The Palomar Transient Factory: Cadence and expected discovery rate

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For the PTF collaboration

Caltech, Columbia, IPAC, LBL+Yale, LCOGT, Weizmann

CFH, PSU

The Palomar Transient Factory

There is nothing like searching, if you want to find something.

You usually find something, if you search,

but it is not always quite the something you were after.

Thorin Oakenshild

The PTF

PTF is dedicated project to identify variable objects and transients

Uniqueness: high cadence

Large sky coverage obtained by single band discovery

Classification of candidate via 3-band photometry

Palomar 60-inch (50% of dedicated time)

MDM, Wise, LCOGT, Etc.

Three types of surveys:

1-night, 3-night and SN-optimized

Science goals

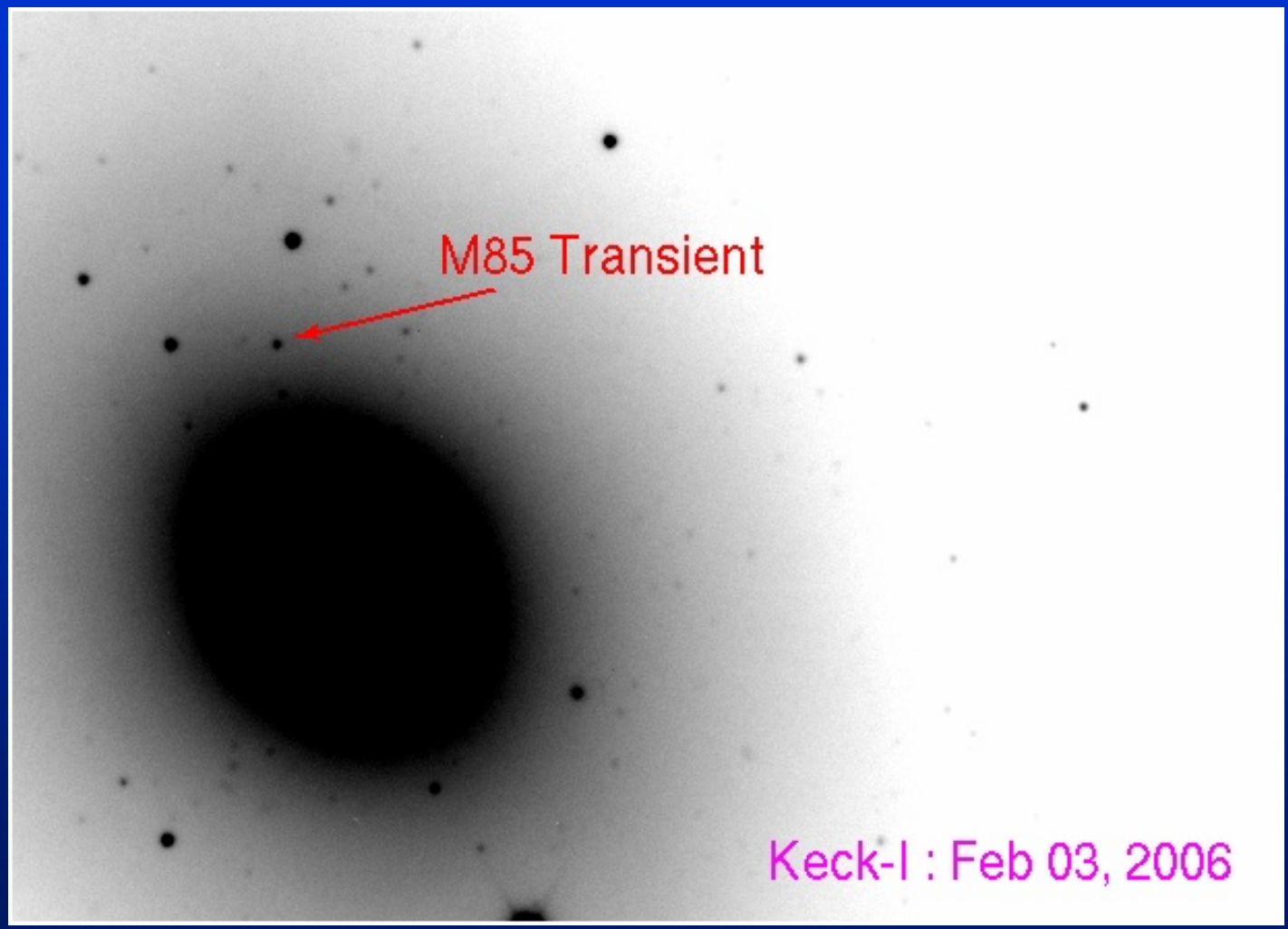
- SNe: Ia and core-collapse

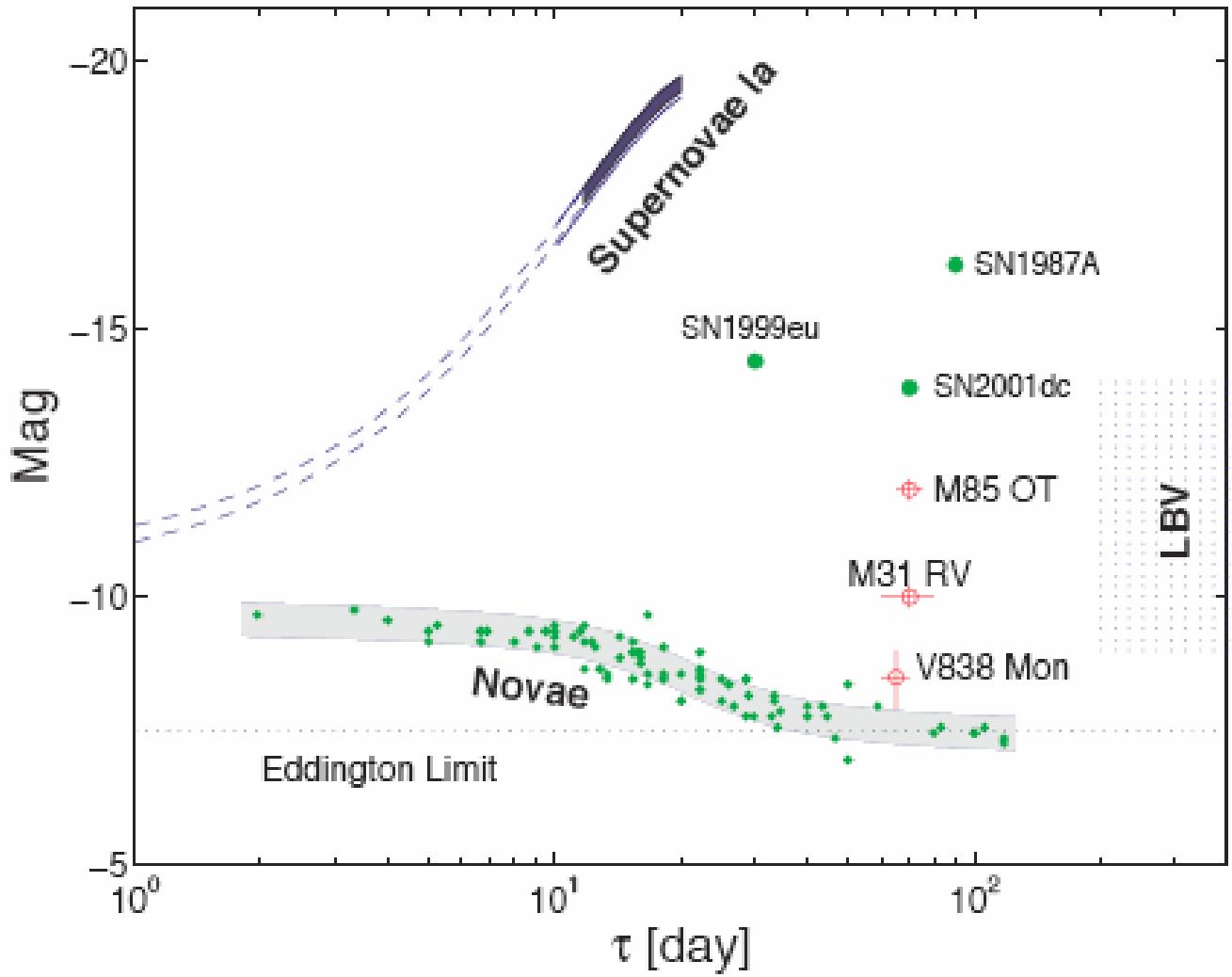
- Transients: Novae, Luminous red novae, LBV/IIns

- AGN/ Blazars/tidal events

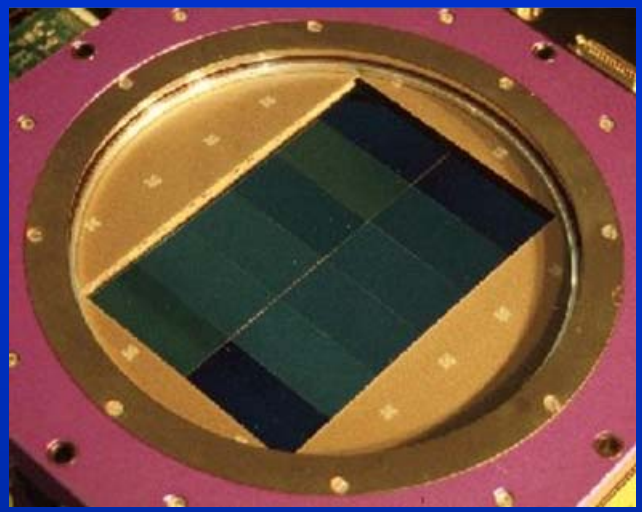
- Stars: CVs, AM CVns, flare stars, eclipsing stars/planets

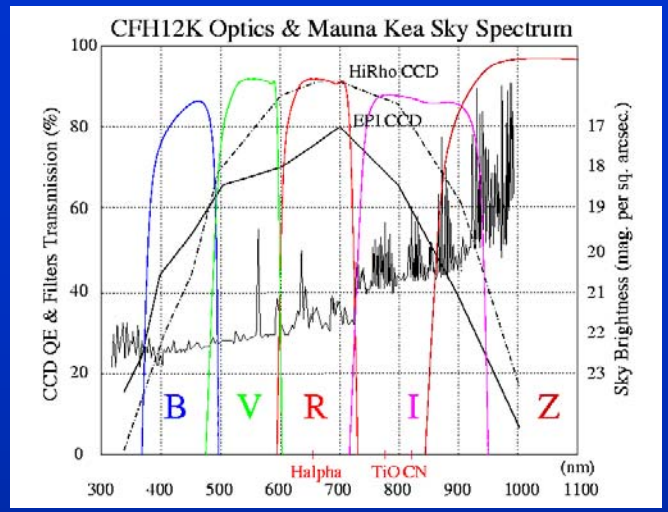
Stellar Mergers: A New Start




−20
−15
−10
−5
Mag
10^0
10^1
10^2
τ [day]
Supernovae Ia
SN1987A
SN1999eu
SN2001dc
M85 OT
M31 RV
V838 Mon
LBV
Novae
Eddington Limit

The PTF camera





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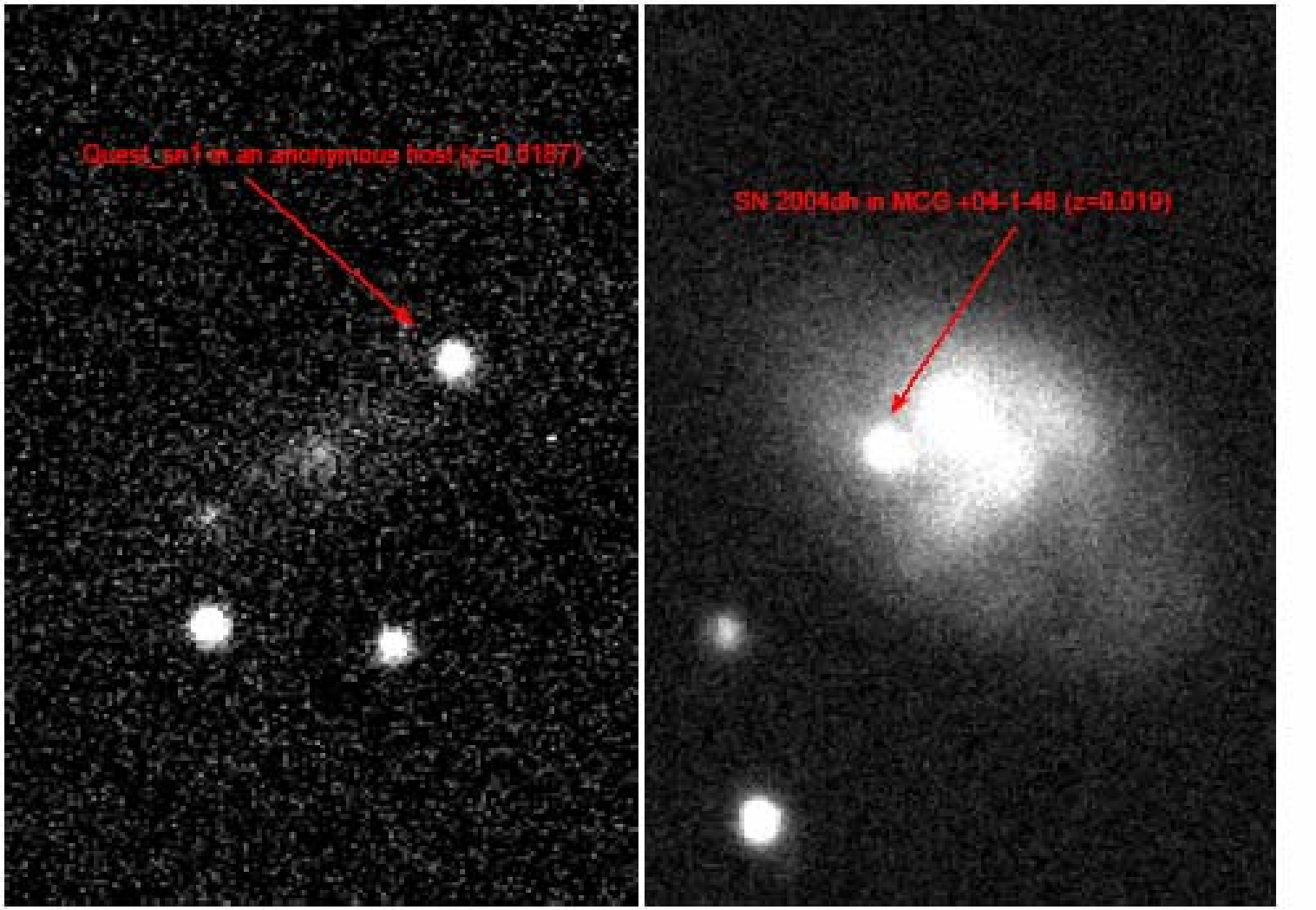
Timeline


Quest_sn1 in an anonymous host (z=0.0187)
SN 2004dh in MCG +04-1-48 (z=0.019)

Data management

Basic input: the SNF rate

Based on Oct. 2006 data:

25 rising SNe above 20 mag at peak in 2,200 deg^2

i.e., 0.011 SN/deg^2

Of those: 20 Ia, 2 IIn, 2 Ib/c, 1 II (P?)

80% Ia is consistent with other works

(e.g. WOOTS, Gal-Yam et al. 2007 in prep. 4/5)

Cadence

1/3 every 9 nights (SN-optimized)

1/3 every 3 nights (intermediate)

1/3 nightly or more (fast transients)

1	2	3	4	5	6	7	8	9
1	2	3	1	2	3	1	2	3
1	1	1	1	1	1	1	1	1

Sky coverage

Integration: ~120s, readout+slew: 30s, 150s total per field

20 fields per hour

2 images per field (asteroids)

70% weather, 80% PTF time

Depth similar to SNF

Expected SN yield

So:

For the 1/9 (SN) component: 20 field/hour

= 140 deg2 / hour

= 350 deg2 / night

= 3150 deg2 / month

X 0.7 x 0.8 = 1764 deg2 / month

Which, assuming 0.011 rising SN/ deg2

= 20 rising SNe / month above 20 mag

Expected SN yield

Which, assuming 0.011 rising SN/ deg2

= 20 rising SNe / month above 20 mag

Of which ~16 cosmology-grade SNe Ia

~ 4 core-collapse SNe

(perhaps 1-2 IIn, 1-2 Ib/c, 1-2 II)

Expect x2 more including fainter + declining events

Thanks