Prompt Observations of Transients: Synergy with Wide Field Survey

- 広視野サーベイ観測と連携した突発天体の即時観測 -

Masaomi Tanaka

田中 雅臣

(National Astronomical Observatory of Japan)

On behalf of KISS collaboration

Tomoki Morokuma (Univ. of Tokyo)

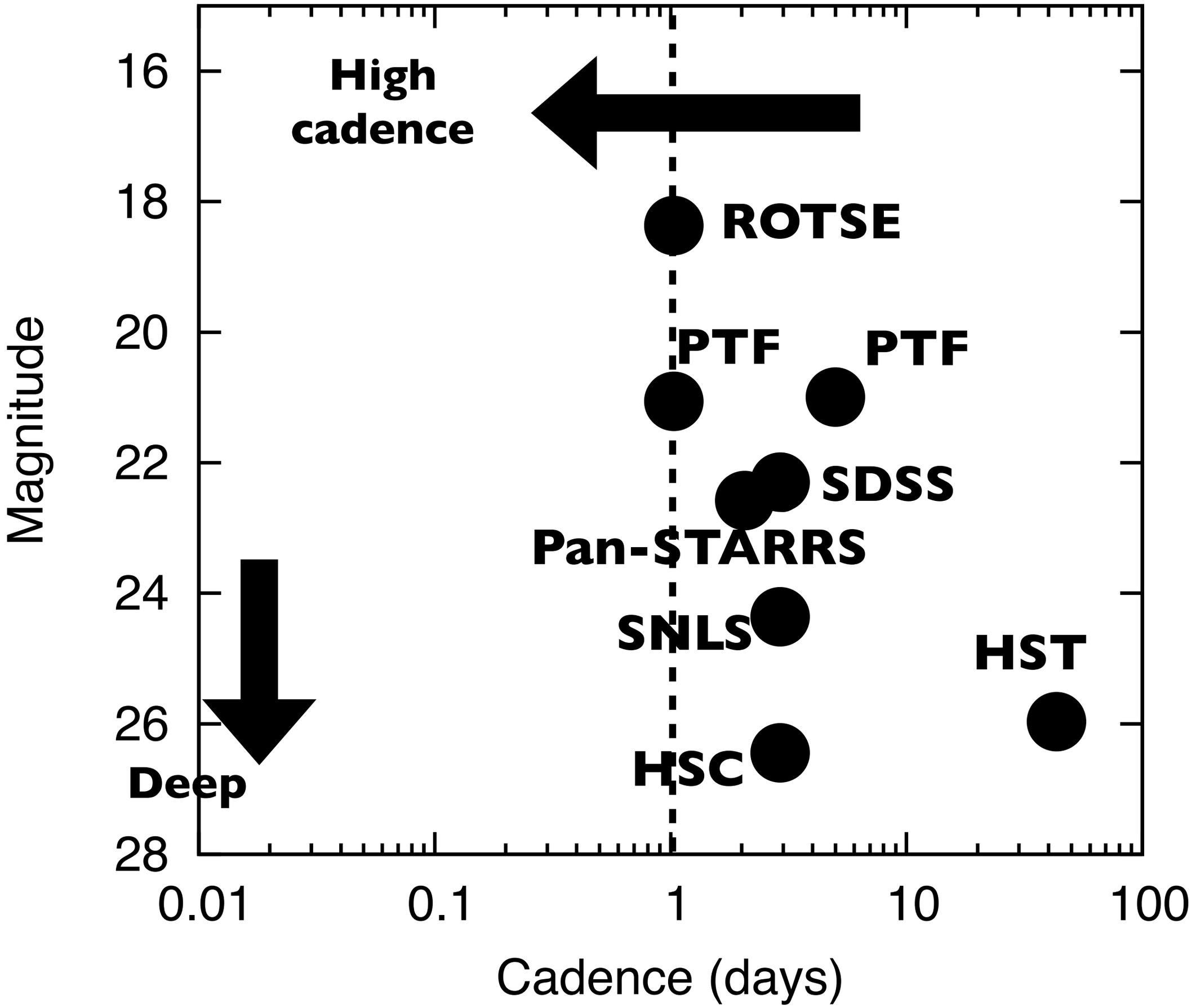
Nozomu Tominaga, Emiko Matumoto (Konan Univ.),

Kensho Mori (Hiroshima Univ.), and KISS members

Optical Transient Search

Survey	Diameter (m)	FOV (deg^2)	Depth (R mag)	Area/ day(deg^2)
LOSS	0.76	0.01	19	galaxy
CHASE	0.4 x 4	0.03	19	galaxy
ROTSE-III	0.45	3.42	18.5	450
KISS	1.05	4	21	100
PTF	1.26	7.8	21	1000
Pan-STARRS	1.8	7	21.5	6000
SDSS-II	2.5	1.5	22.6	150
GOODS	2.5 (HST)	0.003	26	0.04
SNLS	3.6	1	24.3	2
SkyMapper	1.3	5.7	22	--
Subaru/HSC	8.2	1.75	26.5	3.5

(partly taken from Rau et al. 2009, PASP, 121, 1334)


High cadence
Deep
ROTSE
PTF
PTF
SDSS
Pan-STARRS
SNLS
HST
HSC
16
18
20
22
24
26
28
Magnitude
0.01
0.1
1
10
100
Cadence (days)

Theoretically expected

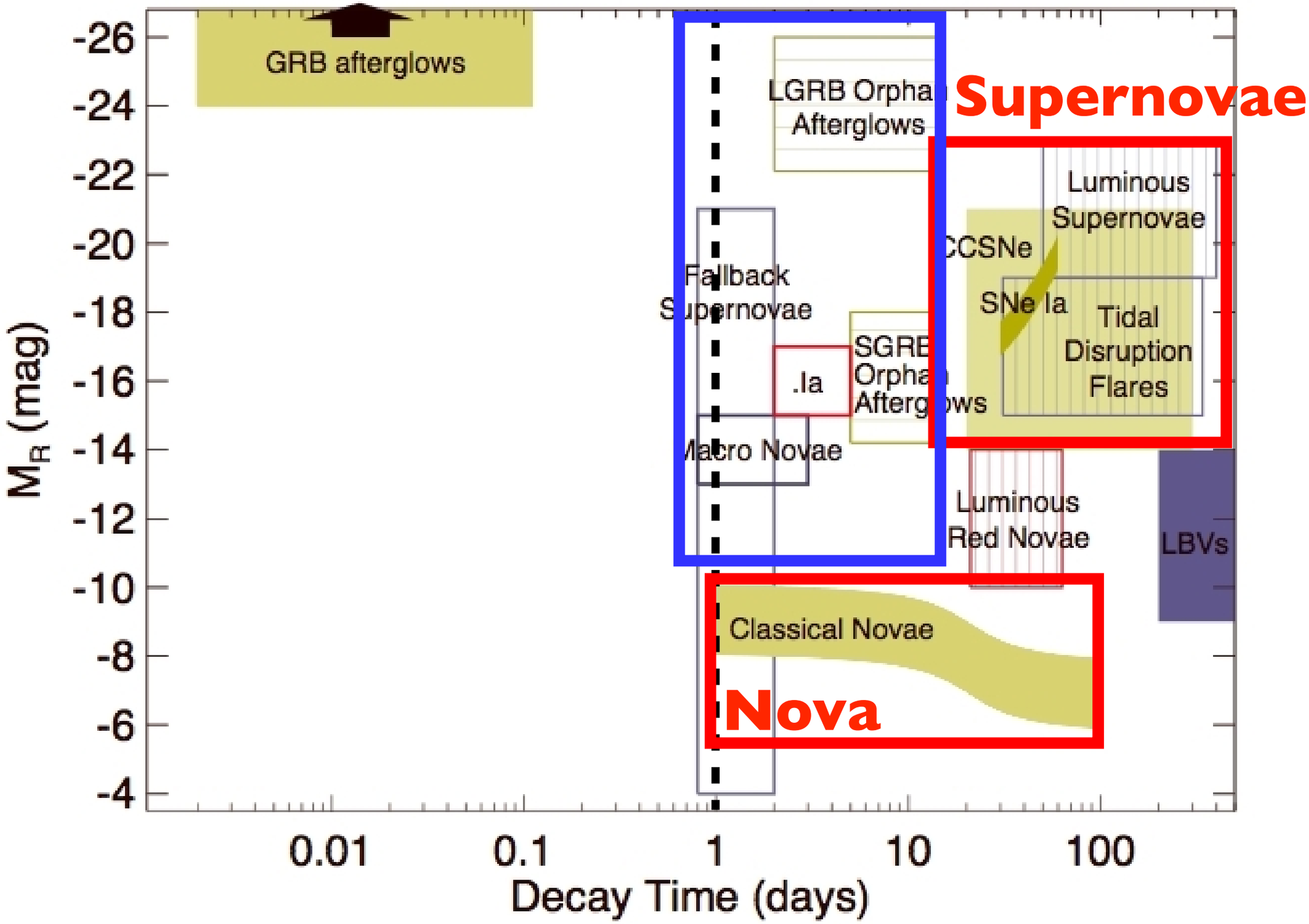
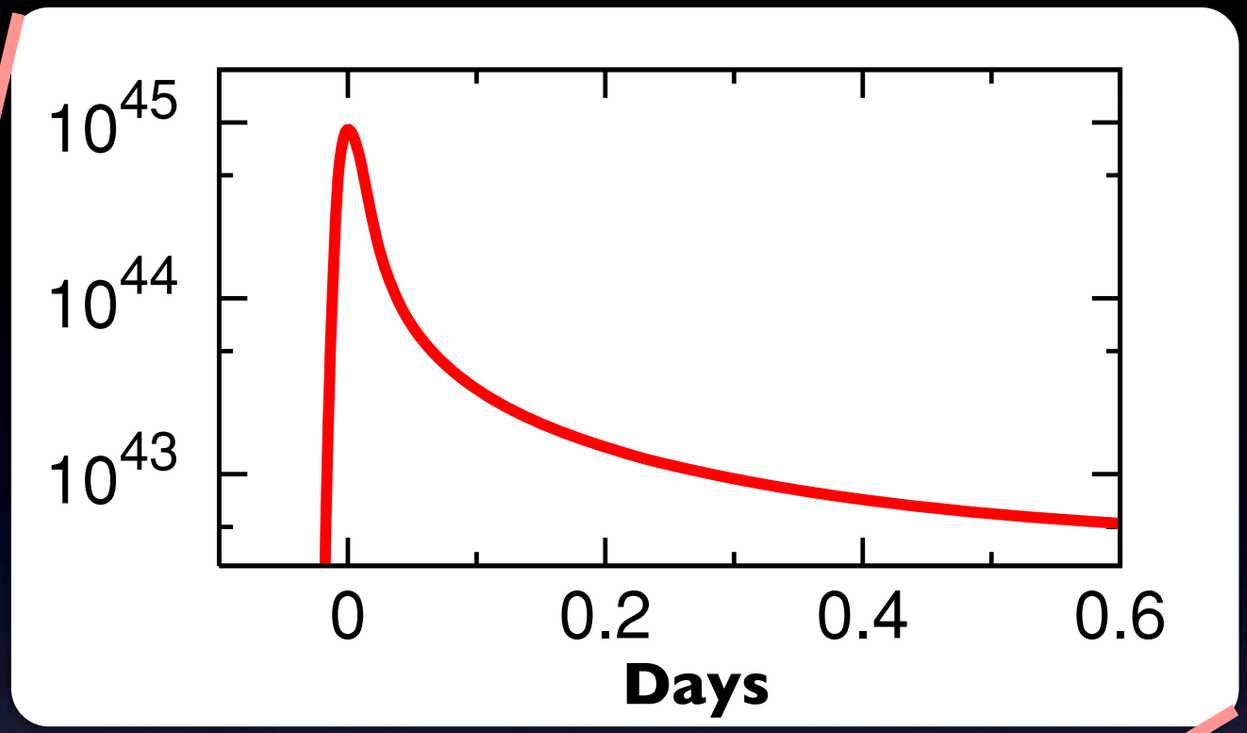
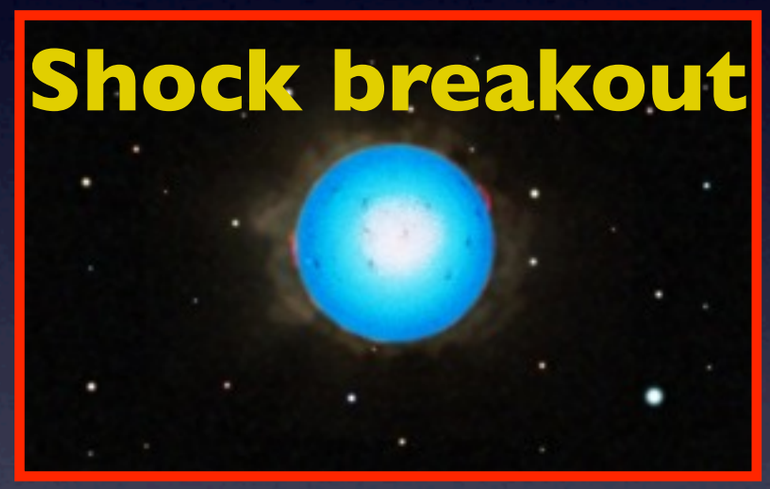
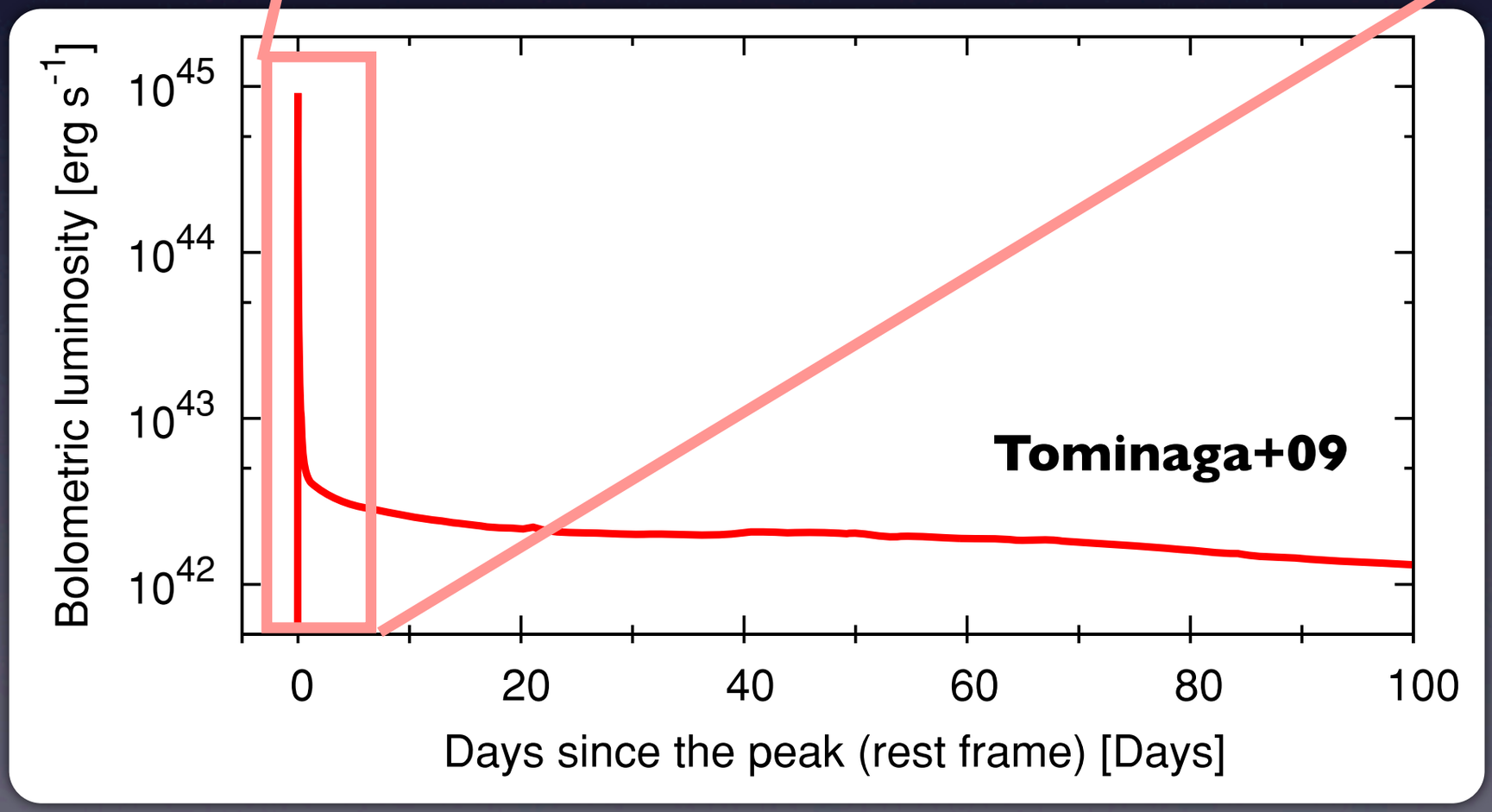


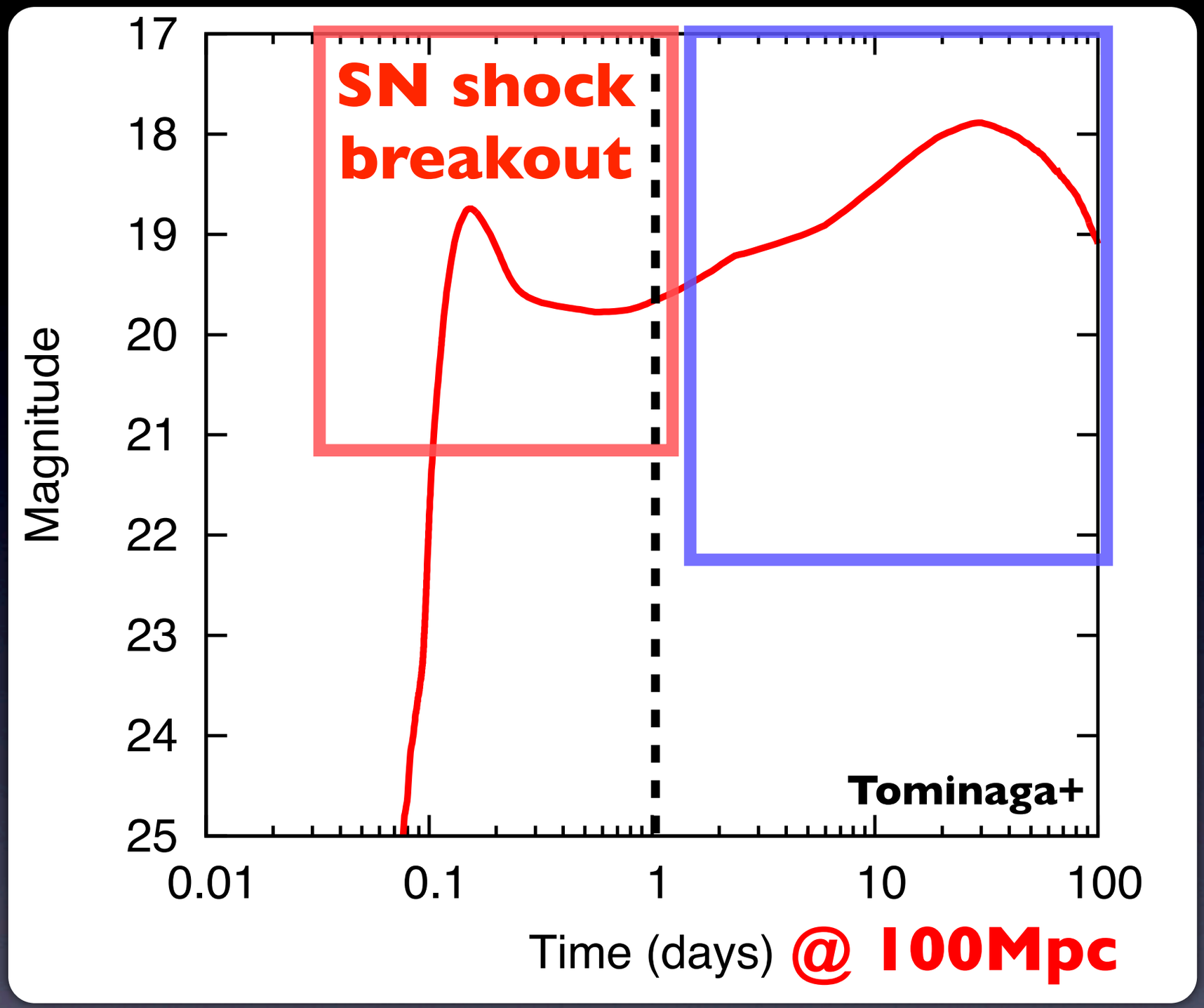
Figure from LSST Science Book
(after PTF collaboration, Rau+09, Kasliwal+,Kulkarni+)

The moment of supernova explosion









*** New window to study supernovae**
(progenitor radius/mass, explosion energy)
*** Tracer of star formation at high redshifts**

KISS: KIso Supernova Survey

2012 Apr: Dry run -
2012 Sep: Main survey -

- Extremely high cadence
  - 1-hr cadence <= 2-3 days
  - 4 deg^2 FOV (KWFC)
  - ~ 21 mag in g-band (3 min)
  - ~50-100 deg^2 /day
  - ~100 nights/yr (around new moon)
  - High SFR field (< 200 Mpc, 30-100 Msun/yr)

Tomoki Morokuma (PI), Nozomu Tominaga, Masaomi Tanaka et al.

~ 1-2 shock breakout / yr

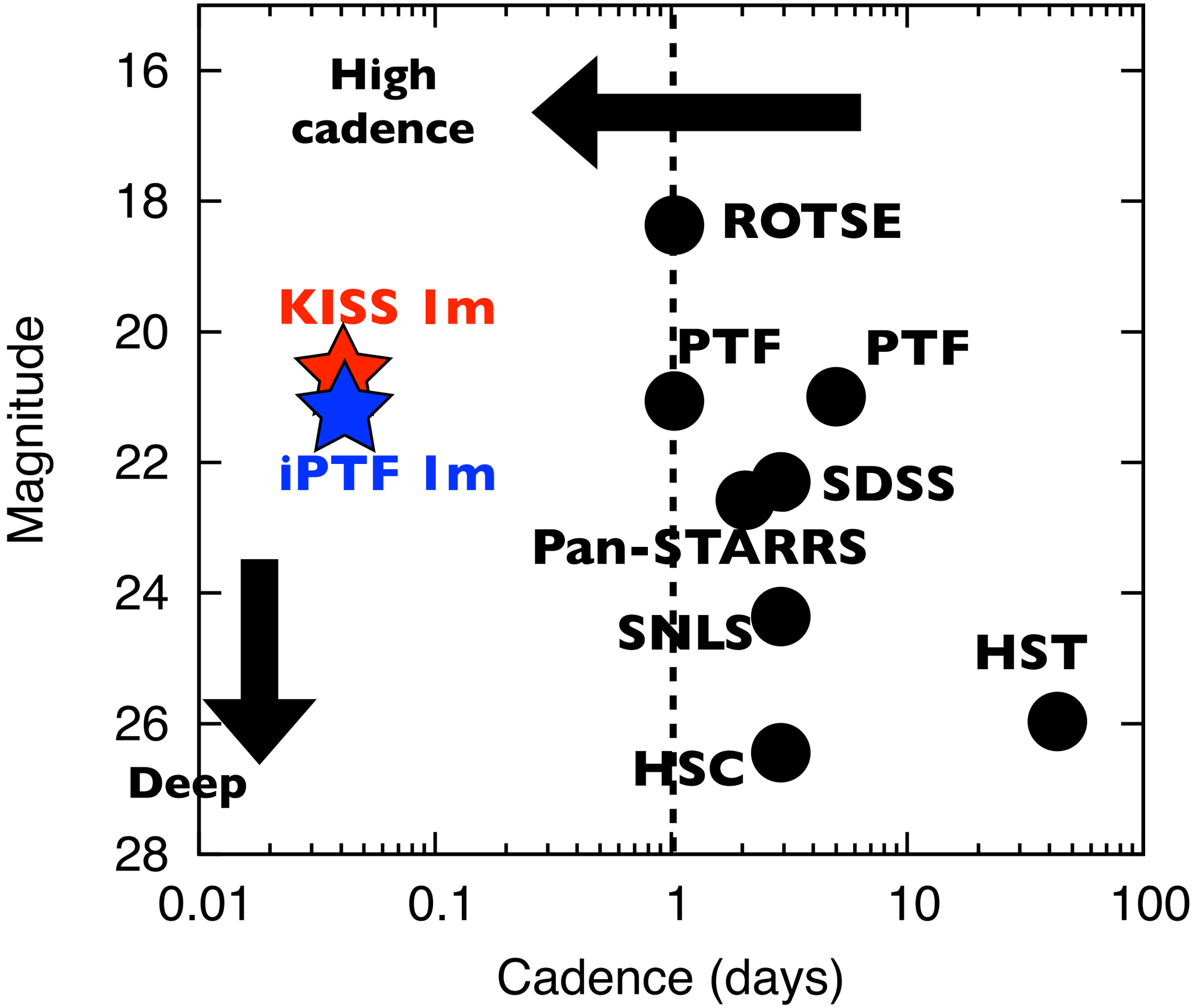
KISS collaboration

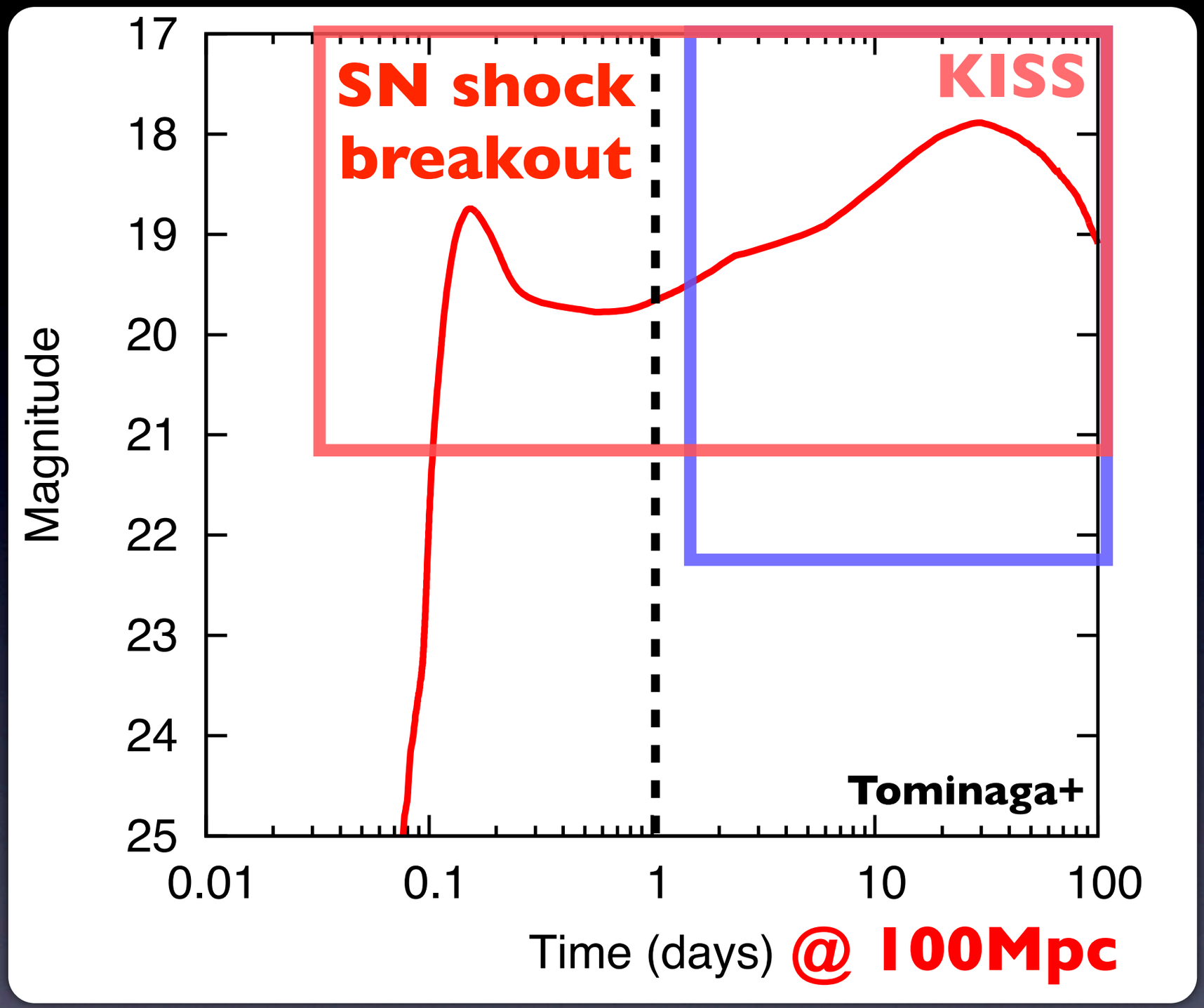


- **Survey members**
  - **Tomoki Morokuma (PI), Nozomu Tominaga, Masaomi Tanaka, Mieko Matsumoto, Kensho Mori**, Koji Kawabata (and Hiroshima group), Yoshihiko Saito (and Tokyo Tech group), Nobuharu Ukita, Michael Richmond, Yuji Urata
- **Indian Institute of Astrophysics**
  - **Devendra Sahu**


- **Carnegie Supernova Project (CSP)**
  - **Eric Hsiao, Maximilian Stritzinger, Mark Phillips, Nidia Morrell, Carlos Contreras, Francesco Taddia**
- **Telescopio Nazionale Galileo (TNG)**
  - **Paolo Mazzali, Emma Walker, Elena Pian**


- **SNFactory**
  - **Greg Aldering**
- **Russian Institutes**
  - **Dmitry Tsvetkov, Nikolay Pavlyuk**


High cadence
Deep
KISS Im
iPTF Im
ROTSE
PTF
PTF
SDSS
Pan-STARRS
SNLS
HST
HSC
16
18
20
22
24
26
28
Magnitude
0.01
0.1
1
10
100
Cadence (days)



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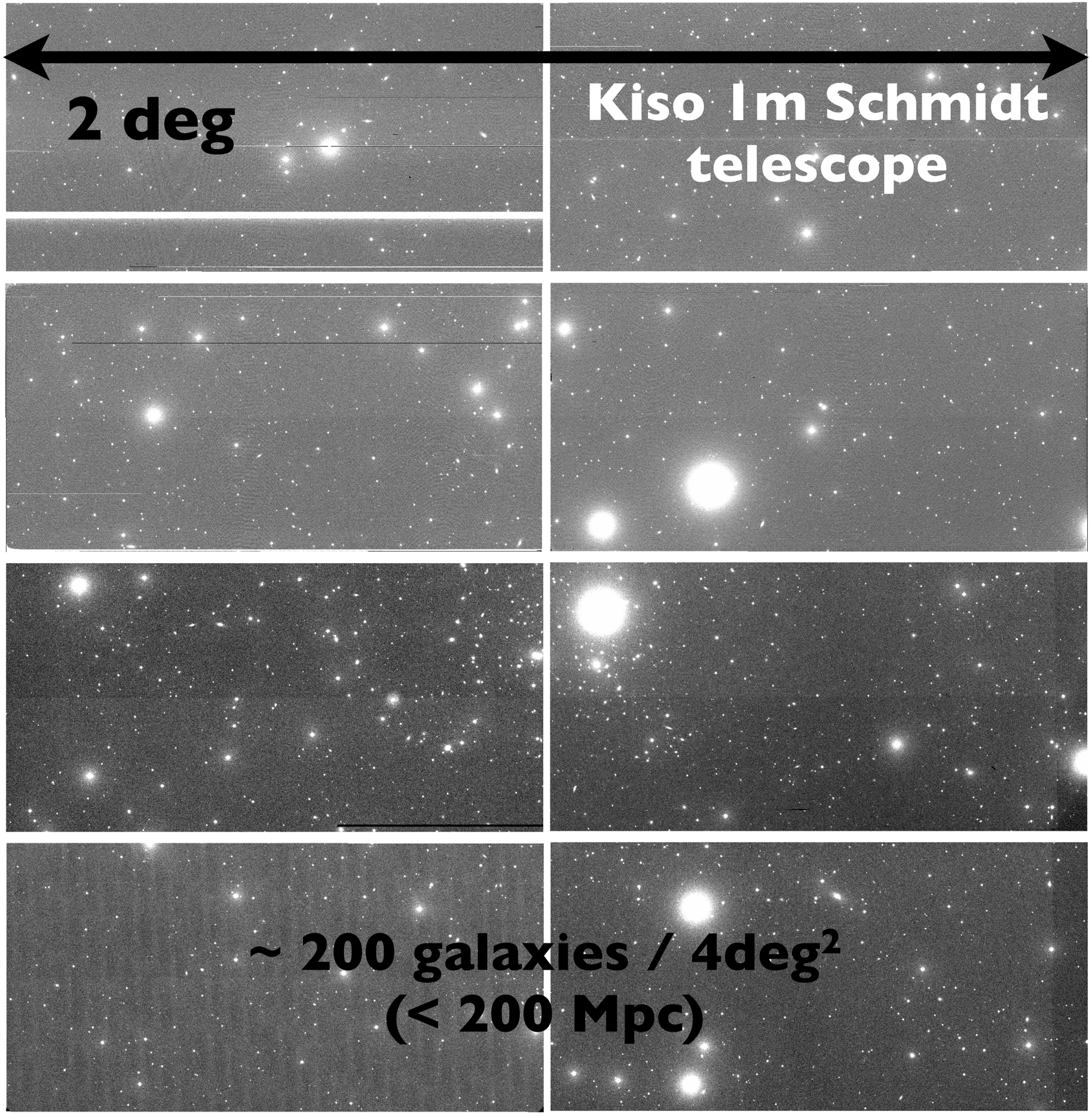
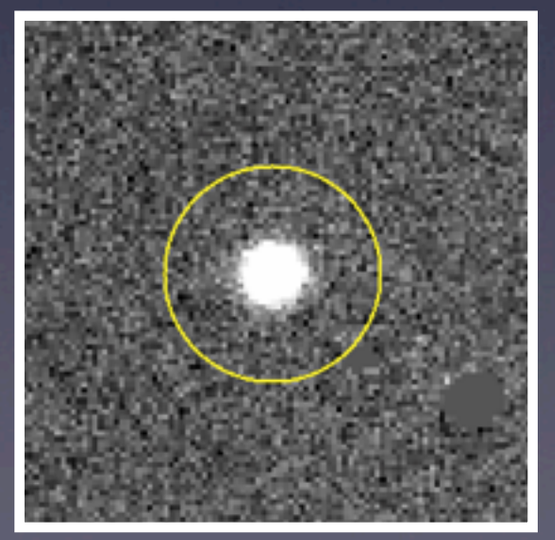

2 deg
Kiso Im Schmidt telescope
~ 200 galaxies / 4deg²
(< 200 Mpc)

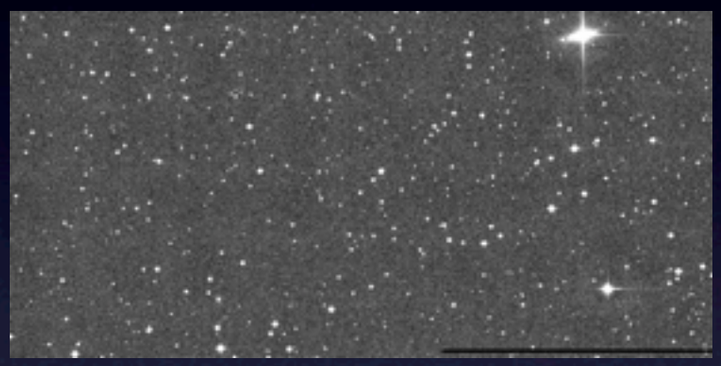
Before

After

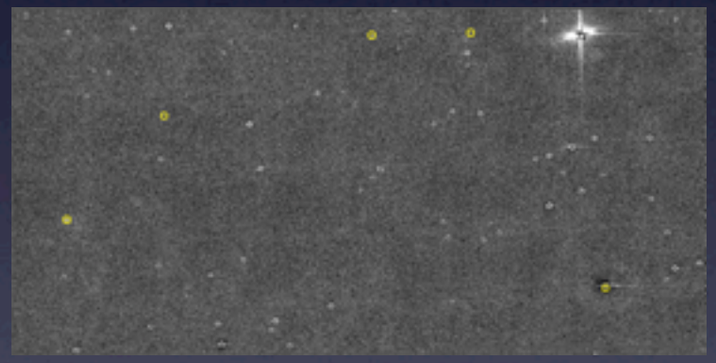
1 deg



Kiso observatory



Standard pipeline



Transient pipeline

< 10 min

~ 50GB/day

cut-out images

KISS database

source info

Anywhere

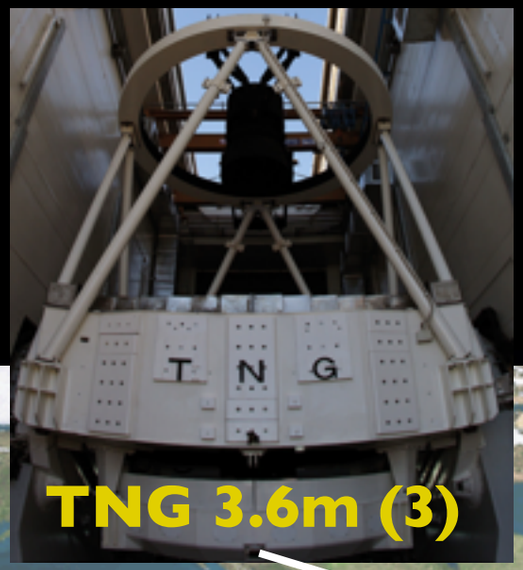
cut-out images

KISS database

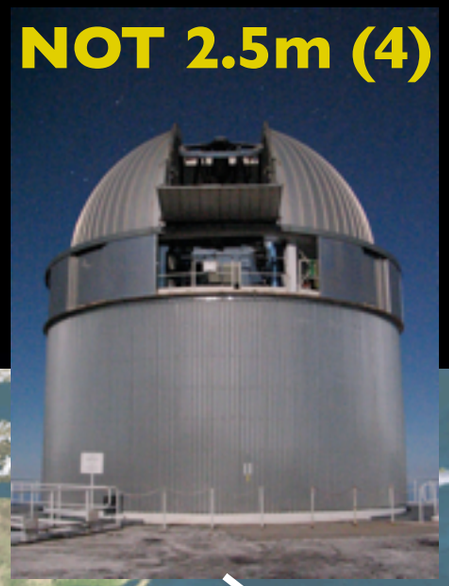
source info

KISS interface

Amateur astronomers



TNG 3.6m (3)



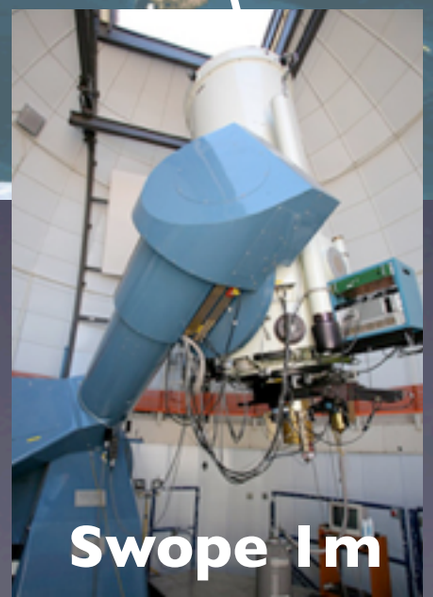
NOT 2.5m (4)

Hiroshima 1.5m (1)

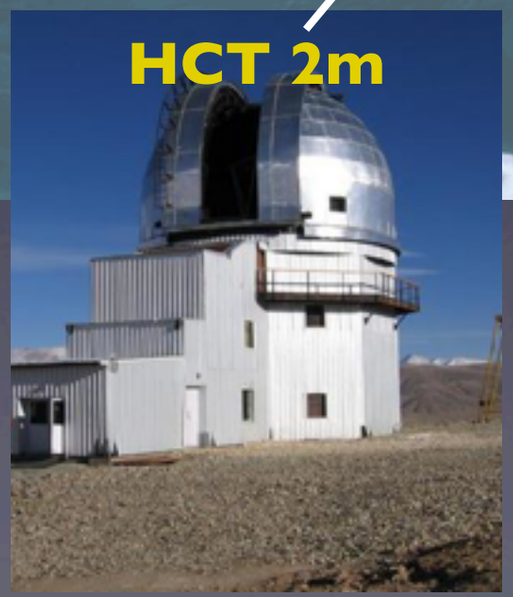
Kiso 1m

Follow-up collaboration

WIYN 0.9m



Swope 1m



HCT 2m

Lulin 1m

Akeno 0.5m

51 SN candidates (as of 2013 May)

KISS12a

KISS12f

KISS12k

KISS13a

KISS12b

KISS12m

KISS13d

KISS12i

KISS12n

KISS13j

No shock breakout yet...
stay tuned!

Only 8 of 51 were confirmed by ourselves

(additional 4 by other groups)

Synergy with 3.8m telescope

- **Rapid follow up**
  - **Fully utilize high speed pointing**
  - **Rapid communication (< 1 hr)**
    (Automatic response?)
- **Low resolution spectroscopy**
  (R~500, v~500 km/s)
  - **IFU is preferred**
    confirmation image + spectroscopy

No Transient Left Behind

Trial with 188cm/KOOLS

- **Coordinated observations with Kiso and Okayama**
  2013 Sep - (4 nights equivalent)
- **Combined with other KOOLS proposals**
- **Low-res spectroscopy for SN candidates (< 19 mag) WITHOUT DELAY**

  ~ 5 SNe (~ 0.1 shock breakout) /month

“One-click” reduction for KOOLS

Mac/Linux
(Python + PyRAF)

データ提供

山中雅之さん、浮田信治さん

Summary

- **Frontier of transient survey**
  - **high cadence (< 1d)**
- **KISS: Kiso Supernova Survey**
  - **1-hr cadence survey for SN shock breakout**
    - **~50 SN candidates so far (no shock breakout)**
- **Synergy with 3.8m telescope**
  - **Rapid communication**
  - **Low-res spectroscopy (IFU is preferred)**
  - **Trial with 188cm/KOOLS (2013 Sep-)**