Star Dust

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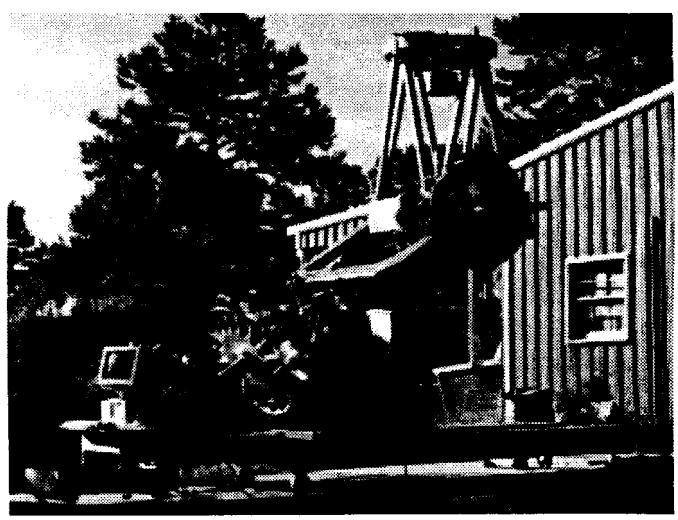
Small Automated Telescopes: An Assessment

by Andrew W. Seacord, II

The advent of the personal computer allowed Louis Boyd, an amateur astronomer who was also an electrical engineer, to construct the first small completely automated telescope. In the decade and a half since then, many astronomers have followed his lead in constructing several successful automated telescopes for photometry. The speaker, Saul Adelman, has obtained differential photometry mainly of magnetic chemically peculiar stars from the 30-inch Four College Automated Photoelectric Telescope (FCAPT) for over six years and has learned to deal with a quarter of the data, the equivalent of 35 to 40 nights/year. He has been involved in efforts to extend this technology to automated spectrophotometric and to 1-m automated imaging telescopes. He will assess what has been done, especially with the FCAPT, as well as indicate what can be done in the next few years.

Saul Adelman was born in Atlantic City and grew up in the Washington, DC area, being formerly associated with the NCA, of which his father Benjamin is still a member. Saul earned a B.S. in physics from the University of Maryland in College Park (1966) and a Ph.D. from the California Institute of Technology (CalTech) (1972). He was an NAS/NRC postdoc toral research associate at the NASA Goddard Space Flight Center (1972-74), assistant professor of astronomy at Boston University (1974-8), and is now an associate professor of physics at The Citadel, Charleston, SC, where he has been since 1978. He had been a guest observer at the Dominion Astrophysical Observatory and on the Hipparcos satellite. His major research interests involve high dispersion spectroscopy of B, A, and F type stars. He has coauthored a book "Bound for the Stars" with his father (1981) and published hundreds of scientific papers in professional journals, mostly in areas of stellar astrophysics (stellar spectra and abundance analyses). He has even collaborated with another NCA member (Wayne Warren) to produce computerized multiple tables for chemical elements commonly found in stellar atmospheres. Saul is a member of the International Astronomical Union, the American Astronomical Society, the Royal Astronomical Society, the British Interplanetary Society, the Astronomical Society of the Pacific, and the Optical Society of America. Significantly, he is also a member of Phi Beta Kappa.



The Puckett Observatory, Mountaintown, GA — Image of the 24" Ritchey-Chretien F/8 reflecting telescope and its drive system. With a focal length of 194", the telescope features 16" worm gears with oversized worms as speed reducers, and 36.5" friction drives on both the right ascension and declination axes. It has a fully computerised drive system consisting of micro steppers, drivers, and other electronics contained within a personal computer. The drive has a resolution of 20.83 microsteps per arc second of the sky. Fully automated observing runs will be possible with the 24" telescope, allowing remote operation from any site with access to a modem. The scope will soon be available via the internet with a TCP/IP interface. Software to run the telescope is called PC-TCS® *by Comsoft, Inc. TCS interfaces with* The Sky® *from Software Bisque.*

Calendar of Monthly Events

The Public is Welcome!

NCA Home Page: http://myhouse.com/NCA/home.htm

Fridays, January 3, 10, 17, 24, and 31, 7:30 PM-Telescope making classes at American University, McKinley Hall Basement. Information: Jerry Schnall, 202/362-8872.

Fridays, January 3, 10, 17 and 31, 8:30 PM-Open nights with NCA's Celestron–14 telescope at Ridgeview Observatory; near Alexandria, Virginia; 6007 Ridgeview Drive (off Franconia Road between Telegraph Road and Rose Hill Drive). Information: Bob Bolster, 703/960-9126.

Saturday, January 4, 5:30 PM-Dinner with the speaker and other NCA members at O'Donnel's Seafood Restaurant as 8301 Wisconsin Ave., Bethesda, MD. *See* map and description on back page.

Saturday, January 4, 7:30 PM-NCA meeting, will feature Saul Adelman (The Citadel). His talk will be "Small Automated Telescopes: An Assessment." More information on Comet Hale-Bopp will also be provided. For directions, *see* map and description on back page.

Mondays, January, 6, 13, 20, and 27, 7:30 PM-Public nights at U.S. Naval Observatory (USNO), in Northwest Washington, D.C. (off Massachusetts Avenue). Includes orientation on USNO's mission, viewing of operating atomic clocks, and glimpses through the finest optical telescopes in the Washington-Baltimore region. Held regardless of cloud cover. Information: USNO Public Affairs Office, 202/762-1438. Home page: http://www.usno.navy.mil.

Tuesdays, January 7, 14, 21, and 28, 7:30 PM-Telescope making classes at Chevy Chase Community Center, Connecticut Avenue and McKinley Street, NW. Information: Jerry Schnall, 202/362-8872.

Friday, January 10, 6:30 — 8:00 PM-"Winter Stars," Historic Bladensburg Waterfront Visitor Center, 4601 Annapolis Rd., Bladensburg, MD. Details & Directions: Geoffery C. Lane (NCA), 301/927-2163, or 301/927-8166 (fax). Weather Permitting.

Saturday, January 18, 7:00 PM-"Astrolights." Montgomery College's Planetarium, Takoma Park, MD. Information: 301/650-1463.

See page 8 for more Washington area astronomical events. Other events too numerous to list in *Star Dust* are listed in the publications *Sky & Telescope*, the *Astronomical Calendar 1996*, the *Observer's Handbook 1996*, in numerous software packages, and other links available on the NCA Home Page (*see* above for address). NCA members can purchase all these (and much more) at a discount. To join NCA, use membership application on page 9.

During questionable weather, call the IOTA Hotline (Phone: 301/474-4945) for NCA meeting status. The absence of a cancellation notice on the Hotline means the meeting will take place.

Bob Ryan's 1997 Almanac

If you have not picked up your copy of this yearly almanac, you may be missing a great quick resource for astronomical information. This year you can find a quick reference to annual meter showers, the night sky for 1997, unusual full Moon facts, and even an article about shadowgraphs written by Leith Holloway. You can pick up your copy at any Giant.

Web Watch

If you would like to observe the sky from a remote site without leaving your home, log on to these web sites. Remote access to observatories are increasing. Be warned, however, getting on may take time and some site addresses do charge. Here is one site with several listings:

www.eia.brad.ac.uk/rti/automated.html. Enjoy.

A Great Loss To All

Carl Sagan died on December 22, 1996 of pneumonia while he was being treated for bone marrow cancer. He was the David Duncan Professor of Astronomy and Space Sciences and Director of the Laboratory for Planetary Studies at Cornell University. He will be remembered for his skill at communicating the excitement of science to general audiences. His death represents not only a loss for astronomy but for the entire world.

Cosmic Rays and Supernova Remnants

by Gary L. Joaquin

At our December meeting Robert Petre of the Goddard Space Flight Center Laboratory for High Energy Astrophysics presented a lecture on cosmic rays and supernova remnants. This review, like last month's review of John Graham's presentation, is written with assistance from a copy of the lecture notes generously provided by the speaker. In order to fully appreciate the latest results of Dr. Petre's research he began with an overview of cosmic rays, x-rays, and stellar evolution.

Cosmic rays were first discovered in 1912 by Victor Hess of Austria. His research with high altitude balloons revealed that radiation of extraterrestrial origin was striking the Earth's upper atmosphere. The term "cosmic ray" is actually a misnomer. Cosmic "rays" are not photons of light, but energized particles, composed primarily of nucleons, which are protons and neutrons, the the components of atomic nuclei. This discovery marked the beginning of high energy particle physics. Nonetheless, the term cosmic "ray" has remained a part of this specialty's vocabulary.

To measure the energy found in a cosmic ray the standard measure of energy, the joule, the potential energy of a one kilogram mass (2.2 pounds) lifted to a height of one meter (39.37 inches) is often inappropriate; it's just too large to be meaningful at the subatomic scale. The more commonly used measuring stick for cosmic rays is the electron volt, the amount of energy absorbed by an electron when it is subjected to an electric potential of one volt. There are 6 x 10^{18} electron volts in one joule. Electron volts are often referenced as shown in figure 1.

Electron Volt Notation

1,000 eV = 1 keV (thousand, 10^3 eV)
1,000 keV = 1 MeV (million, 10^6 eV)
1,000 MeV = 1 GeV (billion, 10^9 eV)
1,000 GeV = 1 TeV (trillion, 10^{12} eV)

Mass of Particles in eV

Electron m_e = 0.5110041 ± 0.0000008 MeV

Neutron m_n = 939.5731 ± 0.0027 MeV

Proton m_p = 938.2592 ± 0.0052 MeV

Figure 1

With this knowledge we can begin to understand figure 2. This plot describes the intensity with which cosmic rays or particles strike a detection device in direct relationship to their energy level. Kinetic energy is defined in eV/ nucleon along the X axis while the intensity defined in particles per square meter per second per steradian of sky is defined along the Y axis. The first conclusion that can be drawn is that the highest energy cosmic particles are the least frequently observed. Particles with 10^{12} eV are relatively common, averaging about 1 particle/m ^{2}/sec. Particles with 10^{16} eV are detected at a rate of 1 particle/m ^{2}/year. The highest observed energy particles in excess of 10^{20} eV are detected on an average of 1 particle/km ^{2}/century.

This energy spectrum is quite smooth except for a couple of features. The first is a slight curvature located at 10^{15} eV that is commonly called the "knee". There is a second kink in the spectrum at about 10^{19} eV is called the "ankle". It is generally thought that cosmic rays with energy levels less than 10^{15} are produced by sources within our own galaxy, the product of ordinary matter subjected to rapid and strong accelerating forces like those found in solar flares, supernovae, supernova remnants, and stellar jets. Cosmic rays with higher energy levels are believed to be produced by extragalactic sources, like the powerful jets associated with quasars.

One of the fundamental problems in high energy physics is that you cannot look up into the sky and see cosmic rays; they are invisible to the human eye. Most cosmic rays (fortunately) are absorbed in the upper atmosphere so they require detection devices to be launched into orbit above the shielding effects of Earth atmosphere. Since cosmic rays are not photons of light, ordinary photographic techniques are useless; special particle detection devices are required. There are other problems as well. Since cosmic rays are charged particles, their trajectories through space are curved by

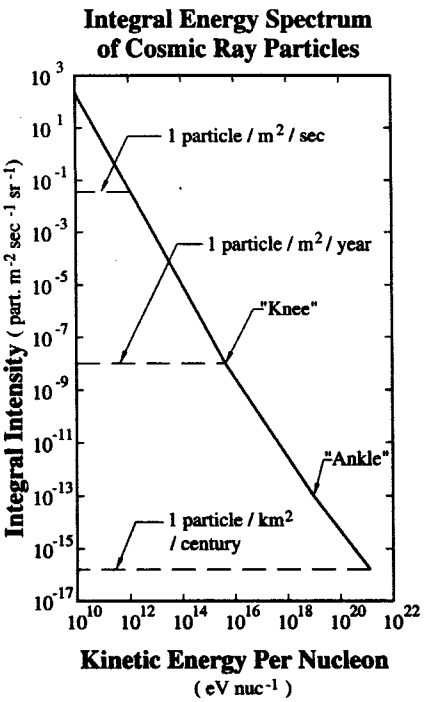


Figure 2

all of the magnetic fields that they encounter. Thus by the time these particles arrive on Earth they have lost all information pertaining to their point of origin. To determine their origin we must observe the consequences of their production, a topic to which we'll return shortly. Let's first take a few moments to review x-rays.

X-rays are a little bit more familiar; they are just another form of light, although still invisible to the human eye. If you light a match you see the light of a flame that is a few thousand degrees. If you heat up something like the gas in a star's corona to a few millions of degrees, the gas will emit x-rays. In visual astronomy we are working with wavelengths of a few thousand angstroms (1 angstrom = 10^{-8} cm where 1 inch = 2.54 cm). In x-ray astronomy the wavelengths being studied are only between 1/10 to 100 angstroms, wavelengths that are well shielded by the Earth's atmosphere. When we look to sources of x-rays beyond the Sun the flux from x-ray sources is so low that once again photographic techniques are rendered useless. We end up using detection devices requiring exposure times on the

order of 30,000 seconds or more to count the number of x-ray events, i.e. the number of x-ray photons that strike the detector. X-ray sources have been detected emitting energy levels between 100 and 100,000 eV, very energetic radiation although several orders of magnitude less than cosmic rays.

The first x-rays observations above Earth's atmosphere were made in the 1940s while observing the sun. The first extrasolar x-ray source was only discovered in 1962. Since that time there have been an enormous array of x-ray satellites launched into orbit. The Rontgen Satellite (ROSAT), a joint German–U.S. venture is the highest resolution x-ray telescope that has been launched into orbit. It has been taking wonderful pictures since 1990. Images from satellites like ROSAT and other sources have enabled astronomers to discover x-rays emanating from the Sun, from Jupiter in the wake of the collisions of the comet Shoemaker-Levy 9, and most recently from the comet Hale Bopp (of which Dr. Petre was a member of the discovery team). X-rays have also been detected in the hot gasses in the coronas of other stars, in matter accelerated in the intense gravitational fields of neutron stars and black hole, emanating from relativistic particles trapped in the intense magnetic field around pulsars, and in the diffuse gas confined in the huge gravitational field of galaxy clusters. The entire sky even glows in x-rays, although not as brightly as the cosmic microwave background. Lastly, x-rays can be detected in the gas heated and ionized by supernova remnant blast waves. This last source is at the heart of our story. To more fully understand the results of Dr. Petre's discovery it is important to review some of the basics of stellar evolution and how supernovae are formed.

A star can end its life in a variety of ways, depending mainly upon its mass. Stars with masses up to about 9 times that of the Sun will expel their outer layers when they have exhausted their nuclear fuel and collapse into a white dwarf; the remaining gaseous shell takes on the form of a planetary nebula. When stars more massive than about 9 solar masses expend their nuclear fuel, they collapse rapidly resulting in a supernova explosion sometimes leaving behind a stellar remnant, either a more densely packed rapidly spinning neutron star or black hole. Also, a white dwarf that grows in mass via the accretion of surrounding matter can explode into a type Ia supernova when its mass exceeds 1.4 solar masses.

Supernovae are some of the most energetic and catastrophic events known; their total kinetic energy release is approximately 10^{51} ergs. The explosion sends a supersonic blast wave, with initial velocities in excess of 1000 km/sec (625 miles/sec), propagating into interstellar space. This blast wave sweeps up ambient material and heats it up to temperatures in excess of 30 million degrees. X-rays are produced as stellar debris and interstellar material are heated by the shock front. Most supernova remnants (SNR) produce x-rays in this manner, as thermal emissions, without being fueled by a rapidly spinning pulsar. When you examine the spectrums of SNRs, you can identify dominant lines from highly ionized nucleosynthesis products; the SNR Cassiopeia A (Cas A, see figure 3) is a good example of a thermal remnant.

In this hot gaseous environment electrons are flying around and colliding with other atoms knocking loose their electrons, producing more ions (atoms with electron deficiencies). Most of the atoms that we see in remnants at these temperatures are elements typical of the debris produced by the process of nucleosynthesis within a star. Atoms are stripped down typically to two electrons, a condition common to helium atoms, creating what is called a helium like state. The outer electrons are easier to knock off than the remaining inner two electrons which are very tightly bound to the nucleus for a variety of quantum mechanical reasons. During these collisions energy is released as x-rays.

Contrastingly, X-ray emissions from other less common supernova remnants are characterized by synchrotron emissions from electrons trapped in the magnetic fields generated by rapidly spinning pulsars. Synchrotron radiation was first observed in particle accelerators used in the 1940s and 1950s. Synchrotron radiation spectrums are smooth and undifferentiated; no spectral lines can be observed. Also, unlike thermal emission supernova remnants like Cas A which tend to be diffuse, remnants dominated by pulsars like the crab nebula (figure 4) tend to be highly concentrated.

SNRs have long been suspected as being sources of cosmic rays. Two Russian scientists, Shklovskii and Ginzburg, independently in 1953, hypothesized that expanding shock fronts in SNRs are likely sources of high energy cosmic ray acceleration. They based their observations on Enrico Fermi's mechanism developed in 1949 (See figure 5). Fermi's mechanism describes what happens when particles

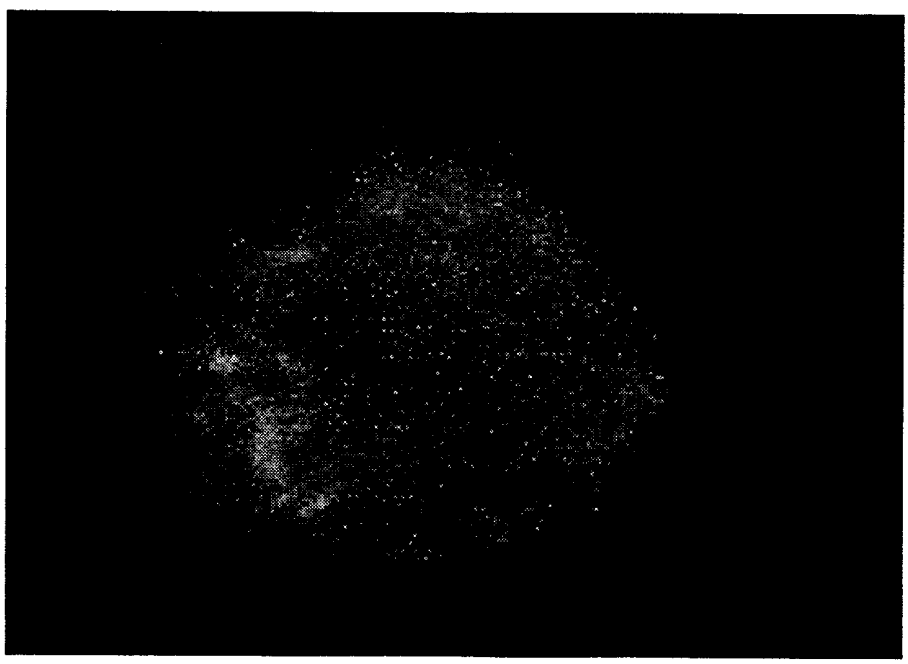


Figure 3, SNR Casseopiea A, from The Universe, *by William J. Kaufmann*

encounter turbulence in a magnetic field; they bounce, change direction, and increase in velocity. As more kinks in the magnetic field are encountered the velocities and overall energy levels continue to increase. Over time a statistically significant increase in the number of high energy comic ray particles results. This theory has not been without opposition: competing theories have cast doubt as to whether it is possible to accelerate enough particles to such velocities. Also, up until recently there has been no observational evidence to support this theory.

Observations of SN1006 may have changed all of this. SN1006 is the brightest supernova ever observed from Earth, first observed by Chinese astronomers in the year 1006. Early observations in the x-ray and radio bands have revealed a bright shell with no evidence of a pulsar. The x-ray spectrum of the entire remnant is featureless looking very much like synchrotron emission. Scientific debate has raged for years trying to explain this featureless spectrum in the absence of a pulsar; the best explanations providing unsatisfying contrived models.

Recent images from the Advanced Satellite of Cosmology and Astrophysics (ASCA), a joint U.S.–Japan project, have shed new light on SN1006. Launched in 1992, ASCA is the first orbiting x-ray observatory with the ability to perform spatially resolved spectroscopy. New images of SN1006 have revealed the expected featureless spectrum, but only in two discrete areas along the limb or edge of the remnant. The remainder of the limb and the entire interior of the remnant reveal a standard, line rich, spectrum. The nonthermal spectrums along the limbs of the remnant are of particular interest. We see evidence of synchrotron emissions at both of these locations. This suggests that high energy cosmic radiation are being generated in these regions in accord with the Fermi mechanism. Even if there was a pulsar in the center of this SNR, the energized particles would have dissipated their energy long before they had traversed the distance from the center of the remnant to the outer limb. Calculations of the energies of these electrons are on the order of 200 TeV, approaching the knee of the cosmic-ray electron spectrum at 1000 TeV. Since there is already much theoretical work to support the presence of other nucleons at similar energy levels, this is the first direct observational evidence that cosmic rays can be generated by super nova remnant shock waves.

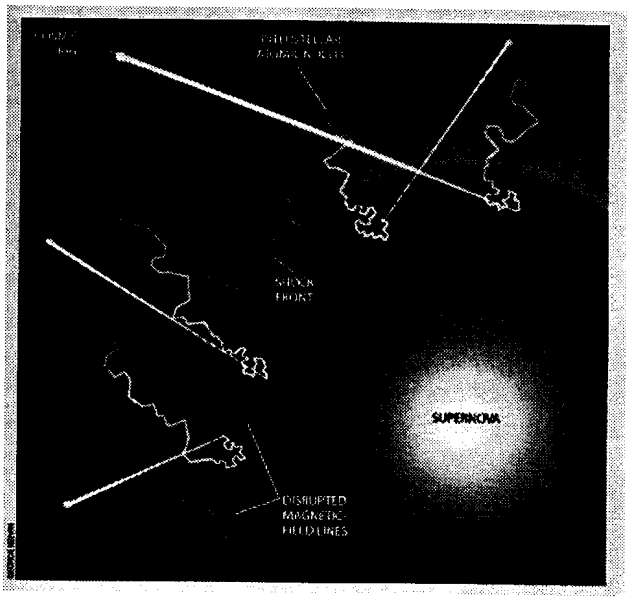


Figure 5, from Scientific American, *"Cosmic Rays at the Energy Frontier,' January, 1997.*

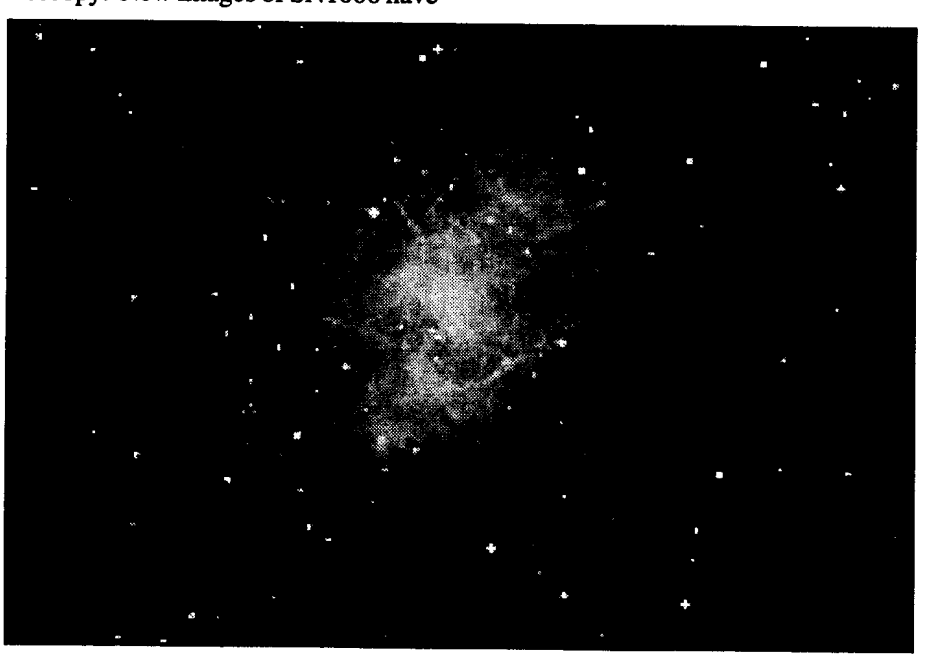


Figure 4, Crab Nebula, from The Universe, *by William J. Kaufmann*

There was much concern that this discovery was an isolated result obtained from a very anomalous SNR. When Dr. Petre's research team began to look for other examples of cosmic ray acceleration in SNRs, supporting evidence has been forthcoming in observations made of Cas A and the SNR IC443. The spectra from these remnants suggest the presence of a nonthermal spectral component, but not as prominent or definitive as in SN1006. Careful observation and analysis is required of other spatially resolved SNRs before any more definitive conclusions can be made about SNR cosmic ray acceleration being a commonplace event.

If any of you are interested in learning more about this subject, a timely article was published in *Scientific American*'s January, 1997 issue. You may also read the results of Dr. Petre's article published in *Nature*, November 16, 1995. For excellent coverage of high energy physics in general, you may also visit the High Energy Astrophysics Science Archive Research Center sponsored by the NASA's Goddard Space Flight Research Center, at http://heasarc.gsfc.nasa.gov. The resources at this site are utterly spectacular, appealing to the total spectrum from the beginner through to the advanced expert, a highly recommended site. ○

Comet Hale-Bopp Countdown

By Daniel Costanzo

Now things are cooking, both figuratively and literally, with the Solar System's friendly incoming "super comet," the ever brightening Comet Hale-Bopp (officially designated C/ 1995 O1). Below are details and predictions up through January's end. Following astronomical custom, most distances are given in astronomical units (AU), the standard Solar System measuring stick, where 1 AU is Earth's mean orbital distance from the Sun, or 149,597,870 kilometers. For example, 2.1 AU means 2.1 times Earth's distance from the Sun. Also, all dates are Universal Time dates. Although the viewing information is customized for the National Capital region, it applies to any place at Northern Hemisphere mid-latitudes around North 40 degrees, e.g., the Lower 48 States. Information and data for this article was obtained from Bob Bolster (NCA), and from *Sky & Telescope* (*S&T*) "Skyline" for 1996 November 29, December 6 and 13, plus *S&T*, 1996 September, pp. 72-73.

December Observations

As of December 15, Hale-Bopp continued holding its own, slowly "cooking" under increasing warmth from the Sun's fusion fire, and giving nothing but good omens for a bright spectacle beginning in January to place it within easy reach of unaided eyes for the first time. By mid-December, the comet had brightened to around forth magnitude before being swallowed up in evening twilight's glow. The comet was easily visible in 8x56 binoculars from NCA's Elkwood, VA Field Station.

Although the comet hadn't brightened as much as expected this past Autumn, mid-November radio telescope observations showed its nucleus pumping prodigious amounts of material out into space: some thirty tons of water every second, and another six of carbon monoxide. In terms of visual spectacle, this output all contributes to the comet producing a bright coma and tail. Anyone questioning the vitality of Comet Hale-Bopp, should take note that this is very good news.

January Predictions

This January, almost a full one-and-a-half years after its auspicious discovery at the extraordinary distance from the Sun of 7.2 AU (i.e., in the Outer Solar System between the orbits of Jupiter and Saturn), Hale-Bopp will have crept out from behind the Sun's glare, and entered the morning sky to begin becoming a relatively bright comet. For many, "H-B" is hopefully about to change from merely "Comet Hale-Bopp" to being a bright visual spectacle.

Come January's beginning, H-B will be found at 1.75 AU from the Sun and steadily chugging Sunward. On January 8, it will have finally entered what is called the Inner Solar System, as defined by an imaginary sphere centered on the Sun and extending to the planet Mars' "aphelion" distance (farthest distance from the Sun) of 1.66 AU. By mid-month, H-B will be eating up almost two million kilometers per day (22 kilometers per second) of its comet-to-Sun distance. By month's end, that distance will decrease to about 1.38 AU, which coincidentally corresponds to Mars' "perihelion" distance (closest approach to the Sun). So come the beginning of February, H-B will have swept closer to the Sun than Mars ever gets. However, H-B still has quite a ways yet to go before reaching its own perihelion distance of 0.9 AU during prime unaided eye viewing time in early April. (At 135 million kilometers from the Sun, 0.9 AU is just inside Earth's orbit, and thus between the orbits of Earth and Venus.)

Keep in mind, however, that we view comets from a moving observing platform: Planet Earth, annually traveling around the Sun at an orbital speed of 30 kilometers per second. The way both Earth and comet perform their interplanetary ballet profoundly affects the particular "viewing geometry" we Earthfolk have to deal with in trying to watch a comet. This month, it means that besides the shrinking comet-to-Sun distance noted above, the equally important comet-to-Earth distance is also closing by – at mid-month – almost three million kilometers per day (31 kilometers per second). During January, that distance shrinks from 2.5 to 2.0 AU on a long slide towards closest approach to Earth in late March of 1.3 AU. (CORRECTION: Up until now in *Star Dust*, I have been incorrectly using the term "perigee" to describe comets' closest approaches to Earth. "Closest approach to Earth" is the more appropriate term, as "perigee" is reserved only for objects in Earth orbit, which Hale-Bopp is definitely not in.)

January will be the first month to start seeing H-B as a relatively bright comet for binoculars and unaided eyes. For during that month, the comet is expected to brighten from the quite significant magnitudes of +2.9 to +1.3. Although comet brightness predictions are not hard numbers, these are very nice magnitudes indeed. Throughout January, H-B will be a predawn object only. It will take until mid-January before the comet can be adequately seen above the horizon before twilight begins. From then on, each successive January morning before dawn, the comet will be placed higher and higher above the eastern morning sky. Best predawn viewing prospects in Moon-free skies occur around the middle of the month. During this period, just before dawn, the comet can be found only around ten degrees altitude above the eastern horizon. So having an eastern horizon free from local obstructions and artificial light is critical. (Using a simple compass helps here.) Towards January's end, H-B will be slowly, but increasingly better placed each morning just before twilight starts.

None of these facts, however, obviates your going outside and observing this visitor from afar. That is the important thing. For best viewing, go out around mid to late January to a dark-sky site, with a clear eastern horizon and no Moon in the sky, and look just before dawn. Don't hesitate to try and attempt viewing it from light polluted sites, even in Moonlight. By January's end, something could be visible, at least in binoculars, from all but the most light polluted areas, but the best views are in clear skies, far from light pollution, Moonlight, and twilight. Either way, try for

the clearest of mornings. Unfortunately, those also tend to be the coldest of mornings, but if you follow directions from the resources NCA provides, and bundle up well, taking a crack at the comet should be worth it!

NCA Resources

Thanks to NCA, there's no reason why you should be kept in the dark about this promising comet. Instead, we can put you in the dark watching it. If you want to watch it with others – always a good idea – NCA can accommodate that, too. But while this "Countdown" is not a comet viewing primer, taking advantage of the NCA resources below is your best bet for viewing the comet.

For information via a printed periodical, consult *S&T* magazine, especially its high quality finder charts. (*S&T* is available to NCA members at a discount.) For information via telephone recordings, call *S&T*'s "Skyline" (617/497-4168). For information, via the World Wide Web, go to NCA's Home Page (http://myhouse.com/NCA/home.htm). For acquiring copies of these "Countdowns" in "softcopy" form, NCA's Harold Williams is posting all of them on the NCA Home Page, including this one. Feel free to download and distribute them.

NCA's Bob Bolster can give expert, practical advice on basic viewing, detailed observation, photography, and electronic imaging. Bob can also provide customized listings and charts of comet positions, best viewing times, etc. (Phone: 703/960-9126, E-Mail: 73257.507@compuserve.com).

Even if you don't know about comets and observing comets, then please don't fret. NCA members are ready, willing, and able to help you. We also know of several relatively dark sky sites in Virginia, Maryland, and West Virginia suitable for comet viewing. Call NCA's General Number at 301/320-3621 to find out who to contact for advice, assistance, and encouragement. That's what we're here for.

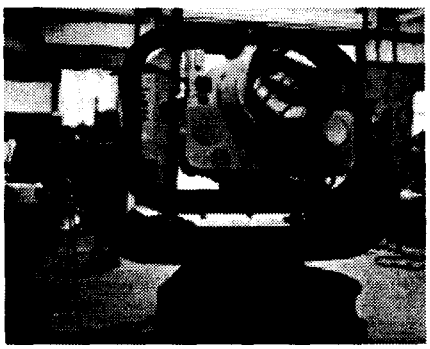
Comet Cruises

Last fall, when *S & T* magazine was proudly advertising its new publication *SkyWatch '97*, as a lure to purchase it, they offered a chance to win a free cruise "to see Comet Hale-Bopp from the dark skies of the Caribbean Sea" in 1997 April. A word of warning to those considering going on such a comet cruise. First of all, unlike Comet Halley in 1985-1986, when at its best, Comet Hale-Bopp is going to be easily seen from high latitudes. Hence, you're better off staying in the Lower 48. Second, why pay for lugging your hotel room around under your feet, when you can observe the same thing far more cheaply from land? And third, due to international law, no matter how dark the ocean vista, ships cannot just blackout all their lights without becoming a hazard to navigation. This is peacetime, you know.

My grandfather, Crescenzo Ernesto Costanzo, participated in the first "comet cruise" when, as a boy, he and his mother went to Naples, Italy in 1910 and boarded the good ship *Madonna* with a one way ticket to a golden land with the fine Italian name of "A-m-e-r-i-c-a." Recounting the voyage to his grandchildren right up through the ripe old age of ninety, memory and time caused him to give two versions of what happened. In the first, the ships' passengers and crew viewed the stunning spectacle of a very bright Comet Halley while out in the middle of the Atlantic. Unfortunately, their reaction was one of confusion and fear, not excitement and wonder. In the other, his family was quite fearful about embarking on the voyage because they were warned by those staying behind that the mighty comet was going to come down, swoosh up the ocean with its tail, and create a watery vortex so powerful that it would suck down all ships upon the seas. Either version is great. Most likely, both happened. Either way, as the *Madonna*'s voyage is recorded, it occurred during prime viewing time for Comet Halley. Unfortunately, people actually died during the trip, due to a combination of conditions aboard being so bad, and passengers' health being so poor. By journey's end, when he first saw Lady Liberty looming out of New York Harbor, Grandpa Costanzo felt this sight, not the Comet, was among the most beautiful he had ever seen before or since. So if you do take a comet cruise, let's hope your voyage is much more hospitable. ○

Comet Watch Programs From Around The World

The Puckett Observatory, Mountaintown, GA — One of the four Baker-Nunn 20" F/1 Schmidt cameras that will be used for the Comet Watch photographic discovery program. The camera features a 5x30 degree field of view and uses 2.25 inch roll film. The cameras have large film magazines for film advance and take up. The Baker-Nunn camera is capable of photographing 150 square degrees of the sky at 408 arc seconds per millimeter. The photographic magnitude obtained in four minutes on hyped film is 18.5 magnitude. The



Baker-Nunn camera features 31" primaries and three element apochromatic coated correctors. The mounts, manufactured by Boller & Chivens for the Air Force, have 34" bronze worm gears and the forks span nine feet. The cameras also have equatorial mounts for precise polar alignment, unlike the cameras used by the Smithsonian and other institutions. The mounts have been fully computerised and use micro steppers for precise pointing, tracking, and slewing. Automated script commands allow the Schmidts to run through the night's object list without ever touching the telescope. Each of the Schmidt cameras weighs 5 tons! (See Sky &Telescope, *December 1996.)*

National Capital Area Astronomical Events

Free Lectures at the Einstein Planetarium and Other Daily Events
National Air & Space Museum

202/357-1550, 202/357-1686, or 202/357-1505 (TTY)
Home page: http://www.nasm.edu

Daily, 10:10 AM to 5:45 PM-"Langley Theater continuing movies, "To Fly," four shows starting at 10:10 AM; "Cosmic Voyage," four shows, starting 10:45 AM; "Destiny In Space," two shows, starting 11:30 AM; "Living Planet," one show at 3:50 PM; "Mystery of The Maya," one show at 5:45 PM. Details & Cost: *See* above numbers.

Daily, 11:00 AM-"SkyQest", Details & Cost: *See* above numbers.

Daily, 11:40 AM to 5:00 PM-"The New Solar System", Details & Cost: *See* above numbers.

Daily, 3:00 PM-"The Stars Tonight", *Free daily planetarium lecture/show.*

Special Note: The Einstein Planetarium will be closed for renovation from January 22 through April 4.

Other Area Astronomical Events

January 6, 7:00 PM-Arlington Planetarium (Arlington, VA) lecture, "The Stars Tonight For January." Details & Cost:703/358-6070 or 6019.

January 24, 3:00 PM-"First Results from SOHO" by Arthur I. Poland, at Goddard Space Flight Center (GSFC—Greenbelt, MD), Building 3 auditorium. Contact Carol Krueger 301/286-6878 (at least 24 hours in advance). Home page: http://www.pao.-gsfc.nasa.gov.

January 30, 6:30 PM-"Peering at the Universe Through Gravitational Lenses" by Irwin Shapiro, at Carnegie Institute, 1530 P Street, NW, Washington, DC. Details: 202/328-6988

January 31, 3:00 PM-"Search for Past Life on Mars" by David McKay, at Goddard Space Flight Center (GSFC—Greenbelt, MD), (*See* above, Jan. 24)

Mondays Through Saturdays, 11:30 AM & 2:30 PM; 1st & 3rd Sundays of Month, 11:00 AM-GSFC (Greenbelt. MD) guided walking tours of Hubble Space Telescope Control Center and NASA Communications Center. Start at Visitors Center.

Mondays Through Fridays, 10:00 Saturdays and Sundays, 10:00 AM and 1:00 PM-Paul E. Garber Preservation, Restoration, and Storage Facility, NASM. Take a tour of this facility where they preserve and restore aircraft as well as spacecraft, engines, propellers, models, and other flight-related objects. Guide conducted tours including the workshops. Individuals and groups are welcome. Reservations must be made two weeks in advance. No heating or air conditioning so dress accordingly. Details: 202/357-1400, or write to ATTN: Reservation Office, Education Services Division, MRC-305, NASM, Washington, DC 20560.

VOLUNTEER WANTED

Calendar Coordinator: Must be willing to go out on a limb and get as much information as possible on astronomical events in the DC area. No experience necessary. Must Meet Deadlines!! Call Alisa & Gary Joaquin at 703/750-1636.

NCA Welcomes These New Members

Pauk S. Algire
13405 Kiama Court
Laurel, MD 20708

Raymond M. & Marta Glass
14405 Pecan Drive
Rockville, MD 20853

Richard W. Wallace
30 Norwood Road
Silver Spring, MD 20905-3874

John Z. Wetmore
5305 Bradley Blvd.
Bethesda. MD 20814-1211

Charles C. Yoder
1503 Crest Road
Silber Spring, MD 20902-3721

"Observer's Handbooks"

Copies of the "Observer's Handbook" for 1997, published by the Royal Astonomical Society of Canada, will be on sale for $12 apiece at the January 4 NCA monthly meeting and at all subsequent meetings until they are sold out. Please bring a check made out to "National Capital Astronomers" rather than cash. If you wish to buy a copy but cannot attend the meeting, call Jeff Norman at 202/966-0739 to make arrangements for pickup. Thanks.

Newsletter Deadline for February *Star Dust* January 15, 1996

DO NOT BE LATE!!!

Send Submissions to Alisa & Gary Joaquin, at 7821 Winona Ct., Annandale, VA, 22003, Leave a message on voice mail 703/750-1636. Text files or graphic files in .GIF or .TIFF may be sent via E-Mail to ajglj@erols.com or fax submissions to 703/658-2233. **No submissions will be accepted after the 20th.** There will be no exceptions. We need a reasonable amount of time to design, edit, and review this newsletter. We would appreciate everyone's help in this matter. Thank you.

National Capital Astronomers, Inc.

SERVING SCIENCE & SOCIETY SINCE 1937

NCA is a non-profit, membership supported, volunteer run, public-service corporation dedicated to advancing space technology, astronomy, and related sciences through information, participation, and inspiration, via research, lectures, presentations, publications, expeditions, tours, public interpretation, and education. NCA is the astronomy affiliate of the Washington Academy of Sciences. All are welcome to join NCA. For information: 301/320-3621 or 703/841-4765.

SERVICES & ACTIVITIES:

Monthly Meetings feature presentations of current work by researchers at the horizons of their fields. All are welcome; there is no charge. *See* monthly *Star Dust* for time and location.

NCA Volunteers serve as skilled observers frequently deploying to many parts of the National Capital region, and beyond, on campaigns and expeditions collecting vital scientific data for astronomy and related sciences. They also serve locally by assisting with scientific conferences, judging science fairs, and interpreting astronomy and related subjects during public programs.

Discussion Groups exchange information, ideas, and questions on preselected topics, moderated by an NCA member or guest expert.

Publications received by members include the monthly newsletter of NCA, *Star Dust*, and an optional discount subscription to *Sky & Telescope* magazine.

NCA Information Service answers a wide variety of inquiries about space technology, astronomy, and related subjects from the public, the media, and other organizations.

Consumer Clinics on selection, use, and care of binoculars and telescopes, provide myth-breaking information, guidance, and demonstrations for those contemplating acquiring their first astronomical instrument.

Dark-Sky Protection Efforts educate society at large about the serious environmental threat of light pollution, plus seek ways and means of light pollution avoidance and abatement. NCA is an organizational member of the International Dark-Sky Association (IDA), and the National Capital region's IDA representative.

Classes teach about subjects ranging from basic astronomy to hand-making a fine astronomical telescope. NCA's instructors also train educators in how to better teach astronomy and related subjects.

Tours travel to dark-sky sites, observatories, laboratories, museums, and other points of interest around the National Capital region, the Nation, and the World.

Discounts are available to members on many publications, products, and services, including *Sky & Telescope* magazine.

Public Sky Viewing Programs are offered jointly with the National Park Service, the Smithsonian Institution, the U.S. Naval Observatory, and others.

NCA Juniors Program fosters children's and young adults' interest in space technology, astronomy, and related sciences through discounted memberships, mentorship from dedicated members, and NCA's annual Science Fair Awards.

Fine Quality Telescopes up to 36-cm (14-inch) aperture are available free for member's use. NCA also has access to several relatively dark-sky sites in Maryland, Virginia, and West Virginia.

YES! I'D LIKE TO JOIN THE NATIONAL CAPITAL ASTRONOMERS

Enclosed is my payment for the following membership category:

[ ] Regular
- [ ] *Sky & Telescope* and *Star Dust*. ($51 per year)
- [ ] Star Dust only ($24 per year)

[ ] Junior (Only open to those under age 18) Date of birth: _____
Junior members pay a reduced rate.
- [ ] *Sky & Telescope* and *Star Dust*. ($42 per year)
- [ ] Star Dust only ($15 per year)

_____ _____ _____ (____) _____
First name Middle Last name Telephone

_____ _____ _____ _____ _____-_____
Street or Box Apartment City State Zip

If family membership, list names of additional participating immediate family members in same household, with birthdates of all those under 18 years old: _____

Note: If you already subscribe to ***Sky & Telescope***, please attach a recent mailing label. You may renew this subscription through NCA for $22 when it expires.

Make check payable to: **National Capital Astronomers, Inc.**, and send with this form to:

NCA c/o Jeffrey B. Norman, 5410 Connecticut Avenue, NW, Apt. #717, Washington, D.C. 20015-2837.

The following information is optional. Please indicate briefly any special interests, skills, education, experience, or other resources which you might contribute to NCA. **Thank you, and welcome to NCA!**

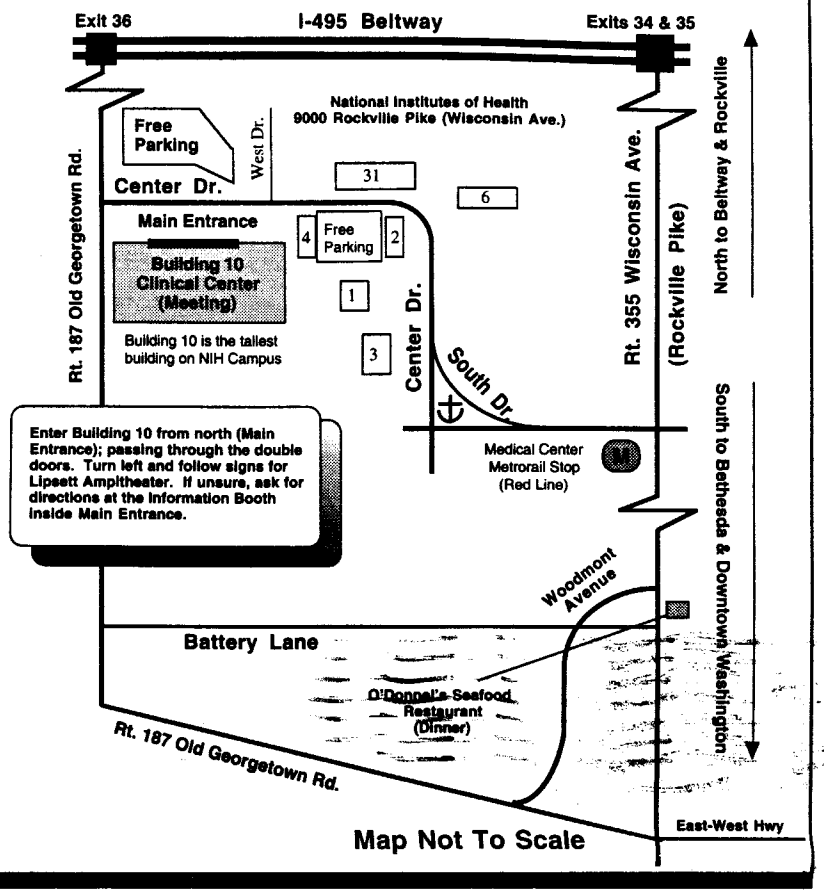
_____

_____

Getting to the NCA Monthly Meeting

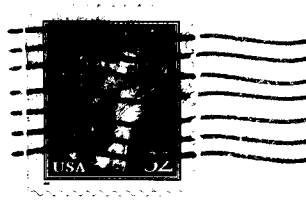
Metrorail Riders - From Medical Center Metro Stop: Walk down the hill, pass the bus stops and turn right at the anchor onto Center Drive. Continue uphill to Building 10 (walking time about 10 minutes), the tallest building on campus. Also, the J2 bus line connects the Bethesda (7:16 PM) and NIH (7:23 PM) Metro stops with Building 10 (7:25 PM).

To O'Donnel's Seafood Restaurant - Take Wisconsin Avenue past Woodmont Ave. toward Battery Lane It is located on the corner of Rosedale and Wisconsin Ave., on the left side of the street. There is free parking across the street on Rosedale. The address is 8301 Wisconsin Ave., Bethesda. MD.



Star Dust **is published ten times yearly (September through June) by the National Capital Astronomers, Inc. (NCA), a nonprofit, astronomical organization serving the entire National Capital region, and beyond. NCA is the astronomy affiliate of the Washington Academy of Sciences and the National Capital region's representative of the International Dark-Sky Association. NCA's Phone Numbers: 301/320-3621 or 703/841-4765. President: Harold Williams, 301/565-3709. Deadline for *Star Dust* is the 15th of the preceding month. Editors: Alisa & Gary Joaquin, 7821 Winona Ct., Annandale, VA 22003, 703/750-1636, E-mail: ajglj@erols.com. Editoral Advisor: Nancy Byrd.**

National Capital Astronomers, Inc.
If Undeliverable, Return to
NCA c/o Leith Holloway, Apt. #M-10
10500 Rockville Pike
Rockville, MD 20852-3331



FIRST CLASS

January 1997