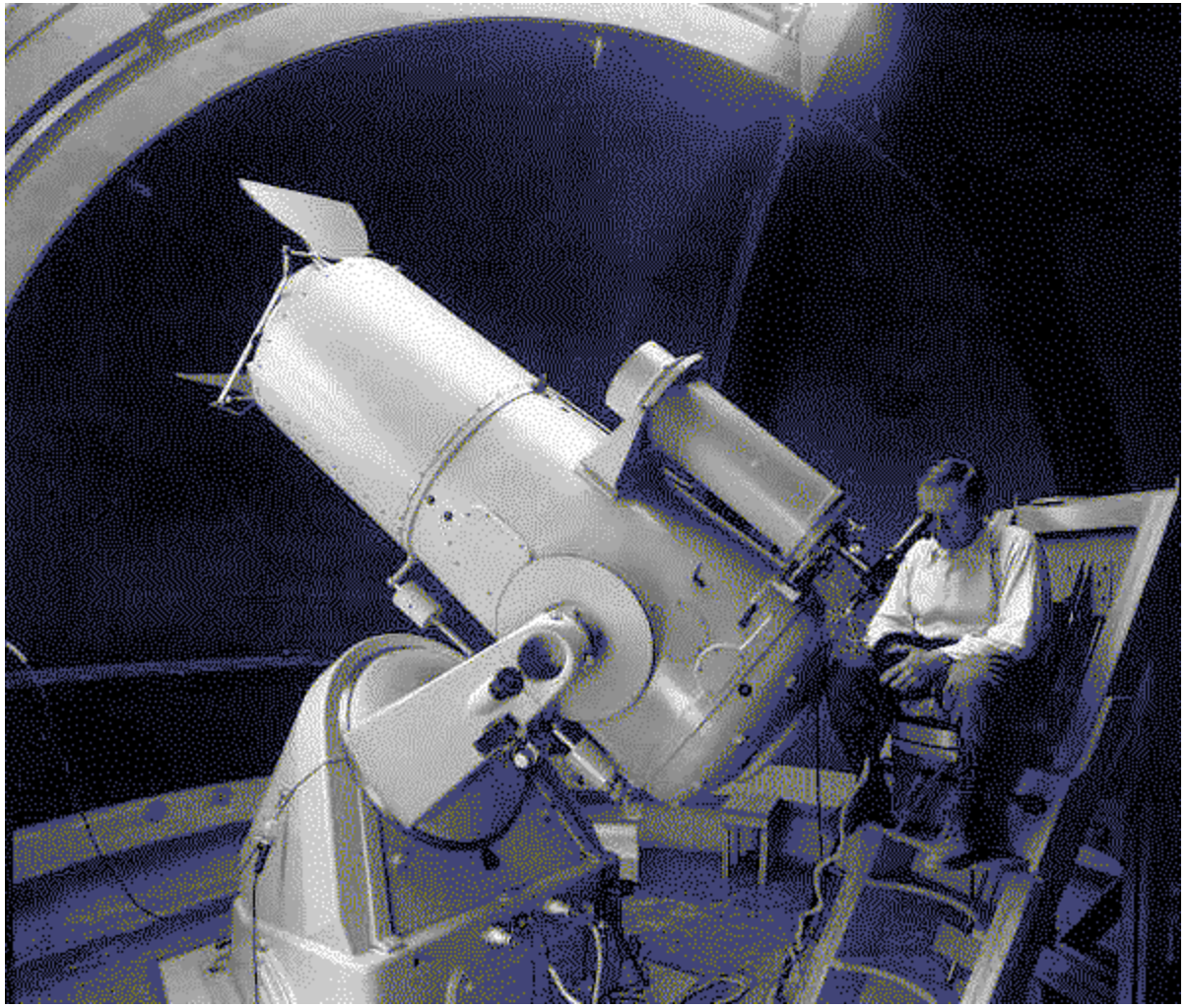
Marek Kowalski
DESY&HU

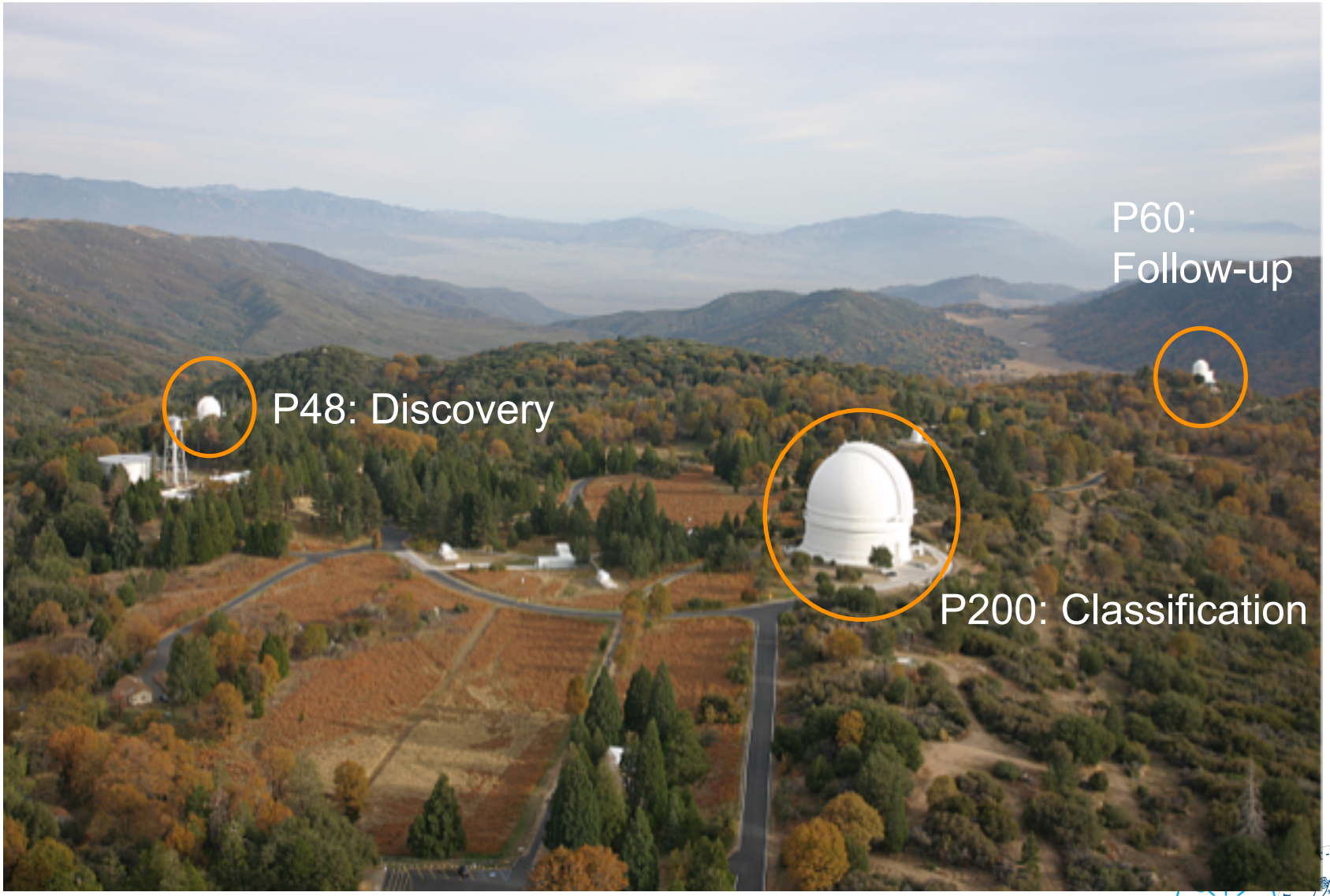
The Zwicky Transient Facility

Magellan-Workshop
HH 17.3.2016

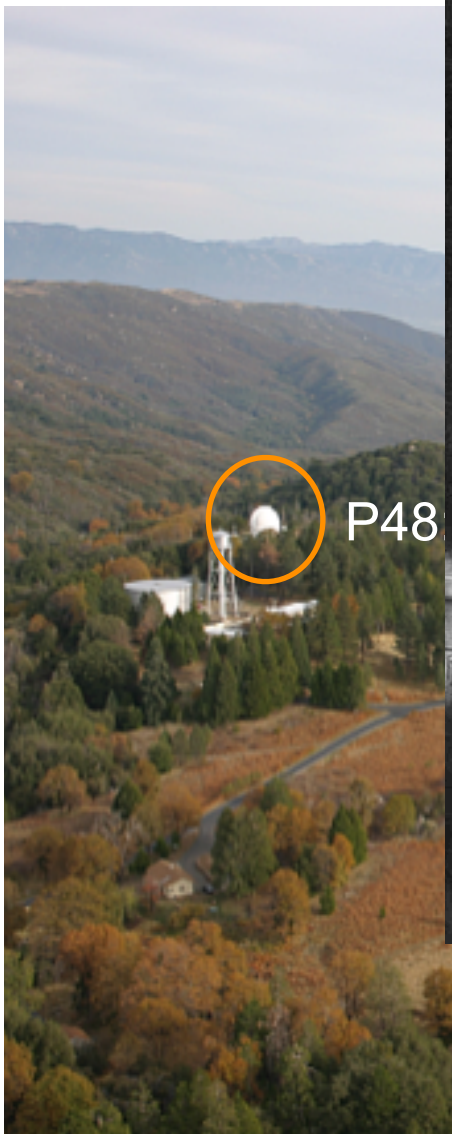
Fritz Zwicky (1898-1974)

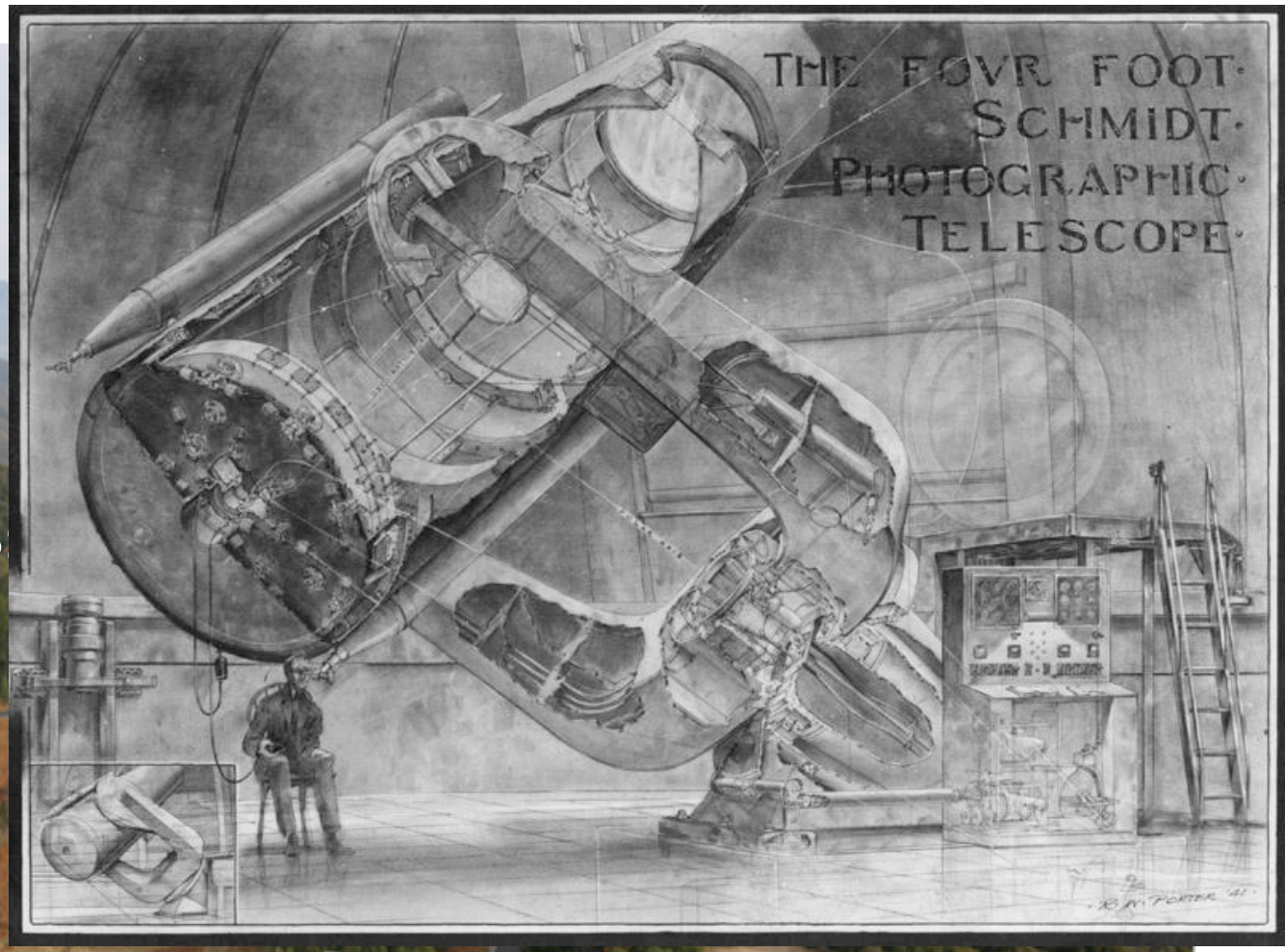


Mount Palomar Observatory



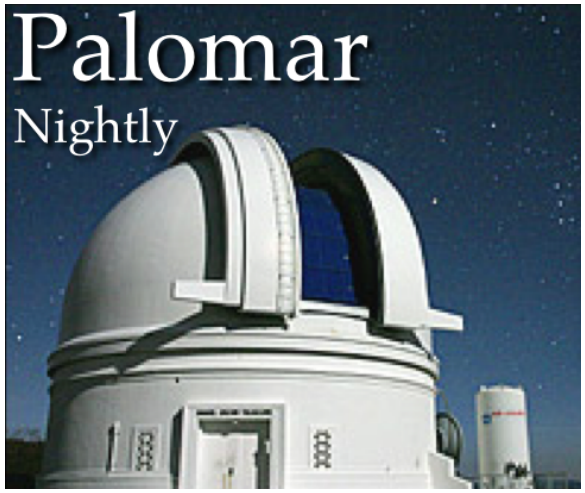
Mount Palomar Observatory



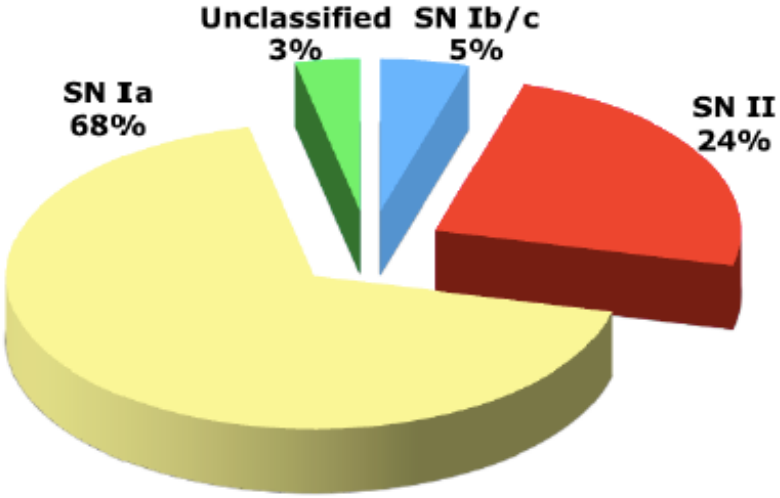


P48 = 120 cm Schmidt-Telescope
The heart of the Zwicky Transient Facility starting 2017

Mount Palomar Observatory



Discovering Supernovae



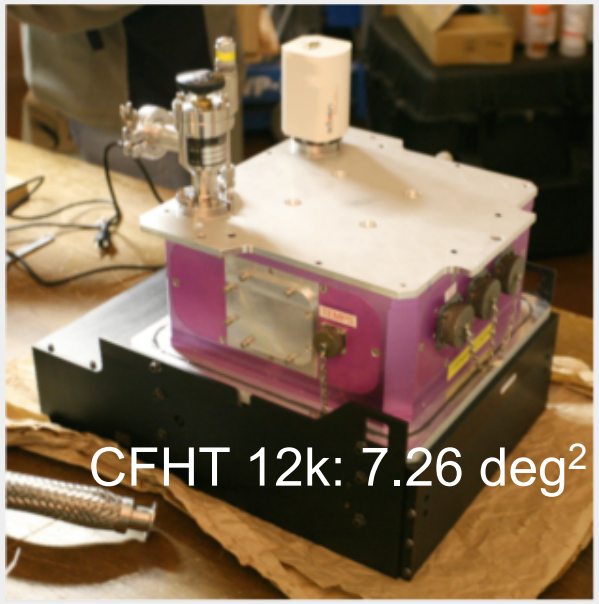
>3000 SNe in total so far detected by the Palomar-Schmidt telescope (PTF & SNfactory)

The PTF survey family has three phases.

PTF *yesterday*

The Palomar Transient Factory
(2009-2012)

General synoptic transient survey



iPTF *today*

Intermediate Palomar Transient Factory
(2013-2016)

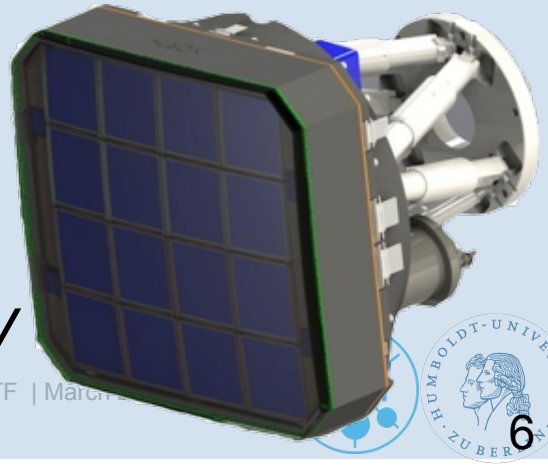
Focused mini-surveys

ZTF *tomorrow*

The Zwicky Transient Facility
(2017-2020)

High-cadence, wide-area survey

new 47 deg² camera



ZTF science

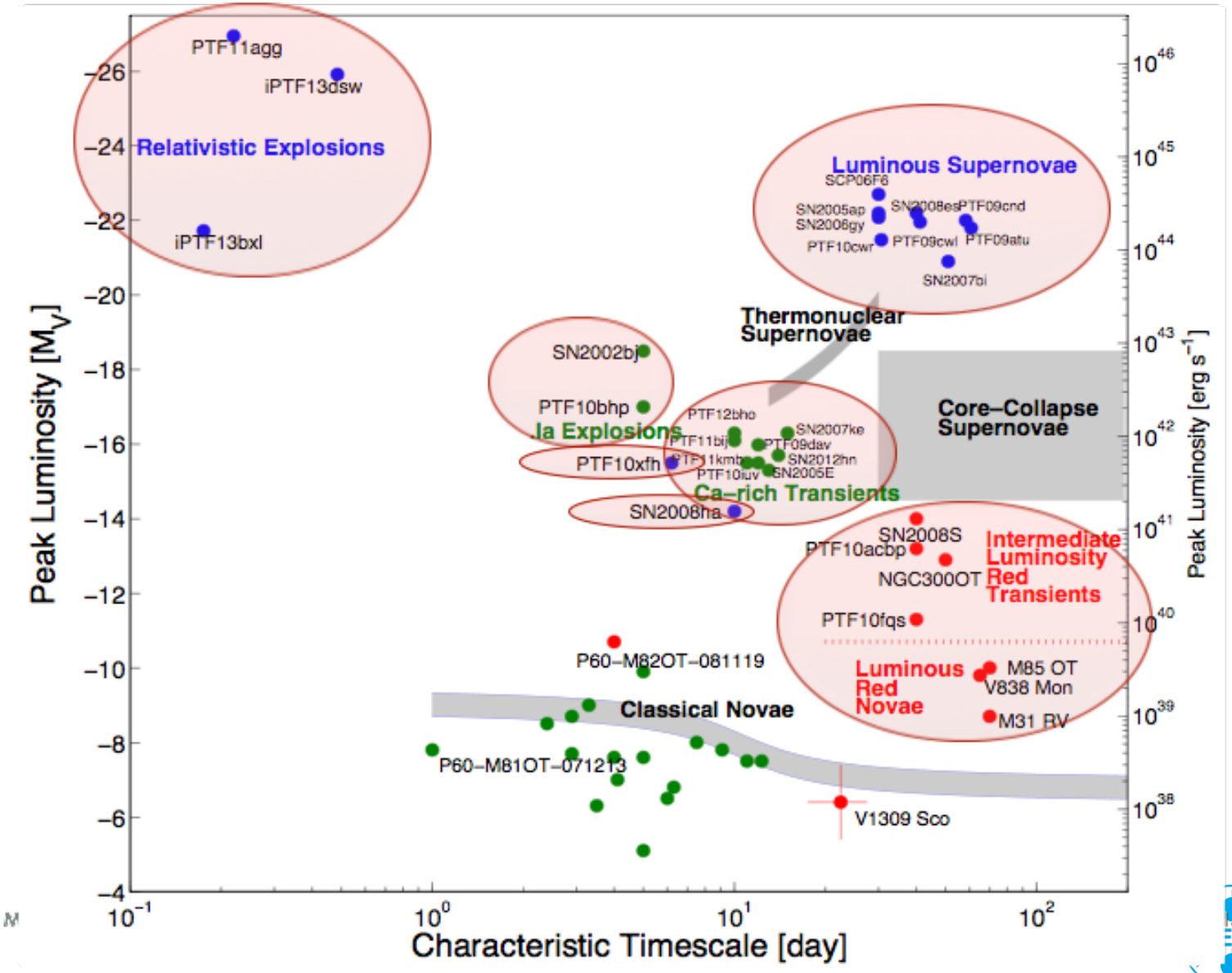
- Young Supernovae
- Fast / Rare Transients
- Galactic Plane Variables
- Active Galactic Nuclei
- Supernova Cosmology
- Gravitational Wave & Neutrino follow-up

ZTF science

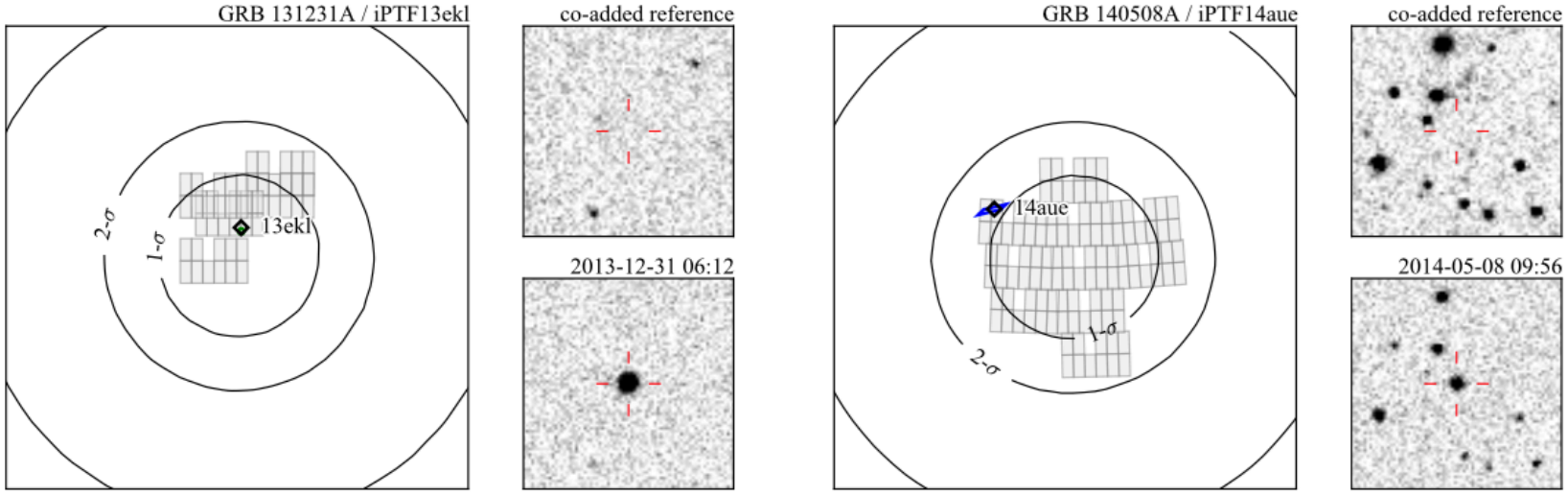
- Young Supernovae
- **Fast / Rare Transients**
- Galactic Plane Variables
- Active Galactic Nuclei
- **Supernova Cosmology**
- Neutrino & GW follow-up (➔talk by Markus Voge)

Fast/Rare transient

Fast / Rare Transients



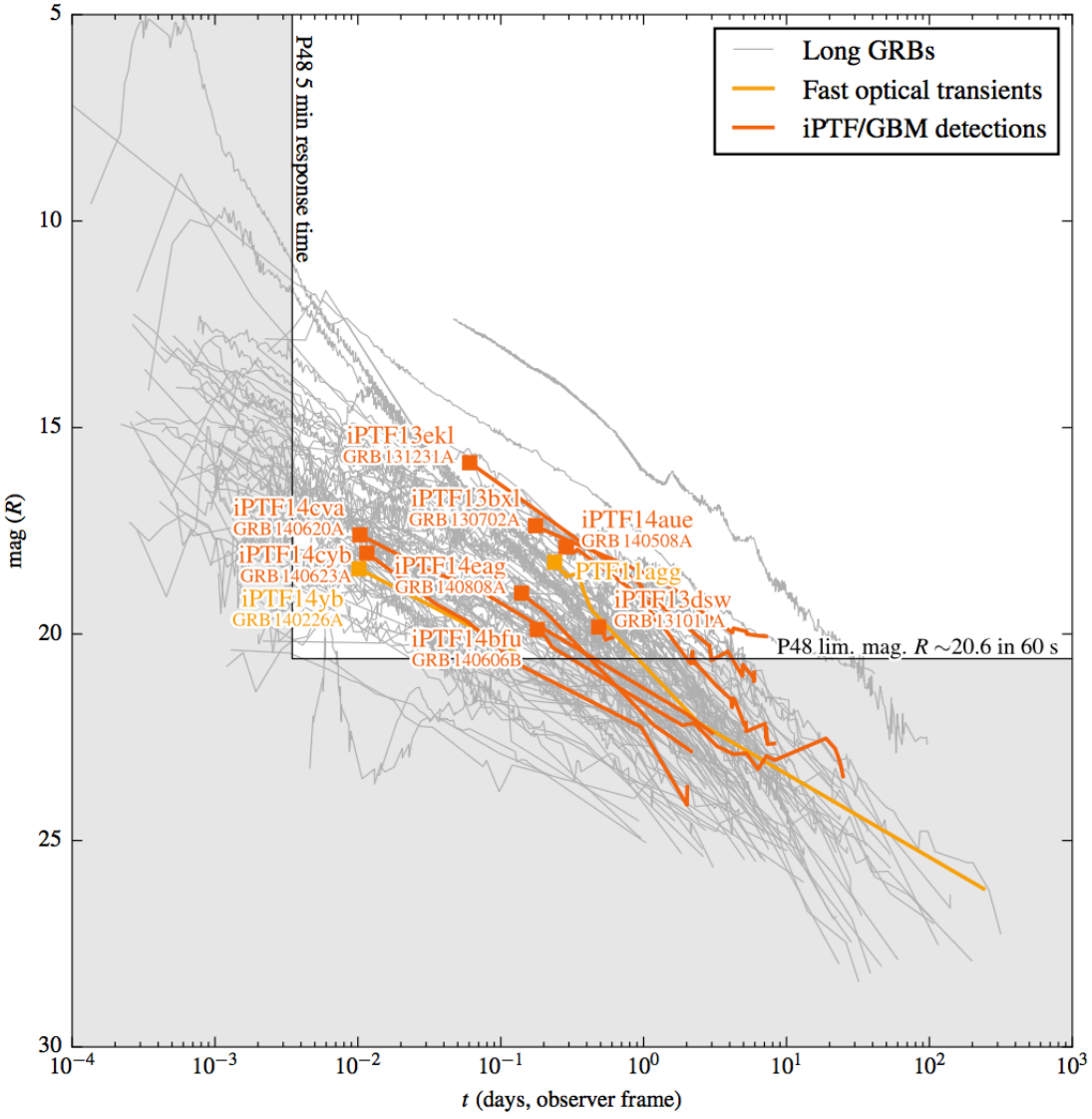
GRB localization through afterglow observation



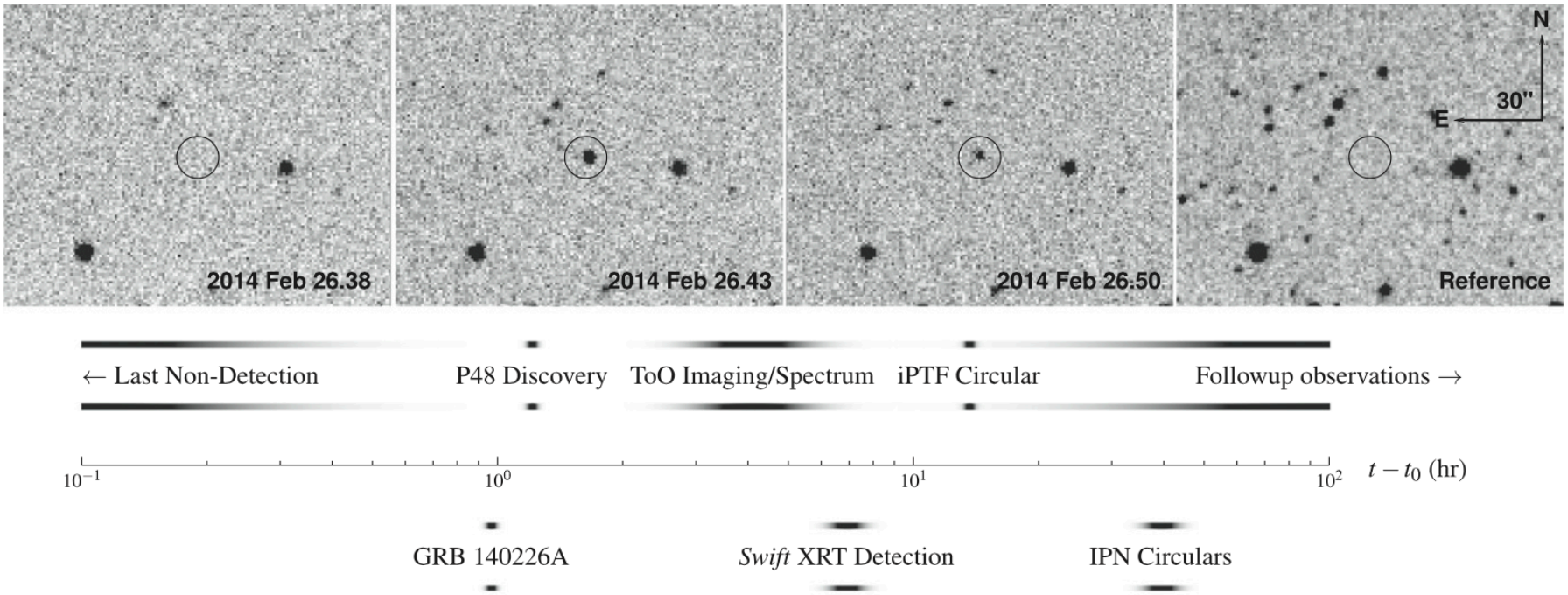
- Observable GRB afterglow present in ~2/3 of all GRBs
- FERMI-GBM has poor localization
- Several pointing with iPTF required

L. Singer, ApJ 2015

GRB localization through afterglow observation



Seeing Gamma-Ray Bursts without seeing Gamma-Rays



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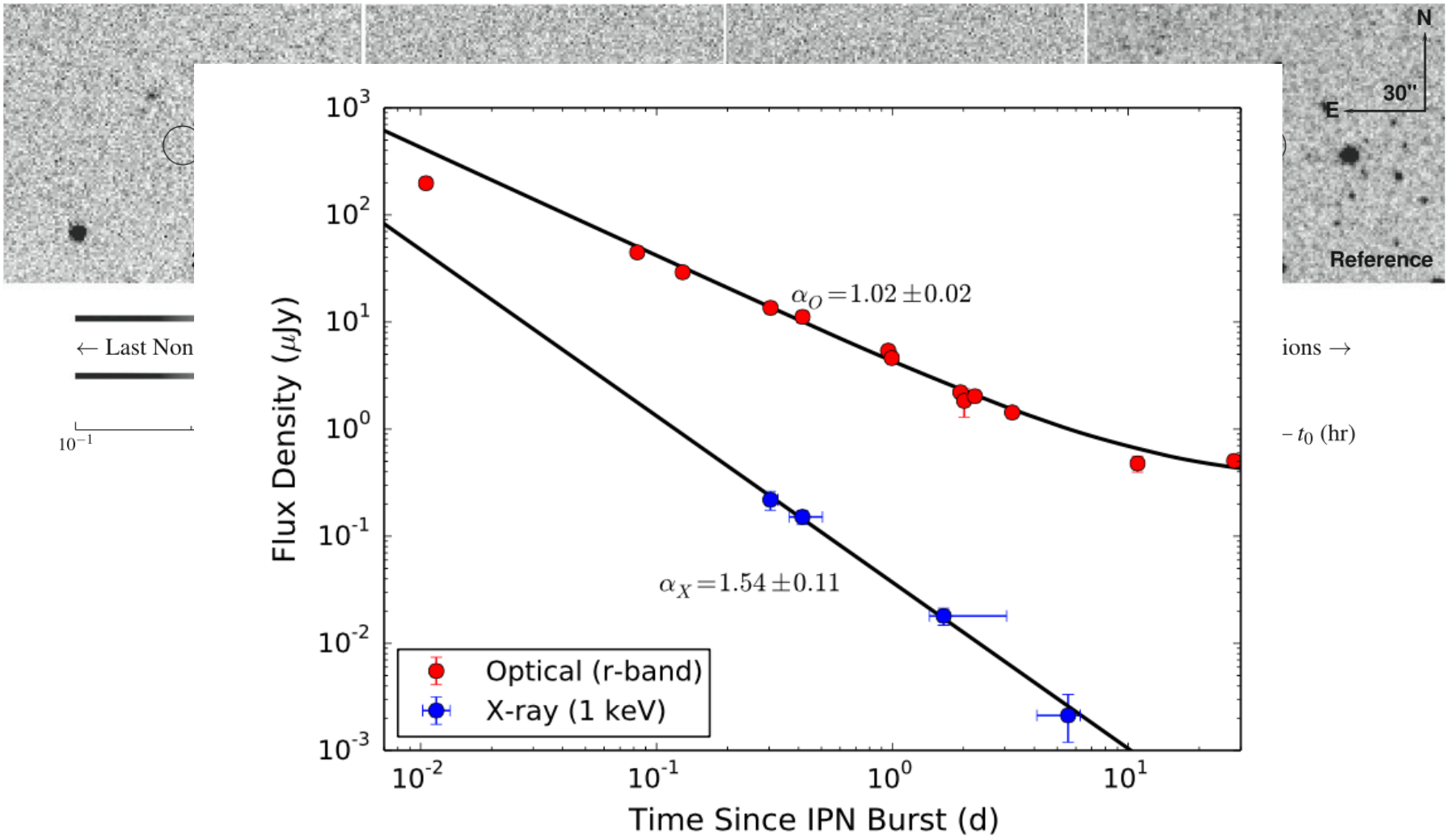
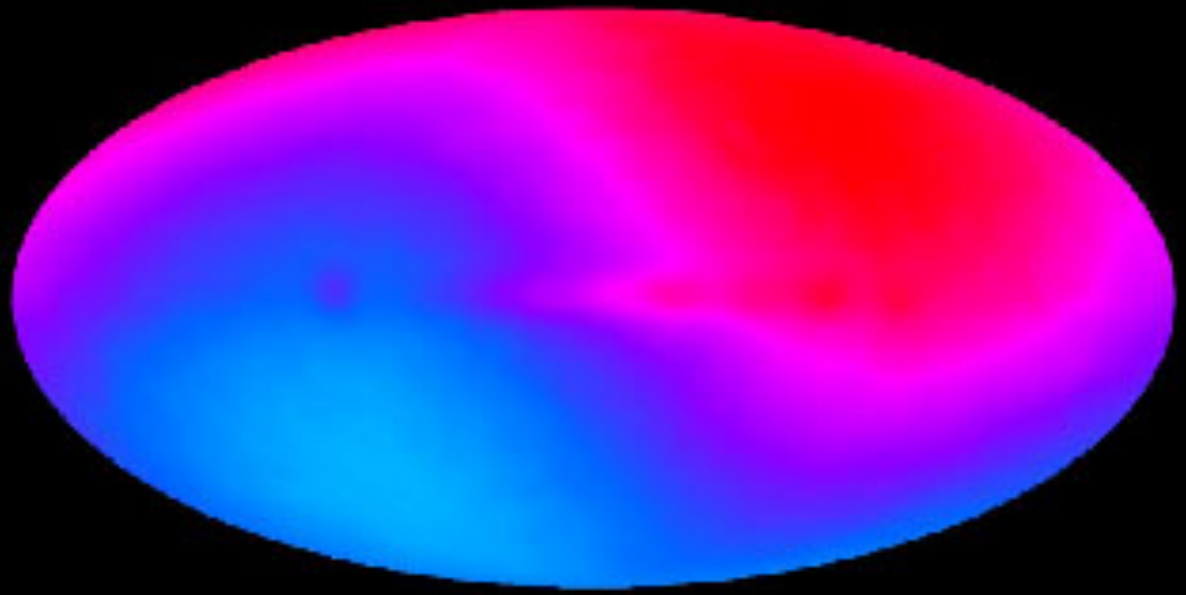


Cosmology

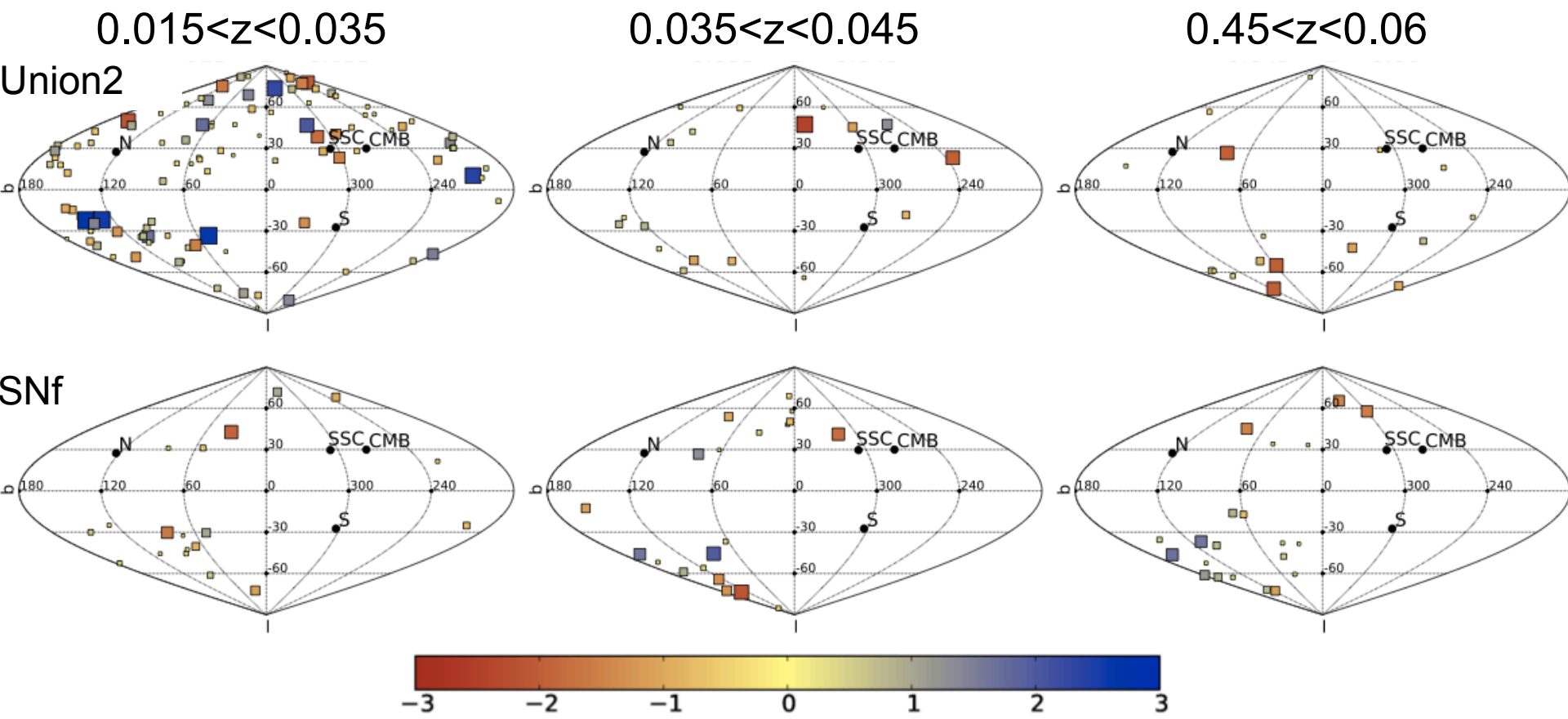
CMB temperature map: $\Delta T \sim 10^{-3}$ K



CMB Dipole due relative velocity of Local Group of 627±22 km/s (Kogut et al. 1993)

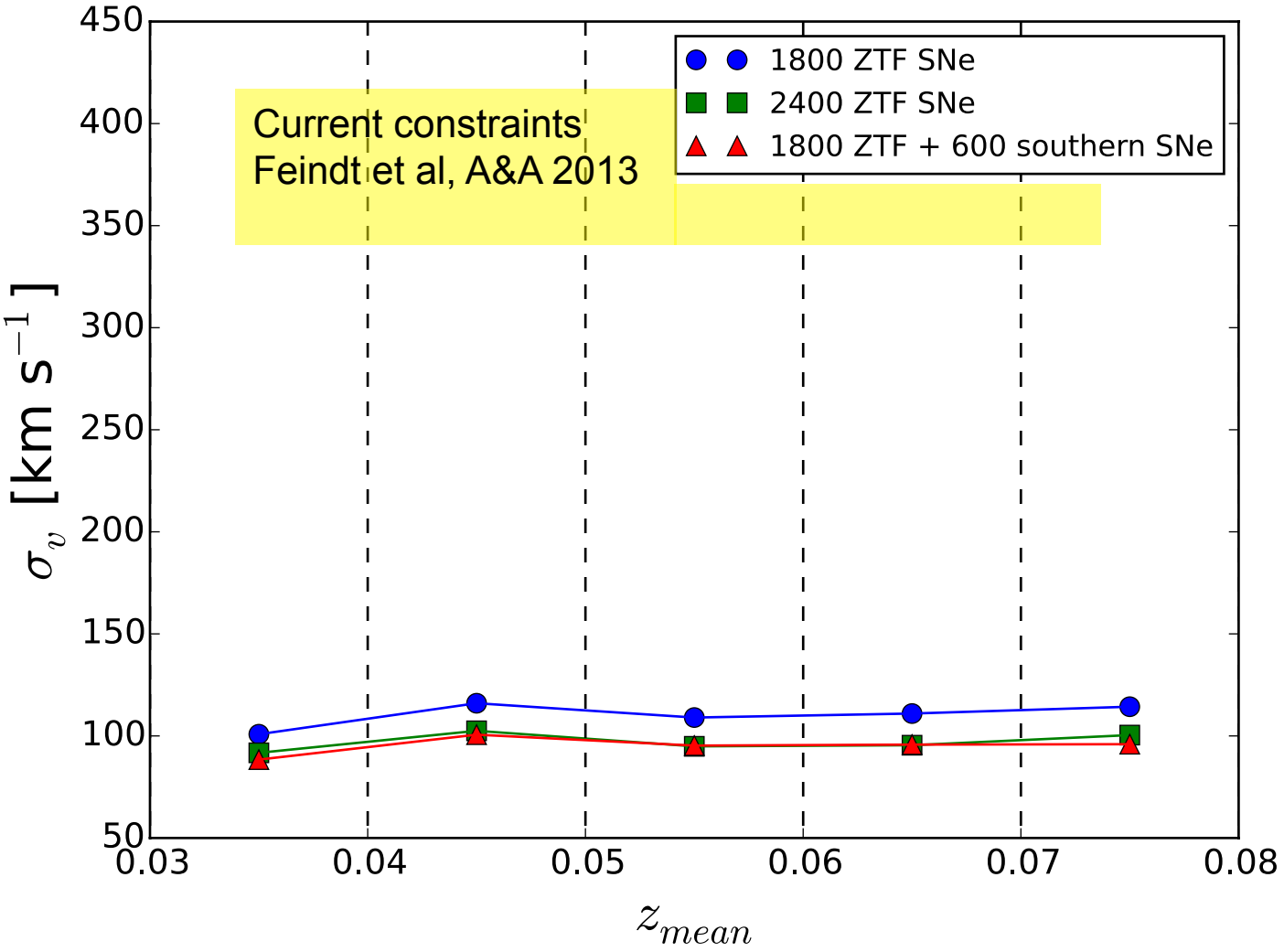
What is dragging us through space?

Dipole fit to SN Ia data in redshift shells

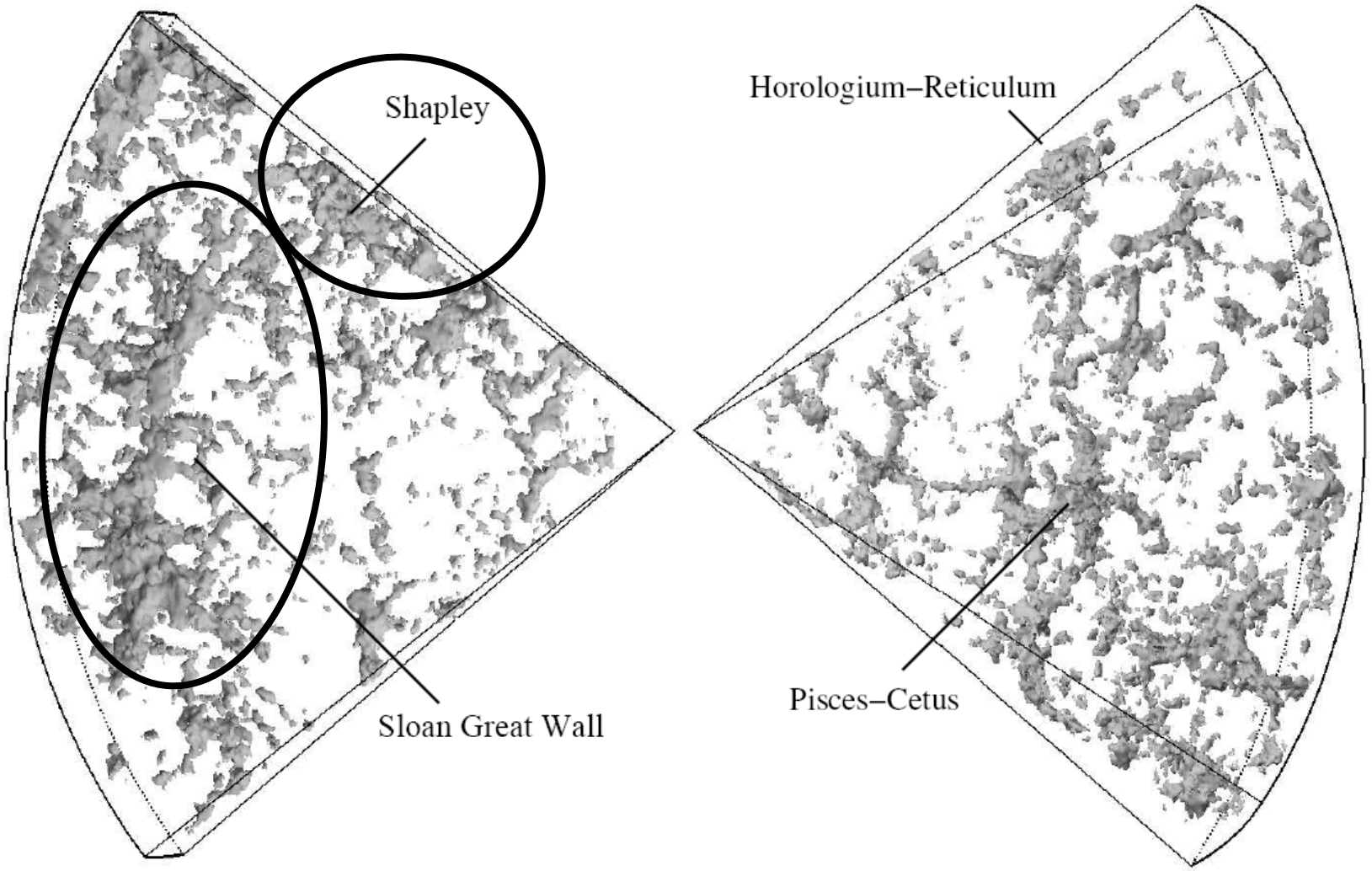


SNfactory & Union2 literature SNe Ia
Feindt et al, A&A 2013

Measuring bulk flows in redshift shells



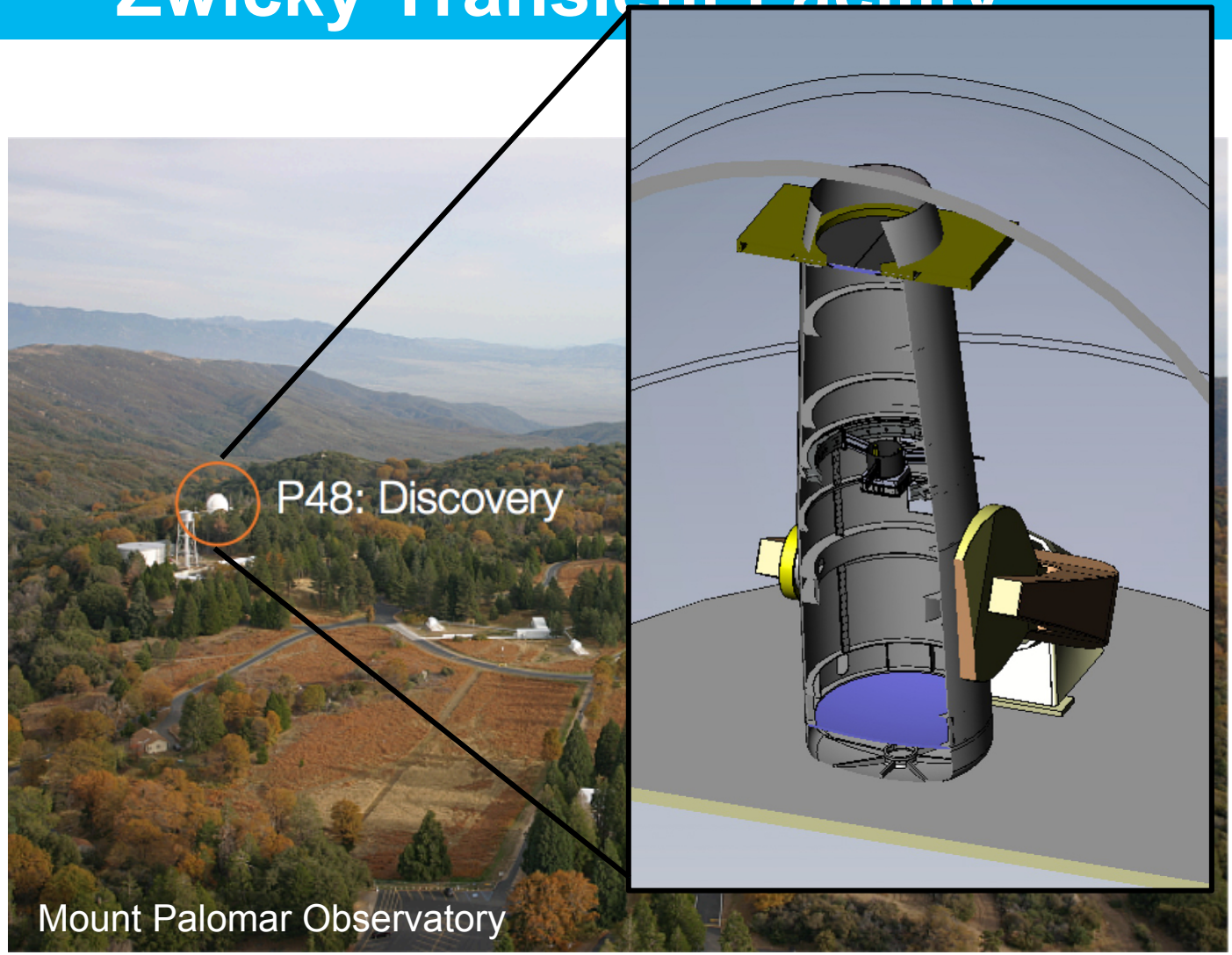
Identifying the attractors?



2dF GRS

The instrument

Zwicky Transient Facility



ZTF versus PTF

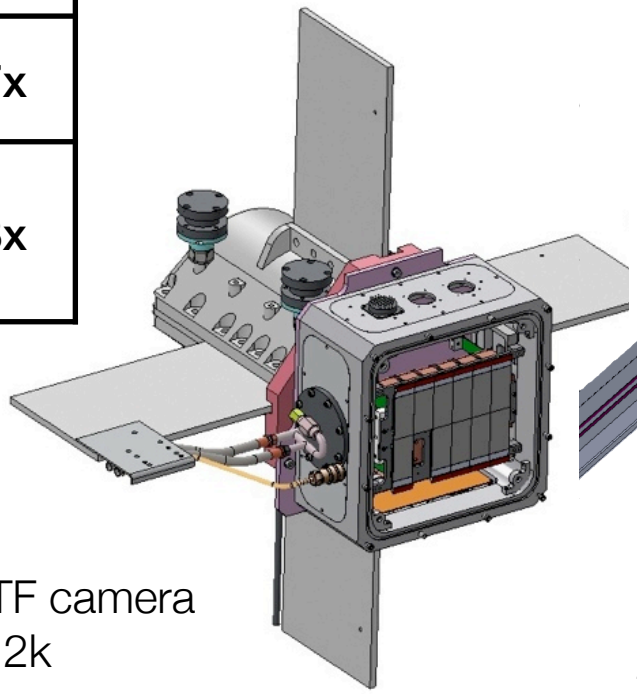
	PTF	ZTF
Active Area	7.26 deg^2	47 deg^2
Overhead Time	46 sec	<15 sec
Optimal Exposure Time	60 sec	30 sec
Relative Areal Survey Rate	1x	**14.7x**
Relative Volumetric Survey Rate	1x	**12.3x**

3750 deg^2/hour

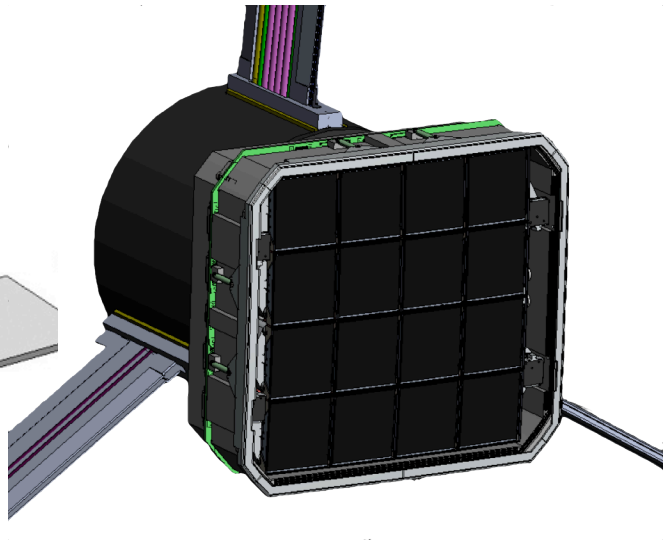
⇒ 3π survey in 8 hours

>250 observations/field/year

for uniform survey



Existing PTF camera
MOSAIC 12k



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

ZTF versus other surveys

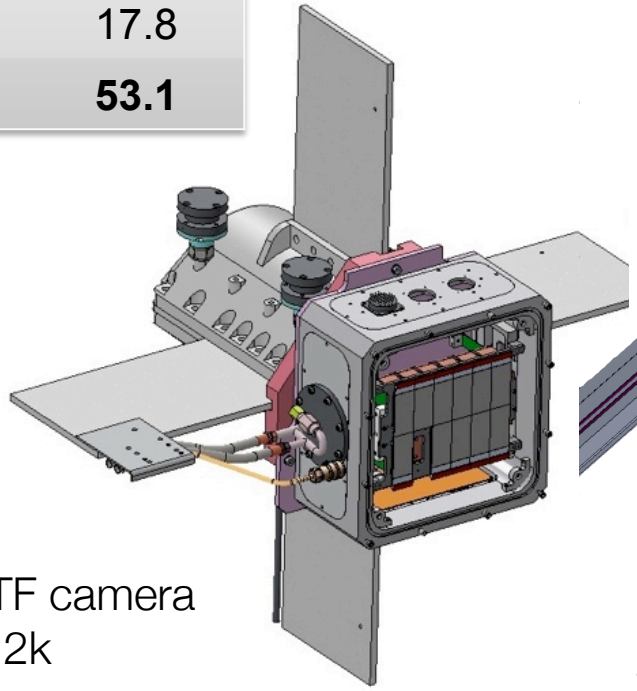
3750 deg²/hour

⇒ 3π survey in 8 hours

>250 observations/field/year

for uniform survey

Survey Camera	D (m)	Ω_{FoV} (deg²)	Etendue (m²deg²)
PTF	1.2	7.3	8.2
DECam	4.0	7.0	37.7
PS1	1.8	3.0	17.8
ZTF	**1.2**	**47**	**53.1**



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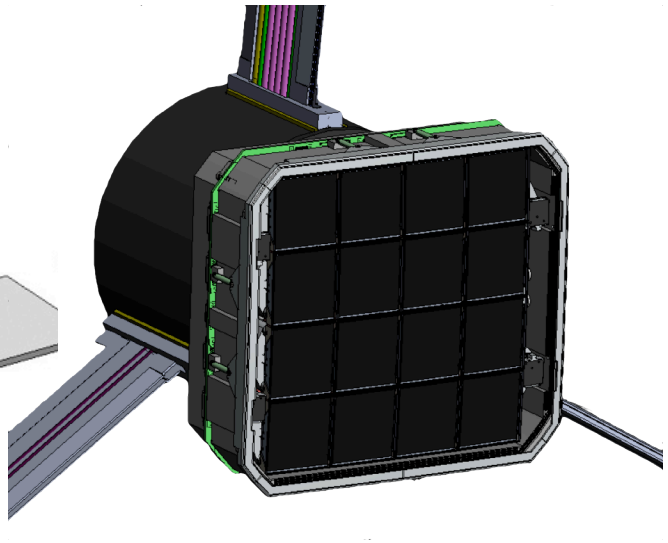

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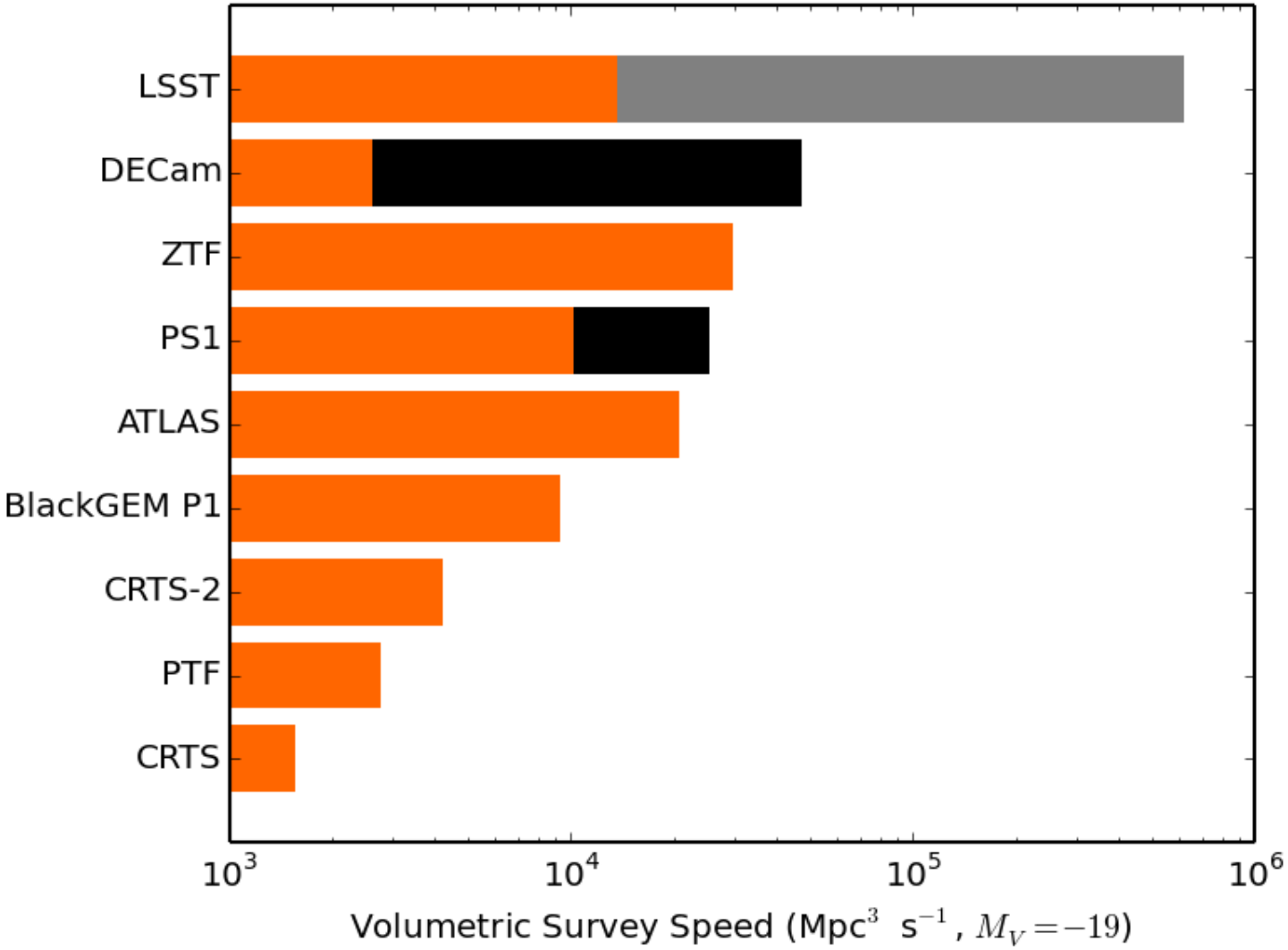
ZTF versus other surveys

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



Summary and Outlook

- Optical wide-field imagining provides access to transient Universe, addressing a range of scientific questions
- ZTF will improve statistics by a factor ~10 over currently available data
- Rapid follow-up provides access to new phenomena
- Survey scheduled to start in summer 2017

ZTF is coming in 2017!