ESO Science Archive Facility - Phase 3 Data Release Description
ESO public survey programme PESSTO - Spectroscopic Survey of Transient Objects, Data Release DR4.1
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PESSTO SSDR4 : ESO Phase 3 Data Release Description

Data Collection	PESSTO_MPHOT
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Date	12.07.2021

Abstract

PESSTO (Public ESO Spectroscopic Survey of Transient Objects) began in April 2012 on the New Technology Telescope using the instruments EFOSC2 and SOFI. We typically target supernovae and optical transients brighter than 20.5^m for classification and select science targets for detailed follow-up. We use standard EFOSC2 setups providing spectra with resolutions of 13-17Å between 3650-9995Å. A subset of the brighter science targets are selected for SOFI spectroscopy with the blue and red Grisms (resolutions 23-33Å) and imaging with broadband JHK_s filters. This catalogue data release provides photometric lightcurve coverage for the PESSTO targets for which follow-up lightcurves have been completed. Photometric lightcurves for a total of 95 objects are now provided, 65 more than in the previous release (lightcurves to 2 previously released transients have been removed from the catalogue as they do not qualify as PESSTO key-science targets).

Overview of Observations

As of 2019-05-01 PESSTO has taken spectra of 2314 optical transients and has chosen around 337 targets for more detailed follow-up. The follow-up observations include spectroscopic and photometric time series data sets in the optical and near infra-red. The photometric datasets typically take longer to complete and release since objects can be followed for longer with photometry and often a template image (or series of images) is required to apply image subtraction methods to remove the host galaxy contamination. This means that fully calibrated photometric time series data often need to wait at least for the second season of observations so that template images which are free from supernova signal can be gathered. These template images need to be with the same camera to reduce colour effects when difference imaging is applied.

PESSTO targets transients which are brighter than around 21^m for optical spectroscopy. While EFOSC2 can provide optical imaging (as discussed in Smartt et al. 2015), the majority of our targets can be followed photometrically with smaller aperture facilities. Use of multiple smaller facilities allows us to gather densely sampled lightcurves and also allows the NTT to concentrate on EFOSC2 spectroscopy and NIR observations with SOFI. EFOSC2 is employed for photometry when targets get too faint for the 1-2m telescopes we use. An example of the PESSTO legacy data set for SN2009ip (Fraser et al. 2013, 2015 ; see also Pastorello et al. 2013) is shown here in Figure 1.

Although most PESSTO target transients are initially discovered by wide-field imaging surveys, PESSTO has made a transient discovery of its own. During the PESSTO follow-up campaign of SN 2018ec, a Type Ic supernova hosted by galaxy NGC 3256, a second transient was serendipitously discovered in EFOSC2 imaging (see Figure 2). This PESSTO discovered transient, AT 2018cuz, was reported in Kankare et al. (2018) and subsequently classified as a sub-luminous Type IIP supernova.

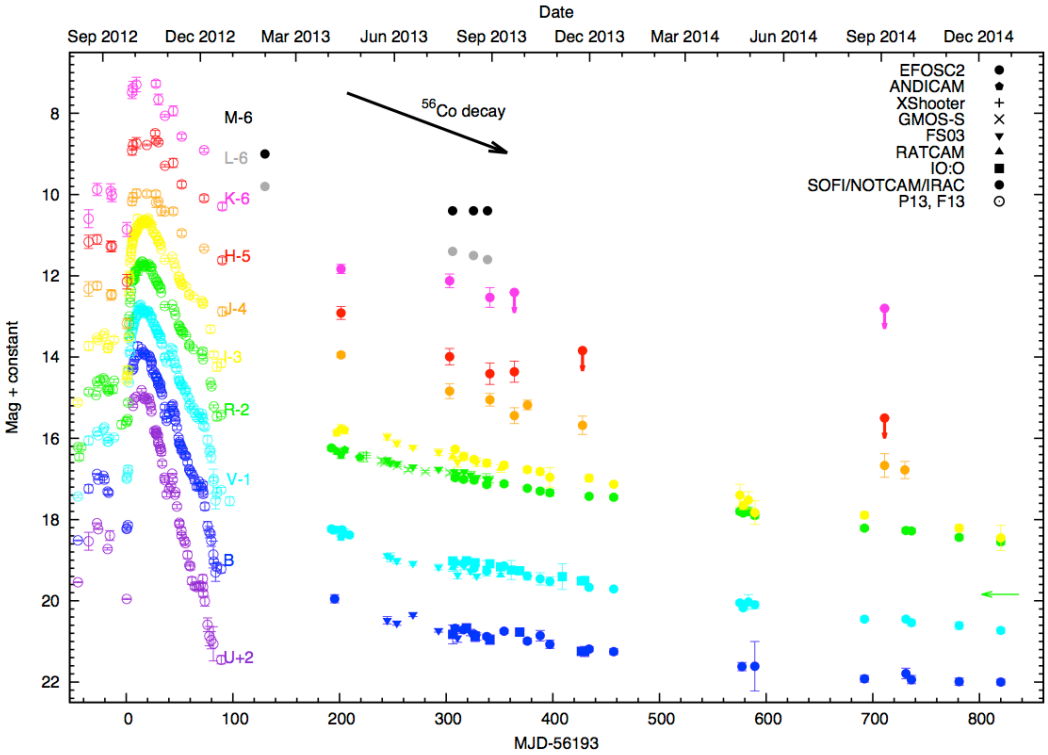

Figure 1 : reproduced from Fraser et al. (2015). Optical and near-infrared lightcurves for the PESSTO science target SN2009ip. The source of each data point is indicated by the key. All data taken by PESSTO and presented in Fraser et al. (2013) and Fraser et al. (2015) are provided in this release.

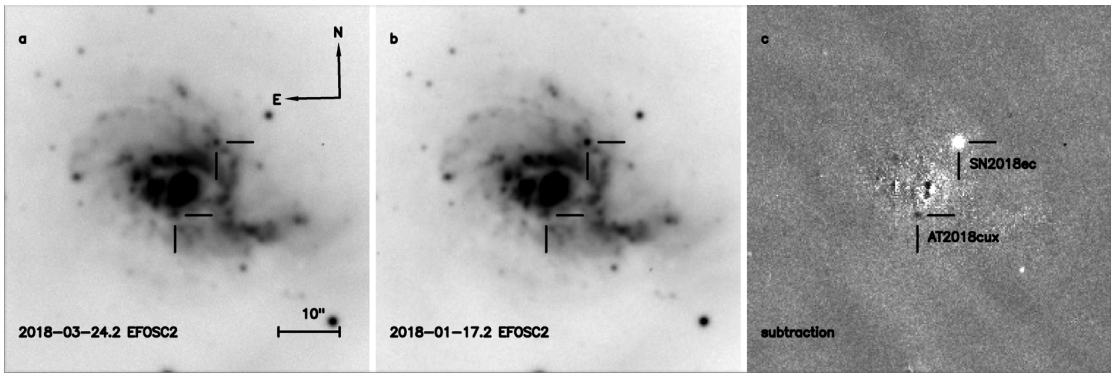

Figure 2 : . Figure 5 of Kankare et al. (2021), replicated here, presents the EFOSC2 discovery image of AT 2018cuz in the left panel, the pre-discovery EFOSC2 image of the same field in the centre-panel and the difference between the images, with the locations of SN 2018ec and AT 2018cuz annotated, in the right-panel.

As photometric data are often, and indeed predominantly, provided from facilities other than the NTT and ESO, the image pixels are not all in the ESO archive. Those which are not ESO data are available on request from the PESSTO survey team. The detrended EFOSC2 images are available from www.pessto.org and the SOFI images are in the ESO archive as full science products. It is our intention to release all EFOSC2 images with trustworthy astrometric and photometric calibration. The calibration of all of the EFOSC2 images with an all-sky reference catalogue (from the Pan-STARRS1 telescope) is currently being investigated.

Release Content

The objects released are given in Table 1 below, with references to the published data where appropriate. The photometric measurements were carried out as described in the individual papers listed in Table 1. Photometry is usually a PSF fitting process unless specifically described otherwise in the papers. The processing of the various camera data are again included in the references. The description of the PESSTO processing of EFOSC2 and SOFI data is in Smartt et al. (2015).

Table 1 : Objects included in this release. The references provide the instrumental, reduction and calibration details. There are 6 unpublished lightcurves of type Ia SNe from Maguire et al. (2013), which are provided here with details of their instrumental source.

Object	Reference
ASASSN-14lp	Baltay C., et al. 2021.
ASASSN-14lw	Baltay C., et al. 2021.
ASASSN-15hf	Baltay C., et al. 2021.
ASASSN-15hx	Baltay C., et al. 2021.
ASASSN-15hy	Baltay C., et al. 2021.
ASASSN-15oi	Holoien T. W.-S., et al. 2018.
ASASSN-15oz	Bostroem K. A., et al. 2019.
AT2016bln (aka SN2016bln)	Baltay C., et al. 2021.
AT2016jbu (aka Gaia16cfr)	Kilpatrick C. D., et al. 2018.
AT2018dyb	Leloudas G., et al. 2019.
AT2018fyk	Wevers T., et al. 2019.
CSS121015-004244+132827	Benetti S., et al. 2014.
CSS131110-023957-083124 (aka LSQ13cuw)	Gall E. E. E., et al. 2015.
CSS140914-010107-101840 (aka CSS140914)	Baltay C., et al. 2021.
LSQ12btw	Pastorello A., et al. 2015.
LSQ12dlf	Nicholl M., et al. 2014.
LSQ12fhs	Baltay C., et al. 2021.
LSQ12fxd	Baltay C., et al. 2021, Maguire K., et al. 2013. Some unpublished photometry data described in Maguire et al. (2013); data are from the Faulkes Telescope South and Spectral camera in filters gri.
LSQ12gdj	Baltay C., et al. 2021, Scalzo R. A., et al. 2014.
LSQ13ddu	Clark P., et al. 2020.
LSQ13fn	Polshaw J., et al. 2016.
LSQ14an	Inserra C., et al. 2017.
LSQ14bdq	Nicholl M., et al. 2015.
LSQ14efd	Barbarino C., et al. 2017.
LSQ14mo	Leloudas G., et al. 2015, Chen T.-W., et al. 2017.
LSQ15bfp (aka iPTF15dld)	Pian E., et al. 2017.
NGC7552-OT (aka AT2014ej)	Stritzinger M. D., et al. 2020.
OGLE-2012-SN-006	Pastorello A., et al. 2015b.
OGLE-2013-SN-079	Inserra C., et al. 2015.
OGLE-2014-SN-073	Terreran G., et al. 2017.
OGLE-2014-SN-131	Karamehmetoglu E., et al. 2017.
OGLE16aaa	Wyrzykowski Ł., et al. 2017.
PS15ae (aka SN2015bn)	Nicholl M., et al. 2016a, Nicholl M., et al. 2016b.
PS15br	Inserra C., et al. 2018.

PS15dpn	Smartt S. J., et al. 2016.
PS15dsr (aka SN2015bs)	Anderson J. P., et al. 2018b.
SN2009ip	Fraser M., et al. 2015, Fraser M., et al. 2013.
SN2012ca	Inserra C., et al. 2016, Inserra C., et al. 2014.
SN2012ec	Barbarino C., et al. 2015, Jerkstrand A., et al. 2015.
SN2012hd	Maguire K., et al. 2013, Baltay C., et al. 2013. Some unpublished photometry data described in Maguire et al. (2013); data are from the Faulkes Telescope South and Spectral camera in filters gri. Some photometric data also from the La Silla QUEST survey and broad gr filter (Baltay et al. 2013).
SN2012hn	Valenti S., et al. 2014a.
SN2012hr	Maguire K., et al. 2013. Some unpublished photometry data described in Maguire et al. (2013); data are from the LCOGT 1m telescope network.
SN2012ht	Baltay C., et al. 2021, Maguire K., et al. 2013. Some unpublished photometry data described in Maguire et al. (2013); data are from the Liverpool Telescope and IO:O camera, in filters gri.
SN2013ai	Valenti S., et al. 2016, Davis S., et al. 2021.
SN2013aj	Maguire K., et al. 2013. Some unpublished photometry data described in Maguire et al. (2013); data are from the Liverpool Telescope and IO:O camera, in filters gri. Some data are provided from the SMARTS 1.3m telescope with ANDICAM and KPNO R-band filter.
SN2013am	Tomasella L., et al. 2018.
SN2013bb	Prentice S. J., et al. 2019.
SN2013ej	Yuan F., et al. 2016, Valenti S., et al. 2014b.
SN2013ek	Prentice S. J., et al. 2019.
SN2013fc	Kangas T., et al. 2016.
SN2013fs	Bullivant C., et al. 2018.
SN2013hx	Inserra C., et al. 2018.
SN2013K	Tomasella L., et al. 2018.
SN2013U	Maguire K., et al. 2013. Some unpublished photometry data described in Maguire et al. (2013); data are from the Liverpool Telescope and IO:O camera, in filters gri.
SN2014dq	Meza N., et al. 2019.
SN2014eg	Baltay C., et al. 2021.
SN2015ah	Prentice S. J., et al. 2019.
SN2015ap	Prentice S. J., et al. 2019.
SN2015F	Cartier R., et al. 2017, Baltay C., et al. 2021.
SN2015H	Magee M. R., et al. 2016.
SN2015L (aka ASASSN-15lh)	Leloudas G., et al. 2016.
SN2016aqf	Müller-Bravo T. E., et al. 2020.
SN2016eiy (aka ASASSN16hp)	Baltay C., et al. 2021.
SN2016frp	Prentice S. J., et al. 2019.
SN2016gsd	Reynolds T. M., et al. 2020.
SN2016hnk	Pastorello A., et al. 2019b.
SN2016hvl	Baltay C., et al. 2021.
SN2016iae	Prentice S. J., et al. 2019.
SN2016iks	Baltay C., et al. 2021.
SN2016P	Prentice S. J., et al. 2019.
SN2017awz	Baltay C., et al. 2021.

SN2017azw	Baltay C., et al. 2021.
SN2017cbv	Baltay C., et al. 2021.
SN2017dcc	Prentice S. J., et al. 2019.
SN2017dio	Kuncarayakti H., et al. 2018.
SN2017ens (aka ASASSN-15pz)	Chen P., et al. 2019.
SN2017fzw	Baltay C., et al. 2021.
SN2017gci	Fiore A., et al. 2021.
SN2017htp	Melandri A., et al. 2019.
SN2017ivv	Gutiérrez C. P., et al. 2020.
SN2017jfs	Pastorello A., et al. 2019a.
SN2018aoz	Baltay C., et al. 2021.
SN2018bgz	Baltay C., et al. 2021.
SN2018bie	Baltay C., et al. 2021.
SN2018bsz	Anderson J. P., et al. 2018a.
SN2018ec	Kankare E., et al. 2021.
SN2018gjx	Prentice S. J., et al. 2020b.
SN2018hgc	Baltay C., et al. 2021.
SN2018ilu	Baltay C., et al. 2021.
SN2018jky	Baltay C., et al. 2021.
SN2018kzr	McBrien O. R., et al. 2019.
SN2018oh	Li W., et al. 2019, Baltay C., et al. 2021.
SN2019bkc	Prentice S. J., et al. 2020a.
SN2019so	Baltay C., et al. 2021.
SSS120810-231802-560926	Nicholl M., et al. 2014.

Previous Releases

The previous release of this catalogue contained the lightcurves of 32 objects. In this release we have removed transients LSQ13ccw and PS15csd from the catalogue as, although they appeared in publications containing photometric data to other PESSTO key-science targets, they are not themselves flagged as key-science targets in the PESSTO Transient Catalogue.

This latest version of the catalogue adds the lightcurves of another 65 objects.

Data Format

The multi-lightcurve catalogue, `PESSTO_MPHOT`, is provided as a FITS binary table and is structured following the standards described in Sec. 12 of Nausicaa et al. (2020). The table is stored as the single data extension within the FITS file and contains 51 columns and 7421 rows. Each row represents a *single epoch of photometry* measured for one of the 95 transients.

The columns are as follows, with the format of the catalogue entry in parentheses.

1. `PHOT_ID`: the unique identification for the single epoch of photometry within the lightcurve catalogue (J)

2. `SOURCE_ID`: the unique identification of the transient found within `PESSTO_TRAN_CAT` (the `TRANSIENT_ID` keyword value), the catalogue of transients classified and followed by PESSTO (A).

3. `MJD`*:* the mean Modified Julian date of the epoch of photometry (E)

4.-51. The remaining 48 columns contain measured magnitudes in one of the 24 different filters that have been used in PESSTO follow-up and their errors (All columns have format E). The columns names provide the name of the filter and the magnitude-system employed (*Vega*, *AB* or *Swift*).

- The magnitudes in the *UBVRI* filters (e.g. U_VEGA_MAG, B_VEGA_MAG etc) are in the Landolt Vega magnitude system.

- The La Silla Quest Survey employs a broad filter covering roughly 400-700nm similar to the combined effect of Gunn $g + r$ filters (see Baltay et al. 2013). The La Silla Quest photometry can be calibrated on a Vega magnitude or AB magnitude system and also converted to standard filters such as *V*, or *g*. There are a small number of photometric points for SN2012hd which are quoted in the natural AB magnitude based system of the filter (LSQGR_AB_MAG).

- Near infra-red magnitudes are in the 2MASS system which is normalised to Vega (hence they are referred to as J_VEGA_MAG etc).

- The magnitudes in the *ugrizY* filters (U_AB_MAG, G_AB_MAG etc) are in the AB magnitude system and are generally based on SDSS reference stars. This means they are effectively on the SDSS AB magnitude scale. Note that the column headers are all in upper case but they refer to SDSS *ugriz*.

- A number of targets were also observed in the UV with Swift through the UVOT filters *uvw2*, *uvm1*, *uvw1* and the optical *u,b and v*. The magnitudes are in the Swift UVOT system (based on Vega magnitudes). The column names are *UVW2_SWIFT_MAG, V_SWIFT_MAG* etc.

- The ATLAS *o* and *c*-bands (orange and cyan) are in the AB magnitude system.

- The PanSTARRS *W*-band (wide) covers the wavelength range spanned by all *gri*-bands and is in the AB magnitude system.

Acknowledgements

If using these data, please cite this paper

Smartt S.J., et al., 2015: PESSTO : survey description and products from the first data release of the Public ESO Spectroscopic Survey of Transient Objects

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Based on data products from observations made with ESO Telescopes at the La Silla Paranal Observatory under programmes 184.D-1140, 188.D-3003, 191.D-0935, 197.D-1075 and 199.D-0143: PESSTO (the Public ESO Spectroscopic Survey for Transient Objects).

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