



the Webfooted Astronomer

News from the Seattle Astronomical Society

August 2007

Density is destiny

The UW's Dr. Eric Agol tells SAS all about supermassive black holes

Most galaxies have one supermassive black hole, and the bigger the galaxy, the bigger the black hole. That's according to Dr. Eric Agol, professor of astronomy at the University of Washington, who gave a talk on one of his major research interests at the monthly meeting of the Seattle Astronomical Society July 18.

One of the first things we learned is that we have a lot of misconceptions about black holes. In fact, Agol said the term itself is something of a misnomer.

"Black holes aren't black, and they aren't holes," he noted. "Originally they were actually called 'frozen stars,' which in some ways is a more accurate description. Neverthe-

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Dr. Eric Agol of the UW spoke about supermassive black holes at the July SAS meeting. Photo by Greg Scheiderer.

NEXT MEETING

August 15 — 7:30 p.m.
University of Washington
Physics/Astronomy Building,
Room A-102

Show and Tell: Favorite observing sites

SAS members and friends will share about their favorite observing locations. Just a month after the Table Mountain Star Party, there will be fun photos and stories from the event. We will also see photos and hear about other star parties, favorite "secret" stargazing spots, observatories, and planetariums in the Northwest.

In addition, people who were unable to share their homemade gadgets or other astro-projects at the June meeting will have an opportunity to do so.

If you would like to share at this meeting please email me to sign up for a time slot...

Anita Eclissi, VP Programs

programs@seattleastro.org

SAS Calendar

August 11 — 8:30 p.m.
Tiger Mountain Star Party (members only)

August 12 — New Moon

August 12
Perseid meteor shower peaks, late p.m. today and early a.m. on Aug. 13

August 15 — 7:30 p.m.
Seattle Astronomical Society Meeting
Show and tell: favorite observing sites

August 15 — 9 p.m.
UW Observatory — Public viewing night

August 16-19
Oregon Star Party

August 18 — 7 p.m.
Seattle Astronomical Society Star Parties
◆ Green Lake, Seattle
◆ Paramount Park, Shoreline

August 20 — First quarter Moon

August 25 — 6:30 p.m.
Amateur telescope makers SIG meeting
Contact: atm@seattleastro.org

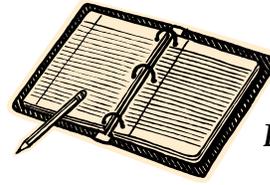
August 25 — 7 p.m.
Moon viewing festival
Seattle Japanese Garden

September 5 — 9 p.m.
UW Observatory — Public viewing night

September 8 — 8:30 p.m.
Tiger Mountain Star Party (members only)

September 19 — 7:30 p.m.
Seattle Astronomical Society Meeting
“Barnstorming the Planets” by Dr. Ron Hobbs

Improving communication



From the president's desk
By Jon Bearscove

The year is already half over, and I wanted to touch base with everyone and first of all say thank you. This has been a challenging couple of months for me, but I think we are in really good hands and I truly appreciate your patience.

At this point, every position on the SAS board has been filled except for secretary, and things are taking a turn for the better. Our newsletter is looking better, with more member-driven content, our website has been more active, and we have new forums available to everyone.

Our programs have been outstanding! Every single guest speaker we've had has captured our imagination and kept us all curious about everything from space elevators to black holes. We've been on fascinating tours, bumped shoulders with real rocket scientists, and even been on the radio regarding our search for a dark sky site. Even the Table Mt.

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Star Party that many of you participate in every year even made front-page news!

I truly feel that we are a dynamic group and have the potential to become the best non-profit astronomy-related organization in the Northwest. Along the way however, there are still areas that need improving.

One area is our ability to communicate with each other. I know this has been an issue for many members, including our own board, so this month I want to announce to everyone that I am attempting to use a feature through Google called "Groups" to enhance our ability to keep in touch.

I have created two forums, one called "Through the Clouds" for all members, and another exclusive group just for our officers. On both of these forums, I have already started several discussions, created different pages on a variety of topics, and have even posted documents for everyone to have access to. So far the response has been pretty good with about 12-15 percent of the entire membership signed up within the first week or so.

The purpose of the officers-only forum is to enhance discussions between the board members in "real-time" regarding issues that the SAS faces on a regular basis. Because we are all volunteers, it's hard keeping up with work email, personal email, and then add on top of that, SAS email, so I hope this mechanism will help us track progress on club issues.

I hope that a forum like this will make it easier for the officers to stay in contact with each other on a regular basis on items affecting the organization. The officers forum is not intended to replace the monthly board meetings, but to enhance them.

Part of my reason for doing this is that I have limited access to our SAS website, and want the ability to post images, documents, tips, tricks, questions, etc., on the spot. When

something comes to mind related to amateur astronomy, I want to let you know what it is...that same moment. I think these forums might do the trick, but I'm not completely sure because this is sort of unexplored territory outside of our existing tools.

If there's anything you'd like to see added or enhanced, or if you have suggestions on how to make SAS a stronger community through this technology, please let me know.

Again, thank you so much for your patience, and I hope that we will continue to head in the right direction. As always, if you ever have any questions, comments or concerns, please don't hesitate to contact me directly.

Jon Bearscove, President
president@seattleastro.org

We promise you the Sun, the Moon, and the stars... and we deliver!

The Seattle Astronomical Society is an organization created and sustained by people who share a common interest in the observational, educational, and social aspects of amateur astronomy.

Established in 1948, the SAS is a diverse collection of over 200 individuals. A variety of programs and activities is presented by the SAS throughout the year. Monthly meetings feature speakers on a wide range of topics, from the Hubble Space Telescope to electronic imaging to personal observing experiences. The club holds public observing "star parties" at Green Lake and Paramount Park every month, dark sky observing parties outside Seattle, plus such activities as meteor watches, public telescope and astronomy displays, National Astronomy Day, and an annual Awards Banquet.

Exploring the new frontier

A group of SAS members visited the Museum of Flight's new Space Exhibit on June 30. Clark Beck was our informative tour guide; he spent two hours with us (twice as long as a usual tour), sharing about the very beginnings of flight, then fast-forwarding to space travel.

Normally docents are only trained to take visitors through the main part of the museum, but Beck's career was in the aerospace industry, so he offered to spend most of his time with us in the new Space Exhibit — sharing firsthand knowledge, pointing out highlights of the exhibit, and answering our many questions.

I highly recommend a visit to this wonderful exhibit, and to tempt your astro-taste-buds,

here's a few of the many must-see items: a "Magic Planet" digital video globe that transforms into a spinning, glowing representation of each planet in our solar system at the touch of your finger on an accompanying computer screen; an Apollo Command Module that was used for practice landings; full-scale mock-ups of the Lunar Roving Vehicle and the ascent stage of the Lunar Module; a mock-up of one of the Viking Landers with *Aerojet* thrusters; a replica of the International Space Station's Destiny Laboratory (museum visitors can actually walk through the laboratory mock-up and look through a window in the floor that reveals video of Earth from the Space Station); and I must mention the simulators that allow you to try your own hand at landing the Space Shuttle here on Earth and the Lunar Module on the Moon!

Anita Eclissi, VP Programs

More info: <http://www.museumofflight.org/>



A "weightless" SAS tour group posed in the mock-up of the International Space Station's Destiny Laboratory during their visit to the Museum of Flight. Pictured from left to right are: Al Armstrong, Anita Eclissi, Chloe Madara, Joshua Madara, Roberta Maguire, Marc Bateman, Eric Holcomb, and Alecia Amspacher. Photo by Anita Eclissi.

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less, black hole is a pretty good metaphor for what these objects are."

The idea of the black hole was first proposed in 1798 Simon Leplace, who suggested that if a star was massive enough, then light could not escape. It was more than a century later that Einstein came out with the theory of relativity, which made mathematical solutions possible.

The fancy math aside, black holes are really pretty simple.

"In order to become a black hole, something just has to be very dense," Agol said. "Sometimes density is destiny, and if you get dense enough, you have to collapse and become a black hole, a very small point of mass, so small that really it's defined by density."

When Agol says dense, he means it: a black hole will have a fairly incomprehensible density on the order of 10^{97} kilograms per cubic meter!

"At the very center of a black hole, the density gets so large that physics breaks down as we know it," he noted. "We can't actually determine if density can go higher than this."

Agol said that this small point of dense mass is called the "singularity," and "this is really where all the action is, this is the black hole."

What we often think of as being a black hole is actually the sphere in space that surrounds the singularity. Agol said that really there's nothing there – it's not a physical object – but it is a point of no return known as the event horizon. There's nothing there because it's a one-

way street. Any matter that falls in is pulled to the singularity by the intense gravity. Not even light can escape, because the gravitational force is so great that the escape velocity is faster than the speed of light. Nothing goes that fast.

There are a lot of stellar mass black holes around, probably formed by collapsing stars. Agol said that to be considered supermassive a black hole would have to have at least a million times the mass of our Sun.

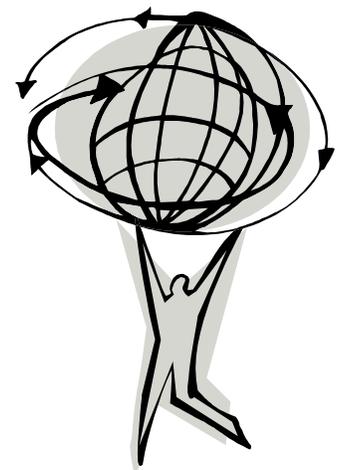
We can't see the Milky Way galaxy's supermassive black hole – there's too much interstellar dust in the way – but Agol said

there's plenty of evidence that it exists. We can see stars orbiting very rapidly around the center of the galaxy, sug-

gesting that there's a massive gravitational force there. We've spotted stars speeding away from the galaxy, and it would take a huge mass to eject a star at such a velocity. Finally, gas near the event horizon would be heated to extreme temperatures before it fell into the black hole, in the process emitting tremendous radio waves and x-rays, and we've been able to detect both at the center of the galaxy.

There's some visual evidence of the black hole, too. The super gravity of the black hole can bend light, and its spin actually drags space, and light. Agol said we can see the effect of

"Either the galaxy is dictating how massive the black hole should be, or somehow the black hole is telling how much stellar mass can build up around it."



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this; because the light is bent, the black hole casts a shadow that is larger than the event horizon. "Black holes, I guess, have a complex that they always look bigger than they are," Agol joked. If the black hole is spinning the shadow will be lima bean-shaped because the photons are dragged around one side of the shadow in the direction of the spin.

There's typically just one supermassive black hole in a galaxy, though Agol said some have been found with two. He notes there is a correlation between the size of the black hole and the size of the galaxy. Even taking into account a wide degree of uncertainty because the measurements are hard to make, the correlation is clear: "Larger galaxies have larger black holes, and smaller galaxies have smaller black holes."

The mass of a supermassive black hole is always about 0.2% of the mass of the bulge and stars of the galaxy. "Somehow either the galaxy is dictating how massive the black hole should be," Agol said, "or, an even more intriguing idea is that somehow the black hole is telling how much stellar mass can build up around it. It's a chicken and egg problem."

The fascinating subject matter of Agol's talk drew lots of great questions from those in attendance. One was about how time behaves near a black hole. It can be a bit goofy.

"Inside a black hole you always have to move in toward the singularity, so in some sense space behaves more like time," Agol explained. "For us, time always moves in the same direction. In a black hole, space always moves in the same direction; you have to approach the center of it. Some people theo-

size that you may be able to move backwards and forward in time slightly within a black hole, but how to really interpret that has been fraught with debate."

Other questions were asked about a supermassive black hole's ability to create – or destroy. Agol said the black hole is not likely to gobble up everything. "Angular momentum has saved us!"

"You may be able to move backwards and forward in time slightly within a black hole."

"Gravity balances inertia, and keeps things moving on a circular orbit," he added. "For the stars orbiting around the central black hole, their velocity leads to a centrifugal force that balances gravity and keeps them

from falling in. They may get very close, but as they get closer they speed up and their centrifugal force becomes greater."

The supermassive black hole is growing, though, probably sucking up about an Earth-mass of matter, mostly gas, each year.

Can a black hole get so massive that it ignites into a big bang? Agol said it could happen, because space is a stretchy thing, but if it did, it would happen inside the event horizon and there would be no way to see it.

"It could be the creation of another universe inside a black hole," he said, noting that some scientists have modeled our universe that way. "Even though it may be expanding and stretching space inside the black hole, there would still be the same amount of mass, and therefore the laws of general relativity would still hold, from our perspective." Agol said there's some disagreement among the experts on whether this can happen.

To learn more about Agol's research, visit:

<http://www.astro.washington.edu/agol/>



Congratulations!

SAS member **Scott Cameron** recently received his Messier certificate, as announced by Mike Langley at the July meeting. To qualify for the Messier award, one of the many observing awards through the Astronomical League, one must record observations of 70 objects on the Messier list. Way to go, Scott!

To learn more about the various observing clubs, visit the Astronomical League Web site:

<http://www.astroleague.org/observing.html>

Contact Mike Langley, SAS VP for education, for more information.

SAS officers

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Future file: upcoming meeting topics

WEDNESDAY, SEPTEMBER 19, 7:30 PM

DR. RON HOBBS - BARNSTORMING THE PLANETS

Dr. Ron Hobbs, Public Programs Assistant at the Museum of Flight and Solar System Ambassador for NASA's Jet Propulsion Laboratory, will be our guide as we travel through the wonders of the solar system via the latest pictures and scientific data from NASA's New Horizons probe, Cassini, the Mars Orbiters, the Rovers — and more.

We don't need spacesuits to visit Jupiter, Saturn, and Mars... Dr. Hobbs will take us there with his vivid, enthusiastic presentation!

http://www2.jpl.nasa.gov/ambassador/profiles/Ron_Hobbs.htm

WEDNESDAY, OCTOBER 17, 7:30 PM

SONNY TREMOULET - MASTER TELESCOPE BUILDER

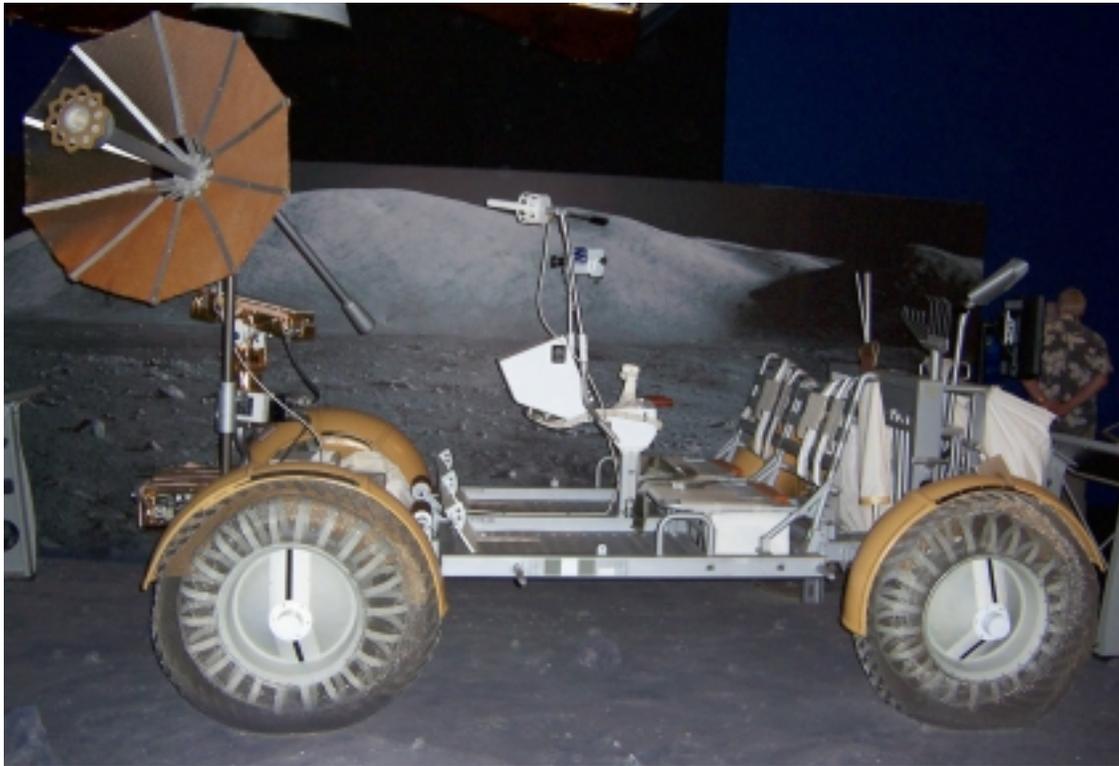
Sonny Tremoulet will bring his award-winning 16" f-4.5 Newtonian telescope and share about its design and construction - including the mirror which he created on his homebuilt, computer controlled, grinding, polishing and figuring machine. He will also share about the mirror making machine itself and the interferometer he uses to test mirrors.

The scope Tremoulet will share with us is outfitted with digital encoders that connect to a Sky Commander setting circles unit, then to a laptop computer. He also built an equatorial platform for this telescope which allows it to track objects without manual adjustments.

For anyone who has dreamed of making their own telescope, or who would just like to understand the innards of their store-bought Newtonian reflector better, this is a wonderful opportunity to learn from and ask questions of an expert!

Details, page 1
Favorite observing
sites... and more!
NEXT MEETING
AUGUST 15

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RETURN SERVICE REQUESTED



This replica lunar rover is part of the Museum of Flight's new Space exhibit visited recently by an SAS group. Photo by Anita Eclissi.