
data systems



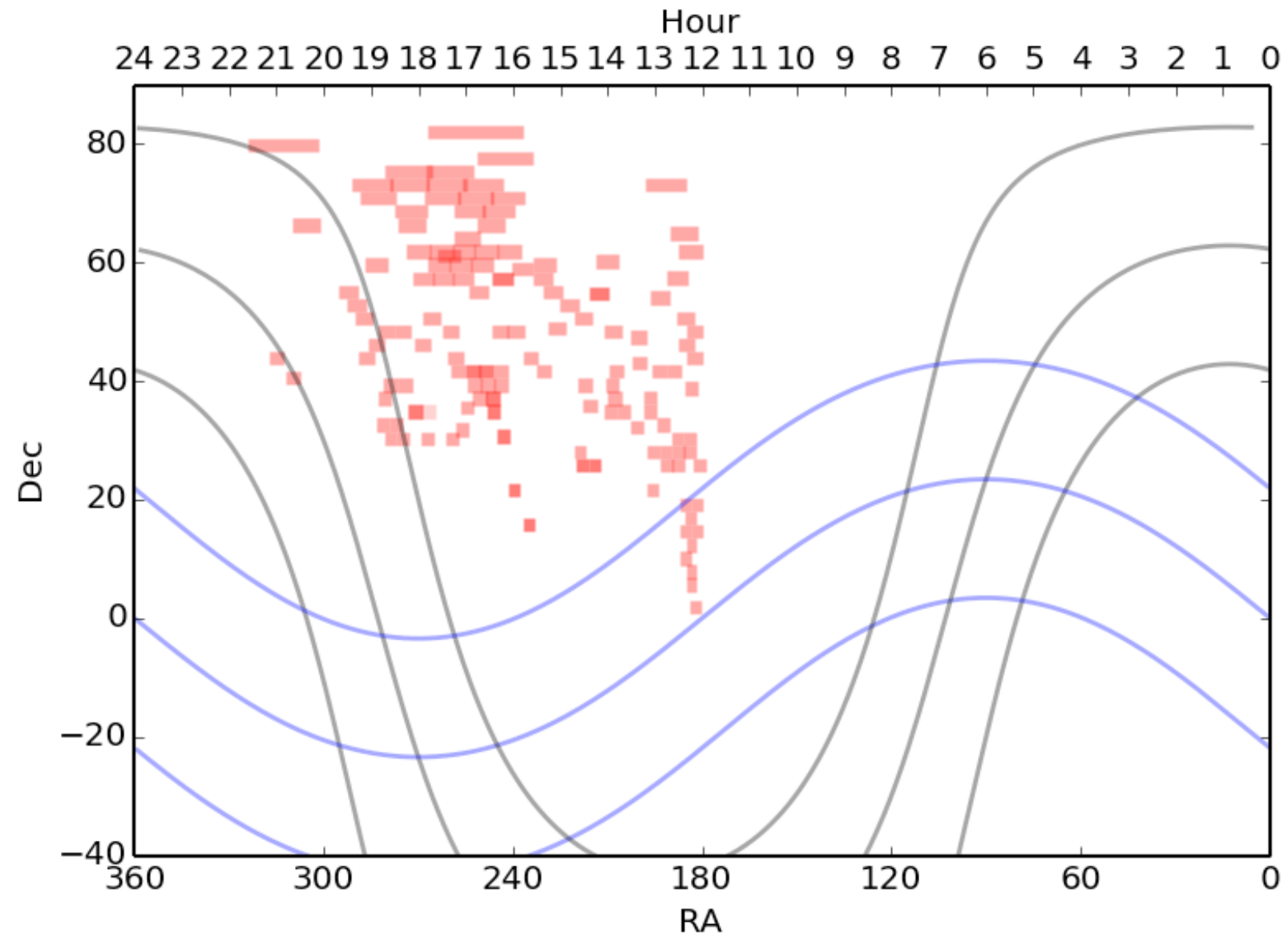
Time to consider how the ZTF survey will differ from iPTF.

Fixed filters?

greater need to keep
slews short

pre-programmed
observing cadences?
(but flexible, TOO-aware)

Mix of 3-4 day all-sky with
high-cadence/specialty?



Discussion of science
implications is welcome &
needed!

Thank you!

