EPSC Abstracts
Vol. 13, EPSC-DPS2019-1011-1, 2019
EPSC-DPS Joint Meeting 2019

EPSC
EPSC-DPS Joint Meeting 2019
15–20 September 2019 | Geneva, Switzerland

Extreme AO Observations of 31 (Euphrosyne) and NIR Spectroscopy of the Euphrosyne Family

Bin Yang (1), Pierre Vernazza (2), Benoit Carry (3), Josef Hanuš (4), Matti Viikinkoski (5), F. Vachier (6), J. Berthier (6), Michael Marsset (7) and Mark Willman (8)
(1) European Southern Observatory, Chile, (2) Laboratoire d'Astrophysique de Marseille, France, (3) Lagrange laboratory, Observatoire de la Côte d'Azur, France, (4) Astronomical Institute, Faculty of Mathematics and Physics, Charles University, V Holešovičkách, Czech, (5) Department of Mathematics, Tampere University of Technology, Finland, (6) Institut de mécanique céleste et de calcul des éphémérides, Observatoire de Paris, France, (7) Massachusetts Institute of Technology, USA, (8) Institute for Astronomy, University of Hawaii, USA

Abstract

The Euphrosyne family occupies a unique place in orbital element space and may be an important contributor to the low albedo Near-Earth objects (Masiero et al. 2015). The parent bodies of this family are thought to be potentially important vectors for the delivery of water and organic materials to forming terrestrial planets.
We conducted a direct imaging study of the largest family member 31 (Euphrosyne), using the Spectro-Polarimetric High-contrast Exoplanet Research instrument (SPHERE) on ESO's 8.2-m VLT. Based on our SPHERE/ZIMPOL observations, a satellite was detected adjacent to the asteroid Euphrosyne. In addition, we performed a systematic study to characterize the physical properties of the Euphrosyne family members via low-resolution spectroscopy using the 3.0 IRTF telescope.
I will present our SPHERE and IRTF observations and will discuss the surface features of 31 (Euphrosyne) and the orbital characteristics of its new moon. I will also discuss the compositions of the Euphrosyne family members via spectral modeling and present meteorite analogs.

1. Introduction

Among the few large, low-albedo families, the Euphrosyne asteroid family is uniquely situated at high inclination in the outer Main Belt, bisected by the ν_6 secular resonance (Carruba et al. 2014). More importantly, it may be an important contributor to the low albedo subpopulations of the Near-Earth objects (NEOs) (Mainzer et al. 2011). The asteroid (31) Euphrosyne is the largest member of its namesake family, which has an optical albedo of $p_V = 0.05 \pm 0.01$ (Masiero et al. 2014), and a taxonomic classification of Cb (Bus & Binzel 2002). There are about 1400 members that have been identified belong to the Euphrosyne family and the exhibit a very steep size-frequency distribution (SFD), significantly depleted in large- and medium sized asteroids ($8 < D < 12$ km). Such a steep SFD is interpreted as a glancing impact between two large bodies resulting in a disruptive cratering event (Masiero et al. 2015). The latest study suggests that the cratering event that formed the Euphrosyne family most likely occurred between 560 and 1160 Myr ago (Carruba et al. 2015).

2. Observations

2.1 SPHERE Observations

High-spatial resolution observations of 31 (Euphrosyne) were carried out with the ZIMPOL/SPHERE (Schmid et al., 2018) at one of the European Southern Observatory's 8m Very Large Telescopes (VLT). ZIMPOL is designed as a high contrast imaging polarimeter, aided with extreme AO, working in the visible regime (0.5 - 0.9 μm). The instantaneous FoV of ZIMPOL is 3.6 x 3.6 arcsec^2 and the plate scale is 3.6 mas pix^{-1} on the CCD detectors. ZIMPOL consists of two arms and for the both arms, we used the R filter. We observed asteroid Euphrosyne over 6 epochs between March to April, 2019 and our observations well-sampled the entire surface of the asteroid.

2.2 IRTF Observations

The NIR spectra of 17 family members were obtained using the NASA Infrared Telescope Facility (IRTF) 3-m telescope atop Mauna Kea, Hawaii from May to November, 2018. A medium-resolution 0.8-5.5 μm spectrograph (SpeX) was used, equipped with a Raytheon 1024 x 1024 InSb array having a spatial scale of 0.15″ pixel^{-1} (Rayner et al. 2003). The low-

resolution prism mode was used to cover an overall wavelength range from 0.8 μm to 2.5μm for all of our observations. We used a 0.8″x15″ slit that provided an average spectral resolving power of ~130. To correct for strong telluric absorption features from atmospheric oxygen and water vapor, we used G2V stars that were close to the scientific target both in time and sky position as telluric calibration standard stars.

3. Preliminary Results

3.1 IRTF Observations

Our preliminary results of the NIR spectroscopic observations show that the Euphrosyne family asteroids generally exhibit flat to moderately red spectral slope from 0.8 to 2.5 μm, see Fig 1. All the observed objects appear featureless with no diagnostic absorption features detected.

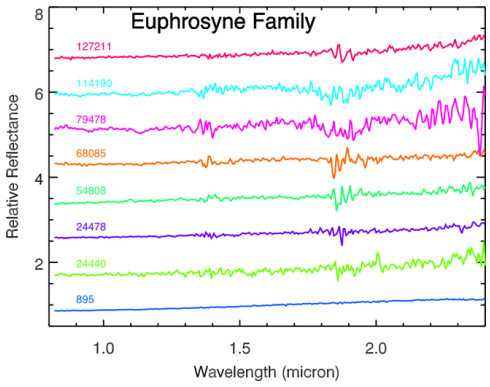

Fig 1. The IRTF/SpeX observations of the Euphrosyne family asteroids. The reflectance spectra are normalized at 1.0 μm and have been vertically offset for clarity.

3.1 SPHERE Observations

A full characterization of the ZIMPOL observations will be presented including surface features, shape model as well as the density of the largest family member, 31 (Euphrosyne). These physical properties will be further compared to those of other C-complex asteroids. Also, we will present the orbital features of the newly detected satellite of Euphrosyne.

Acknowledgements

Based on observations collected at the European Southern Observatory, Paranal, Chile (large program, 199.C-0074).

References

Bus, S.~J., & Binzel, R.~P. 2002, Icarus, 158, 146

Carruba, V., Aljbaae, S.,& Souami, D. 2014, ApJ, 792, 46

Carruba, V., Masiero, J.~R., Cibulkova, H., Aljbaae, S., & Espinoza Huaman, M. 2015, IAU General Assembly, 22, 2247929

Mainzer, A., Grav, T., Bauer, J., et al. 2011, ApJ, 743, 156

Masiero, J.~R., Carruba, V., Mainzer, A., Bauer, J.~M., & Nugent, C. 2015, ApJ, 809, 179

Masiero, J.~R., Mainzer, A.~K., Bauer, J.~M., et al. 2013, ApJ, 770, 7

Rayner, J.~T., Toomey, D.~W., Onaka, P.~M., et al. 2003, PASP, 115, 362

Schmid, H.~M., Bazzon, A., Roelfsema, R., et al. 2018, A&A, 619, A9