

## ROSETTA'S ENCOUNTER WITH ASTEROID 2867 STEINS IN SEPTEMBER 2008

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**Introduction:** The International Rosetta Mission, one of ESA's Planetary Cornerstones, is a space rendezvous with a comet. Launched in March 2004, Rosetta will go in orbit around the nucleus of comet 67P/Churyumov-Gerasimenko in 2014, to accompany the comet into the inner solar system, and land on the nucleus. On its way to the target comet Rosetta will also perform two close fly-bys at main belt asteroids, namely, 2867 Steins and 21 Lutetia. These two asteroids were selected after careful evaluation of the scientific significance of the reachable targets on one hand, and the available fuel budget on the other hand. It showed that 21 Lutetia represented the most interesting asteroid target within reach, because of its size and classification as C-type asteroid, and that 2867 Steins was the most promising target reachable in addition [1]. Asteroid 2867 Steins will be encountered first. The fly-by is scheduled for 8 August 2008 to 3 October 2008, with closest approach on 5 September 2008, 18:30 UT, when the asteroid is at heliocentric and geocentric distances of 2.14 AU and 2.41 AU, respectively

**The Target:** Asteroid 2867 Steins was discovered by Nikolai Stepanovich Chernykh (1931-2006) at Nauchnyj (Crimea) on 4 November 1969. It was first listed as 1969 VC and later named after Karlis Augustovich Steins (1911-1983). The asteroid is a member of the E-type family, which surface composition seems to be dominated by iron-free or iron-poor silicates, and resembles the aubrite meteorites spectra [2]. These asteroids are rather rare with only about 20 objects classified as E-type up to now, which are located mainly in the inner main belt. The size of 2867 Steins has been determined to  $2.24 \pm 0.02$  km assuming a typical E-type asteroid albedo of 40% [3]. Its rotational period was recently determined from observations obtained with the OSIRIS camera system on board Rosetta. The evaluation of the light curve led to a rotational period of  $6.052 \pm 0.007$  hrs [4]. An extensive overview of the properties of both Rosetta asteroid targets is given in [5].

**Fly-By Overview:** The fly-by at 2867 Steins is scheduled from 8 August 2008 to 3 October 2008, with closest approach on 5 September 2008, 18:33:57 UT ( $\pm 30$ s). Prior to command delivery to the spacecraft the exact time will be known to  $\pm 10$  s. The fly-by strategy allows continuous observations of the asteroid before, during and after closest approach, which is targeted for a minimum fly-by distance of 800 km.

Rosetta will fly-by on the Sun side of the asteroid with a relative velocity of 8.62 km/s approaching from low phase angle in the plane defined by the relative velocity and the Sun direction. The fly-by will go through phase angle zero at a distance of 1280 km and move to high phase angles (up to  $140^\circ$ ) after closest approach. The heliocentric and geocentric distances of the asteroid will be  $r = 2.14$  AU and  $\Delta = 2.41$  AU, respectively.

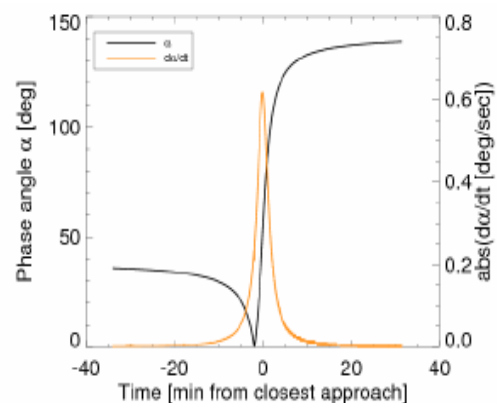


Fig. 1: Phase angle  $\alpha$  and  $d\alpha/dt$  around closest approach.

**Science Measurements:** Most of the scientific instruments on board Rosetta will be switched on to investigate 2867 Steins. Imaging and spectral observations will be obtained covering wavelengths from the UV to sub-mm. In addition a number of in-situ measurements will be performed of the asteroid as well as its direct environment. A detailed overview of the planned Rosetta asteroid fly-by will be given.

References: [1] Barucci et al. (2005) A&A 430, 313-317. [2] Nedelcu et al. (2007) A&A 473, L33-L36. [3] Weissman et al. (2007) A&A 466, 737-742. [4] Küppers et al. (2007) A&A 262, L13-L16. [5] Barucci et al. (2007) SSR 128, 67-78.