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New insights into Pallas' formation and collisional history from VLT/SPHERE and SOFIA/FORCAST

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1. Introduction

Large (D>100 km) asteroids are the most direct remnants of the building blocks of planets. With a diameter of ∼510-540 km (Schmidt et al. 2009, Carry et al. 2010), Pallas is the second or third largest object in the asteroid belt and the parent body of a small collisional family. Its spectral properties in the visible and near-infrared indicate a B-type surface (DeMeo et al. 2009), meaning Pallas is most likely linked to carbonaceous chondrite meteorites. Disc-resolved images of Pallas have revealed a nearly hydrostatic shape overprinted by long-wavelength concavities (Schmidt et al. 2009, Carry et al. 2010). This was interpreted as evidence for an early phase of internal heating subsequent to Pallas's formation, followed by several cratering impacts (Schmidt & Castillo-Rogez 2012). The two most recent estimates of Pallas' density, 2.40±0.25 (Schmidt et al. 2009) and 3.40±0.90 (Carry et al. 2010), are rather inconsistent and prevent from differentiating between the various models proposed for its internal structure (Schmidt & Castillo-Rogez 2012). This currently limits our understanding of the formation and early thermal evolution of Pallas.

2. Observations

We report new high-angular resolution observations of (2) Pallas collected in the frame of the SPHERE large survey of the asteroid belt (see Talk by P. Vernazza) with the adaptive-optics-fed SPHERE+ZIMPOL camera on the Very Large Telescope (VLT). A total of 40 images acquired at 8 different epochs provide a full longitudinal coverage of the surface of Pallas. We also present new mid-infrared (∼10-30 micron) spectra of Pallas collected with FORCAST on the Stratospheric Observatory for Infrared Astronomy (SOFIA).

3. Results

Pallas was resolved with ZIMPOL with around ∼120 pixels along the longest axis. The optimal angular resolution of each image was restored with Mistral (Fusco et al. 2002), a myopic deconvolution algorithm optimised for images with sharp boundaries, which allows the identification of many craters and geological features at the surface of Pallas. A precise 3D-shape reconstruction was achieved with the ADAM software (Viikinkoski et al. 2015), providing a high precision estimate of Pallas's volume and hence density. Finally, the FORCAST data was used to search for meteoritic analogs in the mid-infrared. We will present our results and discuss the implications for Pallas's early thermal and collisional evolution.

References

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