Building Modern Cometary Models Using Ancient Chinese Data

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- Over interval 1059 B.C. through A.D. 1500, Chinese records are virtually the only source for quantitative observations of comets
  - 283 Asterisms containing 1464 stars
  - 28 lunar mansions
ANCIENT CHINESE DATA PROVIDE ONLY LONG-TERM SOURCE OF INFORMATION ON:

COMETARY OUTGASSING CHARACTERISTICS
FIRST AND LAST SIGHTINGS -> ABS. MAGNITUDE
ABS. MAGN. DIRECTLY RELATED TO OUTGASSING GAS & DUST

TIME VARIATION IN NONGRAV. ACCELERATIONS
YES - MAJOR SPIN AXIS MOTION WITH TIME
NO - SPIN AXIS ORIENTATION STABLE WITH TIME

RELATIVE MASSES OF COMETS
ACTIVE COMET WITH NO NONGRAV. ACCEL. OVER LONG PERIOD OF TIME => MASSIVE COMETARY NUCLEUS

METEOR SHOWER CIRCUMSTANCES
MAPPING DUST DISTRIBUTIONS SURROUNDING COMET
COMET HALLEY

COMET'S OUTGASSING RATE AS FUNCTION OF HELIOCENTRIC DISTANCE DOES NOT VARY OVER LONG TIME INTERVALS.

(OBSERVATIONS OF COMET FROM 164 B.C. TO A.D. 1991 CAN BE REPRESENTED WITH NO TIME DEPENDENCE IN ITS MODELLED NONGRAVITATIONAL EFFECTS)

NO OBVIOUS DECREASE IN COMET'S ABS. MAGNITUDE WITH TIME

(FOR EACH FIRST AND LAST SIGHTING BY CHINESE, AN ESTIMATE OF COMET'S ABS. MAGN. CAN BE MADE BECAUSE ITS COMPUTED DISTANCES FROM EARTH AND SUN ARE WELL KNOWN)

HENCE, THE FOLLOWING CAN BE SAID ABOUT HALLEY'S NUCLEUS:
ACTIVE VENTS ARE STABLE OVER ~ 2000 YEARS
SPIN AXES ORIENTATION STABLE OVER SAME INTERVAL
OBSERVED - COMPUTED TIMES OF PERIHELION PASSAGE ($\Delta T$)

1531 AD to 87 B.C.
COMET SWIFT-TUTTLE

ENTIRE OBSERVATIONAL INTERVAL FROM 69 B.C. TO 1993 CONSISTENT WITH NO NONGRAVITATIONAL EFFECTS.

NONGRAVITATIONAL CORRECTION TO PERIHELION TIME =

+ 4 DAYS/PERIOD HALLEY

0 SWIFT-TUTTLE

GAS PRODUCTION RATES OF SWIFT-TUTTLE AND HALLEY COMPARABLE

SWIFT-TUTTLE $q \sim 1 - 3 \times 10^{29}$ FOR $R = 1.0 - 1.1$

HALLEY $q \sim 3 - 6 \times 10^{29}$ FOR $R = 1.0 - 1.1$

ABS. MAG. OF SWIFT-TUTTLE & HALLEY CONSTANT WITH TIME

OUTGASSING IS PROBABLY RELATIVELY CONSTANT AND THE COMETARY MASS IS LARGE ENOUGH THAT OUTGASSING DOES NOT INTRODUCE A NONGRAVITATIONAL ACCELERATION
COMET TEMPEL-TUTTLE

COMET HAS BEEN SPARSELY OBSERVED AT ONLY 4 APPARITIONS

1965 JUNE - JULY  (ONLY 4 OBSERVATIONS)
1865 DEC. - 1866 FEB.
1699 OCT.  (SINGLE OBS. BY G. KIRCH)
1366 OCT. 25-29  (PO COMET OBSERVED BY CHINESE)

NONGRAV. EFFECTS ARE REQUIRED TO FIT LAST 3 APPARITIONS

COMET IS INTRINSICALLY FAINT YET ACTIVE - PROBABLY SMALL
SHOULD EXPECT SUBSTANTIAL NONGRAVITATIONAL EFFECTS

LEONID METEORS DOCUMENTED BACK TO AT LEAST A.D. 902
BUILDING MODERN COMETARY MODELS USING ANCIENT CHINESE DATA

SUMMARY

ANCIENT CHINESE DATA HAVE BEEN USED TO MAKE THE FOLLOWING CONCLUSIONS CONCERNING COMETARY NUCLEI:

COMET HALLEY
SPIN AXIS STABLE OVER 2 MILLENNIA
ACTIVITY OF VENTS NEARLY CONSTANT FOR SAME INTERVAL

COMET SWIFT-TUTTLE
NUCLEUS PERHAPS 10 TIMES MORE MASSIVE THAN COMET HALLEY
ACTIVITY NEARLY CONSTANT OVER 2 MILLENNIA

COMET TEMPEL-TUTTLE
PROBABLY SMALLER THAN EITHER HALLEY OR SWIFT-TUTTLE
STRONG METEOR SHOWERS (STORMS?) LIKELY ON:
1998 NOV. 17.82
1999 NOV. 18.08