Saguaro Astronomy Club

Metro Phoenix, Arizona

SACNEWS

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A Rock or a Rocket

by Dr. Duncan Steel

On November 6th astronomers operating the Spacewatch telescope at Kitt Peak in Arizona found what was at first assumed to be a small rocky asteroid. It was given the code-name 1991 VG. More recent observations from Chile have indicated that this body, which raised a flurry in the world's media when it flew close (on an astronomical scale) by the Earth on December 5th, may in fact be an old rocket body returning to our planet's vicinity.

Spacewatch, operated by Tom Gehrels, Jim Scotti and David Rabinowitz (University of Arizona) is a relatively small (91 cm aperture) telescope which has been fitted with a large CCD array and programmed to search for objects such as asteroids and comets which approach the Earth. They do this by letting the sidereal rotation of the Earth cause the instrument to scan across the sky, with the same area being returned to later, and again once more as a check. Any objects which have moved between scans are picked up by the software, and the operator may then make a visual inspection of the data and calculate a preliminary orbit for the new-found object. Especially for the fainter detections many of the orbits turn out to be geocentric, a piece of man-made debris being indicated. However some very small asteroids have been discovered in this way: 1991 BA last January (the closest-ever observed miss of our planet, at 170,000 km) and 1991 TU in October (at 750,000 km). 1991 VG is the second-closest observed fly-by, at 450,000 km, or just further away than the Moon. All three of these objects were estimated to be about 5–10 meters in size, and are therefore the smallest and intrinsically-faintest items ever observed telescopically above the atmosphere.

However, 1991 VG was soon realized to be in an unusual orbit for an asteroid: its path is very similar to that of the Earth, being almost circular (eccentricity 0.08), the size of its orbit just 5% larger than that of the Earth (so that it takes just a few weeks longer than a year to circuit the Sun), and, critically, an extremely small inclination to the ecliptic, the plane of the Earth's orbit. The latter parameter has a value (about a quarter of a degree only) which is consistent with a man-made spacecraft. Initial computations by Brian Marsden (Harvard-Smithsonian Center for Astrophysics) indicated that it might be an upper stage from the U.S. Centaur rocket which put the German Helios 1 satellite into a heliocentric orbit in December 1974, since tracing the orbit of 1991 VG back in time showed a close approach about then. A Soviet craft was also a possibility. However, as better astrometric data for 1991 VG came in it was possible for its orbit to be improved, and Marsden found that he could not identify a close approach to the Earth since the beginning of the space age, and so the 'rocket' option was discounted. Since there are about a billion asteroids of this size or larger believed to orbit in the inner solar system, the chances are that some of them will have orbits very similar to the Earth, and in fact these are much more likely to be detected by telescopes like Spacewatch. From the opposite point of view a calculation of the probability of a collision by such an object with our planet indicates that its lifetime against such an event is only about 250,000 years, which means that it must have arrived in its present orbit in the astronomically-recent past. Marsden suggested that it might be an object which had spent most of its life in a so-called 'Trojan' orbit, having exactly the same orbital period as the Earth but keeping 60 degrees ahead or behind of the planet at all times, until it recently slipped that mooring. Many Trojan asteroids are seen in association with Jupiter, and in 1990 a Mars Trojan was discovered.

However, close to the fly-by of 1991 VG Richard West (European Southern Observatory) collected time-resolved

Quick Calendar

SAC Meeting
7:30, Friday, February 14

Star Party
Buckeye Hills Recreation Area
Saturday, February 22

...if it is a rocket then how is it back to our vicinity now?

images of the object using the Danish 1.54 m telescope in Chile: the path taken at that time was over the South Pole and therefore out of the reach of most northern telescopes. He found that the brightness of 1991 VG varies rapidly and has a period of about 7–8 minutes, with several extremely bright flashes being detected. These are as expected for a rotating, shiny spacecraft which occasionally renders a specular reflection in the direction of the viewer. Such a short period also seems inconsistent with a natural rocky asteroid, since it is unlikely that such an object of 5–10 m diameter could have a spin period of less that one hour without flying apart: its cohesive strength would be too low. In addition the relative brightnesses in different regions of the visible spectrum were essentially solar, warranting for a colourless object rather than a reddish asteroidal reflection spectrum. West concludes that 1991 VG is most likely an artificial object rotating about more than one axis.

This being the case it opens up a problem for dynamicists: if 1991 VG is indeed the Centaur rocket body launched in 1974 then how has its orbit been perturbed so as to bring it back to our vicinity now? One possibility is that excess fuel has escaped and therefore had a rocket-effect without being ignited. It also seems inevitable that it will also soon be claimed as being an alien spacecraft left by extraterrestrial visitors, even though science will undoubtedly be able to provide a plausible solution. If it is a rocket then 1991 VG also provides an example of mankind's ability to pollute not only his own planet and immediate space environment, but interplanetary space as well: the prevention of such pollution was the subject of a resolution of the International Astronomical Union at its General Assembly in Buenos Aires last August.

So is 1991 VG a rock or a rocket? An answer to this may be gained when Steve Ostro (Jet Propulsion Laboratory) attempts to get radar echoes from it using the giant radar at Arecibo (Puerto Rico). An attempt from Goldstone (California) on December 12th was unsuccessful. The radio reflection properties of metal are very different to those of rock, so that a spacecraft would give a much stronger echo; its structure would also affect the returned polarization. Even then the answer may not be definitive since it is known that many asteroids, like meteorites, are made of nickel-iron.

Is it so unlikely that a spacecraft would come back to Earth? In fact, using the orbit of 1991 VG prior to the recent encounter (a = 1.05 AU, e = 0.075, i = 0.22 deg) the chance of this object hitting the Earth converts to a lifetime of only 250,000 years (other Earth-crossing asteroids have lifetimes more like 100 million years). Increasing the cross-section to that having a radius equal to the miss distance of 450,000 km implies that an object in such an orbit would fly-by the Earth by that distance or less once per 20 years or so: pretty frequent.
Dr. Duncan Steel, Anglo-Australian Observatory, Coonabarabran, NSW.

Directions to SAC Events

SAC General Meetings 7:30 PM at Grand Canyon University, Fleming Building, Room 105 — 1 mile west of Interstate 17 on Camelback Rd., north on 33rd Ave., second building on the right.

SAC Star Parties at Buckeye Hills Recreation Area — Interstate 10 west to Exit 112 (30 miles west of Interstate 17), then south for 10.5 miles, right at entrance to recreation area, one-half mile, on the right. No water and only pit toilets. Please arrive before sunset; allow one hour from central Phoenix.

Bits and Pieces

Coming Events

Several Public Star parties are being planned for the Spring. Reach 11 on April 11 and Thunderbird Park on may 9th.

Minutes of the January Meeting

President Paul Lind called the meeting to order at 7:35pm. Announcements were made about upcoming events. There are two public star parties planned one on April 11 at Reach 11 and another on May 9 at Thunderbird park. Gene Lucas announce that there were two supernovae announced by the AAVSO (NGC 4374 and NGC 1380). The beginnings of an All-Arizona star party is in the works at Sentinel with the date set for April 4. Paul Dickson made a motion, which passed, to have SAC's executive board to look into getting a Post Office Box for the club, giving SAC a permanent mailing address and to report back to the club at the February meeting. Harold Moorin then brought up the need for expanded notification of club activities, both to the general public and to High Schools.

Following the business part of the meeting, there were four short topics. Steve Coe led with a review of the Orion Sky Block 49mm filter. He showed several slides and received several suggestions for further testing. The next three subject were about the annular eclipse in Southern California. Rick Rotramel and Rich Walker showed slides while Pierre Schwaar show video tape.

The main speaker was Chris Schur who talked about his experiences with astrophotography while using autoguider from the Santa Barbara Instrument Group (SBIG).

Deep Sky Meeting

The next Deep Sky meeting will take place on Thursday, March 26 at 7:30pm.

March Newsletter Deadline

Be sure to mail items to be included in the newsletter by Feb 19. Items sent later will not be included, but will be included in the next newsletter.

1992 SAC Meetings	1992 SAC Star Parties
February 14	February 22
March 20	March 28
April 17	April 25
May 15	May 23
June 12	June 27
July 17	July 25
August 14	August 22
September 11	September 19
October 9	October 24
November 6	November 21
December 12 Party	December 19

SAC Officers

President	Paul Lind	863–3077
Vice President	Steve Coe	878–1873
Secretary	Susan Morse	
Treasurer	Bob Dahl	582–5526
Properties	Rich Walker	997–0711
SACNEWS Editor	Paul Dickson	841–7044

Comet Comments

by Don Machholz

Two new comets are now moving southward in our evening sky. Meanwhile, Comet Shoemaker-Levy (1991d) remains in our morning sky.

Comet	Shoemaker-Levy				(1991d)
Date	RA-2000-Dec		Elong	Sky	Mag
01–24	18h01.8m	+40°51'	69°	M	11.0
01–29	18h18.3m	+40°58'	68°	M	11.0
02–03	18h34.2m	+41°04'	67°	M	11.1
02–08	18h49.3m	+41°09'	67°	M	11.1
02–13	19h03.7m	+41°13'	66°	M	11.1
02–18	19h17.3m	+41°18'	66°	M	11.2
02–23	19h30.2m	+41°23'	65°	M	11.2
02–28	19h42.3m	+41°28'	65°	M	11.3
03–04	19h53.6m	+41°33'	64°	M	11.3
03–09	20h04.2m	+41°40'	64°	M	11.4

The year 1991 saw 34 designated comets.

- Three were finds of new comets by amateurs, one being a photographic discovery.
- Sixteen new comets were found by professionals. Usually these professional discoveries were part of two different sky surveys taking place in both hemispheres. The Shoemaker-Levy team found seven, McNaught found four.
- Fifteen comets were recovered — although four of them were at first thought to be discoveries — and three of these did not pick up the discoverers' names. Of the remaining recoveries, Seki of Japan recovered five, while Scotti of Kitt peak recovered four.
- Also occurring last year was an outburst of Halley's Comet and a splitting of the nucleus of Periodic Comet Chernykh.

Periodic Comet Tsuchinshan 2 (1991e$_1$): Jim Scotti and D. Rabinowitz recovered this comet on Dec 3 at magnitude 21. It will remain faint.

Periodic Comet Kowal 2 (1991f$_1$): M. Ishikawa of Japan photographically discovered this comet — it turns out that this is a returning comet, 54 days early. Then at 14 magnitude, it is slowly fading.

Periodic Comet Zanotta-Brewington (1991g$_1$): Mauro Zanotta of Italy discovered this comet on Dec 23, Howard Brewington of New Mexico picked it up nine hours later. Zanotta was using a homemade 6" reflector at 25x to find this. He had also independently found comets 1989a$_1$ and 1991i, but too late to receive credit. Howard Brewington used his 16" reflector at 55x to pick up the ninth magnitude object. He had searched for 228 hours since his previous find earlier in the year.

The comet was found in the western evening sky in the northern part of the constellation Delphinus. It is approaching perihelion on Jan 31 at 0.64 AU. It will be visible to Northern Hemisphere observers through early Feb. then the Southern Hemisphere will be able to view it as it fades over the next few months.

Comet	Zanotta-Brewington				(1991g$_1$)
Date	RA-2000-Dec		Elong	Sky	Mag
01–24	23h04.6m	−03°41'	43°	E	6.6
01–29	23h30.5m	−10°35'	41°	E	6.4
02–03	23h55.5m	−18°07'	41°	E	6.3
02–08	00h19.1m	−25°47'	42°	E	6.4
02–13	00h41.1m	−33°04'	45°	E	6.7

Comet Mueller (1991h$_1$): Jean Mueller discovered this comet on Dec 13 as part of the Palomar Sky Survey II. It was then magnitude 17 and in the morning sky.

The orbit will carry the comet to within 0.20 AU of the sun on March 21. Until then it will brighten in our evening sky. Observers are encouraged to observer it at every opportunity to determine if 1) it outbursts or increases in brightness rapidly as it approaches the sun, and 2) if it survives perihelion. It will be too close to the sun for easy observation through most of March, but if it survives it will appear in our April morning sky, moving rapidly northward.

Don Machholz (916) 346-8963

Comet	Mueller				(1991h$_1$)
Date	RA-2000-Dec		Elong	Sky	Mag
02–13	02h38.4m	+18°36'	79°	E	12.3
02–18	02h17.0m	+11°44'	67°	E	11.8
02–23	01h59.4m	+05°47'	56°	E	11.2
02–28	01h43.6m	+00°38'	46°	E	10.4
03–04	01h27.9m	−03°52'	37°	E	9.3
03–09	01h10.0m	−07°48'	28°	E	7.8