A note on eclipse comets

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Abstract. Eclipse comets are a rare phenomenon but some suitable photographic or photometric observations can be of some scientific value. 10 years of photographic observations, covering six total solar eclipses, have yielded data that indicate the possible existence of one or more relatively objects within 20 solar radii. Three of the events were monitored by more than one observation site; each site produced multiple confirmation plates. The object images indicate some alignment with the ecliptic and range from +9 to +7 equivalent visual magnitude.

Key words: eclipses – comets

1. Introduction

There is no doubt that any total solar eclipse offer an excellent opportunity to see objects that are very close to the Sun. Comets have been found or observed at least five times during the total eclipses since the beginning of the 19th century. The 'Eclipse comet Tewfik' X/1882 K1 was seen during the eclipse on May 17, 1882. Even if it was a bright comet, it disappeared immediately and was never seen again. Its orbital elements remained unknown. Comet Tewfik was the first comet that was photographed during the total solar eclipse; when the French astronomer C. Trépied succeeded in taking a picture from his station in Egypt. Another example is the Comet 1948 XI that was photographed by R. d'E. Atkinson in Nairobi (Kenya) on November 1, 1948 (Figure 1). This comet was discovered on October 27, when its heliocentric distance was roughly 20 millions km. The last occasion was the very bright comet C/1995 O1 Hale-Bopp. E. Marková, P. Kotrč and their expedition succeded to take pictures of this comet during the total eclipse on March 9, 1997 (Marková et al., this issue). This comet was so exceptionally bright that it was recognized even on the very bright sky above the snow covered Siberia. Since the comet had the solar elongation of more than 40°, the picture was taken with a wide field camera. Paradoxically, the comet was found on the picture only much later, when the colour slide was projected on the screen (Marková, 1997). Eclipse comets belong, with some exceptions, to the Kreuz family of sungrazing comets.

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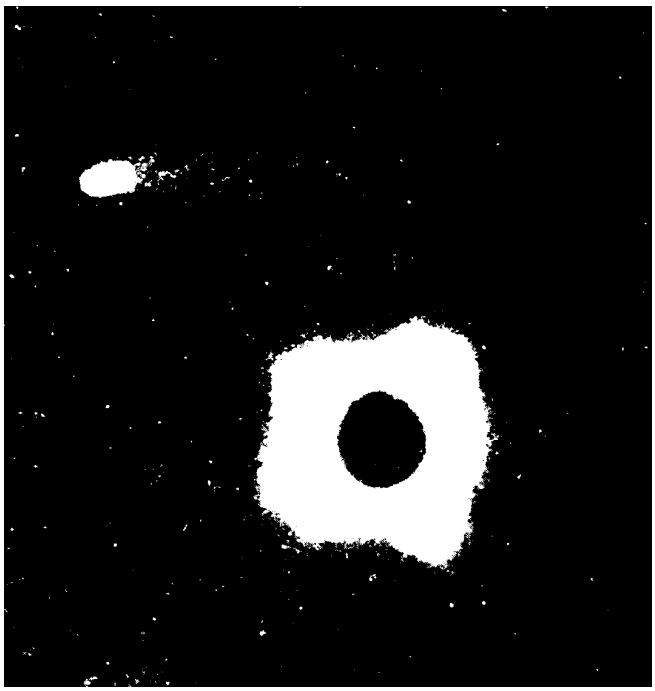

Figure 1. Eclipse comet 1948 XI as it was photographed by R. d'E. Atkinson in Nairobi, Kenya, on November 1, 1948. Picture was taken in the white light.

2. SOHO and sungrazing comets

Sun-grazing comets pass very close to the Sun or eventually hit the solar surface. Strong warming near the perihelion passage is the reason of a fast evaporation (or better to say sublimation) and so the sungrazing comets become very bright. For instance, the Great March Comet of 1843 (1843 I or C/1843 D1) was observed during the daylight when it was near perihelion on February 27.9, 1843, at the perihelion distance of 0.0055 AU. A possible projection of this comet on the solar surface (Figure 2) was drawn by Flammarion (1871).

Since the sun-grazing comets have perihelion distances in the range between 0.005 and 0.07 AU, they project on the sky close to the solar disk and can be usually seen only in a coronagraph: ground-based or on board of a satellite. The comet C/1965 S1 Ikeya-Seki approached Sun at closest on October 21.2, 1965. It was monitored by coronagraphs on several observatories. High resolution spectra taken before, during and after the perihelion passage revealed maximum strength of silicate features at the time of closest approach. A similar result was found by Chochol et al. (1983) during merging of another comet into the solar atmosphere.

The first satellite observations of a sungrazer were done for the comet Howard-

Koomen-Michels (1979 XI), seen by an externed occulted coronagraph aboard the Solar Maximum Mission satellite (SMM). Within a few hours after discovery the comet merged into the corona that brightened substantialy after the impact. Disappeared material of the 1979 XI comet in the solar corona was spectroscopicaly observed, for the first time, at the Lomnický Štít coronal station (Chochol et al., 1983). This comet was never registered again, but even if there were no astrometric data due to the short time of observation, this was probably the first documented collision of a comet with the Sun. In next years SMM discovered at least 10 other sun-grazing comets. The satellite SOLWIND discovered at least 6 sungrazers and the LASCO 2 and 3 coronagraphs on SOHO satellite found at least 58 sungrazers between 1996 and end of February 1999. Prior to the launch of SOHO, only 25 Sun-grazers had ever been discovered.

The twin comets named SOHO-54 and SOHO-55 were found on June 2, 1998. They posessed similar, but not identical orbits. If they originated due to splitting of a larger comet, it happened longer time before. They hit solar surface and approxiamtely one hour later a strong coronal mass ejection and an eruptive prominence were registered.

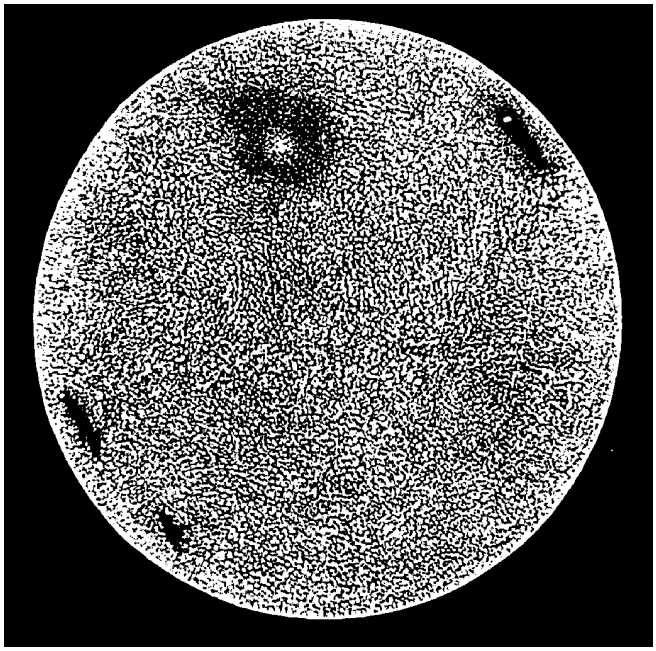

Figure 2. Drawing of the Great March Comet 1843 I, as it might appear when projected on the solar disk (Flammarion, 1871).

The Kreutz group of sungrazing comets may be fragments of a Sungrazer Parent Comet with diameter 120 km. Marsden (1968) carried out some calculations under assumption, that it appeared between 20,000 and 10,000 years ago.

The parent body would have had a period of about 1,000 years, and fragmentation would have occurred between 10 and 20 periods ago. It split probably into two major groups, denoted I and II, and it was possible to assign each of the known sungrazers either to the first or second group.

3. Remark to observations of eclipse comets

Czechoslovak expedition to Poland in 1954 took wide field pictures in the white light of the eclipsed Sun on June 30 in order to estimate the brightness of the Encke comet.

Donn and Dossin (1963) used an airborne photographic equipment to take pictures of solar vicinity during the eclipse on July 20, 1963. Courten et al. (1969) searched for comets during the eclipse on November 12, 1966. They used wide field cameras covering the sky up to 40 solar radii, equipped with interference filters for the region of CN bands. Even if there was comparatively bright sky background, they recorded stars up to +7th magnitude together with extended coronal structures. Filters for CN bands enable the best contrast of cometary emissions on the background of diluted light of corona, but photographies in the white light can be valuable, too.

4. Conclusion

Numerous comets discovered mainly by the SOHO mission and historical observations of eclipse comets as well do represent a strong impuls for observers to cary out also a cometary observing programme during the next total solar eclipses. Besides the interest for cometary astrophysics, there are always some problems concerning the astrometry, timing and the determination of orbits of sungrazers. Even small-scale pictures can contribute substantially to this problem.

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