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ORIGINAL ARTICLE

Comet Machholz (C/2004 Q2): morphological structures in the inner coma and rotation parameters

Federico Manzini · Raoul Behrend · Lorenzo Comolli · Virginio Oldani · Cristiano B. Cosmovici · Roberto Crippa · Cesare Guaita · Gottfried Schwarz · Josep Coloma

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Abstract Extensive observations of comet C/2004 Q2 (Machholz) were carried out between August 2004 and May 2005. The images obtained were used to investigate the comet's inner coma features at resolutions between 350 and 1500 km/pixel.

A photometric analysis of the dust outflowing from the comet's nucleus and the study of the motion of the morphological structures in the inner coma indicated that the rotation period of the nucleus was most likely around 0.74 days.

A thorough investigation of the inner coma morphology allowed us to observe two main active sources on the comet's nucleus, at a latitude of $+85 \pm 5°$ and $+45 \pm 5°$, respectively. Further sources have been observed, but their activity ran out quite rapidly over time; the most relevant was at $\text{lat}_{\text{com.}} = 25 \pm 5°$.

Graphic simulations of the geometrical conditions of observation of the inner coma were compared with the images and used to determine a pole orientation at RA $= 95 \pm 5°$, Dec $= +35 \pm 5°$.

The comet's spin axis was lying nearly on the plane of the sky during the first decade of December 2004.

Keywords Comets · Comet Machholz · Jets · Rotation period · Shells

F. Manzini (✉) · V. Oldani
SAS, Stazione Astronomica (IAU A12), Sozzago, Italy
e-mail: manzini.ff@aruba.it

R. Behrend
Geneva Observatory, Geneva, Switzerland

L. Comolli · C. Guaita
GAT, Tradate, Italy

C.B. Cosmovici
IFSI/INAF, Roma, Italy

R. Crippa
Osservatorio di Tradate (IAU B13), Tradate, Italy

G. Schwarz
DLR, Oberpfaffenhofen, Germany

J. Coloma
Observatorio de Sant Gervasi (IAU A90), Sant Gervasi, Spain

1 Introduction

Comet C/2004 Q2 (Machholz) was discovered by Don Machholz (2004) in the morning of August 27, 2004. It seems to be a member of the Oort cloud, with an estimated orbital period of 113,000 years (Marsden 2005).

Due to the favorable geometrical conditions of the appearance (Green 2004), the comet became as bright as magnitude 3.5, reaching its highest luminosity in the first week of January 2005, when it passed at the perigee (Yoshida 2006, and Yoshida, priv. comm.). Moreover, comet Machholz became circumpolar for the northern observers in March and April 2005, thus allowing extensive observational sessions.

On February 9, 2005, the first determinations of the rotation period and of the pole position were announced by Sastri (Sastri et al. 2005a, 2005b), but his solution (rotation period of 9.1 h, pole orientation at RA $= +190°$, Dec $= +50°$) was demonstrated to be incorrect by Farnham and co-workers (Farnham et al. 2007b), who proposed a new estimate for the rotation period of 0.733 days (17.6 h) and for the pole position at RA $= +50°$, Dec $= +35°$, after observing the comet extensively from February to April 2005.