Betelgeuse, Betelgeuse, Betelgeuse: are you alone?

Abstract

Data from this collection have been obtained through ESO program 114.28H9. These are SPHERE-ZIMPOL observations of Betelgeuse. The goal of the program was to search for the close companion of Betelgeuse at its maximum elongation of December 2024.

Overview of Observations

The observations were performed with SPHERE-ZIMPOL on Betelgeuse (at the center of the field). Two observation modes were used:
- P1: slow polarization, with the V and N_I filters
- CI: classical imaging with pupil stabilization (hence field rotation) through the CntHa and N_Ha filters.
In both cases, no coronograph was used.

Release Content

SPHERE_ZIMPOL_Betelgeuse_P1_N_I_phase3.fits
Centered on Betelgeuse
RA/Dec (J2000): 05 55 10.30536 / +07 24 25.4304
Mode: P1
Filter: N_I
Observing date: 2024-12-03
Seeing: 0.51 – 0.56 arcsec
Ancillary product: **SPHERE_ZIMPOL_Betelgeuse_P1_N_I_DOLP.fits**, degree of linear polarization

SPHERE_ZIMPOL_Betelgeuse_P1_V_phase3.fits
Centered on Betelgeuse
RA/Dec (J2000): 05 55 10.30536 / +07 24 25.4304
Mode: P1
Filter: V
Observing date: 2024-12-03
Seeing: 0.51 – 0.56 arcsec
Ancillary product: **SPHERE_ZIMPOL_Betelgeuse_P1_V_DOLP.fits**, degree of linear polarization

SPHERE_ZIMPOL_Betelgeuse_ADI_CntHa_phase3.fits
Centered on Betelgeuse
RA/Dec (J2000): 05 55 10.30536 / +07 24 25.4304
Mode: CI
Filter: CntHa
Observing date: 2024-12-06
Seeing: 0.46 – 0.70 arcsec
Ancillary products:
Betelgeuse_B_PCA_2024-12-06_CntHa.fits, Principal Component Analysis residual map
Betelgeuse_B_PACO_2024-12-06_CntHa.fits, Angular plus Spectral Differential Imaging PAtch Covariances signal-to-noise ratio map

SPHERE_ZIMPOL_Betelgeuse_ADI_N_Ha_phase3.fits

Centered on Betelgeuse
RA/Dec (J2000): 05 55 10.30536 / +07 24 25.4304
Mode: CI
Filter: N_Ha
Observing date: 2024-12-06
Seeing: 0.46 – 0.70 arcsec
Ancillary products:
Betelgeuse_B_PCA_2024-12-06_N_Ha.fits, Principal Component Analysis residual map
Betelgeuse_B_PACO_2024-12-06_N_Ha.fits, Angular plus Spectral Differential Imaging PAtch Covariances signal-to-noise ratio map

Release Notes

Photometric calibration has been performed using the American Association of Variable Stars Observers magnitude of Betelgeuse in the V and R band at the time of the observations, propagated to the various filters using a PHOENIX model for red supergiant stars (Lançon et al. 2007) at a temperature of 3700K.

To infer the photometric zeropoint (PHOTZP keyword in the FITS headers) it was used a red supergiant model spectrum for Betelgeuse, normalized to its contemporaneous V-band magnitude, and convolved with the actual ZIMPOL filter transmission curves to predict the star's magnitude in each filter. Synthetic magnitudes are then combined with the measured aperture fluxes to derive the photometric zeropoints.

Filter	Vega mag	AB mag	PHOTZP AB	ABMAGLIM	ABMAGSAT
CntHa	-0.22395	-0.03004	20.050435	10.118	-2.030
N_Ha	-0.56919	0.04187	20.012471	9.115	-1.958
N_I	-1.53734	-1.05777	19.319035	8.338	-3.058
V	0.55778	0.57315	20.161580	10.939	-1.427

Data Reduction and Calibration

Intensity maps within this release are the direct product of the SPHERE-ZIMPOL pipeline and were produced by the he High Contrast Data Centre.

The ancillary products for the P1 mode are the direct output from the processing of the Stokes images produced by the pipeline (see eg. Cannon et al. 2021 and Montargès et al. 2023).

The ancillary product for the CI mode has been obtained through high contrast processing. The Principal Component Analysis (PCA) is described in Soummer et al. 2012 and Amara & Quanz 2012. The Angular plus Spectral Differential Imaging PAtch Covariances is described in Flasseur et al. 2020a,b.

Data Format

Files Types

This release only contains FITS images following the following naming convention:
SPHERE_ZIMPOL_<source>_<mode>_<filter>_phase3.fits

Acknowledgements

Data from this release have been published in Montargès et al. (2026), A&A, 711, L12.

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https://doi.org/10.18727/archive/114

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