

Studying Extragalactic Transients in The Local Universe

Keiichi Maeda

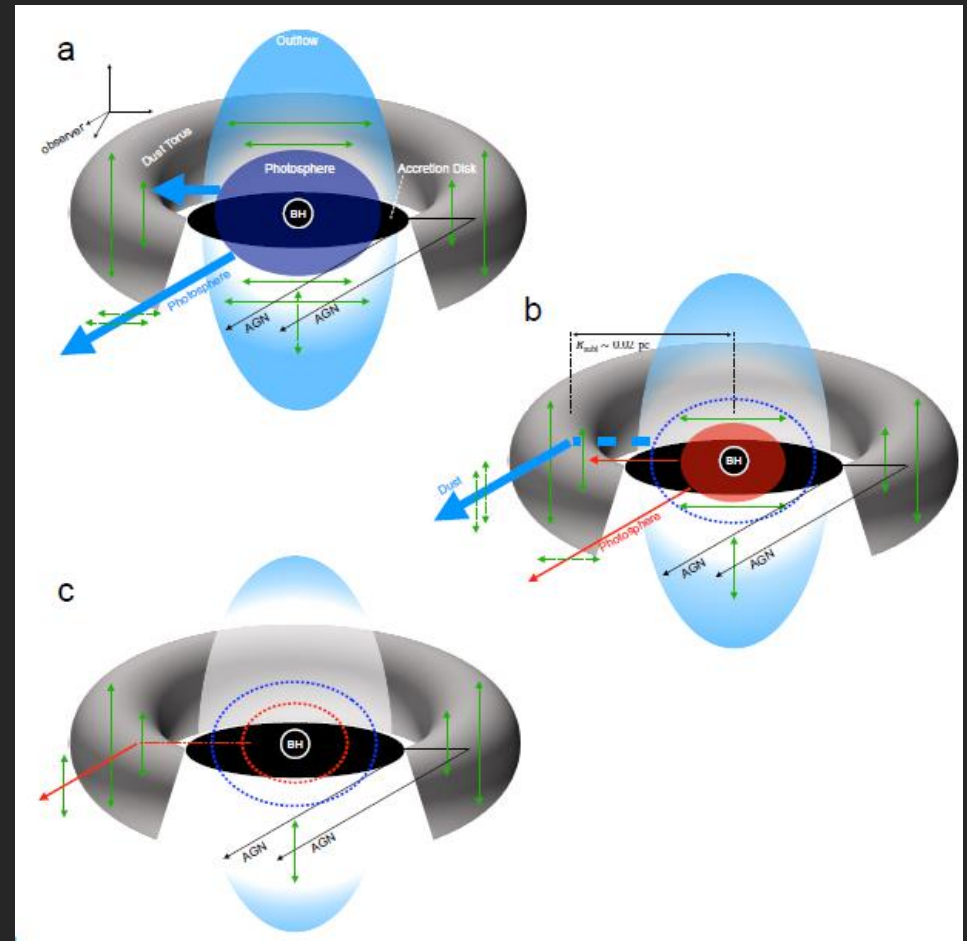
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The second annual conference of
Transformative Research Areas (A),
“Multimessenger Astrophysics”

2024.11.19 @ Minakami, gunma



Schematic picture of a TDE embedded in an AGN torus, as probed by Subaru/FOCAS
(Uno, KM+, submitted)

New Time Domain Era

Survey	Depth (mag)	Area (deg ²)	Cadence
BlackGEM	21.5	10,000	2 weeks
DES	23.5	5,000	1 week
KMTNet	~21	~6,000	1 day
MOA	~21	~1,000	1 day
TNTS	20.0	2,000	?
PTSS	20.5	4,000	1 day
HSC	25	800	1 day
Tomo-e	18/19	7,000	2 hr/1 day
ZTF	21	23,000	3 days
	21	2,000	1 day
	21	6,000	2 hr
ASAS-SN	17	40,000	1 day
DLT40	20	600 gal	1 dat

Catch transients/SNe even in the first day.

Discover rapidly-evolving transients/SNe.

Find unprecedented evolution (w/ monitoring).

©M. Tanaka

Ongoing surveys
+ Rubin/LSST to come

SNe = Supernovae

(Rapid) follow-up observations as a key

- The survey information is very limited (only photometry, 1 or 2 bands in the optical).
- Need multi-bands, spec, multi-frequency, ...
 - ⇒ Need global collaborations.
- Our effort/contribution (“KASTOR”):
 - Model/interpretation.
 - Communication w/ surveyors: Tomo-e, ZTF, WFST, ...
 - Optical/NIR.
 - Seimei & Kanata telescopes as a “heavy user”.
 - Subaru and Gemini telescopes through open-use slots.
 - Regular collaborations w/ Finnish & Indian groups.
 - Case-by-case collaborations w/ various groups.
 - Radio & X-rays.
 - ALMA, VLA, ATCA, GMRT, JVN, SWIFT, etc.

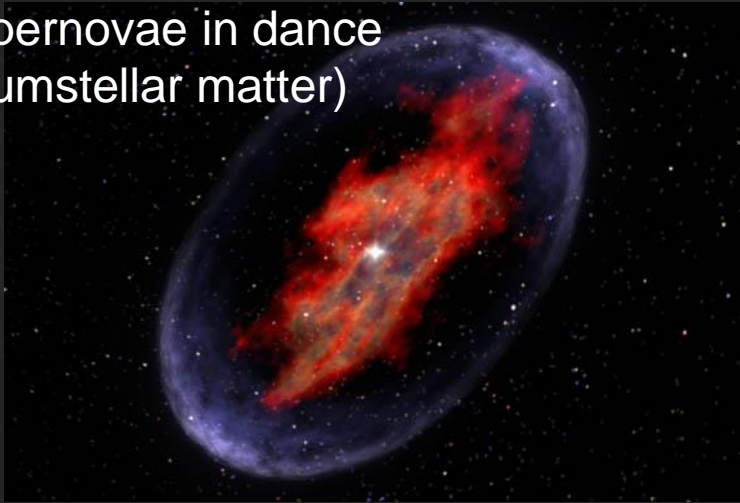
Toward Automation

- Contributing to the development of automatic observing scripts:
 - e.g., v /GW counterpart search by TriCCS; Taguchi-san).
- TriCCS imaging data-reduction pipeline:
 - Effort by Kawabata-san.
- Test bed for various automation / scheduling / analysis pipelines (ongoing activities):
 - Automatic ToO?
 - Automatic scheduling?
 - KASTOR trigger and scheduling: to be major updated.

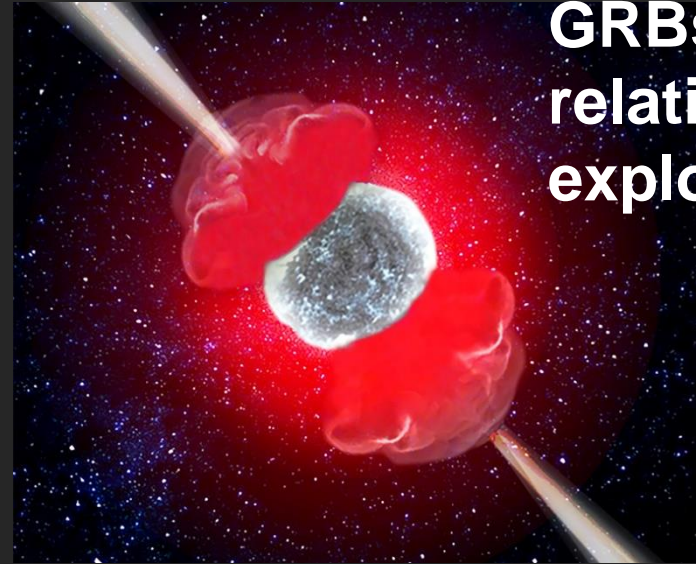
Possible transient neutrino counterparts

SN-CSM interaction

(Supernovae in dance
circumstellar matter)



GRBs and relativistic explosions



Tidal Disruption Events (TDEs)



Their observational properties
are very diverse
(yet to be fully understood)

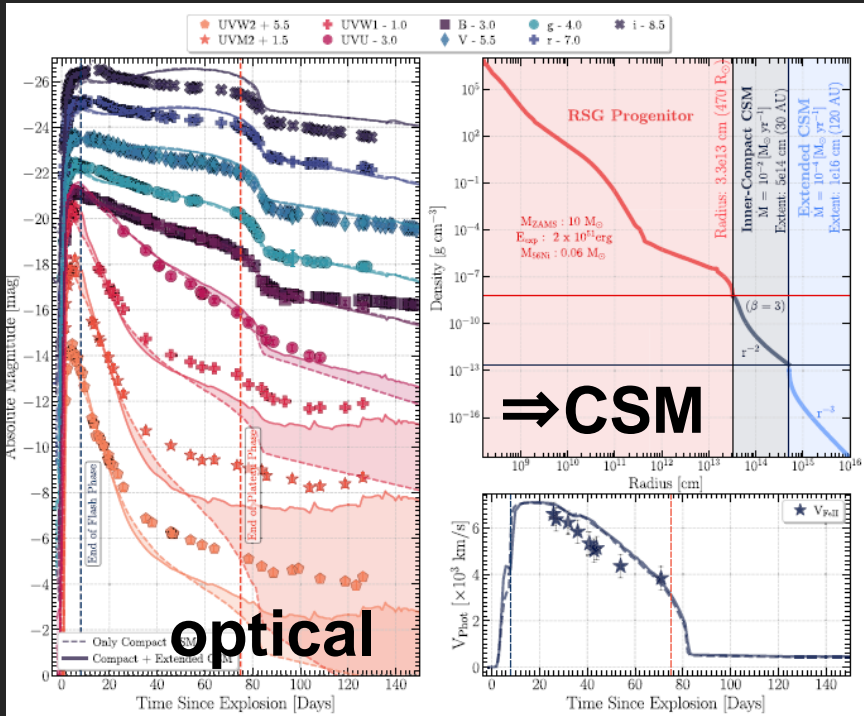
Characterizing physical conditions
⇒ which are strong ν emitters?

Mapping progenitor systems
⇒ how many such systems?

Papers under JP24H01810

- SN-CSM interaction:
 - 3 papers accepted, 4 papers submitted.
 - GRBs and relativistic explosions:
 - 3 papers accepted, 1 paper submitted.
 - TDEs:
 - 1 paper accepted, 1 paper submitted.
 - Others:
 - 4 papers accepted.
- + >10 papers in the advanced preparation stage.

Characterizing physical conditions

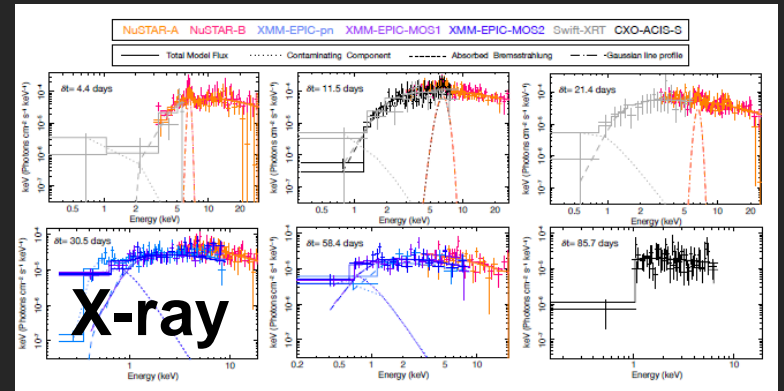


Singh+ 2024, ApJ

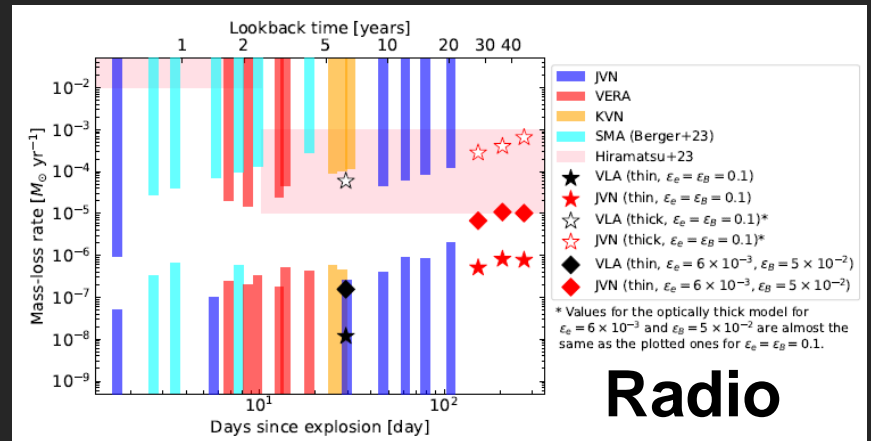
The nature of the “confined and dense CSM”.

⇒ input to the “multi-messenger model”.

SN 2023ixf as an example (SN-CSM interaction)
Nayana+, submitted to ApJ



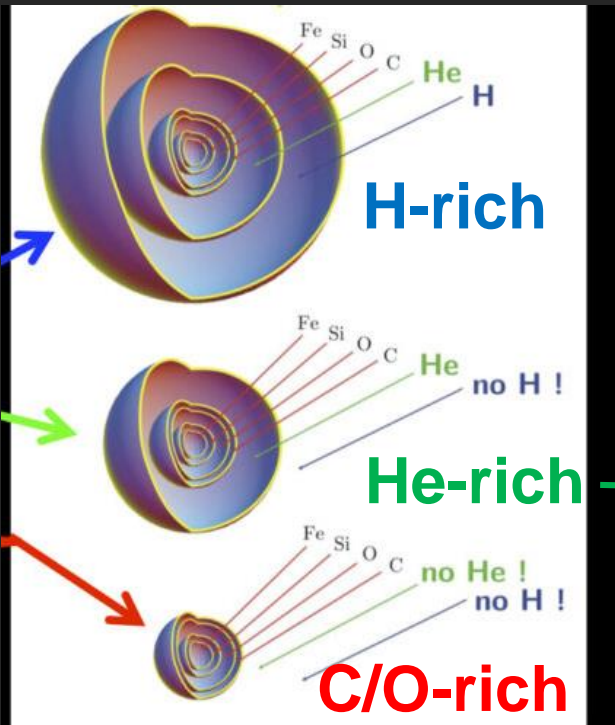
Iwata+ 2024 (JVN+), ApJ



Radio

Mapping the progenitor systems

© Maryam Modjaz



II/IIn

Ib/Ibn

Ic/Icn

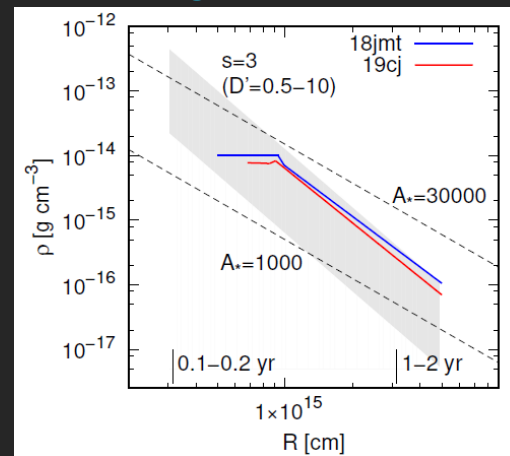
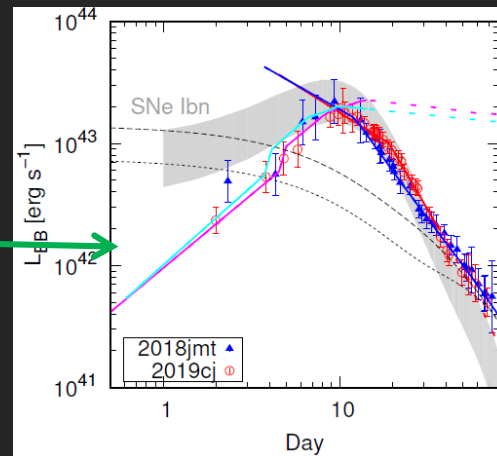
H-rich

He-rich

C/O-rich

Interacting stripped-envelope SN progenitors as an example (SN-CSM interaction)

Wang+ 2024, A&A

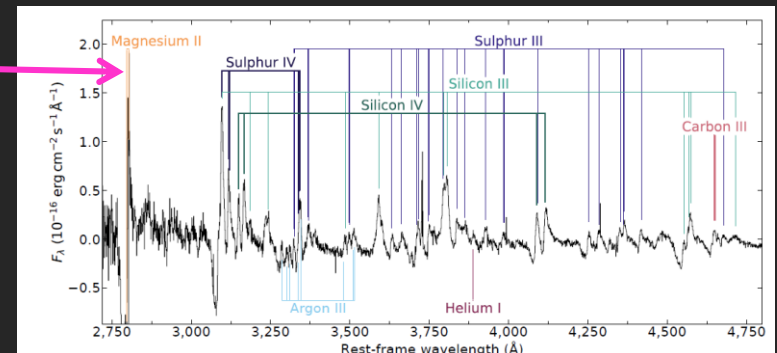


Mass loss (when and how?)

↓ Icn? (Si/S-rich)

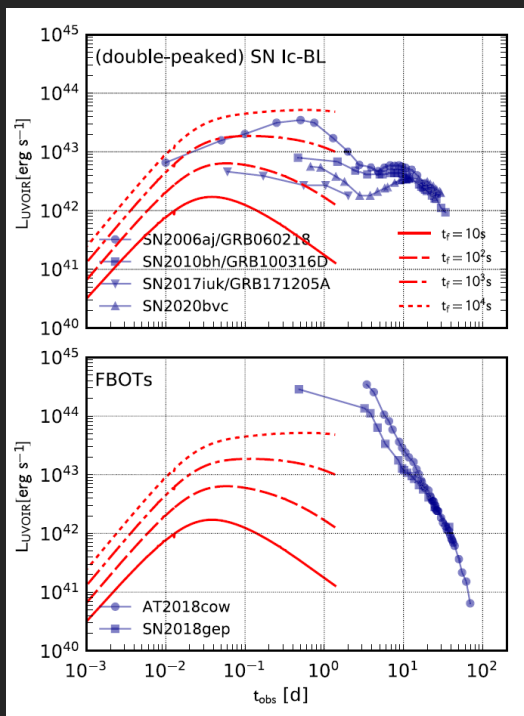
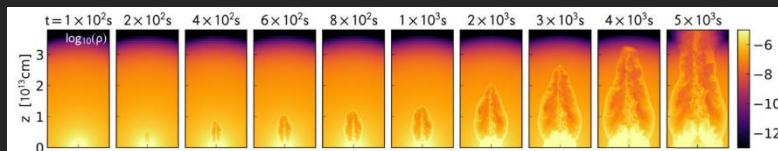
Schulze+, submitted

⇒ input to the “multi-messenger model”.



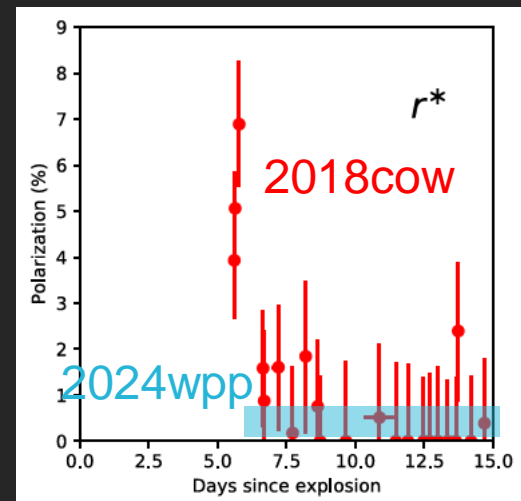
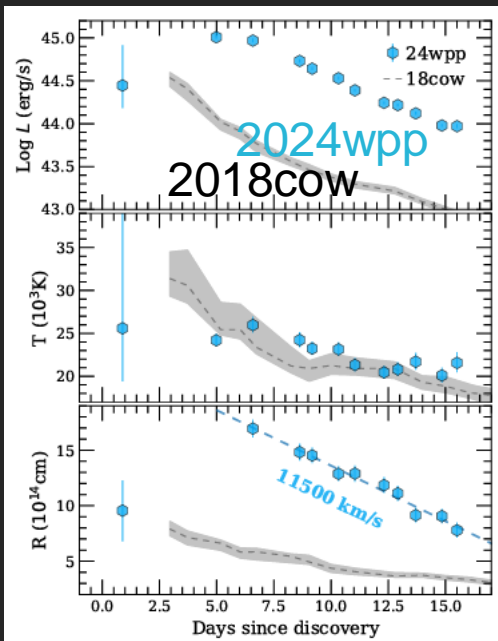
GRBs and relativistic explosions

Luminous Fast-Blue-Optical Transients (LFBOTs): “2018cow”-like Relativistic explosion? Sample rare.



Suzuki+
2024,
PASJ

AT2024wpp (nearest next to 2018cow)



Pursiainen+2024,
submitted
discovery+polarization (jet?)

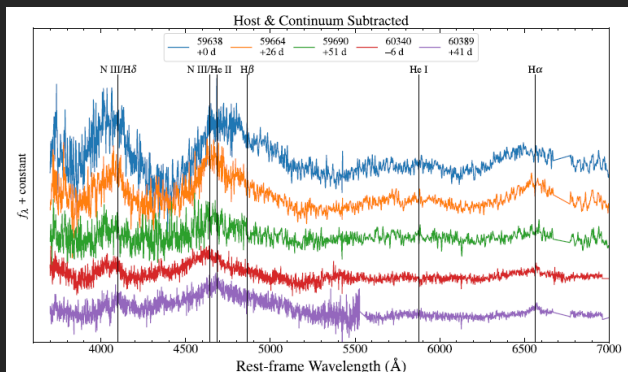
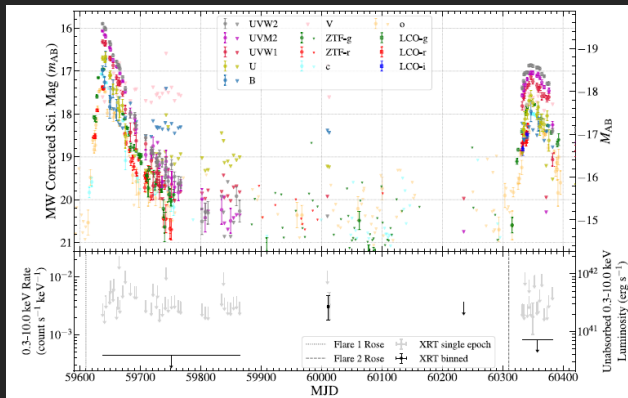
Chocked jet dynamics & emission
⇒ input to the “multi-messenger model”.

Follow-up ongoing
(multi-λ + multi-modes)

TDEs... yet to understand diverse properties

Repeating TDE
(1st robust spec. identify)
partial/repeated disruption?

Nearest optical TDE
Classified/identified by Seimei
Best TDE pol data (Subaru/FOCAS)
Outflow & AGN torus perpendicular;
AGN-induced TDE or AGN activity?



RA/DEC (2000) Type Redshift
11:40:09.397 +15:19:38.54 TDE
175.0391524 +15.3273735

[Discovery Report](#) [Classification Report](#)

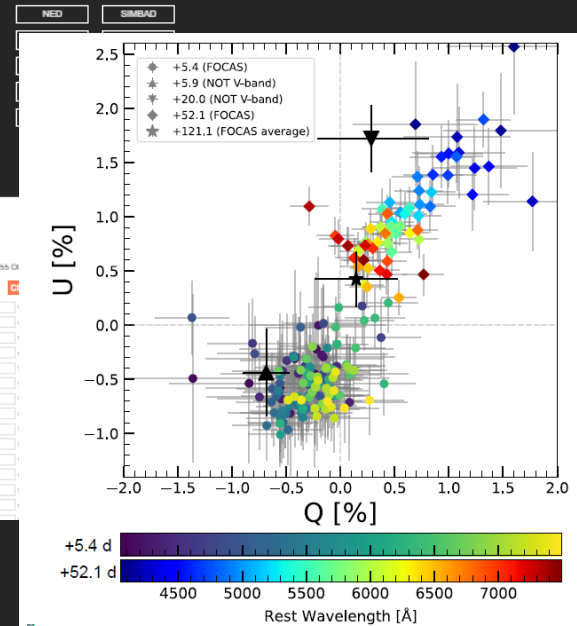
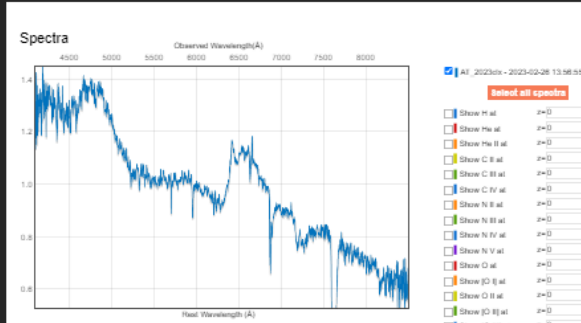
Related AstroNotes: [2023-51](#)

Taguchi+ 2023, TNS

Reporting Group	Discovering Data Source	Discovery Date	TNS AT	Public	Host Name
ABA 8-8N	ABA 8-8N	2022-02-22 06:02:24.000	Y	Y	NGC 3798

Host Redshift: 0.91107 Discovery Mag: 18.5 Filter: g-Bloan

Reporters: K. Z. Stanek, for the ABA 8-8N team



Lin+ 2024, ApJL

Uno, KM+, submitted

Ongoing and coming follow-up activities (opt.)



Long-term monitoring (KM+): Subaru
Rapid spec ToO (KM+): Gemini



<1 min time-resolving (KM+): Subaru, Seimei
New! Einstein Probe low-luminosity local GRBs:
Gemini (Tanaka), Seimei (Taguchi)
New! High-z GRBs (Asada+): Seimei



Polarization (Uno+): Subaru
Intra-night variability search (KM+): Seimei
New! Rapid spec ToO (KM+): Gemini

+ Seimei/Kanata transient follow-up program (KASTOR):
rapid ToO + long-term monitoring for these transients (baseline)

Summary (of JP24H01810 activities)

- Intensive follow-up activities of local transients.
 - Including potential ν counterparts.
 - Observing systems continuously updated.
- Under JP24H01810, we aim at
 - Characterizing physical conditions (ν -emitting or not?).
 - Mapping progenitor systems (how frequent?).for SN-CSM interaction, GRBs/LFBOTs, and TDEs.
- A few highlights reported here, including
 - New type of SN progenitors?
 - New nearby LFBOT follow-up – jet or not?
 - New type of TDE – AGN-induced TDE or TDE-like AGN activity?and more to come – stay tuned.