SEATTLE ASTRONOMICAL SOCIETY

The Webfooted Astronomer

September 2002

Building a Model of a Star

By George Best

September Meeting

Dr. Douglas A. Downing
Associate Professor

Seattle Pacific University

Wednesday, Sept. 18
7:30 p.m.

Physics-Astronomy Building
Room A102
University of Washington
Seattle

Come early at 7 p.m. for coffee and to visit with your fellow members.

Bring your slides to show after the program.

DR. Douglas A. Downing, associate professor of economics at Seattle Pacific University (SPU) will discuss how to build a model of a star at the Sept. 18 Seattle Astronomical Society meeting.

Downing, a member of the SAS, teaches astronomy as well as economics at SPU. He will discuss the HR diagram and its relation to computer modeling of stellar structure, stellar evolution, and the ages of stellar clusters.

He received his B.S. in Economics and Astronomy/Physics in 1979 and his Ph.D. in Economics in 1987, all from Yale University. He is the author of eight books on mathematics, including the math adventure trilogy—*Algebra the Easy Way, Trigonometry the Easy Way, Calculus the Easy Way.* And he has also written six books on computer programming and computers in business.

The Seattle Astronomical Society meeting will be held Wednesday, Sept. 18 at 7:30 p.m. in room A102 of the Physics-Astronomy building.

Dark Skies Northwest will hold its monthly meeting prior to the SAS meeting from 6:30-7:30 p.m. in room A216 of the Physics-Astronomy Building.

Seattle Astronomical Society

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Thanks to Solar System Ambassadors

By Greg Donahue

I want to thank the several volunteers (Randy Johnson, David Brodeur, Brian Allen, Scott Cameron, David Dorais—whom am I forgetting guys?) who came out to Rattlesnake Lake Friday, Aug. 9, to support the public star party that night. Though we had a slight mix-up (my fault) on where to set up initially, the event was a big success. I personally appreciate your support. I have included a few excerpts below from a couple of the members of the public that attended. For those who may not be familiar with this event, here is some background.

The SAS committed to a nominal amount of community service at the Cedar River Watershed in return for our use of the "back side" of Rattlesnake Lake as a viewing site for authorized SAS members. (See http://www.galaxyguy.com/rattlesnake_lake.htm for more information).

To fulfill our commitment, I arranged to present a series of NASA/JPL "Solar System Ambassador" programs throughout the summer at the education center (see http://www.itsoveryourhead.com/SSA/engagements.htm#20020629 for details of my programs, and http://www.jpl.nasa.gov/ambassador/ for information about the "Ambassador" program).

The final program was held Aug. 9. It included a 1-hour "Solar System Stroll" up the Iron Horse Trail to walk off a scale model of the solar system, and my 45-minute multimedia presentation "What Worlds May Come: The Boundless Future of Planetary and Space Exploration." The program was topped off by a public star party at the cul-de-sac turn-around site at Rattlesnake Lake.

The whole program, including the star party, was a big hit with those in attendance. Here are a few excerpts from e-mail feedback:

"My family and I attended the solar systems lecture at the education center on Friday evening. It was really very good and there were about 15 people there. I didn't count, but several families and then some adults. The sky watching party after was fabulous! We only stayed until 10:30 pm, but it only got better as it got darker. Even my 17 (almost 18) year old had a good time. So I just wanted to let you know that."

(Continued on page 4)

Rattlesnake Lake *(Continued from page 3)*

"We did really enjoy the program. My son took an astronomy class at his high school and they had done the solar system walk-off. He was fascinated with the NASA program information and truly enjoyed the star party. Many thanks to the volunteers from the Astronomy society as well for their wonderful information and quiet teaching skills. I can now find Cygnus and the star Vega adding a few more to my constellation vocabulary!"—Susan R.

"Chris and I (husband) went to "What Worlds May Come" on Friday evening, and it was great. Just the right amount of depth and breadth for an audience that was all over the place age wise. Great presenter; great presentation. Thank you all for helping to make these things happen." —Wendy

Thanks again to those who came out to support the effort. It was a great success! I hope to build on this and be back next summer with an even bigger and better event.

Welcome to Our New Members!

The Seattle Astronomical Society is pleased to welcome these new members:

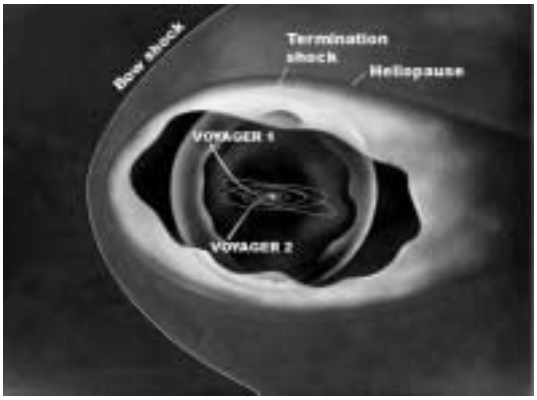
Alex & Maureen Anderson	Brad Bemis & Sarah Allen
Robert J. Bennett	Jason & Shea Browne
Laura Buscio	Paula Clark
Carolyn & Andy Cole	The Cruz-Talaveda Family
Chuck Cunningham	Ryan Edwards
Fred Herring	Wayne & Alicia Hixon
Chris Laurel	Armando Lemus
Michael G. Lewis	Richard L. Marshall
Rebecca Nelson	Robert D. Paraker
Al Perthou	The Rourke Family
Ganesh Sankaranarayanan	Carol Sidis & Jonathan Tuell
Patrick Snetsinger	Roger Steyaert
Chris Villiers	Michael Wagenbach

NASA's Space Place

Seeking the Edge of the Solar System

IN September and August, respectively, the Voyager 1 and 2 spacecraft will observe their 25th anniversaries in space, continuing to perform long after their original mission to visit the Jupiter and Saturn systems. After Voyager 1's encounter with the two gas giants, it was aimed upward out of the plane of the ecliptic. Voyager 2, after its visit at Jupiter and Saturn, was given two more planetary destinations, Uranus and Neptune. It completed its "grand tour" of the outer planets in 1989. It was then aimed downward out of the ecliptic plane.

Now, at about 85 AU, Voyager 1 is the most distant human-made object. Round-trip light time is 24 hours. Voyager 2 is at about 68 AU. Their mission now is to study the heliosphere, the vast bubble of space within the Sun's influence, and the heliopause, the boundary of the solar system with interstellar space. At the heliopause, the outward pressure exerted by the solar wind balances the inward pressure of the interstellar wind. The region where solar wind particles begin piling up against the heliopause is the termination shock, where the solar wind should drop from about 1,500,000 kilometers (nearly 1,000,000 miles) per hour to 400,000 kilometers (250,000 miles) per hour. Voyager 1 is already detecting a slowing of the solar wind from the pressure of inbound interstellar particles leaking through the heliopause.



Voyagers 1 and 2 are headed out of the solar system in search of the heliopause, the region where the Sun's wind stops and interstellar space begins.

No one knows exactly how much farther Voyager 1 must travel to reach the termination shock or the heliopause. Dr. Ed Stone, Voyager Project Scientist since mission inception, estimates

(Continued on page 6)

Space Place (Continued from page 5)
that the spacecraft could reach the termination shock within three years. Once there, Dr. Stone predicts it will still have about 5 billion to 8 billion kilometers (3 billion to 5 billion miles) and 10 to 15 years to go before actually crossing the heliopause into interstellar space. Because the heliosphere expands and contracts with the level of solar activity and the inward pressure of the interstellar wind is uncertain, it is very difficult for scientists to estimate the actual extent of the heliosphere.

Read more about the Voyager mission to find the heliopause at http://voyager.jpl.nasa.gov/ . For children, go to http://spaceplace.nasa.gov/vgr_fact1.htm to read about the Voyagers' grand tour of the outer planets and find out the secret code they use to send pictures back from space.

This article was provided by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

Autumn Star Party at Goldendale Observatory

The SAS has reserved the group camp site at Brooks Memorial Camp Ground for a late year, SAS viewing event on the weekend of Oct. 4 The site is at 2500 feet, has darker skies than Table Mountain, easy access and all the amenities within easy walking distance. The price for camping is based on a flat fee of $40 dollars per night for the site, plus $2 dollars a night for tent camps or $7 dollars a night for RVs. Thus the more campers the lower cost.

As an added inducement for attending this event, the Goldendale Observatory has a public star party planned for the same weekend and they have asked if we would like to help with it. See: http://w3.gorge.net/jwhite/friends/Flier.GIF for more information on the public star party.

Steve Stout, Goldendale's director, says that the observatory would remain open all night for the use of the amateurs and the public.

So here is a chance to do some late year viewing, educate the public, and then enjoy the views through the 24.5 at Goldendale.

Steve asked if members from other clubs participating in this event and looking for a place to camp could join us at Brooks. I told him that would be okay as long as we didn't exceed the capabilities of the site (it lowers the cost).

If you are interested in joining in on this event, let me know soon for planning purposes. – *Karl Schroeder*

From the President's Pen . . .

The Accidental Comet

By Mary Ingersoll

HOW do you find a comet? Well, you can try this method: Pick a night when you're unable to sleep. Drive to your favorite viewing site that just happens to have a terrible view to the North and West but is okay to the East, Southeast and South. Clear skies are essential, no clouds and preferably after a flood. Don't be prepared for any serious observing time, after all you're there by accident. Set up your MEADE 10-inch Schmidt-Cassegrain telescope (26mm eyepiece), but make sure it's not set up perfectly and your Goto-System should also have a few quirks in it. Also make sure the battery to the clock is off. Start observing at 2 a.m. with the Moon just behind a small hill.

This may not seem like the perfect setup to do anything serious, but with these conditions Sabastian Hoenig found a faint fuzzy that wasn't supposed to be there. He had also forgotten his sky charts, and he didn't even have a piece of paper on which to write his information. He finally went to his car, ripped the label off of water bottle and scribbled a rough drawing of the brightest stars around the mystery object. After reporting to the CBAT (Central Bureau for Astronomical Telegrams) and contacting other comet watchers around the globe, he finally got confirmation that he was the first to find it. It wasn't until later that he learned that he'd made history, too. This was the "first visual comet discovery from German ground since 1946." Sabastian lives in Dossenheim (outside Heidelberg), Germany, and has been looking for comets for only the past five years. He is credited for having found 20 comets in SOHO images.

Congratulations to Sabastian Hoenig and his accident! The rest of us in the Northern Hemisphere can watch Comet Hoenig until early October. It is presently observable before dawn (at magnitude 9) passing through Ursa Major heading towards Virgo.

Poo Poo Point Road Report

According to Steve Van Rompaey, Poo Poo Point keymaster, the road to Poo Poo Point has deteriorated lately because of construction. The large trucks and construction equipment are causing the road to be severely rutted. Steve recommends you take a truck or high-clearance vehicle to the site. The next Poo Point Star Party will be held on Sept. 7, weather permitting.

Saturn—It's Worth the Effort!

By Tim Mckechnie

IT'S now 6 am. I got up at 4 am to collimate and star test an 8-inch Schmidt-Cass that I've been modifying for someone. Saturn is now high in the eastern sky just east of Zeta Tauri, the lower horn of the Bull. This scope has fairly good optics but nothing sensational. Even so, at 118x with a #8 yellow filter, Saturn showed exquisite detail. I could see clearly the A, B and C rings around the entire circumference, the southern equatorial band and many more subtle bandings above and below, the polar hood and limb haze darkening as well as eight satellites. I've never seen so many moons around Saturn in an 8-inch scope before.

While it is an inconvenience and an effort, I definitely recommend you get up at this uncivilized hour to check out Saturn, the waning Moon and Jupiter, which is very low in the East.

The fact that civilization is dormant makes the predawn sky that much more rare and precious. Everything is so quiet, cool and still that it is something to be savored. The temperature is 60 degrees, the dead calm air , and the world is still asleep. There is a "smell" in the air when the late turns into the early that I can't describe.

Time's Running Out – Join the SAS Board Today

There are only 12 more weeks until the club elections, and if we don't have any volunteers for the elected positions, then I'll be a chairman of a nonexistent board! The terms are up for *all* the board positions.

If such a thing happens, you'll probably find me wandering among the trees singing "Mother McCree" (off key) and trying to book a flight to Llandudno (not an easy thing to do in a city park).

If you are considering the possibility of volunteering for any of the officers' positions, please contact one of us soon. We are waiting to hear from you. Otherwise, we may have to do something drastic, like give you a personal call. Here are the open board positions:

- President
- First VP–Programs
- Second VP–Education
- Third VP–Membership
- Fourth VP–Publicity
- Treasurer
- Secretary

– Mary Ingersoll

September 2002

Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2 Labor Day	3	4	5	6 ●	7 Poo Poo Point Star Party
8	9	10	11	12	13 ◐	14 Green-lake, Cromwell Park Star Parties
15 Astro-photogra-phers at Keith Alred's	16	17	18 SAS Meeting	19	20	21 ○ Tele-scope Makers at Peter Hirtle's
22 Autumnal Equinox 9:55 pm	23 SAS Board	24	25	26	27	28
29 ◑	30					

Want to Go Into Orbit?

By Jason Black

RECENTLY I had the good fortune to attend a lecture by Peter Diamandis, who runs the $10-million X-Prize Foundation, on the subject of the X-Prize and low-cost space access.

I have always wanted to visit space myself, and naturally the lecture rekindled my excitement about the prospect. Of course, I don't have Dennis Tito kind of money lying around, so I'll be waiting for something a little more off-the-shelf to come along.

In the meantime, I decided to collect some real data about people's space tourism preferences, so I put up a survey on my website. I hope that, over time, I can collect a substantial body of truly useful data on this subject.

So please take a few minutes to help me get going. Just point your browser over to http://zero.hhhh.org/space_survey/ and follow the directions.

If you have any problems, please let me know. All the reasonably modern browsers I know of should do ok with it, but yours doesn't, I'd appreciate knowing that.

Also, you are welcome (and encouraged!) to forward this URL on to anybody you can think of who might be interested. More data is always better!

Turn off the Lights April 12, 2003

National Dark Sky Week (NDSW) is a week when everyone in America turns out his or her outdoor lighting. It reduces light pollution so that people may see the wonder that the universe has to offer.

The 2003 event will occur April 12–19 from 10–12 pm Eastern (9–11 pm Pacific time.)

Help spread the word of NDSW. Then, on these dates, during the scheduled time, turn out your lights and watch the greatest show that was ever created.

For more information, contact Jennifer Barlow, Astronomer107@comcast.net.

Minutes

It's About Time, It's About Space, About Gravitons in the Strangest Place . . .

By Greg Donohue

THIS year, research sponsored by the UW exceeded $800 million, making it the research leader among public universities. And at the August SAS general meeting, we were privileged to hear Dr. Craig Hogan, Vice Provost for Research at the University of Washington and a professor in the Astronomy and Physics departments. Dr. Hogan got his undergraduate degree from Harvard, and Ph.D. from Cambridge. A member of the UW faculty since 1990, he served as Chair of the Astronomy Department from 1995 to 2001. Though this was Dr. Hogan's first visit with us, it was he who gave us permission to hold our general meetings in the physics/astronomy building. (Dr. Hogan was a speaker for the National Science Foundation's 50th Anniversary Symposium, is the author of *The Little Book of the Big Bang*, and appeared in the UW Astronomy department's "New Cosmos" series.)

Dr. Hogan started off his presentation with a small physics lecture about Schrödinger's electron wave function. Only 3 parameters are needed to describe the state of an electron in an atom, yet an amazing degree of complexity can arise from this simple function. Solutions to Schrödinger's equation only occur for certain discrete states of these three numbers. When an atom changes from one of these discrete states to another, it either absorbs or emits a specific frequency of light. The point of the physics lesson was to remind us that nature is, at its foundation, discrete (quantized).

At the moment of the Big Bang, the entire universe as we now know it—all the matter, energy, and space—started out as an inconceivably small point of energy. The enormous structures—such as galaxies and filaments and voids—present in the universe today were imprinted on the cosmos when it was smaller than a single atom! The famous cosmic background radiation map (http://nssdca.gsfc.nasa.gov/anon_dir/cobe/images/dmr/phys_today_cover_big.gif) obtained from the COBE (COsmic Background Explorer) satellite reveals that the universe is not uniformly smooth. After subtracting out the Earth's own motion through the background radiation, the sky is seen to have areas that are slightly warmer or cooler (by about 1 part in 10^5) than the average background radiation temperature (about 2.7 K, so the

variations are measured in microKelvins).

Acoustic sound waves move through the "photosphere" of the cosmic background, driven to speeds of 1/3 the speed of light by the pressure of the background radiation. The frequency at which these sound waves vibrate is a function of how much matter is present in the universe. So by looking at this acoustic pattern (from data gathered, for example, from BOOMERANG, a telescope on a balloon flying over Antarctica), we can surmise the amount of matter and the "shape" of the universe (open, closed, or flat). These observations reveal that the cosmos is flat; that is, light travels in straight lines, rather than being bent/focused by any overall curvature in space. The Inflationary Big Bang model predicts this flatness.

A second conjecture about the universe is that it started with very little information, and its complexity has increased with time. Galaxies are very complex, yet each started as something smaller than a sub-atomic particle that had very little information. Gravity turns out to be the agent of change that brought about the extra complexity (http://www-hpcc.astro.washington.edu/picture/movies/evr.mpeg). The Sloan Digital Sky Survey (SDSS; see http://skyserver.fnal.gov/en for a great public user interface to the data) is helping map this complexity. This will result in a 3-D map to compare with cosmic web simulations.

The universe is expanding, but is the *rate of expansion* constant, or perhaps slowing down with time due to gravity? A 1998 study of type Ia supernovae (which shine as bright as a whole galaxy for a couple of weeks) led to the startling conclusion that the expansion is actually *accelerating*! This implies that the "empty" space between galaxies is in fact permeated with a "dark energy" that creates a previously unknown force—a sort of "repulsive" gravity. If this repulsive force stays constant, then eventually all the objects around us will be receding faster than the speed of light, so we will be unable to see anything beyond our local group of galaxies.

The most powerful sources of energy in the universe emit most of their energy in the form of gravity waves (analogous to electromagnetic waves). For example, colliding massive black holes can, over the course of perhaps an hour, "outshine" (produce more energy) by a factor of a million everything else in the universe combined!

(Continued on page 14)

Minutes *(Continued from page 13)*

Facilities to attempt to detect such waves of gravity are being built. LIGO (Laser Interferometer Gravitational wave Observatory) is one such instrument, with several facilities around the world, including Hanford, Washington. The task is technologically daunting, since displacements due to gravity waves are on the order of 10^{-18} meters. (For comparison, atoms are on the order of 10^{-10} meters, and atomic nuclei are on the order of 10^{-15} meters.) Accounting for and subtracting out a myriad of other sources of displacement noise (such as the noise of ocean waves on the Pacific coast, lunar tidal forces, large trucks driving by, thermal expansion of the ground, etc., etc.) is challenging to say the least. The frequency of gravitational waves are ~1 kHz, which is in the audible range.

Another proposed gravity wave detector—LISA (Laser Interferometer Space Antenna)—would operate in space. Due to its large size (3 detectors separated by 5 million kilometers!), it will detect all kinds of gravity waves: not just black hole mergers, but also binary white dwarfs. (That is, if it works at all, since technological challenges must still be overcome.) Perhaps about once per year, LISA would be expected to detect a huge event – the merging of two super-massive blacks holes (found in the centers of galaxies). This rough calculation is based on the fact that there are about 10^{10} galaxies, each galaxy merges on average once over the life of the universe, and the current age of the universe is about 10^{10} years.

Just as the atom is quantized, so there is some conjecture that a map of the cosmic background radiation with sufficient resolution might reveal that it too is discrete. This would be an effect of quantum gravity, which we do not have a good theory of yet. Some of the fluctuations in the cosmic background radiation may be elementary particles of gravity and the elementary particles responsible for the inflationary period of the big bang.

Just as photons are quanta of electromagnetic waves, so "gravitons" would be quanta of gravitational waves. As the atom can be completely characterized by only 3 numbers, is it possible that the universe could be completely characterized by a large, but finite, set of numbers as well?

If this is so, then I suggest we create a game of cosmic powerball: the winner being the "lucky-for-eternity" person who correctly guesses the million or so numbers needed to completely characterize the cosmos. Sure, the chances of winning would be slim, but the payout would be truly *astronomical* (moan)!

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