AT2018cow
A fast luminous relativistic transient

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Cow, what cow?

- Discovered by ATLAS as a likely foreground CV spatially coincident with a galaxy at 60 Mpc
- 59 ATels followed
- 6 papers already out:
     *The cow: Discovery of a luminous, hot, and rapidly evolving transient*
     *X-ray Swift observations of SN 2018cow*
     *The fast, luminous ultraviolet transient AT2018cow: Extreme supernova, or disruption of a star by an intermediate-mass black hole?*
     *Swift spectra of AT2018cow: A white dwarf tidal disruption event?*
     *An embedded X-ray source shines through the aspherical AT2018cow: Revealing the inner workings of the most luminous fast-evolving optical transients*
     *AT2018cow: A luminous millimeter transient*

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?. Kann et al. in preparation
Discovery

- Discovered by ATLAS on June 16.44 UT (Smartt et al. 2018)
- Coincident with a galaxy at $z = 0.014$ (61 Mpc)
- Last non detection on June 15.13
- Estimated explosion on June 15.34 (Prentice et al. 2018)
- Rise to peak in ~3.5 days
- Peak at $g' = 13.40$
- Peak luminosity $4 \times 10^{44}$ erg (Perley et al. 2018)
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Our data

- **Spectroscopy**: GTC (15), X-shooter (3), Calar Alto (6) and NOT (5)

- **Photometry**: UVOT, GTC, VLT, HST, OSN, CAHA, WHT, Ondrejov

- **Millimeter**: NOEMA (9), ALMA (5)
Black body emission

- UV/Optical/NIR well described with a hot black body
- Temperature decreasing from 30,000 K to 12,000 K
- Radius decreased from $10^{15}$ to $10^{14}$ cm (70 to 7 AU)
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Broad-band component

- Detection of X-ray emission (Rivera Sandoval, ATeIl#11737) with flaring episodes
- Detection of a bright mm counterpart (de Ugarte Postigo et al., ATeIl#11749)
- Are they linked?
- Spectral slopes don’t seem to match
- At late time, both decay in a similar way
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A hard X-ray component was detected using NuSTAR and INTEGRAL (Margutti et al.).

Observations covering between 0.3 and 100 keV (also XRT + XMM).

Significant only during the first days.

Possible Fe K-alpha emission (typical in accretion disks and interacting SNe).

Excess at $E > 10$ keV (Compton hump?)
Spectral evolution

- Very broad features at early times (first 10 days)
- Emission features appear at day 13, strengthen until day 42, disappear at day 50
- Broad [CI] feature developing at 8800 Å between 40 and 70 days
Host galaxy

- Star forming barred spiral:
  - Mag = -18.66
  - Age = 2.00$^{+0.07}_{-0.36}$ Gyr
  - Mass = $1.51^{+0.15}_{-0.16} \times 10^9$ M$\odot$
  - SFR = $1.19^{+0.29}_{-0.11}$ M$\odot$/yr
  - Z $\sim$ 70% Solar (shallow gradient)
- HST UV observation
- CO detection
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Comparisons: Optical

- Extreme peak luminosity (like SLSNe)
- Very fast rise time
- Very fast decay (not compatible with $^{56}$Ni powered emission)
- Observed emission dominated by black body
Comparisons: X-ray

- Consistent in luminosity with GRB afterglows
- But late decay is faster than any GRB
- Brighter than SNe
Comparisons: Radio

- Similar to low luminosity GRBs, both in radio and millimetre wavelengths.
- More luminous than SNe (especially in millimetre)

Margutti et al. 2018
Progenitor models

- Prentice et al.: Magnetar in a binary neutron star merger
- Rivera Sandoval et al.: Some type of SNe ejecta interacting with an LBV-like ejecta
- Perley et al.: Relativistic jet within a fallback supernova, Disruption or a star by an intermediate-mass black hole
- Kuin et al.: White dwarf tidal disruption event
- Ho et al.: Energetic shock expanding into a dense medium
- Margutti et al.: SNe from low-mass H-rich stars, Failed explosions from blue supergiants
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Summary

• Rise time ~3.5 d
• Very fast ejecta (~0.1c)
• Black body that cools from 30 000 to 10 000 K and shrinks from $10^{15}$ to $10^{14}$ cm
• Spectral features: Early broad features, He/H emission lines, 8800 Å feature.
• Radio and millimetre emission
• X-ray emission, including flaring
• Hard X-ray component
• In a star forming galaxy, within a star forming region, with abundant CO