The EREBOS project - Studying the influence of sub-stellar objects on late stellar evolution (196.D-0214)

ESO Phase 3 Data Release Description DR 1

Abstract

The EREBOS (Eclipsing Reflection Effect Binaries from the OGLE Survey) project is an ESO Large Program (196.D-0214) using FORS2 in long-slit mode. We observed several post-common envelope eclipsing binaries with a hot subdwarf primary and a cool, low-mass companion using time-resolved spectroscopy to derive their radial velocity curve and the atmospheric parameters. The goal of this project is to study the interactions of low-mass stellar and sub-stellar companions with low-mass stars. All targets were selected photometrically from the Optical Gravitational Lensing Experiment (OGLE) survey as eclipsing binaries showing a prominent reflection effect and short orbital periods around 0.1 d. We observed all targets with grism GRIS_1200B+97, which covers a wavelength range from 366-511 nm. We always used a 1'' slit, which results in a resolution R = 1420. In this data release 1 we publish a target catalogue with the coordinates, magnitudes and orbital periods derived from the OGLE survey together with the reduced 1D spectra. Additionally, also the reduced 2D spectra and finding charts of each target are attached as auxiliary files. A catalogue of all individual spectra including the epochs of the observations in HJD and the corresponding orbital phases is released as well.

Overview of Observations

The EREBOS project has been awarded 113 h with FORS2 at the VLT/UT1 in long-slit mode over four semesters as a large filler program. The observations were taken in service mode grouped in observation blocks of 1-hour duration, which were taken, whenever the conditions did not allow to observe other targets. In each OB time-resolved spectroscopy of one single target was performed. Depending on the orbital period of the target 5-8 spectra were taken consecutively during one OB. The exposure time did not exceed ~5% of the orbital period to prevent orbital smearing.

The constraints demanded for the observations were thin cirrus, seeing < 2'', air mass < 1.8, no moon restrictions and moon angular distance > 30°. The individual observations were taken at arbitrary times. 1.5% of the spectra were obtained under very bad conditions resulting in not useful data and removed from this release. Since our targets are located in very crowded regions (OGLE galactic disc field or OGLE bulge field) of the sky, finding charts are of utmost importance to identify the correct target. We therefore created new finding charts of excellent resolution and quality from the FORS2 acquisition frames and included them in this release.

The observations of this DR1 were taken during the first three semesters of the program (P96, P97 and P98).

More details on this project and the target selection strategy can be found in Schaffenroth et al. 2017, Open Astronomy, Vol 26, Issue 1, Special Issue on Hot Subdwarfs and Related Objects VIII, 208-213.

Release Content

Here we release data of the first 9 targets observed in the EREBOS project.

For each target we provide the reduced 1D spectra (27-59 per target) as Phase 3 compliant fits files. Additionally, the 2D spectra, which are the output of the FORS2 Reflex reduction pipeline, and finding charts (2-3 per target in different zooms) are released as auxiliary data.

The release also contains a target catalogue with the magnitudes, the coordinates, and the ephemeris of the observed binaries. In addition, a catalogue of the individual spectra with the observation date in HJD and the orbital phase, in which they were observed, is released.
In the next releases it is foreseen to update the target catalogue with the atmospheric parameters (T_eff, log g and helium abundance) of the targets as well as the semi-amplitudes of their radial velocity curves derived from the spectra. Radial velocities of all individual spectra will be provided as soon as the problems mentioned below are solved. We will also release data for 4 more targets from the last semester of the campaign.
As this is a filler program the data quality is very inhomogeneous and there are observations at different conditions, which are also changing during the OBs. The spectral range of all spectra between 3731-5200 Å is sampled with a resolution of FWHM ~ 3 Å (R = 1420 at central wavelength 4360 Å) and a sampling of 0.36 Å/pixel.
In the table below, we list the target name, coordinates, orbital period, number of spectra per target, and the exposure time of the individual spectra.

TARGET	COORDINATES	PERIOD [D]	NUMBER OF SPECTRA	EXPOSURE TIME [S]
OGLE-BLG-ECL-000114	17:41:20.5 -34:34:48.5	0.07030228	43	300
OGLE-BLG-ECL-000103	17:59:27.25 -27:25:56.8	0.07781521	24 20	335 300
OGLE-BLG-ECL-000124	18:02:17.95 -32:01:50.0	0.06937682	42	300
OGLE-GD-ECL-11471	13:35:14.73 -64:21:10.3	0.12082222	20	520
OGLE-BLG-ECL-000091	17:56:38.74 -31:16:28.8	0.06742161	59	290
OGLE-BLG-ECL-000212	18:36:22.73 -23:15:45.0	0.06258789	56	300
OGLE-BLG-ECL-000207	18:20:48.29 -24:27:07.0	0.08843965	27	300
OGLE-BLG-ECL-000109	18:00:16.41 -36:31:25.3	0.09550029	41	400
OGLE-BLG-ECL-000110	18:00:23.28 -28:23:42.1	0.09502377	27	400

The observing date of the single spectra is given in the spectral catalogue and the signal-to-noise ratio is given in the header of the 1D spectra.

Release Notes

The spectral reference system of our 1D and 2D spectra is topocentric. The barycentric correction has not been applied. The wavelength axis refers to wavelength measured in air.

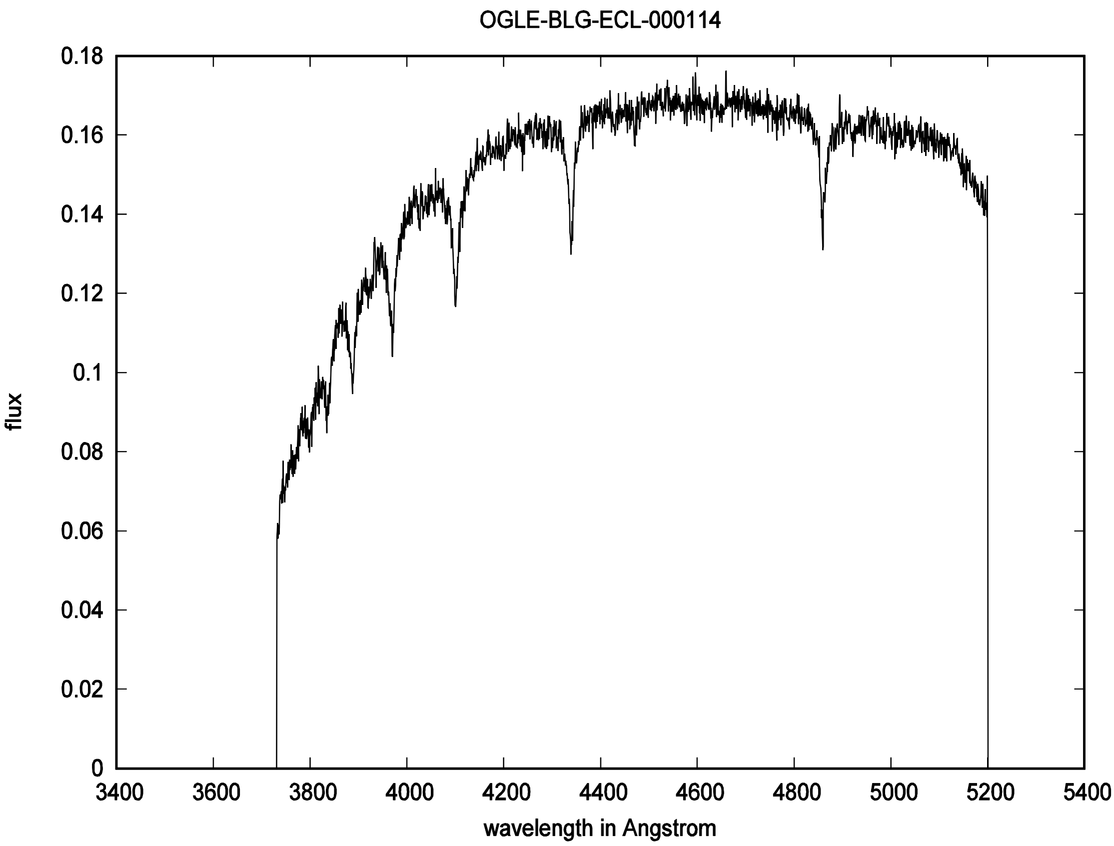
Data Reduction and Calibration

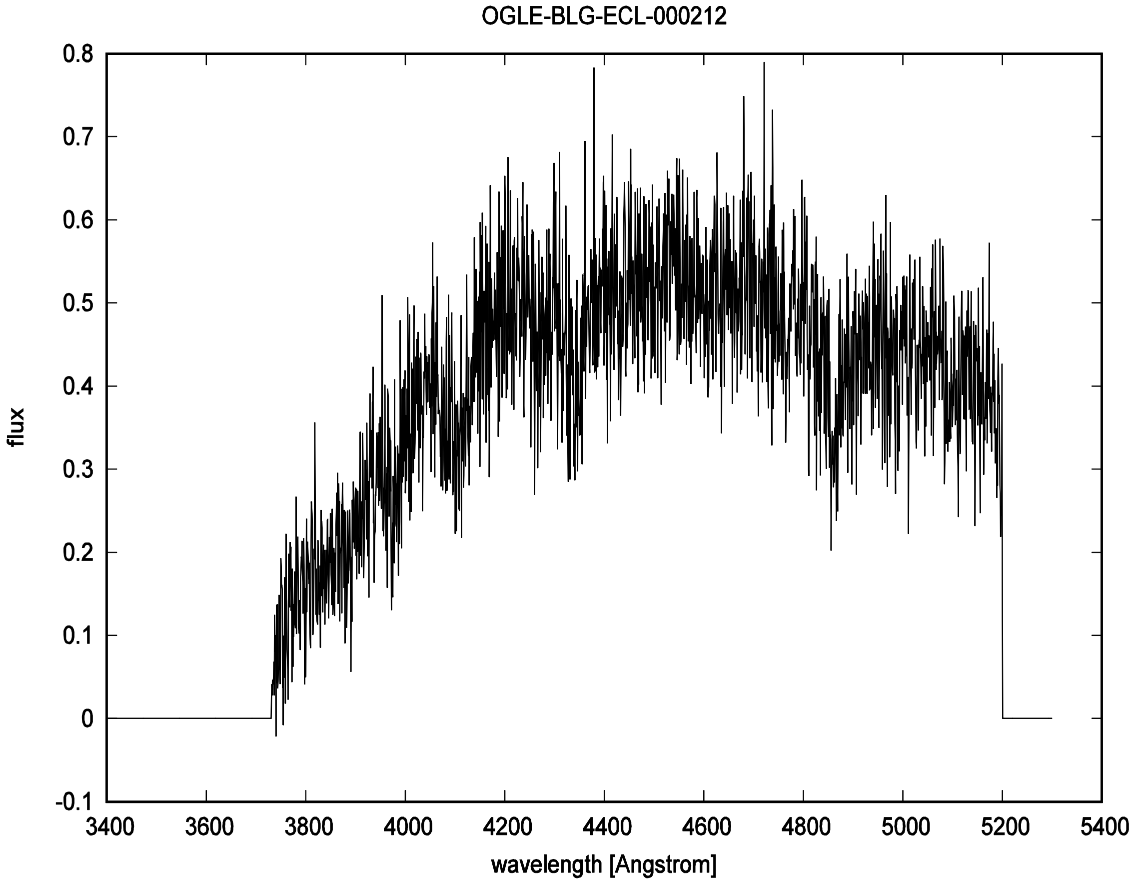
The data were reduced using the ESO FORS pipeline Version 5.3.11. For the reduction we used the Reflex workflow v2.8.5 provided by ESO (https://www.eso.org/sci/software/reflex).
The data reduction used the standard parameters recommended in the FORS Reflex workflow. The reduction of each spectrum was supervised to ensure a good wavelength calibration, and to make sure the signal-to-noise of the spectrum is high enough for the pipeline to extract the spectrum. The spectra were flat-fielded and wavelength-calibrated. If possible, we applied the cosmics routine, which is optional in the workflow. The output of the Reflex pipeline is a 2D file, which contains all extracted spectra present in the slit with sufficient signal-to-noise. As FORS2 has a very long slit and our targets are located in crowded fields, spectra of many stars were ex-

tracted from each individual frame. The mean resolution R at central wavelength (4360 Å) measured from the arcs is around R=1450.
To extract the individual 1D spectra from the 2D file (NAME_REDUCED_SCI_LSS.fits), we used IRAF (http://iraf.noao.edu/). The total number and sequence of the spectra stored in each individual 2D file depend on the exact alignment of the slit and the actual observing conditions, because faint targets are not extracted by the Reflex pipeline if their S/N is too low. To identify our targets, all individual spectra of each 2D file had to be extracted and visually inspected. Hot subdwarfs show spectral features of hydrogen and helium and can be easily distinguished from cool stars, which are the dominant population in the fields observed.
The 1D spectra and associated error columns of our targets were converted to an ascii file using the IRAF method ***rspectext***. Subsequently, we used a python script to generate ESO phase 3 compliant fits tables with wavelength, flux, and flux error columns.

Data Quality

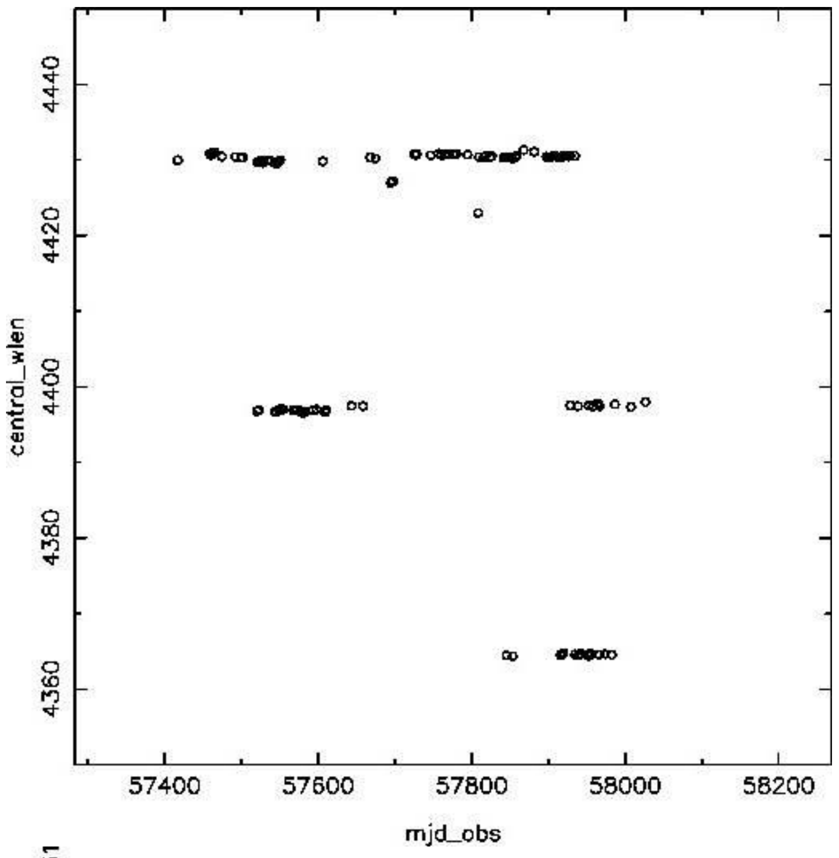
During the data reduction, we supervised the wavelength calibration and made sure the spectrum was properly extracted. Due to the different magnitudes, observing conditions, and limited exposure time, the signal-to-noise of the individual spectra is variable (S/N = 1.5-48). The two following figures show two examples.

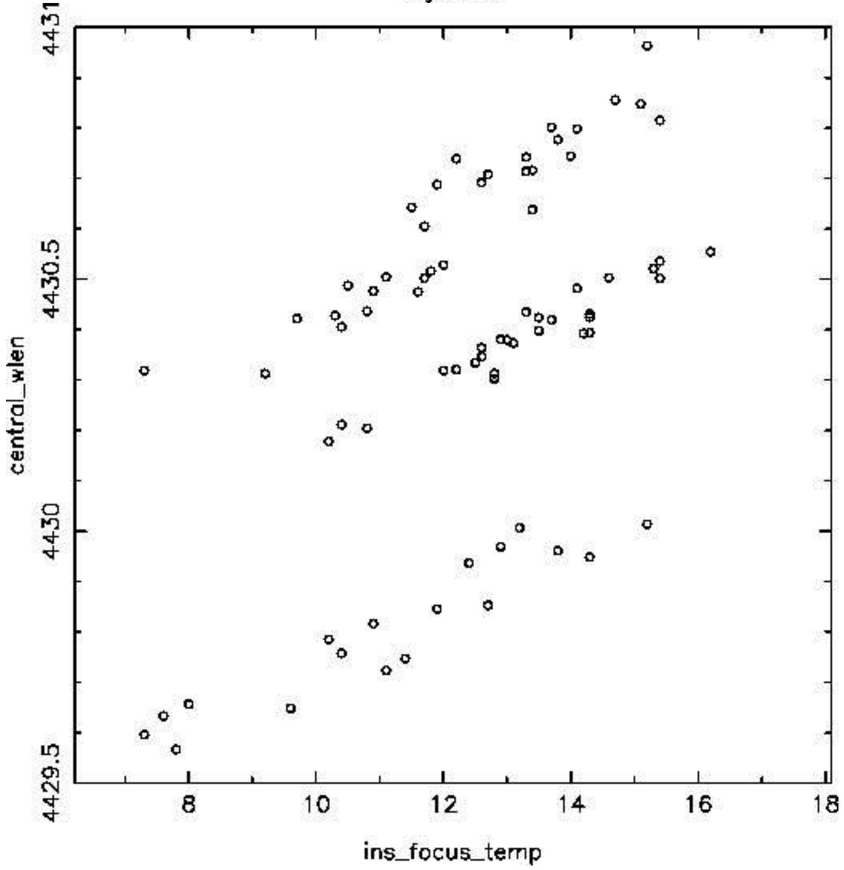




Known issues

Unfortunately, we realized that the wavelength calibration of FORS2 is not as stable as expected. Due to the fact that arc lamps are only taken during the day and with the telescope in zenith position, flexure turned out to be a non-negligible factor. Another problem is that there seems to be a dependency of the central wavelength on the FORS2 focus temperature.
(**https://www.eso.org/observing/dfo/quality/FORS2/qc/qc1.html**).
Moreover, when checking the quality control pages, it is visible that there are also jumps in the central wavelength (see following two figures). Therefore, combining the radial velocities from different nights is not straight forward and has to be done with extreme caution. Also during one night trends are visible due to changing temperature. That is why we did not include the radial velocities in the first release yet. In the next releases we try to quantify and correct for these effects.





Previous Releases

This is the first data release.

Data Format

Files Types

The reduced data products are one-dimensional, wavelength-calibrated, and sky-subtracted spectra with associated error column. All spectra of the same target have a consecutive number, which is not in chronological order. They are named:

- Target name_"# of OB"_REDUCED_SCI_LSS_"#of spectrum"_phase3.fits

Associated with each 1D spectrum are the reduced 2D spectra (fits images), which are the output of the FORS pipeline using the reflex workflow:

- Target name_"# of OB"_REDUCED_SCI_LSS_"# of spectrum".fits

Additionally, we release finding charts created from the FORS acquisition files, for each target as jpg files:

- fc_target_name[_zoom].jpg or
- target_name_fc[_zoom].jpg

Catalogue Columns

The target catalogue with the name EREBOS_cat.fits is a fits table with the following columns:

- SOURCE_ID: target name
- I_MAG: magnitude in the I band derived by the OGLE survey
- RA_2000: right ascension (derived by the OGLE survey)
- DE_2000: declination (derived by the OGLE survey)
- PERIOD: orbital period (as derived by the OGLE survey)
- T_MIN: Time of the primary minimum in HJD (as derived by the OGLE survey)

The spectral catalogue with the name EREOBS_RV_cat.fits contains all released spectra and is a fits table with the following columns:

- SPEC_ID: unique identifier for each spectrum (100001-100359)
- SOURCE_ID: target name
- HJD_MID: mid of observation in HJD
- phase: orbital phase in which the target is observed derived by using the ephemeris provided by the OGLE survey

Acknowledgements

Any publication making use of this data, whether obtained from the ESO archive or via third parties, must include the following acknowledgment:

- "This paper uses data from the EREBOS project (Schaffenroth et al. 2017, Open Astronomy, Vol 26, Issue 1, Special Issue on Hot Subdwarfs and Related Objects VIII, 208-213)
- "Based on data products created from observations collected at the European Organisation for Astronomical Research in the Southern Hemisphere under ESO programme 196.D-0214"

If the access to the ESO Science Archive Facility services was helpful for your research, please include the following acknowledgment:

- "This research has made use of the services of the ESO Science Archive Facility."