832 KARIN: ABSENCE OF ROTATIONAL SPECTRAL VARIATIONS. P. Vernazza[1], A. Rossi[2], M. Birlan[3], M. Fulchignoni[1], A. Nedelcu[3,4], and E. Dotto[5], [1]Observatoire de Paris, 5 Place Jules Janssen 92195 Meudon, France, pierre.vernazza@obspm.fr, [2]Spaceflight Dynamics Section (Pisa), Italy, [3]IMCCE, Observatoire de Paris, France, [4]Astronomical Institute of the Romanian Academy (Bucharest), Romania, [5]INAF, Osservatorio Astronomico di Roma, Italy.

Introduction: 832 Karin is the largest member of the young Karin cluster that formed 5.75 ± 0.05 Myr ago in the outer main belt [1]. Surprisingly, recent near-IR spectroscopy measurements [2] revealed that Karin's surface shows different colors as a function of rotational phase. It was argued that 832 Karin shows the reddish space-weathered exterior surface of the parent body as well as an interior face, which had no time to become space-weathered. We aimed to confirm/infirm this surprising result by sampling Karin's spectrum well throughout its rotation.

Here, we present new visible (0.45-0.95 µm) and near-infrared (0.7-2.5 µm) spectroscopic observations of 832 Karin obtained in January and April 2006, covering most of Karin's longitudes.

Observations: The observations presented here were performed (January 2006) in the visible at the European Southern Observatory (La Silla, Chile) with the 3.58 m New Technology Telescope (NTT) and in the near-IR (April 2006) with the 3m NASA Infrared Telescope Facility (IRTF) on Mauna Kea. In the visible, we used the grism 1 (150 gr/mm) in the RILD arm of EMMI to cover the 0.4-1.0 µm wavelength range with a slit width of 1.5". We obtained 30 spectra over 4 nights covering almost all rotational longitudes (Fig. 1). In the near-IR, the run was remotely conducted from the Observatory of Paris-Meudon during three consecutives nights. The spectrograph SpeX combined with the 0.8 x 15 arcsec slit was used in prism mode for acquisition of the spectra in the 0.7-2.5 µm wavelength range.

Results: i) Visible: The spectra have been normalized to unity at 0.55 µm. Fig. 2 shows the averaged spectrum for the 4 different nights. We find that the position of the maximum is the same (0.747±0.007 µm) for all spectra. In Fig. 3, we show the difference between all the 30 NTT spectra and the mean spectrum, enclosed by ±1σ and ±3σ contours (magenta lines). Only a few spectra show peaks outside the ±3σ contours. Indeed, those peaks correspond to telluric features that the division by the solar analog spectrum didn't remove. Thus, the difference between all the Karin spectra and the mean Karin spectrum (ignoring the telluric peaks) is well within ±3σ contours.

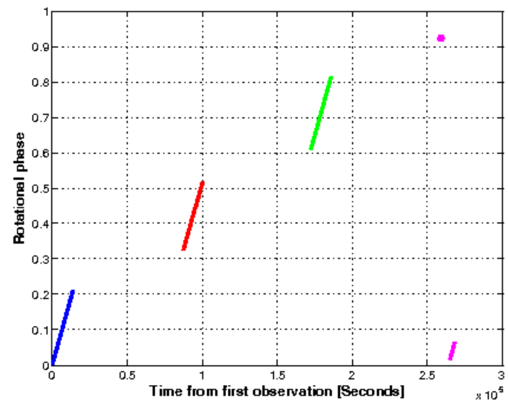

Fig. 1: Rotational phase coverage of the NTT observations.

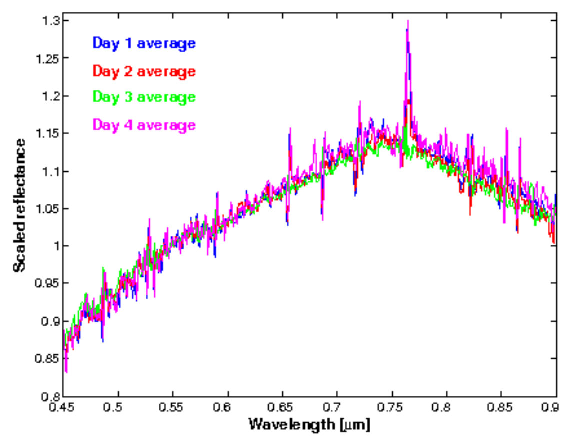

Fig. 2: Daily average spectra (NTT). The spectra are normalized to unity at 0.55 µm.

To sum up the situation, our visible data implies that 832 Karin, in its January 2006 pole configuration, is homogenous (i.e. same surface composition and same surface age) at a 3-sigma level. This result is in agreement with [3]. [3] observed Karin on the IRTF during the same period (UT 7-14 January 2006) sampling its spectrum well throughout its rotation. As in our case, they find that Karin exhibits minimal spectral variations with rotation, certainly nothing of the magnitude reported by [2].

ii) Near-IR: The spectra have been normalized to unity at 0.8 µm and are shown in Fig. 4. As in the visible range, the 3 near-IR spectra look very similar. The three spectra show no variation in the 0.7-1.3 µm range. However, we notice a little slope variation in the 1.4-2.45 µm range. Nonetheless, this variation is nothing of the magnitude reported by [2]. In the near-IR, we obtain the same result as in the visible: Karin's spectrum shows no "real" rotational spectral variations.

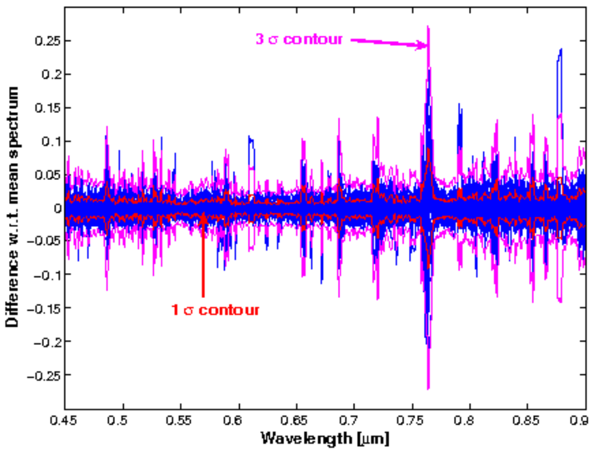

Fig. 3: Difference between the 30 NTT spectra and the mean spectrum; we show also ±1σ and ±3σ contours.

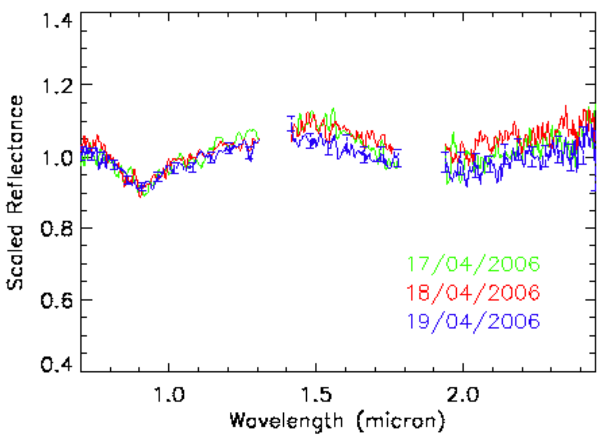

Fig. 4: Karin spectra obtained during three consecutive nights with SpeX (IRTF). The spectra are normalized to unity at 0.8 µm.

Discussion: In contrast to the results of [2], our observations (and those of [3]) indicate that Karin's surface is homogeneous throughout its rotation. We do not see any spectral variation reflecting a variation of the surface composition and/or a variation of the surface age (i.e. space weathering degree). Two possible explanations exist for the difference between our results and those obtained by [2] based on a much redder spectrum:

1) Their 'red' spectrum is 'spurious'. In this case, the reported color change by [2] would be wrong, as well as all the implications mentioned by [2].

2) Their 'red' spectrum is correct. In this case, the results difference must be due to a significant difference in the pole position between our January & April 2006 runs and their 2003 observational campaign.

Unfortunately, we don't have enough lightcurve data, which would allow us to determine Karin's pole position for a given period. However, the ignorance of Karin's pole orientation doesn't necessarily imply that we cannot bring an answer concerning the presence/absence of Karin's rotational spectral variations.

If Karin was pole-on during both runs (January & April 2006), we would not expect any spectral variation with the rotation. Thus, our obtained result would be normal (banal) and the reported color change ([2]) could be right. [2] showed that they observed Karin (from the lightcurve plot in their Fig. 1) in a configuration that was not pole-on.

In our case, if Karin's axis of rotation was perpendicular (or nearly so) to the orbital plane, then Karin could not be pole-on during both runs (the inclination of Karin's orbit to the ecliptic plane is ~1°). The only possibility for us to have observed Karin pole-on, is the case where Karin's axis of rotation would be significantly inclined with respect to the orbital plane (i.e., obliquity close to 90°). In that case, since the rotational axis should be nearly fixed in inertial space, there would be a period during which we would observe the south pole, one during which we would observe the north pole and in between we would observe the middle latitudes. From Karin's orbital diagram (see neo.jpl.nasa.gov/orbits), we can see that we (both us and [3]) observed Karin half heliocentric orbit apart from the [2] observations. Therefore, since [2] did not observe pole-on, we did not too, because the portions of the orbit in which Karin would show us one of the poles are those 90° (in true anomaly) either before or after our observations.

Therefore, while it is true that determining Karin's pole position would help us to better constrain the results, the difference between our results and those of [2] can't be due to a dramatically different viewing geometry. This implies that it is highly probable that [2]'s 'red' spectrum is 'spurious' and that the reported color change is wrong. On the basis of our observations, we rather suggest that 832 Karin is very homogeneous throughout its rotation.

References: [1] Nesvorný, D. et al. *Nature, 417, 720.* [2] Sasaki T. et al. (2004) *ApJ, 615,* L161. [3] Chapman et al. (2006) *AAS/DPS Meeting Abstracts 38, 71.08.*