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Next Docent Meeting
February 21

The next docent meeting will be held on Monday, February 21. The meeting will convene at 6:00 in the main conference room and will feature dinner and a speaker. Docents should contact Nick Petrosino in the visitor center to schedule their hours for March prior to the February meeting.

Kitt Peak Docent Program

950 N Cherry Ave
Tucson, AZ 85719

Docent Forum: http://groups.yahoo.com/group/docentforum/
Volunteering at Kitt Peak:http://www.noao.edu/outreach/kpoutreach.html
Calcium Calendar: http://www.noao.edu/perl/Calcium

www.noao.edu

KITT PEAK DOCENT

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Kitt Peak Docent Program

DOCENT NEWS

Number 88
February 2005

KITT PEAK DOCENT

Points of Interest:

- The docent meeting will be held February 21, featuring dinner and a speaker.
- February 11: Deep Impact trajectory correction maneuver #1
- February 12 to 20: Earth & Space Week.
- February 14: Asteroid 2004 EW near-Earth flyby (.059 AU).
- February 14: Asteroid 2000 YS134 near-Earth flyby (.062 AU)
- February 15: Venus passes .9° from Neptune.
- February 18: 75th anniversary (1930) of Clyde Tombaugh's discovery of Pluto.
- February 27: Moon occults Jupiter.

For additional information about these points of interest, visit http://www2.jpl.nasa.gov/calendar/.

USING YARN TO DEMONSTRATE CASSEGRAIN FOCUS

I've used a long piece of orange yarn to demonstrate the Cassegrain focus on telescopes in the introductory talk. It seems to work rather well in that it's a graphic demonstration, it involves the audience, and it breaks the ice in the group.

The teaching points of the demo are: astronomers like big mirrors and long focal lengths to get better resolution of images; long focal lengths mean huge, heavy mounts and buildings (and astronomers themselves in rather awkward positions). In the 17th century, M. Cassegrain came up with the brilliant idea that one can fold the light path back on itself using a second mirror, and send it back through a hole in the primary mirror so that the astronomer in those days, and now the instruments, can be located in a much more efficient place. The total length of the telescope is also reduced considerably.

The only prop necessary for the demo is a 30-foot piece of yarn, kept wound on a cardboard spindle. This small piece of cardboard is important. For the first several demos, I had the yarn wound up in my pocket, and then I wasted a good bit of time in front of the group untangling the yarn! Cut a 3" X 5" piece of stiff cardboard in the shape of a fat capital I—that is, have tabs on the ends so the yarn won't fall off. Cut a small slit on one edge to secure the ends of the yarn. Choose a smooth yarn in a bright color. I use orange (I think it's acrylic) worsted-weight . It needs to be smooth—I had some fuzzy green yarn that kept sticking to itself, and combined with the tangle in my pocket, it was a disaster. Fellow docents have said that the orange is much more visible than the green, anyway

For the demo, I ask for three volunteers from the group. (You can do this even if you only have 3 visitors; you don't need an audience.) Position two of them side by side at the theater side of the lecture area facing the wall with the panoramic views of Tucson at night. Ask the third volunteer to sit and wait on a front row seat. Give the two ends of the yarn to the two people to hold. (Make sure you've doubled the yarn before winding on the cardboard spindle. That way the two ends will be immediately accessible.) Unwind the yarn, and stretch it out to its focal point. Explain that the two guests on the other end are a "concave mirror". (This week, one portly gentleman sucked in his tummy and said, "I don't think so!") Have the audience imagine a light source, a star if you will, in the neighborhood of the parking lot, shining into the "mirror." Point out (or elicit from the group) that the light will be reflected back by the mirror, and since the mirror is curved, it will bounce it back to a point. The orange yarn represents the reflected light. You are standing at the prime focus. Point out how long the telescope would have to be to accommodate that focal length. Then, invite the third volunteer to be the secondary convex mirror (best not to dwell on the bulge factor, especially if your guest is heavy!), have her stand facing the other two volunteers about halfway to your original focal point. Give her the two strands of yarn, one for each hand, which she holds about 6 inches apart. You then take the point again back to the "primary mirror". If you figure it correctly, you'll end up with your focal point right in front of the original two volunteers. You point out that you could put your astronomer and all his equipment right there, but that would rather mess up the mirror. At this point, you go between and behind the two primary mirror volunteers, and reposition the "secondary mirror" so that you have a neat cassegrain light path demo in orange yarn. At this point thank the volunteers (applaud, especially if they were children), and re-wind your yarn. Point out the doughnut hole from the 4 m.

There are some minor factors that are not totally covered by this demo. I've thought

MILKY WAY BLACK HOLE ACTIVE HISTORY REVEALED

The centre of our galaxy has been known for years to host a black hole, a 'super-massive' yet very quiet one. New observations with Integral, ESA's gamma-ray observatory, have now revealed that 350 years ago the black hole was much more active, releasing a million times more energy than at present. Scientists expect that it will become active again in the future.

Most galaxies harbour a super-massive black hole in their centre, weighing a million or even a thousand million times more than our Sun. Our galaxy too, the Milky Way, hosts a super-massive black hole at its centre. Astronomers call it Sgr A* (pronounced 'Sagittarius A star') from its position in the southern constellation Sagittarius, 'the archer'.

In spite of its enormous mass of more than a million suns, Sgr A* appears today as a quiet and harmless black hole. However, a new investigation with ESA's gamma-ray observatory Integral has revealed that in the past Sgr A* has been much more active. Data clearly show that it interacted violently with its surroundings, releasing almost a million times as much energy than it does today.

This result has been obtained by a international team of scientists led by Dr Mikhail Revnivtsev (Space Research Institute, Moscow, Russia, and Max Planck Institute for Astrophysics, Garching, Germany). As Revnivtsev explains, "About 350 years ago, the region around Sgr A* was literally swamped in a tide of gamma rays."

This gamma-ray radiation is a direct consequence of Sgr A*'s past activity, in which gas and matter trapped by the hole's gravity are crushed and heated until they radiate X-rays and gamma rays, just before disappearing below the 'event horizon' - the point of no return from which even light cannot escape.

The team were able to unveil the history of Sgr A* thanks to a cloud of molecular hydrogen gas, called Sgr B2 and located about 350 light-years away from it, which acts as a living record of the hectic black hole's past.

Because of its distance from the black hole, Sgr B2 is only now being exposed to the gamma rays emitted by Sgr A* 350 years ago, during one of its 'high' states. This powerful radiation is absorbed and then re-emitted by the gas in Sgr B2, but this process leaves behind an unmistakable signature.

"We are now seeing an echo from a sort of natural mirror near the galactic centre - the giant cloud Sgr B2 simply reflects gamma rays emitted by Sgr A* in the past," says Revnivtsev. The flash was so powerful that the cloud became fluorescent in the X-rays and was even seen with X-ray telescopes before Integral. However, by showing how high-energy radiation is reflected and reprocessed by the cloud, Integral allowed scientists to reconstruct for the first time the hectic past of Sgr A*.

The high state or 'activity' of black holes is closely linked to the way in which they grow in size. Super-massive black holes are not born so big but, thanks to their tremendous gravitational pull, they grow over time by sucking up the gas and matter around them. When the matter is finally swallowed, a burst of X-rays and gamma rays results. The more voracious a black hole, the stronger the radiation that erupts from it.

The new Integral discovery solves the mystery of the emission from super-massive but weak black holes, such as Sgr A*. Scientists already suspected that such weak black holes should be numerous in the Universe, but they were unable to tell how much energy and of which type they emit. "Just a few years ago we could only imagine a result like this," Revnivtsev says. "But thanks to Integral, we now know it!"

As for the duration of the latest high state of Sgr A*, 350 years ago, Revnivtsev and his team have evidence that it must have lasted at least ten years and probably much longer. The team also expect that Sgr A* will become bright again in the foreseeable future. Detecting the next burst would provide much needed information about the duty cycle of super-massive black holes.

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ARCHIVED MESSAGES

Messages on the docent forum are now archived. Members may browse previous messages and respond to any topics that grab their interest.

The forum is a useful vehicle for exchanging ideas. Any docent wishing to join the forum should go to the URL on page 4 and follow the directions for joining a group. Then join the conversation.

ASTRONOMY CAMP

Public Outreach is again joining Arizona Youth University to host the two week-long Astronomy Camps. The camps are scheduled for the weeks of June 13 and 20.

This year the department invites docents to participate. Assistance is needed to facilitate the activities. Details of the camp will be made available soon, and any interested docents should contact the program coordinator.

February 2005

Sun	Mon	Tue	Wed	Thu	Fri	Sat
		1 Larry, Joyce, Barbara	2 Punch, Sheila	3 Gene, Jerry	4 Don, Doug 25 H.S. students	5 Jim O., Eugene
6 Jerry, Anna	7 Jim M., John	8 Joyce, Phyllis	9 Punch, Sheila	10 Gene, Jerry	11 Bob, Don, Doug	12 Jim O., Jerry
13 Anna, Phyllis, Ken	14 Jim M., Jessica	15 Eugene, John	16 Punch, Sheila	17 Gene, Jerry	18 Pat	19 Doug, Jim O.
20 Jerry	21 Bob Docent Meeting	22 Phyllis, Joyce	23 Punch, Sheila	24 Jerry, Pat	25 Don, Doug, Pat	26 Jim O., Jerry
27 Eugene	28 Jim M., Jessica 28 Seniors at 10:00					

YARN, CONTINUED FROM PAGE 1

about getting more technical (to satisfy all you physics people), but I feel that it would be more confusing to the audience and blur the point. One factor is that in a real cassegrain configuration, the original focal point is just beyond the convex mirror, quite close in fact. The secondary, convex mirror, actually extends the focal length. (Thank you, John, for that lesson!) This could be the point, and you could demonstrate it with the yarn; I usually focus on the physical length of telescopes and their necessary apparatus.

The obvious question by guests is, “doesn’t the hole mess up the mirror?” and the answer is no. The diameter of the mirror is more important than the actual space in the center.

Another good question to elicit is “why didn’t they use the cassegrain configuration with the solar telescope and save themselves all that tunneling into granite?” This is a good time to point out that with the solar telescope, they have the additional temperature control problem of having a very hot beam of sunlight bouncing off the mirrors and heating the air in the tunnel. They work hard to stabilize the air in the tunnel, and it’s made difficult by the heat of sunlight itself. If they folded the beam back again, it would at least double the heat. Claude told me that some solar telescopes do indeed use a Cassegrain configuration; they have other ways to control the distortion—like a vacuum.

I only use this demo once, either with the 2.1 or the 4m tour. I suspect it would be overkill to use it twice, but that would depend on how much the audience changed from one tour to the next. And that is a decision for the docent to make.

Joyce Park
Kitt Peak Docent