

**Transient Science**  
**with Wide Field Survey**  
**and 3.8m Telescope**

- 広視野突発天体サーベイと3.8m望遠鏡によるサイエンス -

**Masaomi Tanaka**

田中 雅臣

**(National Astronomical Observatory of Japan)**

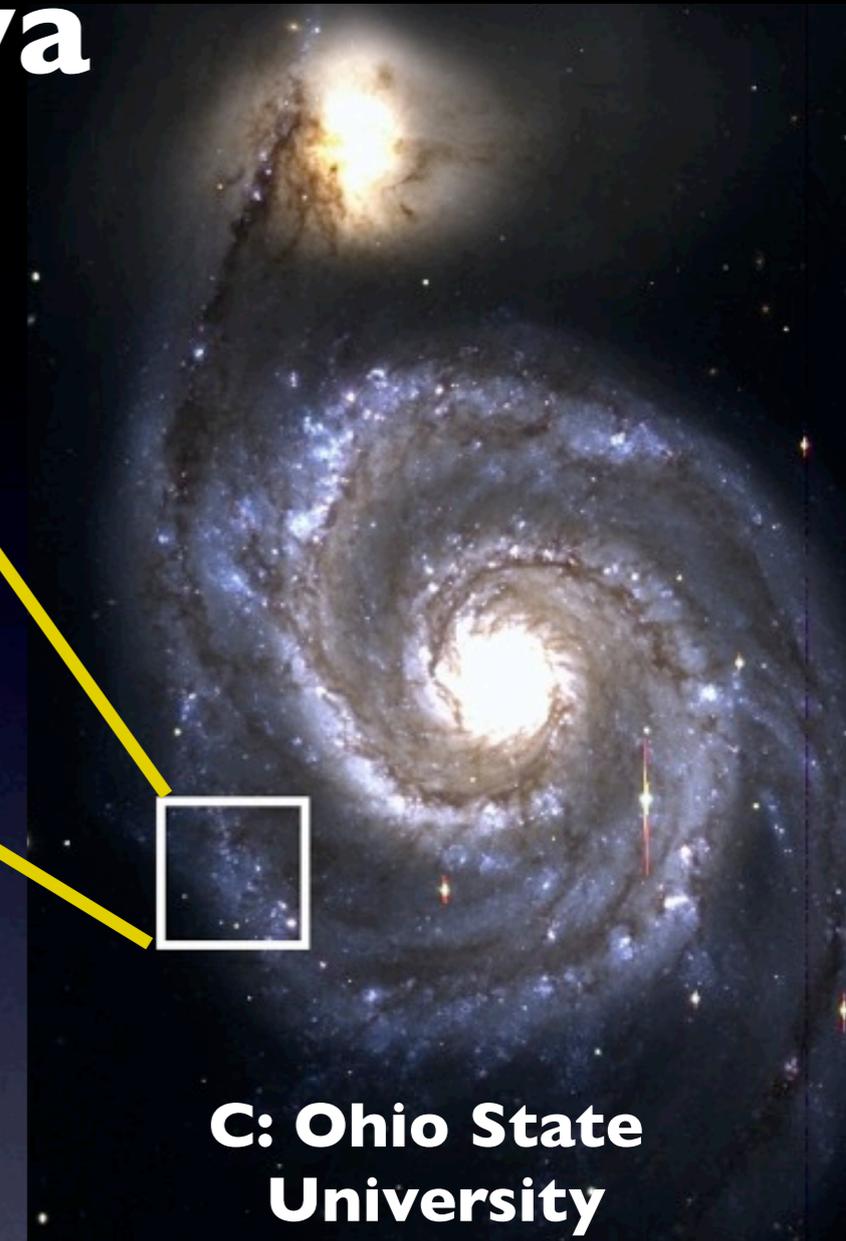
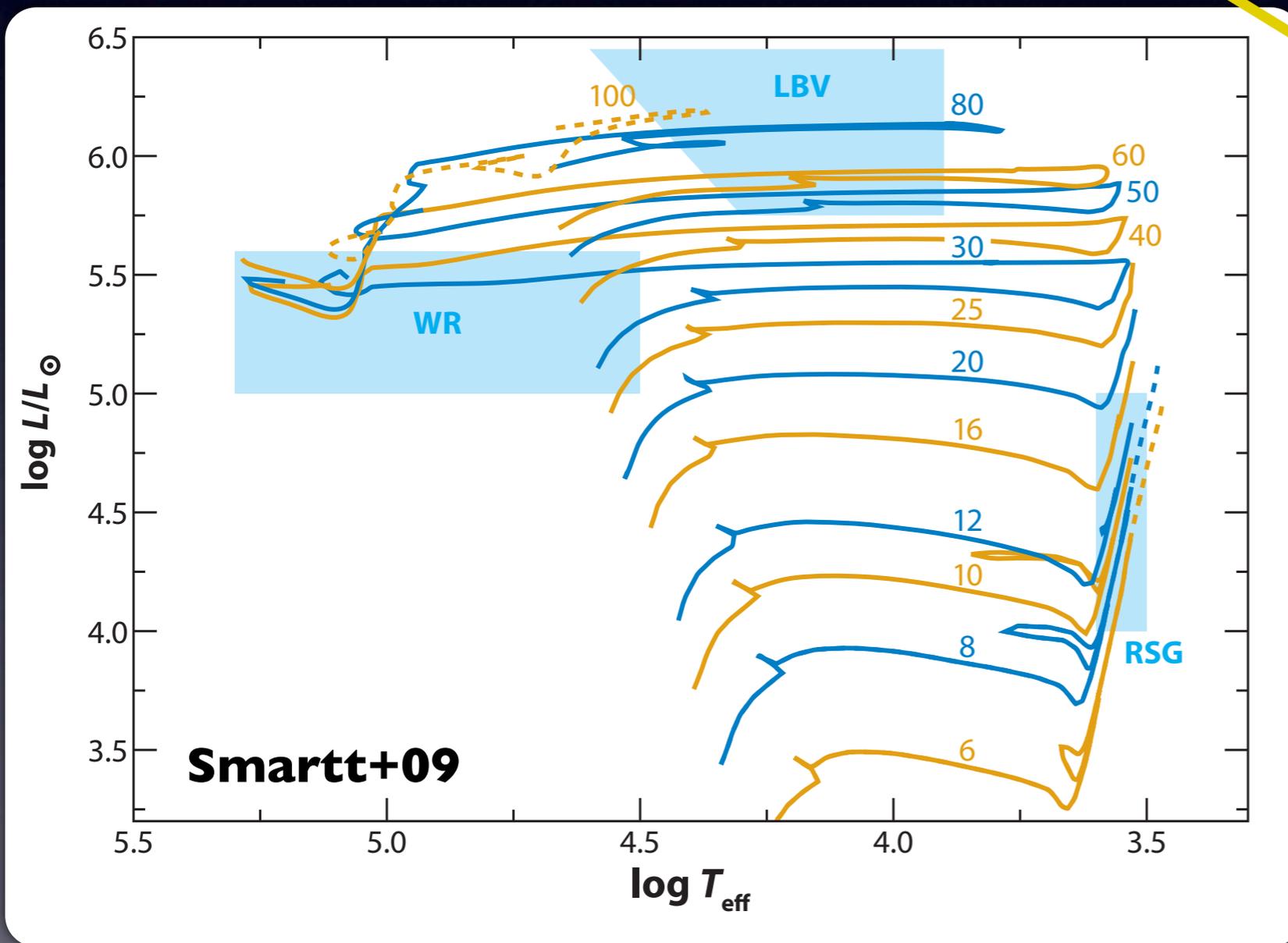
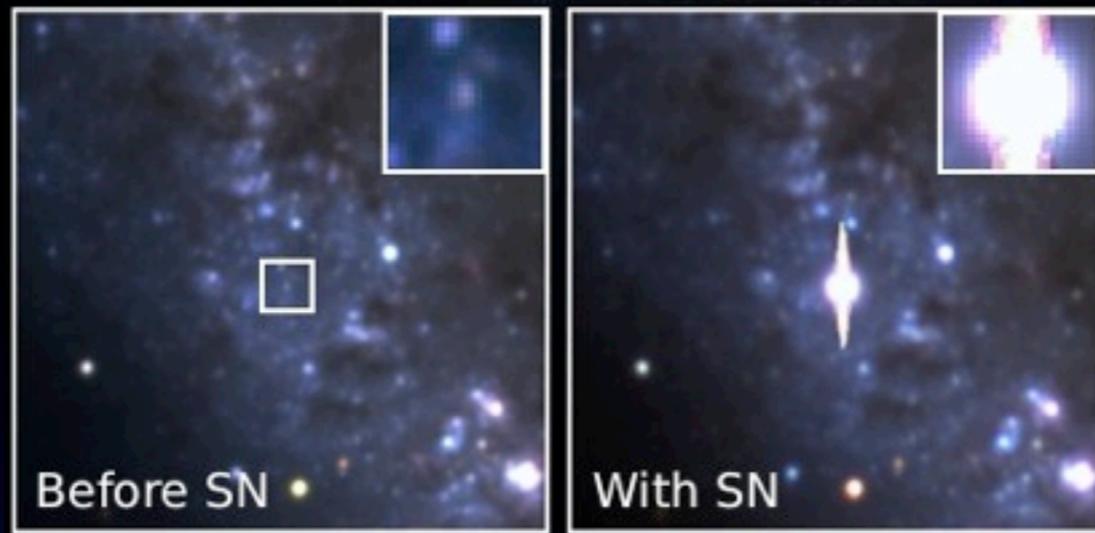
On behalf of **KISS** collaboration

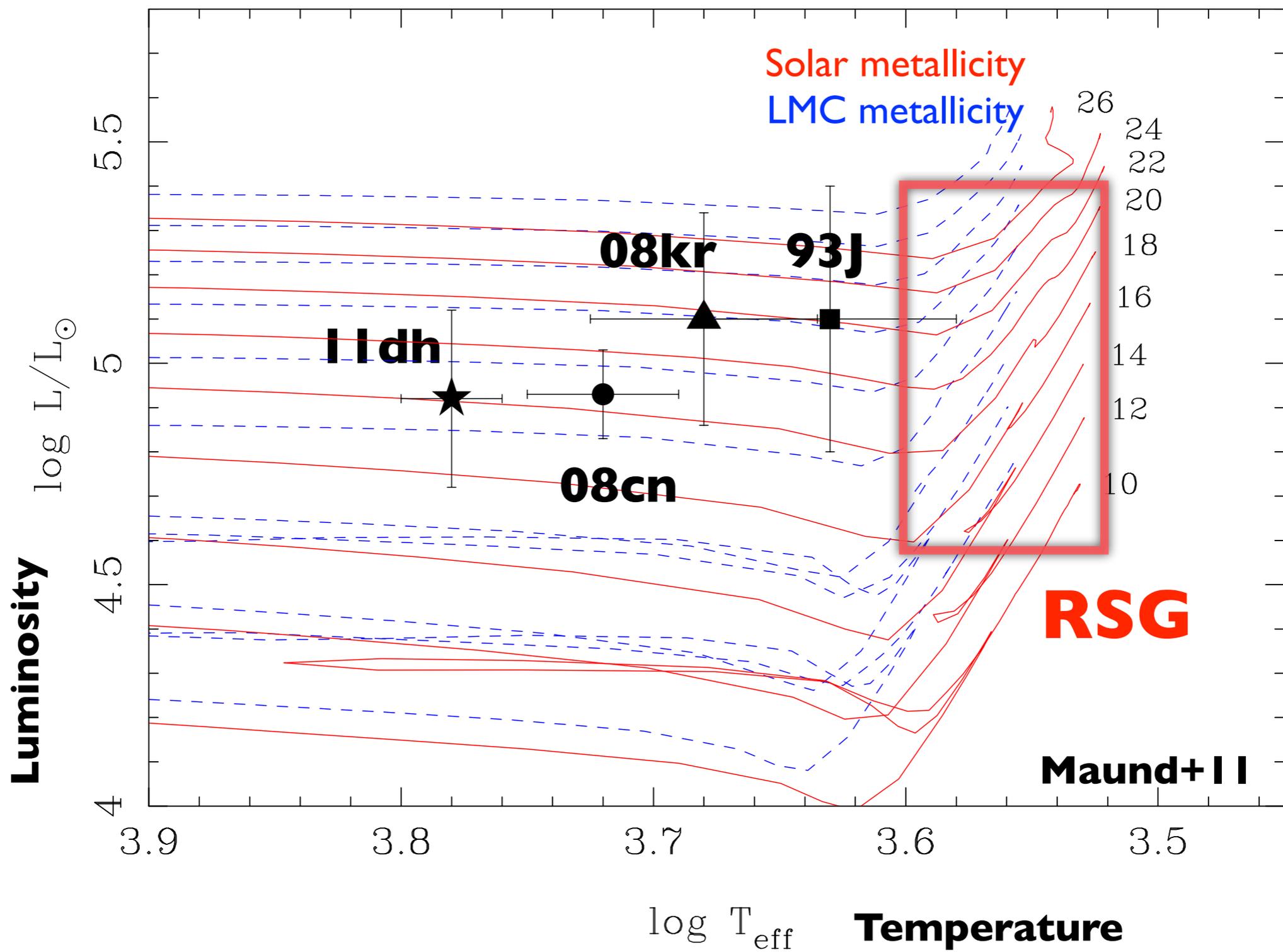
Tomoki Morokuma (Univ. Tokyo)

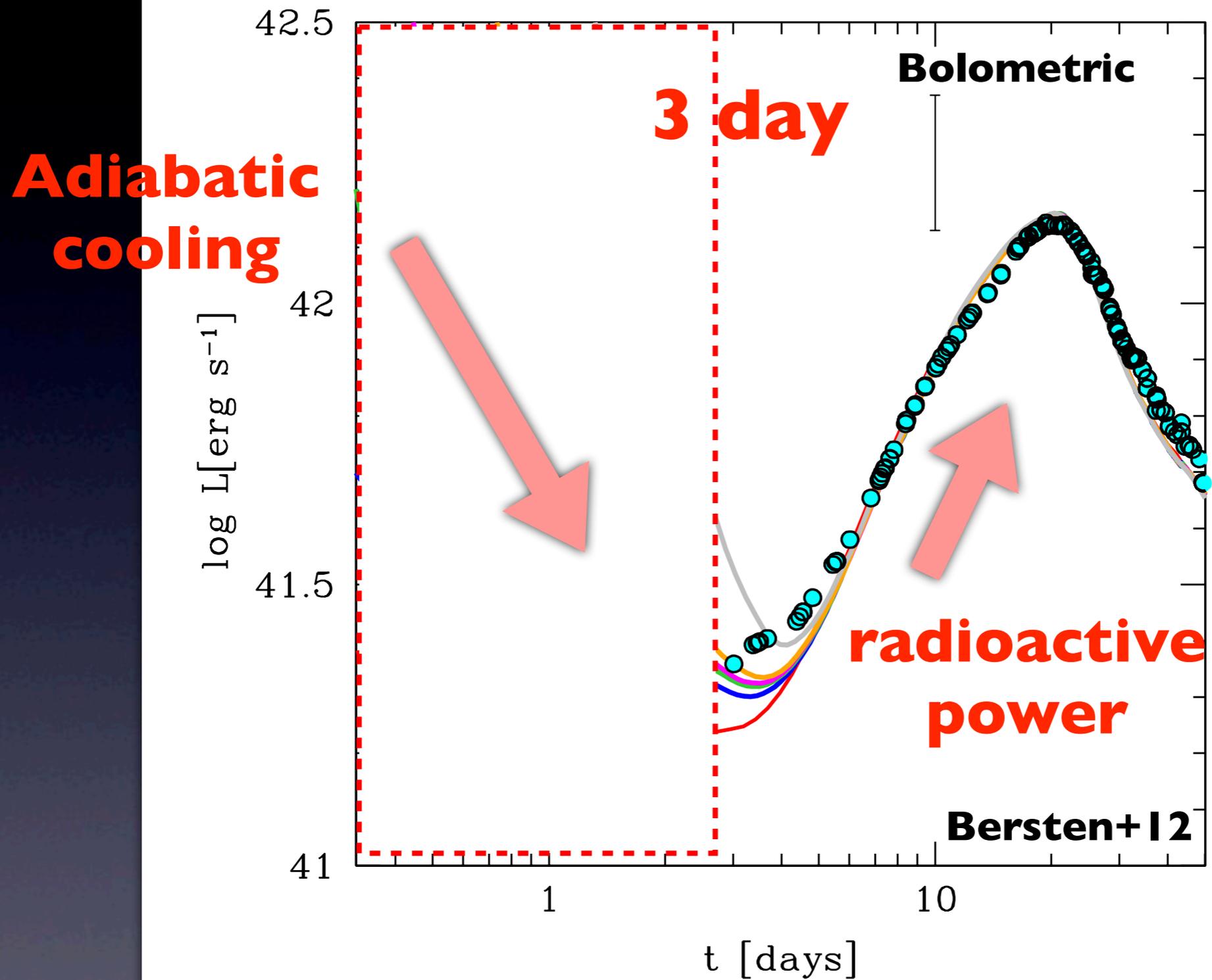
Nozomu Tominaga, Kensho Mori (Konan Univ.)

- **Frontier of Transient Survey**
- **KISS (Kiso Supernova Survey)  
and Synergy with 3.8m Telescope**
- **Future Plan**

# Stellar Evolution - Supernova







**Too late with typical 2-3 day cadence**

# SN shock breakout

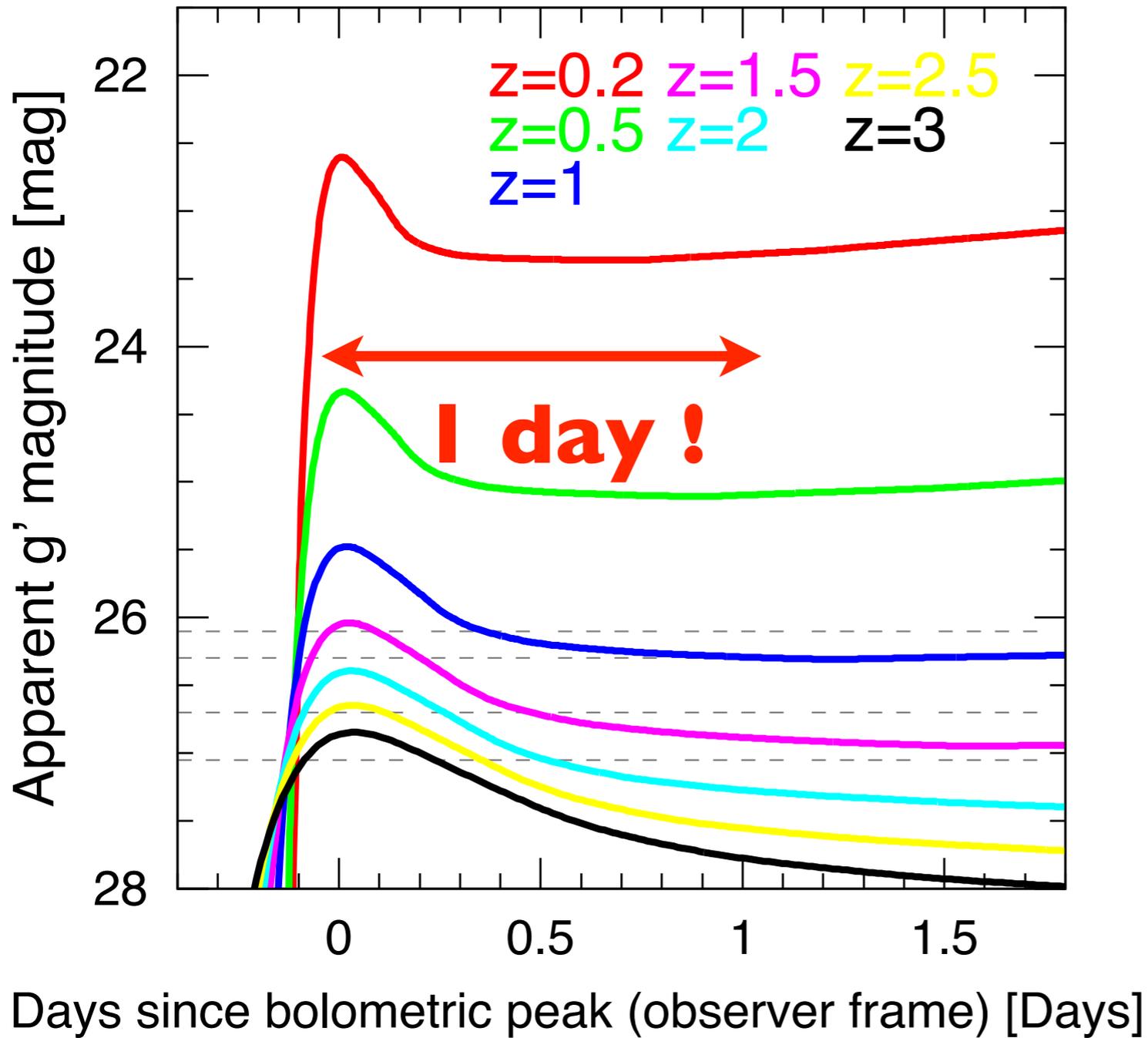


Figure from N. Tominaga

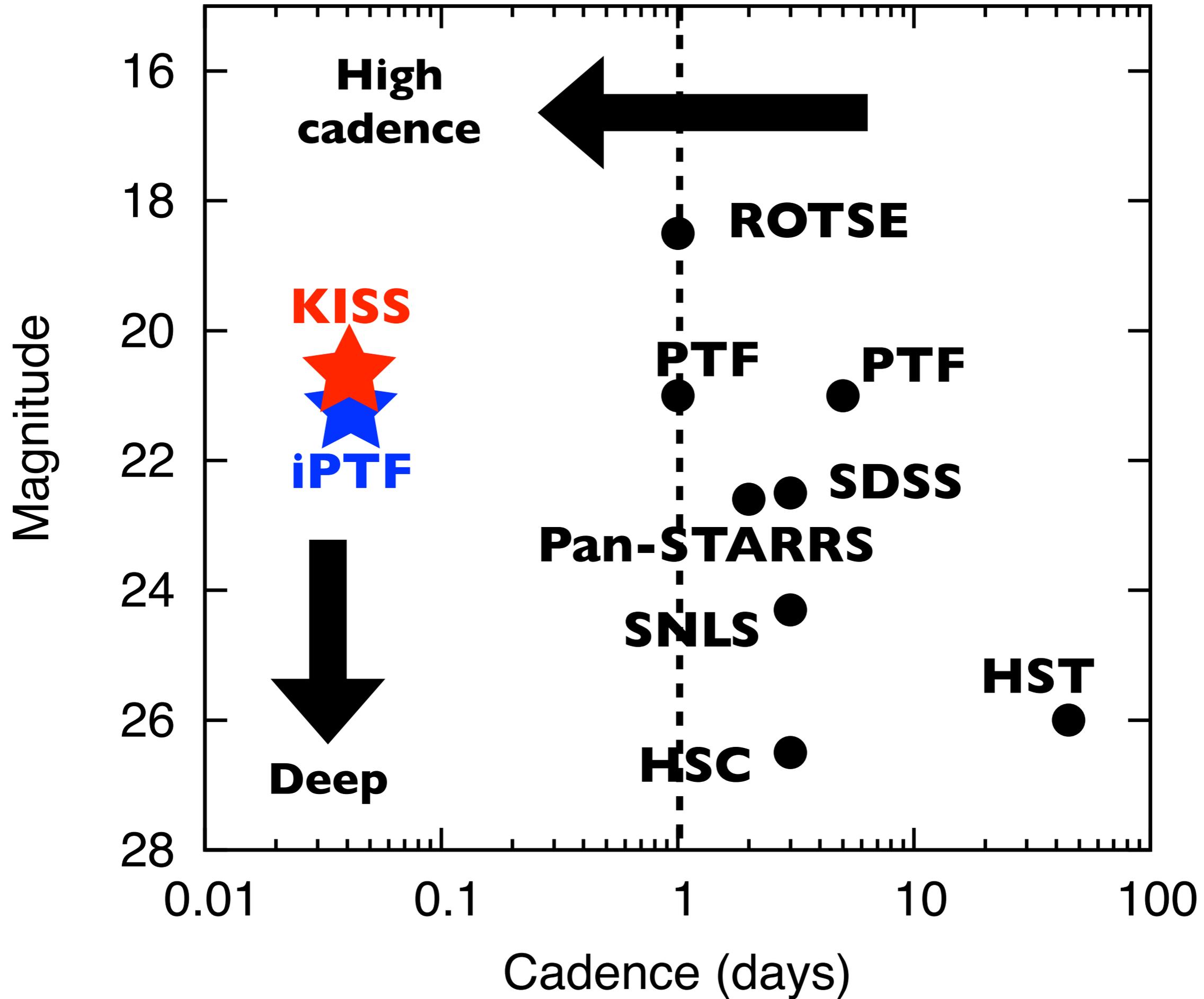
progenitor star



> a few days



➔ **Star formation tracer  
at high redshift**



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# **KISS: KI**so **S**upernova **S**urvey

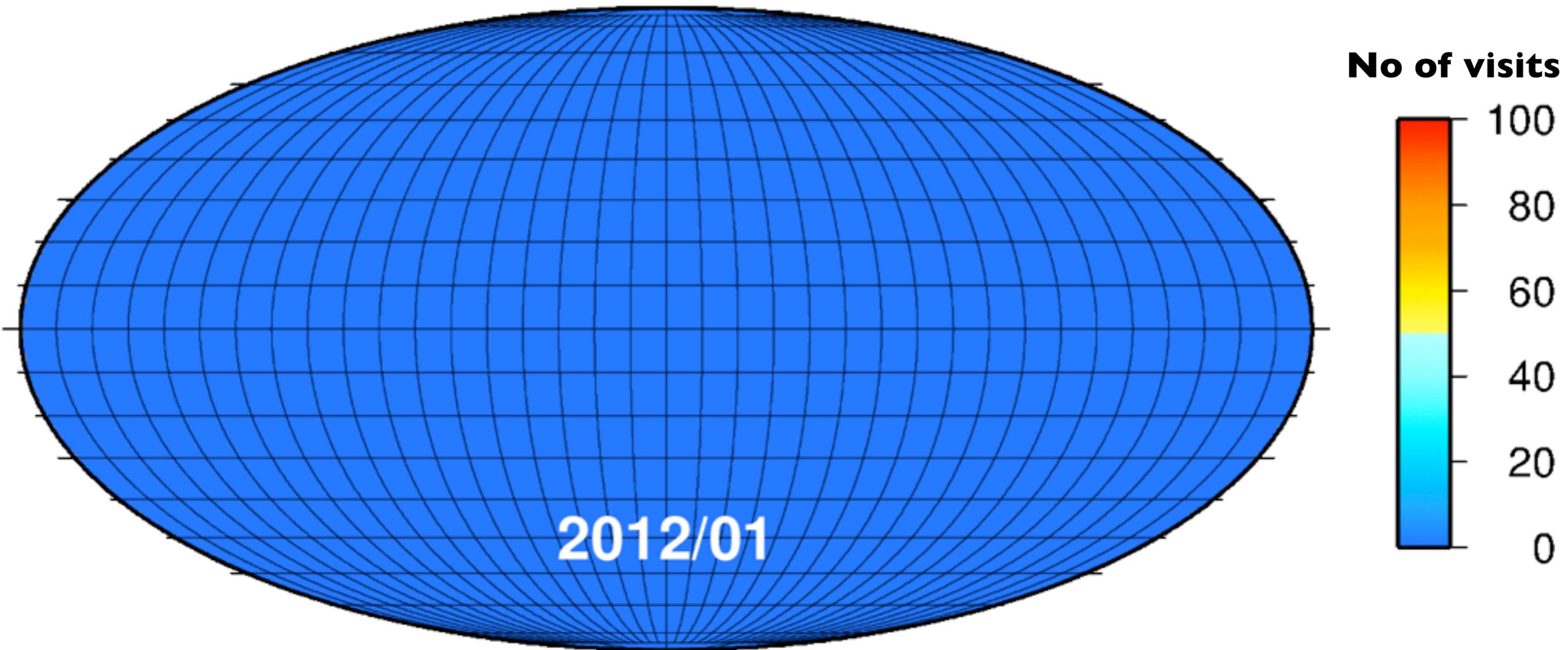
- **Extremely high cadence**
  - **1-hr cadence**
  - **4 deg<sup>2</sup> FOV**
  - **3 min exposure**
  - **~ 21 mag in g-band**
  - **~50-100 deg<sup>2</sup> /day**
- **100 day observations/yr (around new moon)**
- **High SFR field (< 200 Mpc, 30-100 Msun/yr)**



**2012 Apr: Dry run -**

**2012 Sep: Main survey -**

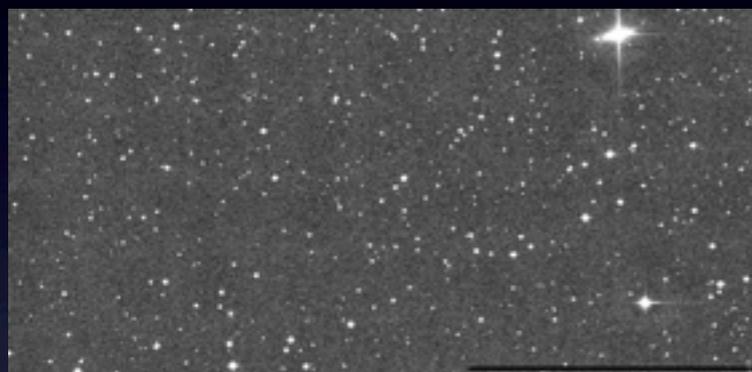
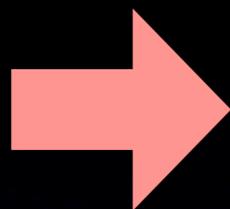
# KISS 1st year



# Kiso observatory



## KISS pipeline



standard reduction

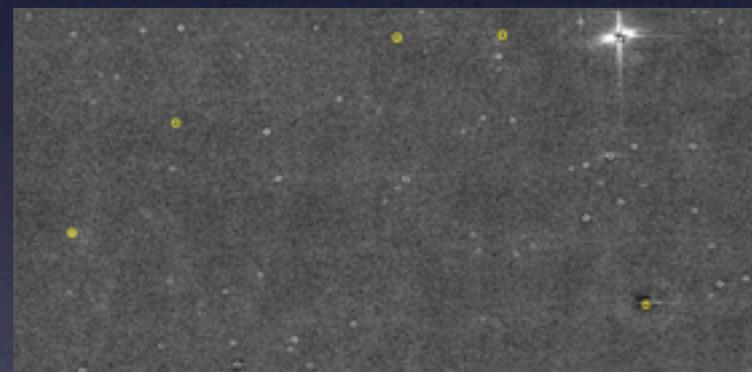


image subtraction

source detection

**< 10 min**

**~ 50GB/day**

## cut-out images

Ref

New

Sub

## KISS database

source  
info

# Anywhere

## cut-out images

Ref

New

Sub

## KISS database

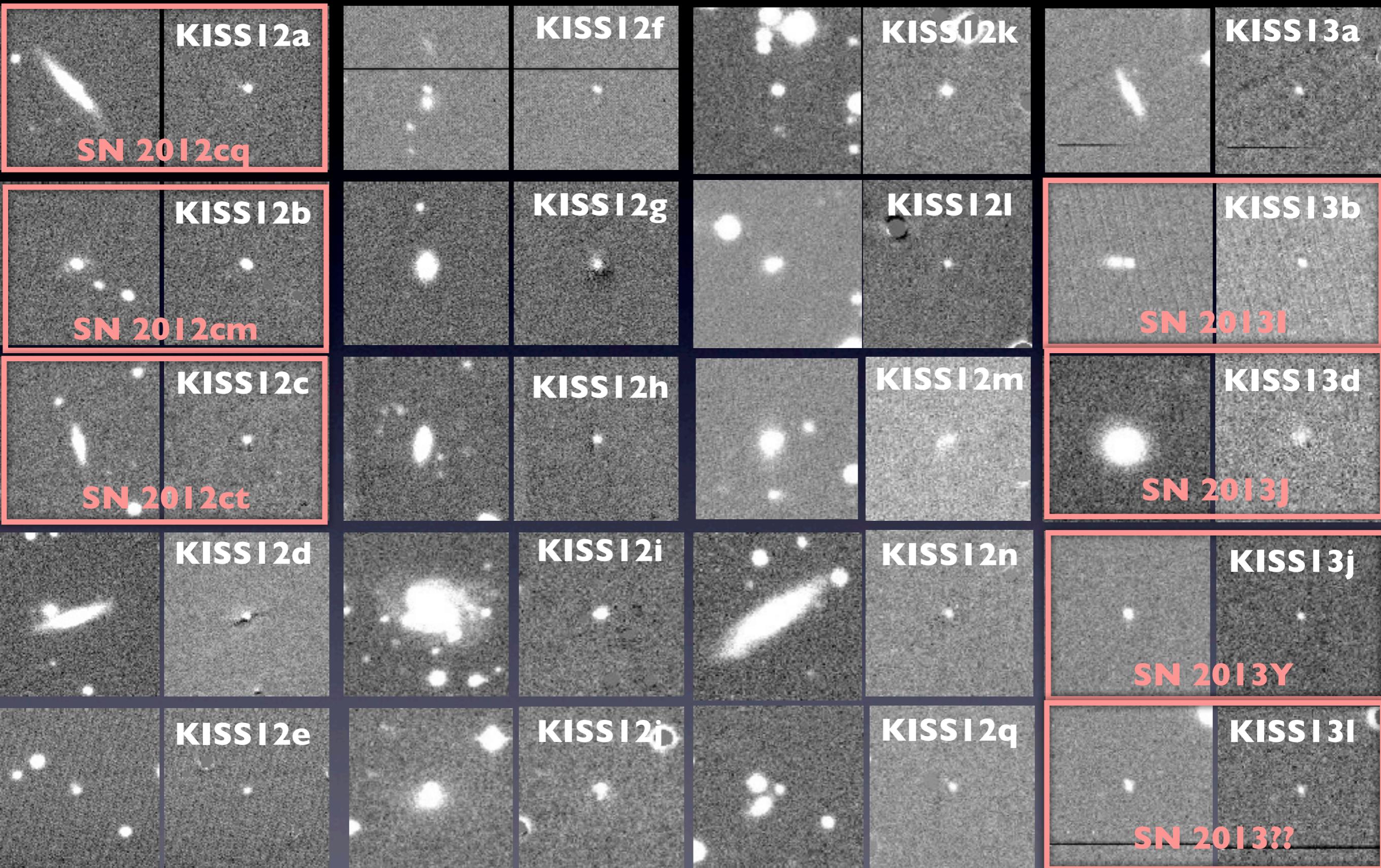
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info

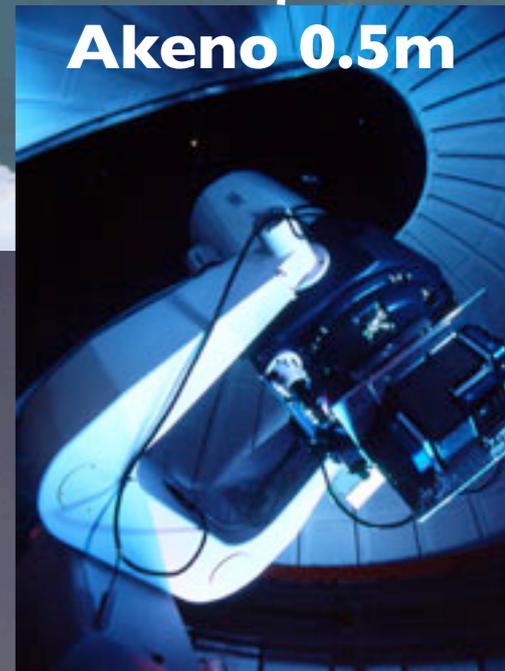
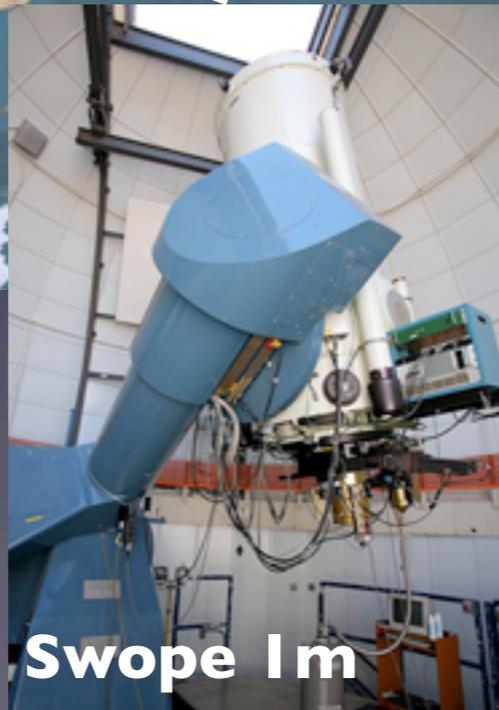
## KISS interface



**Amateur astronomers**

# 37 SN candidates





# KISS collaboration

- **Survey members**

- **Tomoki Morokuma (PI), Nozomu Tominaga, Masaomi Tanaka, Kensho Mori, Koji Kawabata, Yoshihiko Saito, 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**

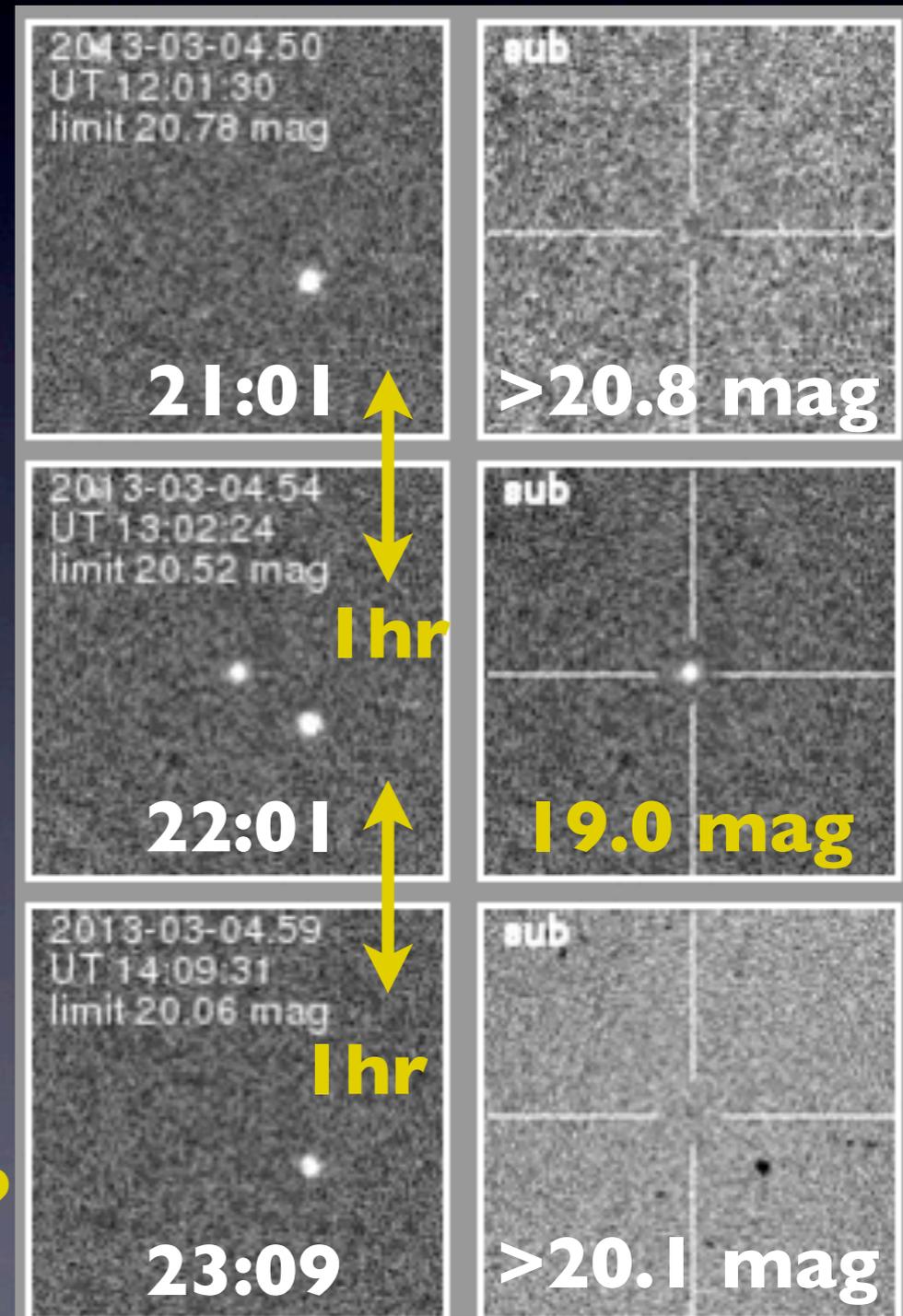
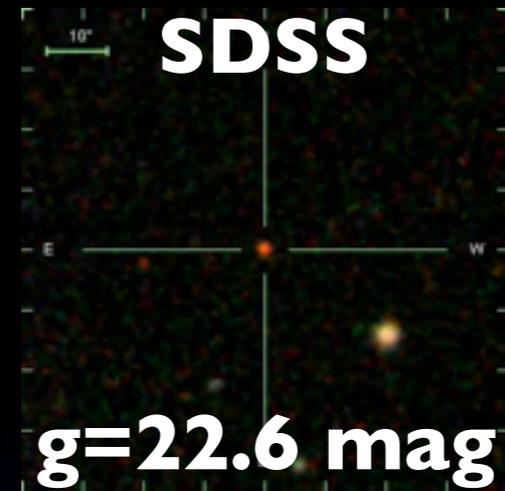


# Synergy with 3.8m Telescope

- **Rapid follow up**
  - High speed pointing of 3.8m telescope is critical (1 min, Nagata-san, Kurita-san)
  - **Rapid communication (< 1 hr)**  
Target feed takes ~ 10-60 min
  - Automatic response
- **Low resolution spectroscopy**  
(R~500, v~500 km/s)
- **IFU** is preferred (Ota-san, Matsubayashi-san)  
confirmation image + spectroscopy  
占有性・機動性が最も重要な要素  
**No Transient Left Behind**

# By-products from high-cadence survey

- **Variable QSO**
  - ~ 110
- **Variable stars**
  - ~ 80  
(High Galactic latitude)
- **Rapid flare (< 1 hr)**
  - ~ 5 (after Maehara et al. ...)  
(High Galactic latitude)  
Nogami-san's talk



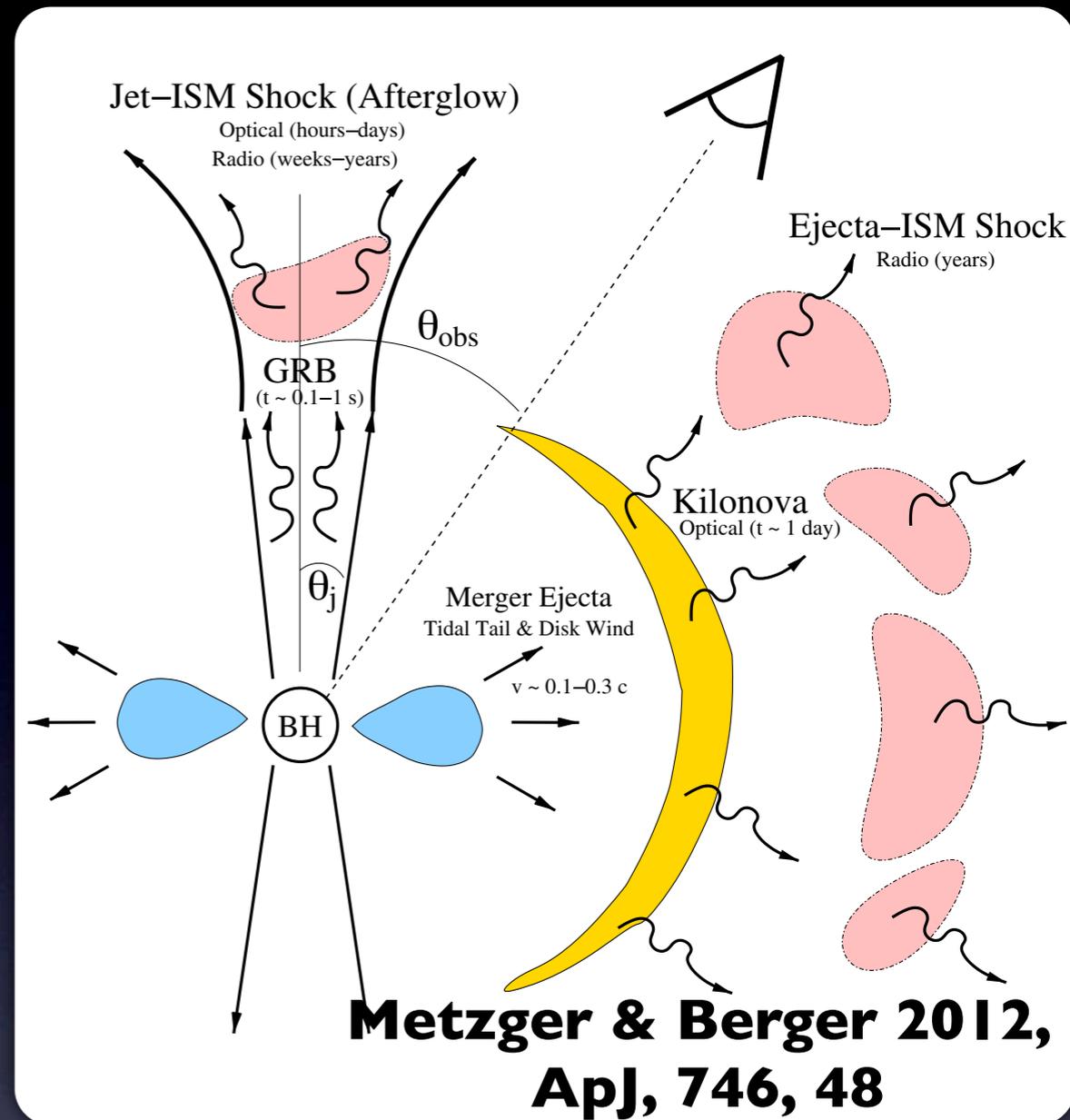
**Spectroscopy during the flare!?**

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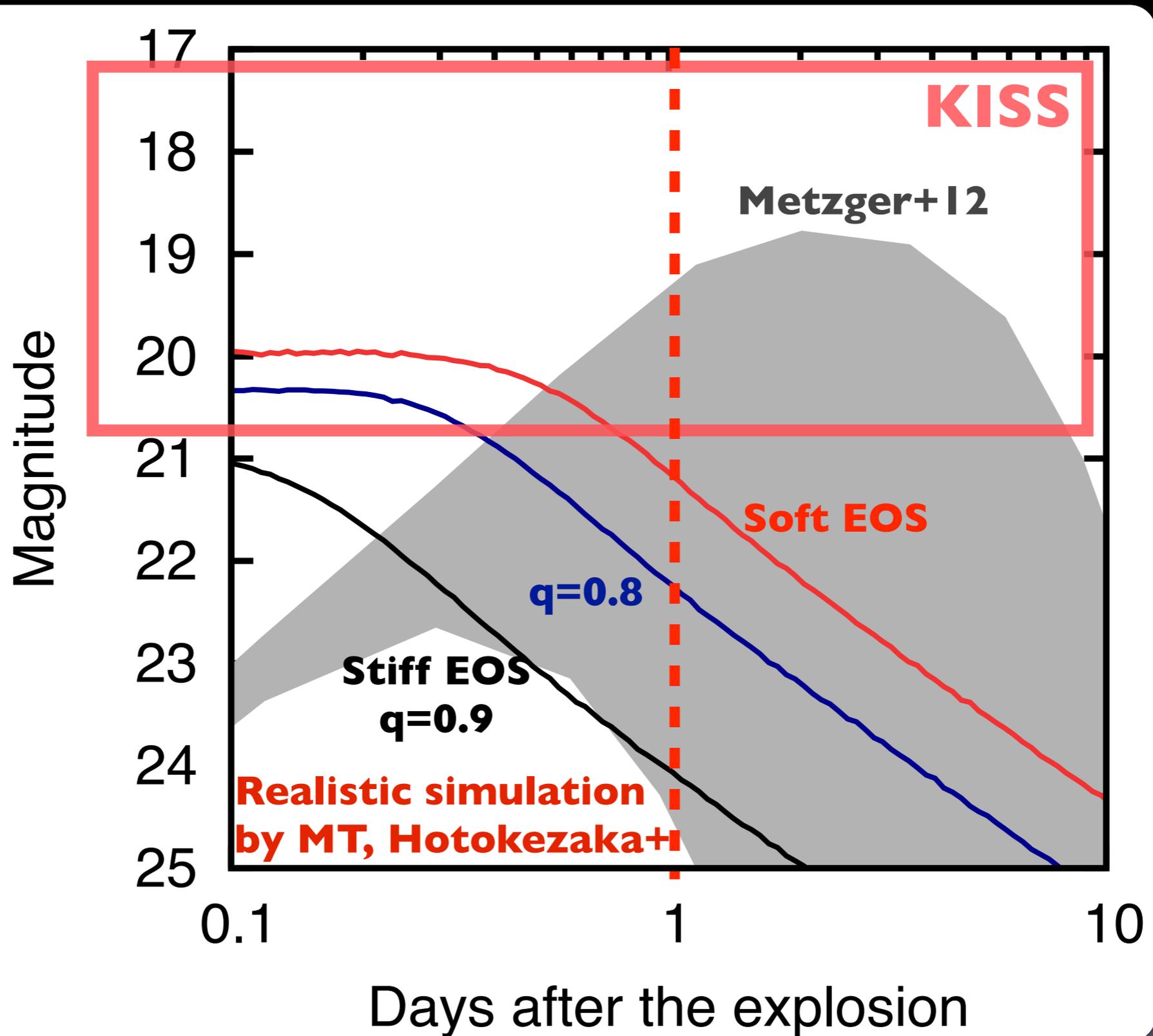


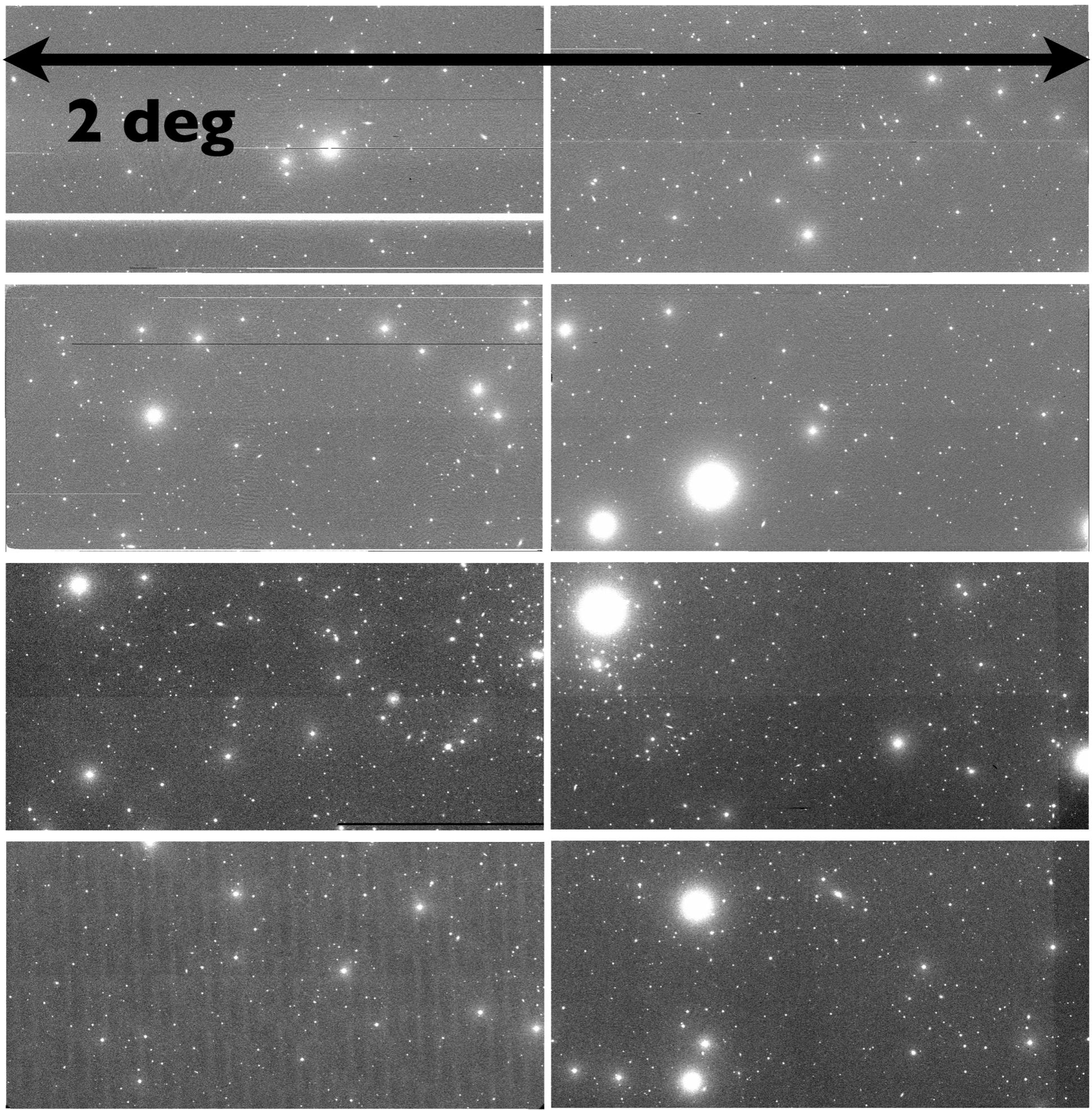
# EM signature from NS-NS merger

- On-axis short GRB
  - very rare
- Off-axis radio emission
  - delayed ( $\sim 1$  yr)
  - no guarantee of association
- “kilonova” (macronova)
  - could be common if r-process occurs



# Neutron star merger @ 200 Mpc



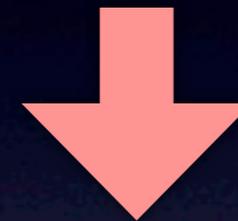


# GW alert error box

10 deg x 10 deg  
(for example)

6 deg

Localization with  
Schmidt telescope



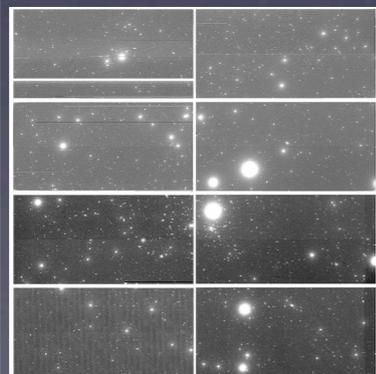
Spectroscopy with  
3.8m telescope

2 deg



25 pointing

=> 2-3 hr



□ 0.3 deg

# Transient Science with 3.8m Telescope

- (Need wide field survey) Kambe-san
- Rapid follow up for **high-cadence** transient survey
  - Shock breakout of supernovae
  - Rapid flare
- **Critical role in GW-EM astronomy**
  - 3.8m Telescope + 1m Schmidt (wide field)
- Hope for 3.8m Telescope
  - Low resolution spectroscopy ( $R \sim 500$ )
  - **IFU** (image and spec, reducing time loss)
  - Rapid communication/automatic response