ESO Workshop GW2018, Garching, 1st February 2018

ESO P101 programs of Optical/near-infrared follow-up

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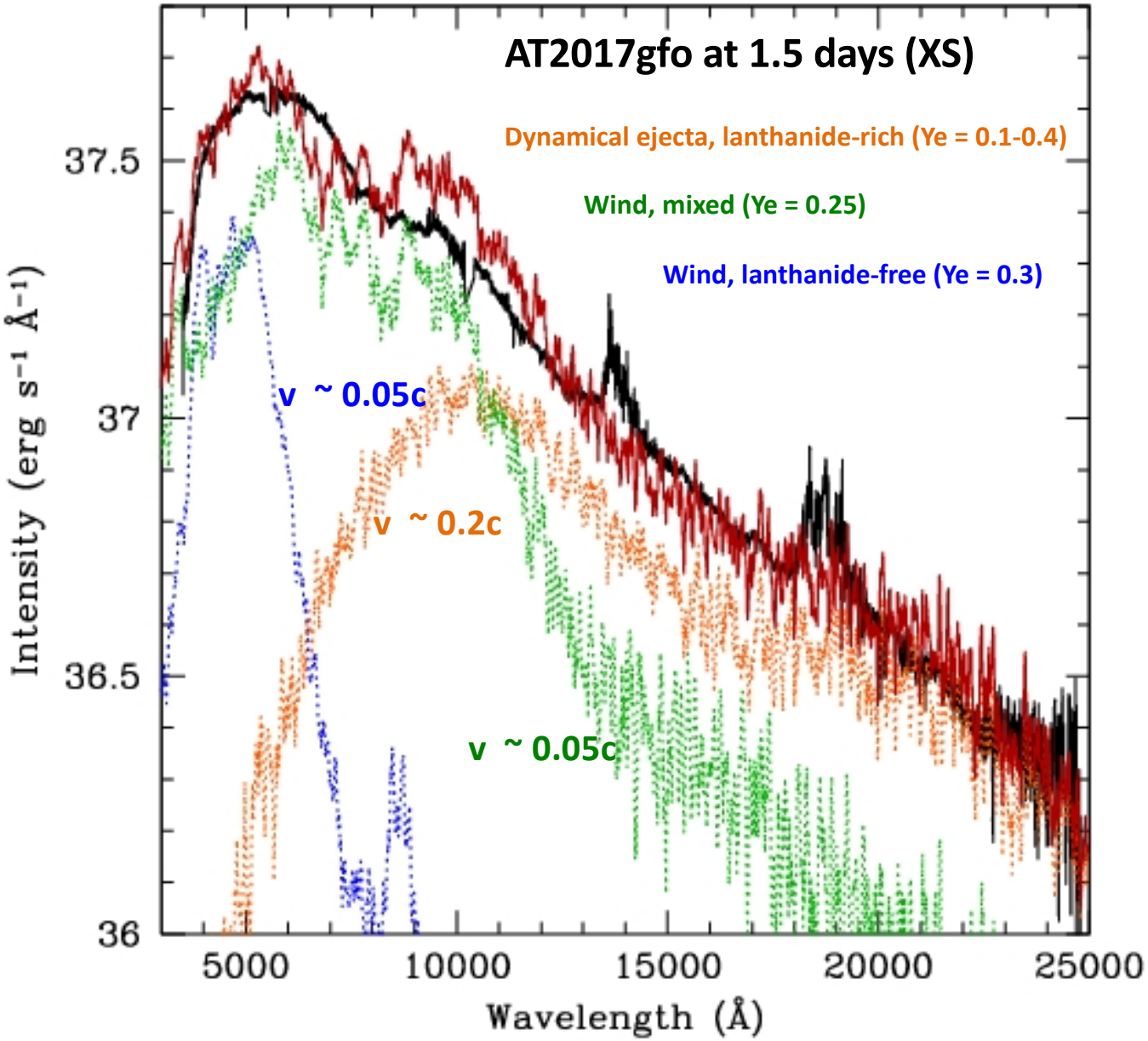
Open problems in kilonova science

One or more emission components?

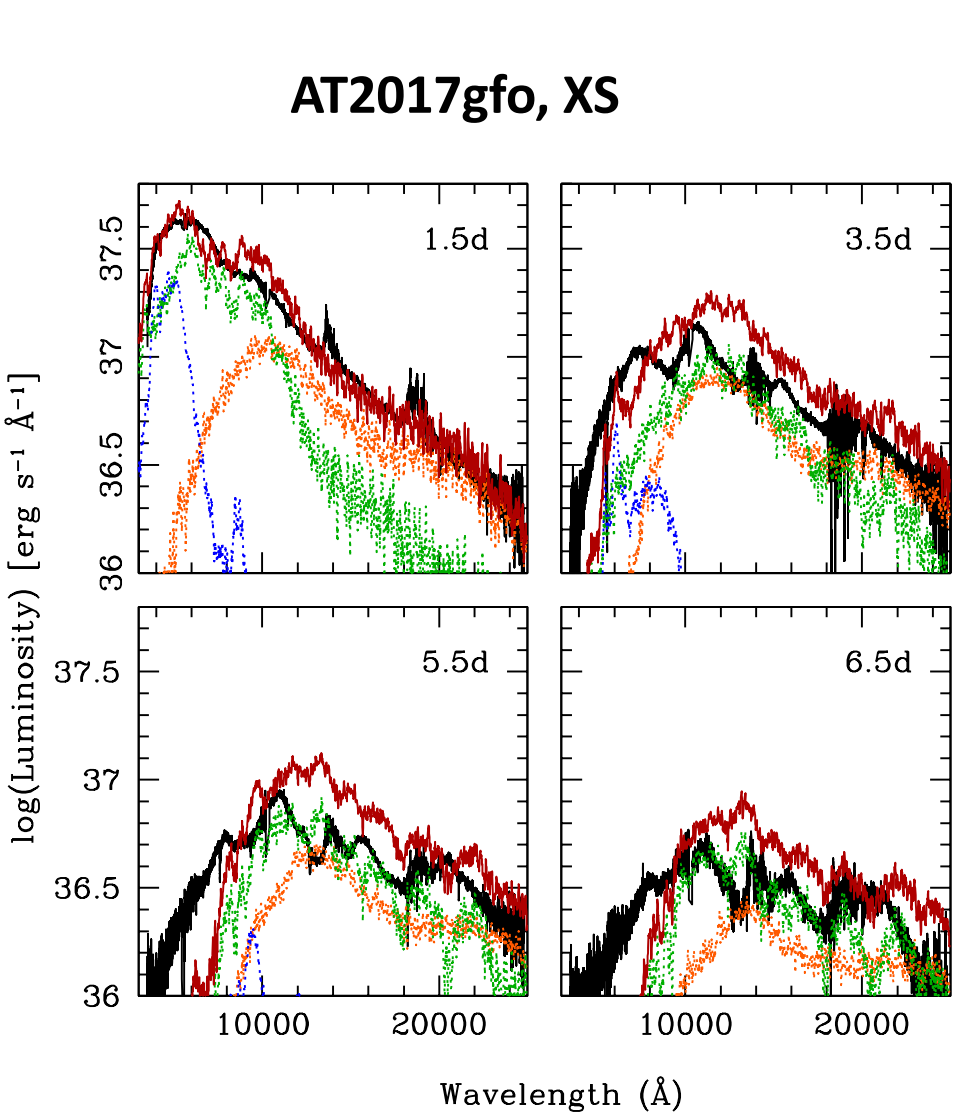
Which atomic species, in which abundances, and which geometries?

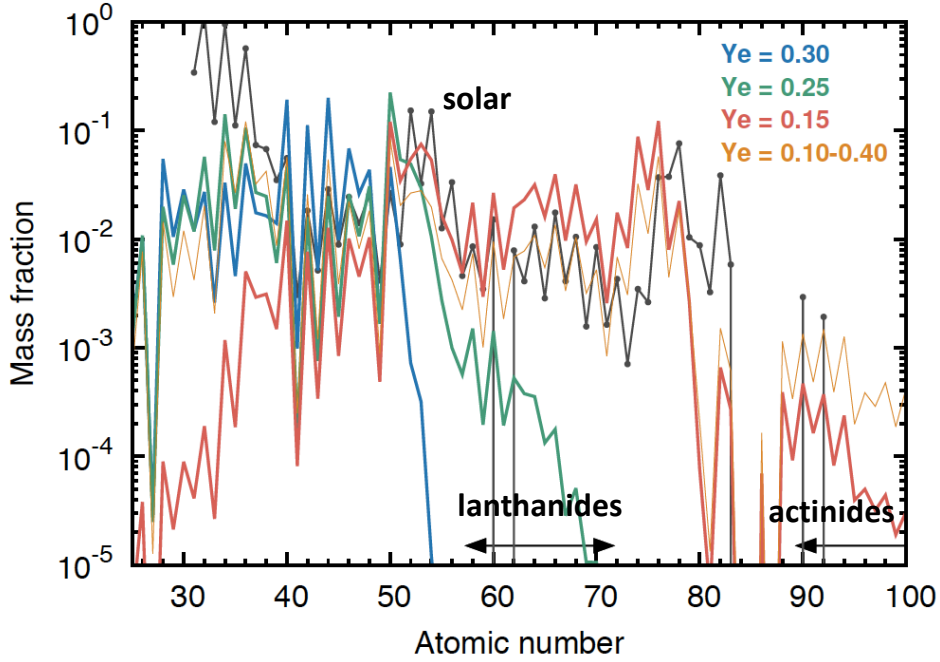
Identify and monitor BH+NS mergers

Joint GW and EM work



Open problems in kilonova science





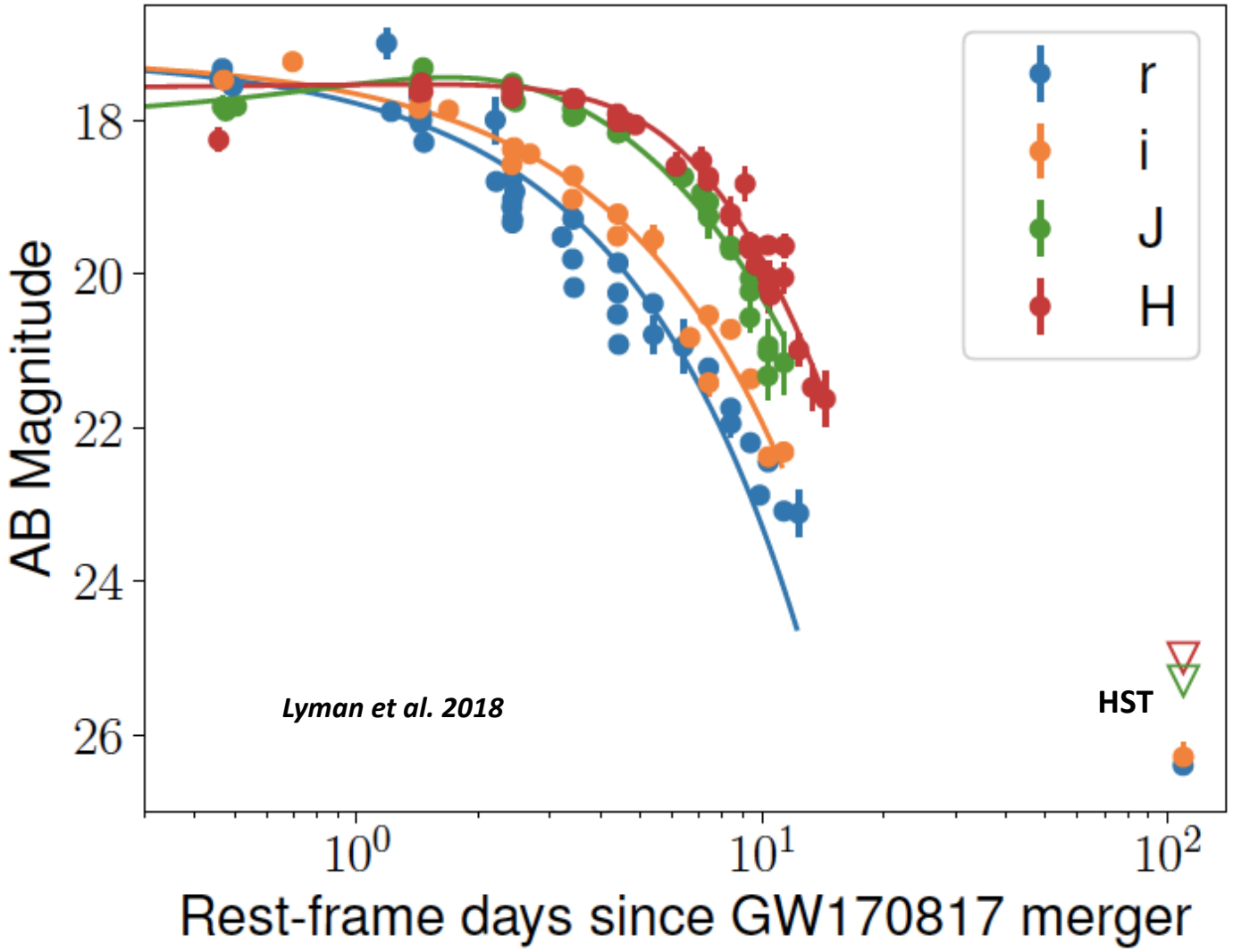
Identify nuclear reaction network

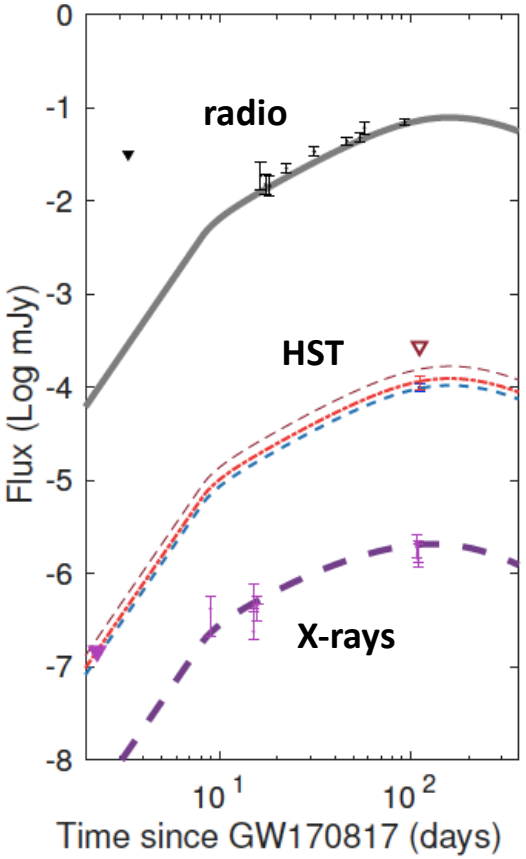
Identify atomic species via atomic models

Measure abundances via radiative transport models

Open problems in kilonova science

Observe late epoch afterglows of off-axis (?) short GRBs





ESO P101 TOO program on GWs 0101.D-0682

PI: E. Pian, Co-Is: M. Boer, A. Castro-Tirado, C. Copperwheat, J. Fynbo, B. Gendre, J. Hjorth, L. Hunt, M. Kasliwal, S. Klose, C. Kouveliotou, A. Levan, D. Malesani, P. Mazzali, B. Milvang-Jensen, P. Møller, D. Perley, J. Selsing, M. Tanaka, N. Tanvir, D. Watson, D. Xu

1. Title — Category: **D–7**

Spectroscopic and imaging follow-up of gravitational radiation sources with the VLT

2. Abstract / Total Time Requested

Total Amount of Time: 0 nights VM, 12 hours SM

Gravitational waves (GWs) in the kHz range from the inspiral and coalescence of two ~30 $M_\odot$ black holes were detected in Sep and Dec 2015 by the two LIGO interferometers in the USA. A few more events were announced in the second LIGO observing run (O2), that ended on 25 August 2017 and benefitted from the participation of the Virgo interferometer. Toward the end of O2, a GW signal from a nearby (40 Mpc) double neutron star merger was detected with excellent S/N, and localized with sufficient accuracy to allow the detection of an optical counterpart. Our VLT X-shooter spectroscopic monitoring over 3200-24800 Å identified the signature of *r*-process nucleosynthesis, the hallmark of "kilonova" emission. A third LIGO-Virgo observing run (O3) will start in September 2018. We propose follow-up observations with VLT X-shooter, FORS2, and HAWK-I of GW candidate counterparts localized with sub-arcmin precision.

3.

Run	Period	Instrument	Time	Month	Moon	Seeing	Sky	Mode	Type
A	101	XSHOOTER	8h	any	n	1.4	THN	s	TOO
A/alt	101	FORS2	2h	any	n	1.4	THN	s	TOO
B	101	FORS2	2h	any	n	1.4	THN	s	TOO
C	101	HAWKI	2h	any	n	1.4	THN	s	TOO

Triggering probability:

~20%, owing to small anticipated overlap between Ligo-Virgo O3 and P101.
One GW event only in P101 (with possibly more than 1 candidate)

Follow-up observations start when sub-arcmin position is Available and V <~ 21-22

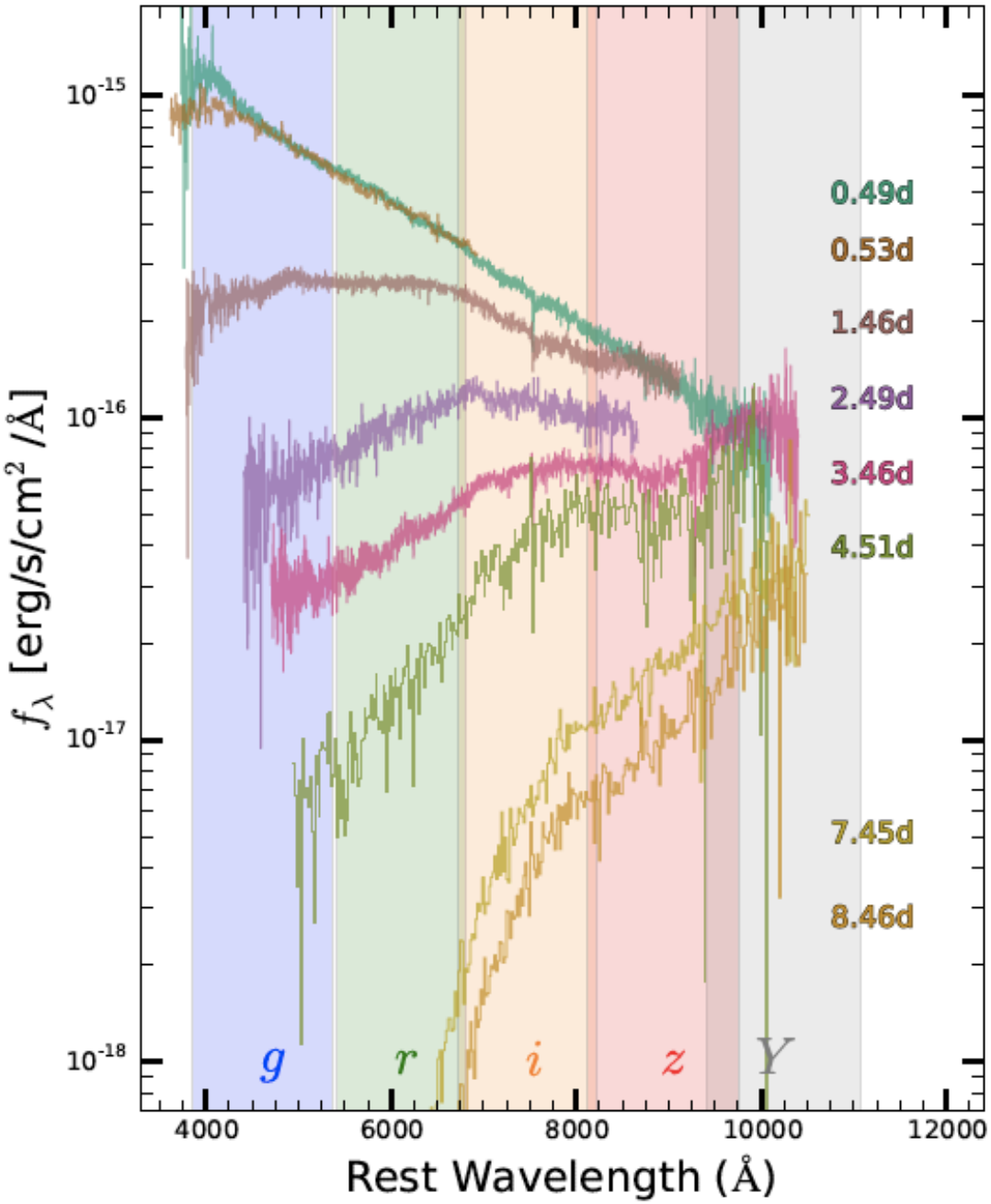
VLT Runs:

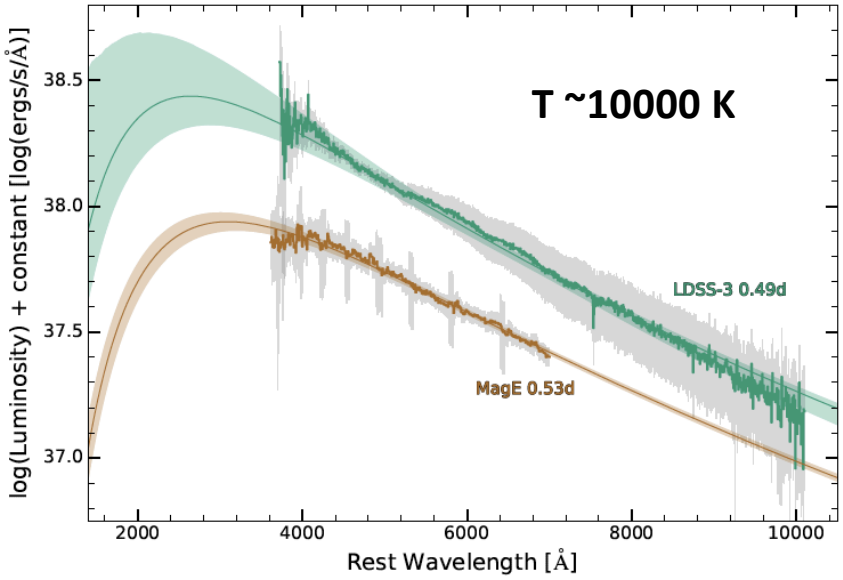
Run A (8h): X-Shooter NUV-to-NIR spectra (alt/A FORS2)
Run B (2h): FORS2 optical photometry (light curve and spectral calibration)
Run C (2h): HAWK-I NIR photometry (light curve and spectral calibration)

Coordination and synergy with multi-wavelength facilities

Rapid activation and turnaround will make a difference

Magellan spectral sequence of AT2017gfo





Early spectra set a constraint on initial photospheric speed: may justify RRM if conditions allow

Shappee et al. 2017