ToO Observations with Subaru

Spectropolarimetry of Supernovae

すばる望遠鏡ToO観測　ー超新星爆発の即時偏光分光観測ー

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in collaboration with

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K. Nomoto, P. A. Mazzali, K. Aoki, T. Sasaki, and M. Iye

Target of Opportunity (ToO)

Subaru Open Use Policy

Applicants may submit proposals for Target of Opportunity (ToO) observations of transient and/or rare phenomena with specific or non-specific objects based on clear observational strategy, such as nearby supernovae, Gamma-Ray Burst follow-up, etc.

...

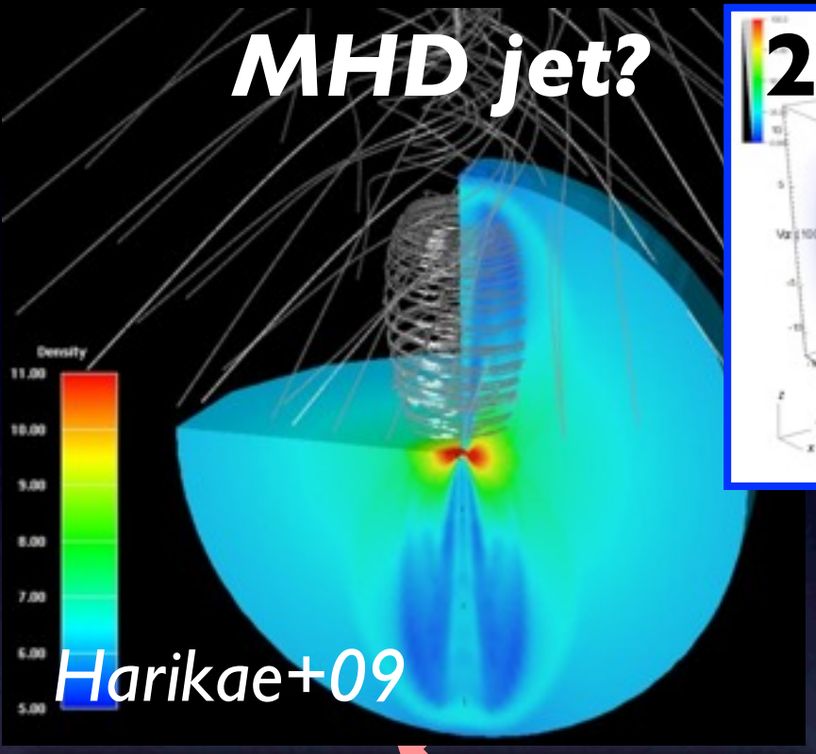
You may also submit ToO proposals (excluding GRB observations) to the time-exchange program with Gemini, which will be executed at queue mode.

Acceptance Letter

You have rights of implementing your TOO observations in principle in any "Subaru time" in S11B (Subaru open use time and observatory/engineering time indicated in the schedule as 'S11B-???' or 'Eng'/'obs'/'service'), while "UH/Keck/Gemini times" are NOT allowed.

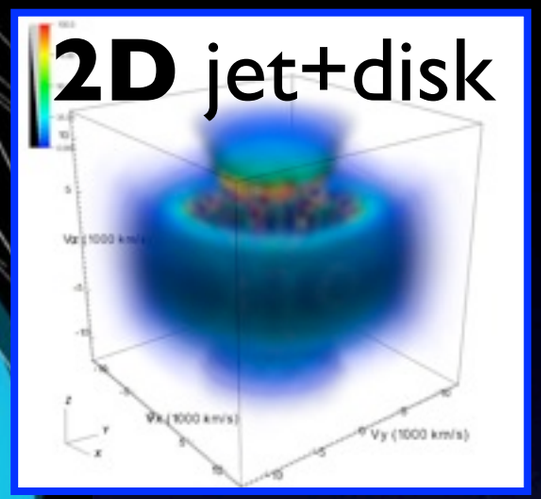
Spectropolarimetry => SN Explosion Mechanism

MHD jet?

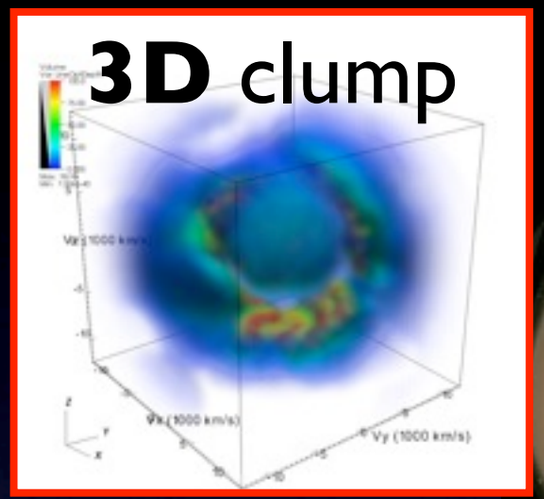


Harikae+09

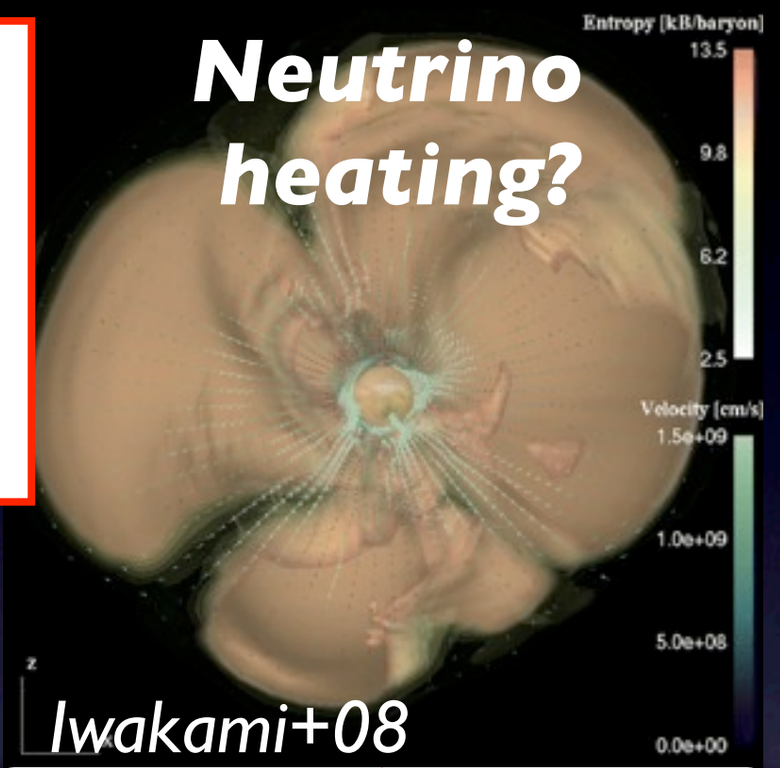
2D jet+disk



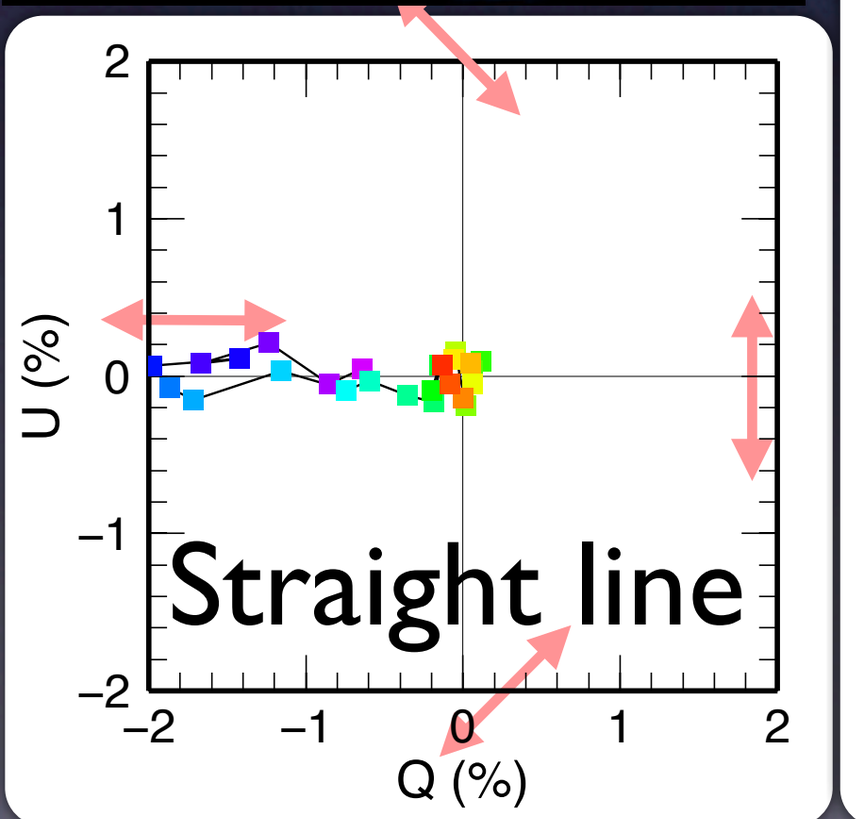
3D clump

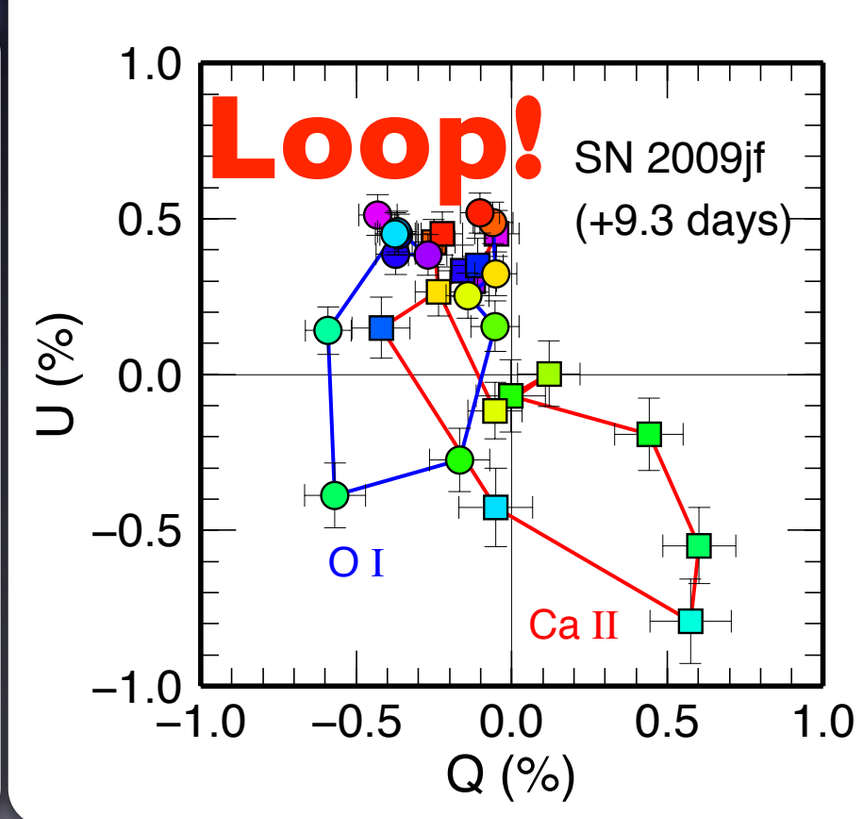


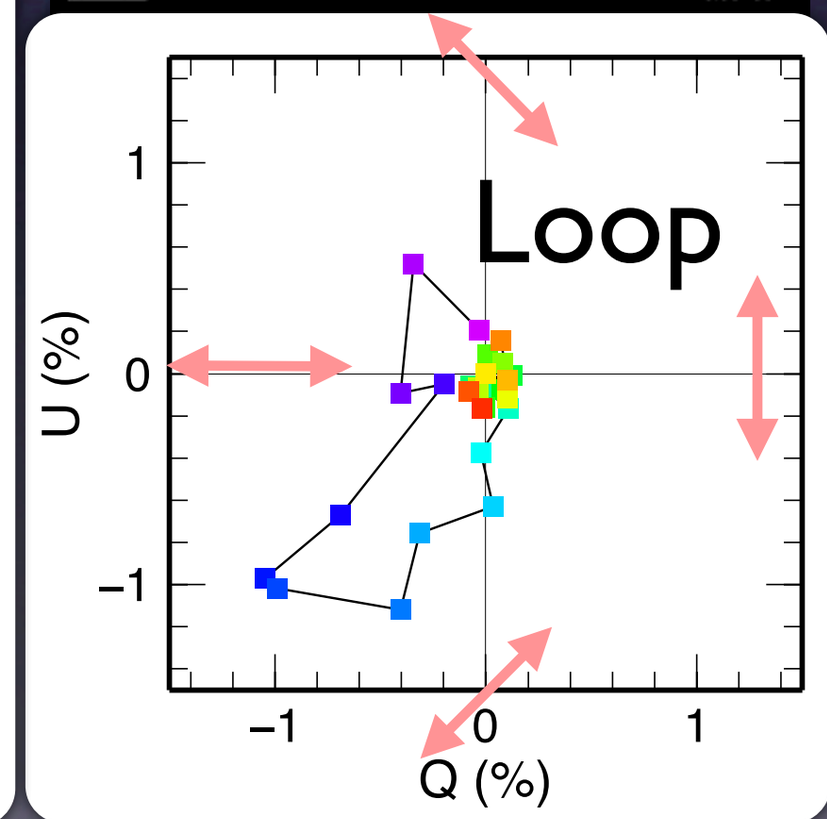
Neutrino heating?



Iwakami+08





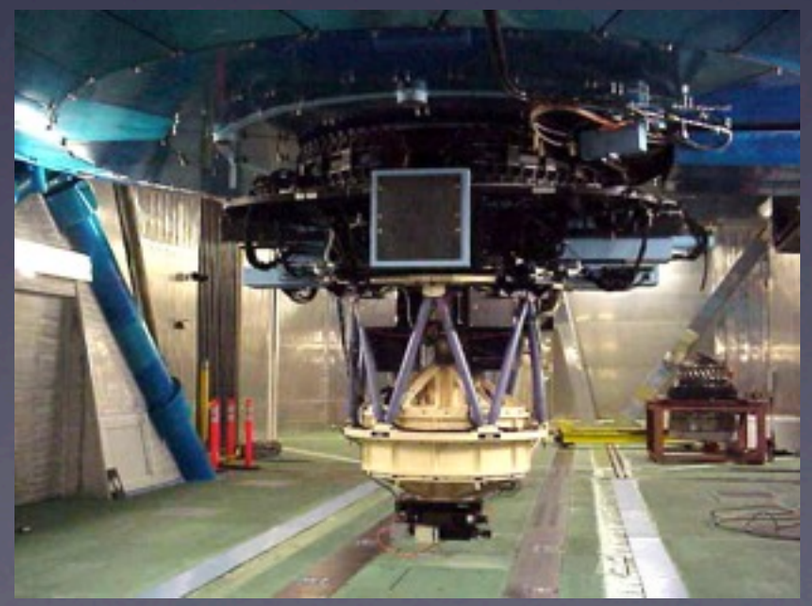


ToO Spectropolarimetry of SNe with Subaru/FOCAS

PI: M. Tanaka
Co-I: K. S. Kawabata, T. Hattori. E. Pian, K. Maeda, M. Yamanaka, K. Nomoto, P. A. Mazzali, K. Aoki, T. Sasaki, and M. Iye

S09A: 1 night
S09B: 2 nights
S10A: 2 nights
(S11B: 1 night)

- Boundary conditions
  - Number of bright SNe ~ 2-4 / semester
  - Observable for ~ 2 week **("slow" ToO)**
  - Total observable time window
    ~ 1-2 months / semester
  - Time exchange?
    - No polarimetric instrument in Gemini
    - No ToO with Keck



S09A: 1 ToO night

FOCAS available

SN discovery

Our observation

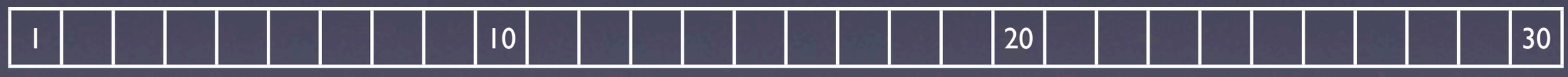
2009/02

2009/03

2009/04

2009/05

2009/06



2009/07

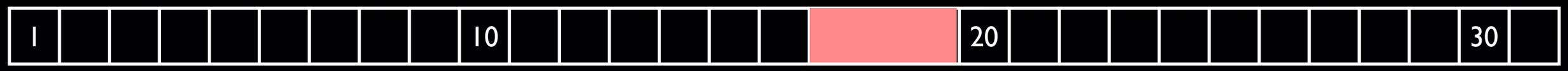
S09B: 2 ToO nights

FOCAS available

SN discovery

Our observation

2009/08

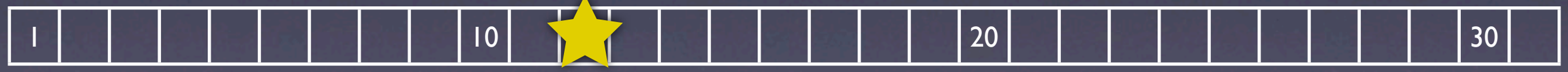


2009/09

2009/10

2009/11

2009/12



2010/01

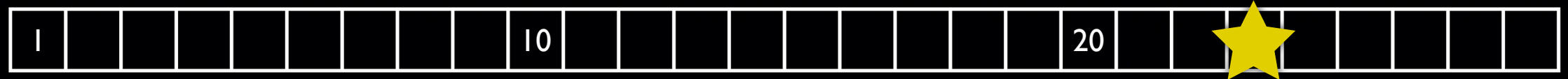
S10A: 2 ToO nights

FOCAS available

SN discovery

Our observation

2010/02

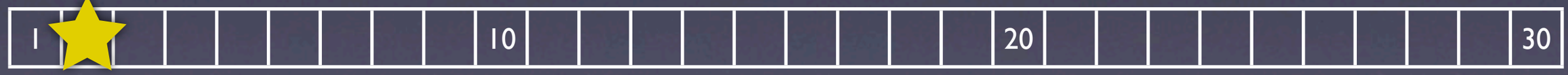


2010/03

2010/04

2010/05

2010/06



2010/07

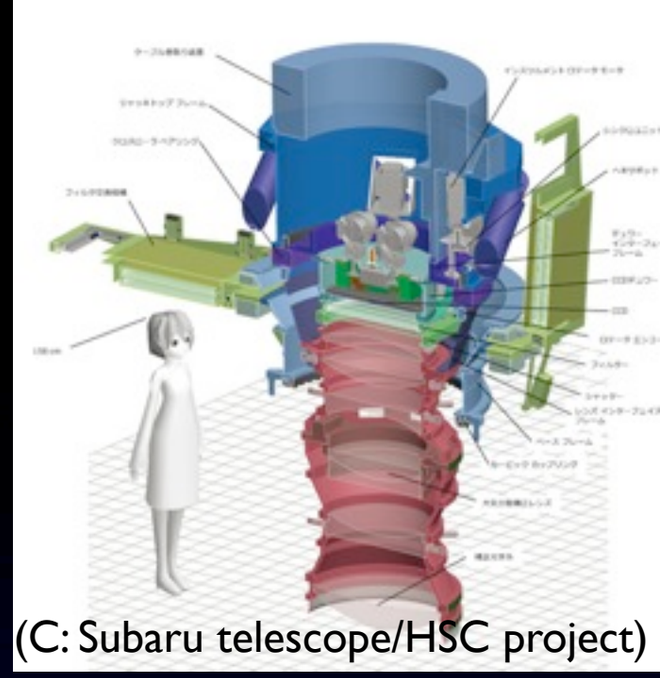
So far, so successful

- Triggered 3.5 nights / allocated 5 nights = 70 %
- Best response: 0.5 day!!
  Thanks to great effort by the observatory (Director, Associate-directors, Terada-san, ...), Hattori-san (FOCAS support astronomer), and many observers at the summit
- Not many nights for FOCAS
  - Observations at > 2 weeks after the discovery
    => low S/N ratio

1. Instrument exchange for "slow" ToO (or explicit policy for the exchange)

Subaru ToO in the Future

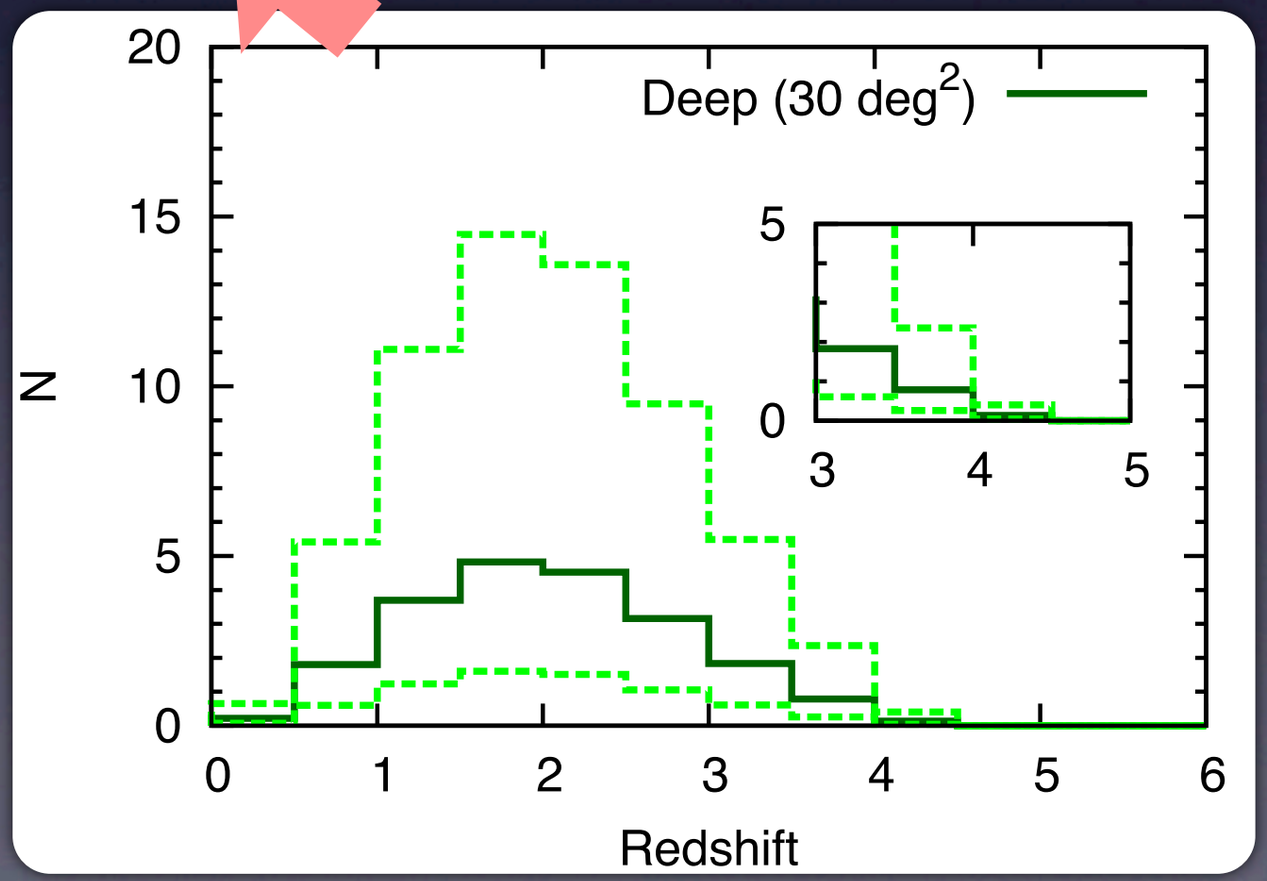
- Subaru/HSC can be a great discovery engine of supernovae/transient (~50 per 1 FOV)
  - High-redshift Type Ia supernovae (cosmology)
  - Very luminous supernovae at z>2
  - Unknown transients?
- Very unique before LSST


(C: Subaru telescope/HSC project)

HSC Transient WG

T. Morokuma, N. Yasuda, Y. Urata, L. Huang, N. Tominaga, T. Moriya, M. Tanaka, J. Okumura, A. Kong, N. Yoshida, C-H Tang, M-F Wang, C-H Shen, M-F Tsai

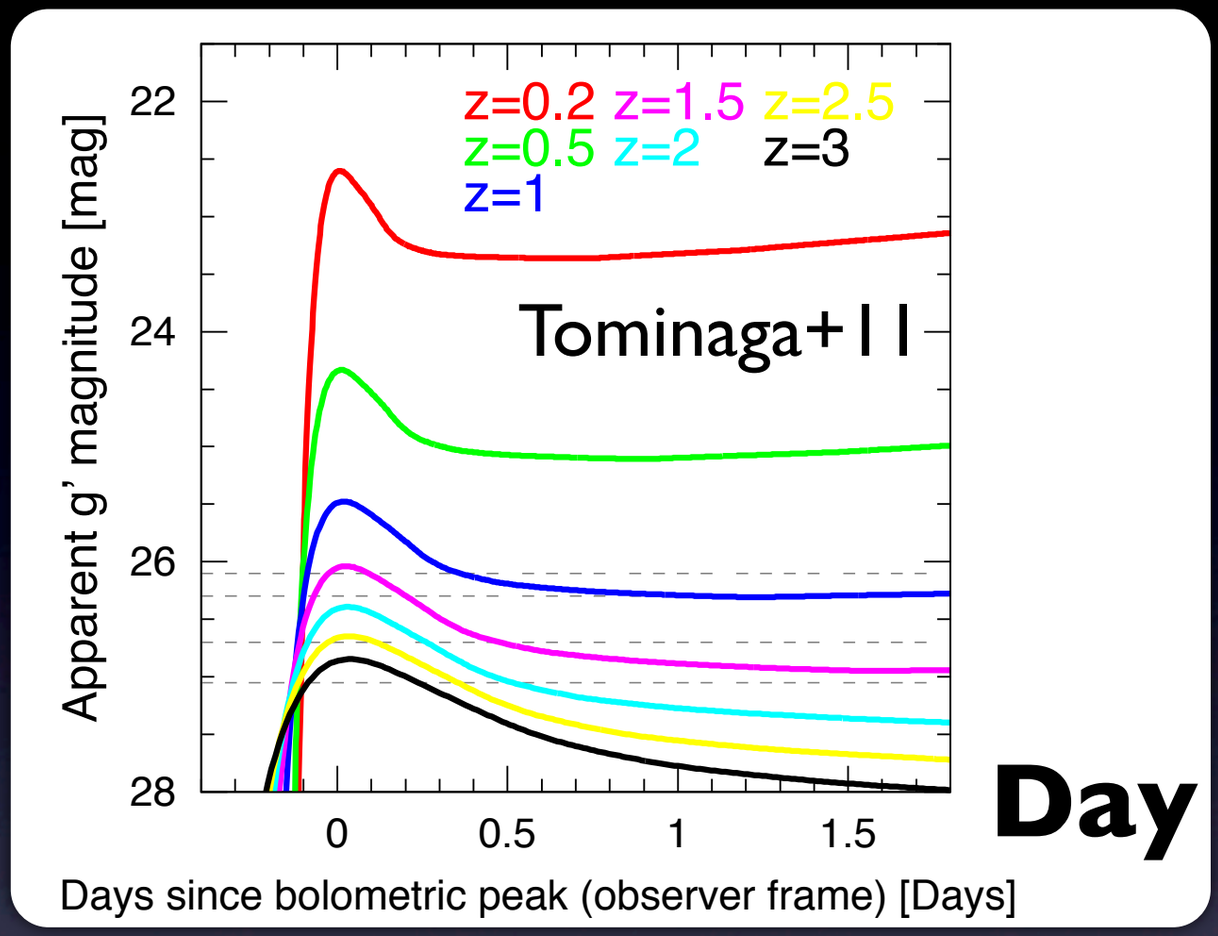
Tanaka, Moriya, Yoshida+, in prep



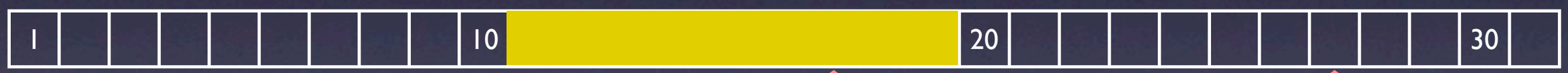
Spectroscopic identification is crucial

Discovery

- Redshift
- SN type



2013/03? HSC



Realtime follow-up

No spectroscopic instruments??

2. More time exchange with Keck and Gemini

Summary

- ToO spectropolarimetry of nearby supernovae
  - Triggered 70% of total allocated time
    (Best response: 0.5 day!)
  - Sometimes low S/N <= not many nights for FOCAS
- Subaru/HSC can be a great discovery engine
  - Very unique before LSST

0. Queue mode observations

1. Instrument exchange for "slow" ToO

2. More time exchange with Keck and Gemini