The Big Eye

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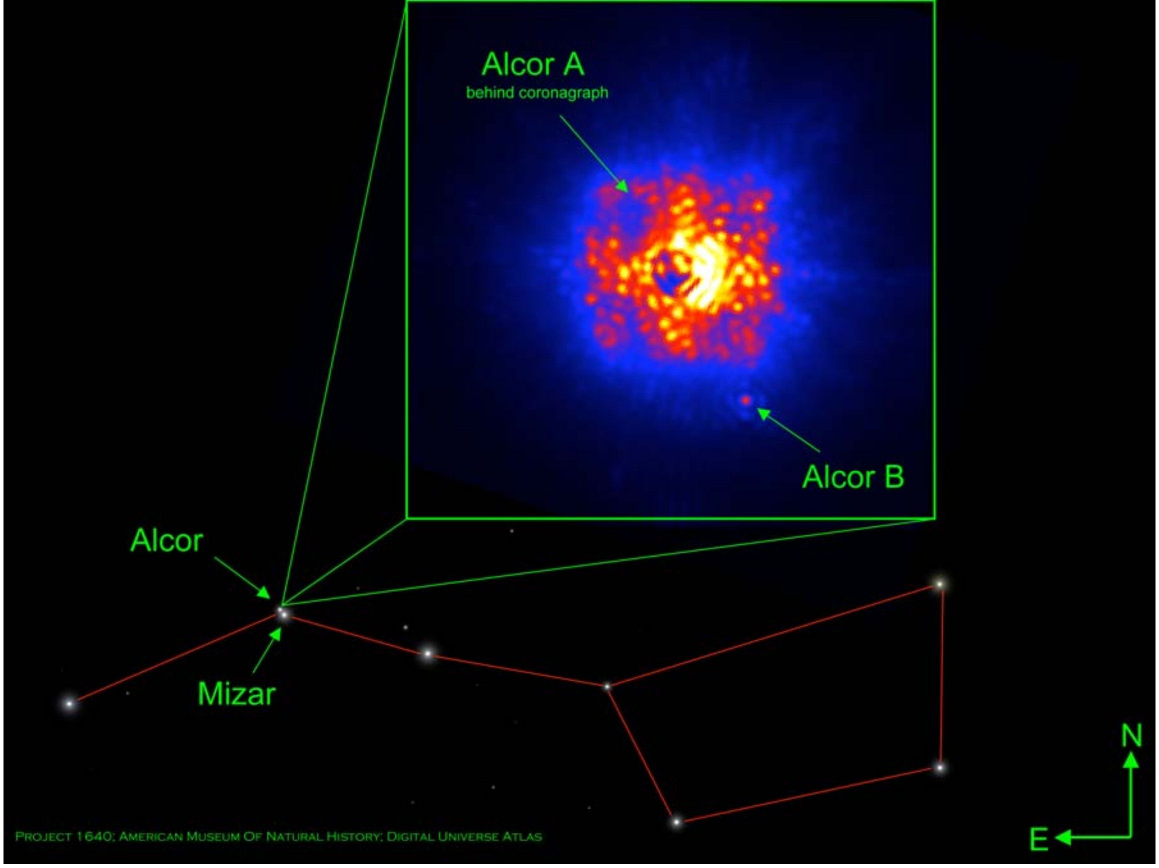
A Faint Star Orbiting the Big Dipper's Alcor Discovered

Next time you spy the Big Dipper, keep in mind that there is another star invisibly (at least to the unaided eye) contributing to this constellation. According to a new paper published in The Astrophysical Journal, one of the stars that makes the bend in the ladle's handle, Alcor, has a smaller red dwarf companion. Newly discovered Alcor B orbits its larger sibling, caught in the act with an innovative technique called "common parallactic motion" by members of Project 1640, an international collaborative team that includes astrophysicists at the American Museum of Natural History, the University of Cambridge's Institute of Astronomy, the California Institute of Technology, and NASA's Jet Propulsion Laboratory.

"We used a brand new technique for determining that an object orbits a nearby star, a technique that's a nice nod to Galileo," says Ben R. Oppenheimer, Curator and Professor in the Department of Astrophysics at the Museum. "Galileo showed tremendous foresight. Four hundred years ago, he realized that if Copernicus was right—that the Earth orbits the Sun—they could show it by observing the "parallactic motion" of the nearest stars. Incredibly, Galileo tried to use Alcor to see it but didn't have the necessary precision." If Galileo had been able to see change over time in Alcor's position, he would have had conclusive evidence that Copernicus was right. "Parallactic motion" is the way nearby stars appear to move in an annual, repeatable pattern relative to much more distant stars, simply because the observer on Earth is circling the Sun and seeing these stars from different places over the year.

Alcor is a relatively young star twice the mass of the Sun. Stars this massive are relatively rare (less than a few percent of all stars), short-lived, and bright. Alcor and its cousins in the Big Dipper formed from the same cloud of matter about 500 million years ago, something unusual for a constellation since most of these patterns in the sky are composed of unrelated stars. Alcor shares a position in the Big Dipper with another star, Mizar. In fact, both stars were used as a common test of eyesight—being able to distinguish "the rider from the horse"—among ancient people. One of Galileo's colleagues observed that Mizar itself is actually a double, the first binary star system resolved by a telescope. Many years later, the two components Mizar A and B were themselves determined each to be tightly orbiting binaries, altogether forming a quadruple system.



Now, Alcor, which is near the four stars of the Mizar system, also has a companion. This March, members of Project 1640 attached their coronagraph and adaptive optics to the 200-inch Hale Telescope at the Palomar Observatory in California and pointed to Alcor. "Right away I spotted a faint point of light next to the star," says Neil Zimmerman, a graduate student at Columbia University who is doing his PhD dissertation at the Museum. "No one had reported this object before, and it was very close to Alcor, so we realized it was probably an unknown companion star."

The team returned a few months later and re-imaged the star, hoping to prove that the two stars are companions by mapping the tiny movement of both in relation to very distant background stars as the Earth moves around the Sun, parallactic motion. If the proposed companion were just a background star, it wouldn't move along with Alcor.

"We didn't have to wait a whole year to get the results," says Oppenheimer. "We went back 103 days later and found the companion had the same motion as Alcor. Our technique is powerful and much faster than the usual way of confirming that objects in the sky are physically related." The more typical method involves observing the pair of objects over much longer periods of time, even years, to show that the two are moving through space together.

Alcor and its newly found, smaller companion, Alcor B, are both about 80 light-years away and orbit each other every 90 years or more. Over one year, the Alcor pair moves in an ellipse on the sky about 0.08 arc seconds in width because of the Earth's orbit around the Sun. This amount of motion, 0.08 arcsec, is about 1000 times smaller than the eye can discern, and a fraction of this motion was easily measured by the Project 1640 scientists.

The team was also able to determine the color, brightness and even rough composition of Alcor B because the novel method of observation that Project 1640 uses records images at many different colors simultaneously. The team determined that Alcor B is a common type of M-dwarf star or red dwarf that is about 250 times the mass of Jupiter, or roughly a quarter of the mass of our Sun. The companion is much smaller and cooler than Alcor A.

“Red dwarfs are not commonly reported around the brighter higher mass type of star that Alcor is, but we have a hunch that they are actually fairly common,” says Oppenheimer. “This discovery shows that even the brightest and most familiar stars in the sky hold secrets we have yet to reveal.”

The team plans to use parallactic motion again in the future. “We hope to use the same technique to check that other objects we find like exoplanets are truly bound to their host stars,” says Zimmerman. “In fact, we anticipate other research groups hunting for exoplanets will also use this technique to speed up the discovery process.”

A Brief History of the Telescope - Part 2

Do you ever wonder who invented the telescope? 2009 was designated as the International Year of Astronomy by the International Astronomical Union. Astronomy would not be the same without the telescope. In this multi-part series, we will give you a brief history of the telescope and how that history influenced the building of Palomar Observatory.

In a previous issue of The Big Eye, we told you about Hans Lipperhey, and how he went to his government with an actual working telescope. Lipperhey’s name has been more or less forgotten over time, as others took this marvelous new invention and started doing spectacular things.

One of those people is the reason 2009 was celebrated as the International Year of Astronomy. Galileo Galilei began using a telescope to study the heavens in 1609 – 400 years ago. And still we look up, seeking “to turn starlight into knowledge”.

When the telescope first appeared on the global stage, it was not known as a “telescope”. There were many different terms used to describe this instrument. The patent office reviewing Lipperhey’s application called it “the instrument for seeing far”. Other names were perspective glass, spyglass, perspective cylinder, perspicillum, and Dutch trunk. It wasn’t until several years later that Galileo christened it “telescopium”.

Galileo was actually not the first person to turn a telescope towards the sky. For example Thomas Harriot, an Englishman, actually started his observations before Galileo.

However, he did not publish his findings until after Galileo. Even back then, "publish or perish" was the rule in the academic community.

Unlike today, Galileo could not simply go to his local telescope store and buy a telescope. He heard of the invention, and a friend gave him a decent description of what it was. Galileo then reverse-engineered the design and built his own device. He constructed a 3-power (3x magnification) telescope in July 1609, presented an 8-power telescope to the Venetian Senate in August, and was observing with a 20-power telescope by November.

He published details of his first observations in 1610. The book immediately made Galileo famous. It was titled Sidereus Nuncius – The Sidereal (or Starry) Messenger. In it he describes (among other things) observations of the moon, and the discovery of the four brightest moons of Jupiter. Even today, these are still often referred to as Jupiter's "Galilean" moons. That's not what he called them, however! Galileo was looking for patronage from the Grand Duke of Florence – the Grand Duke Cosimo II de' Medici. So Galileo named these the "Medicean Stars".

It worked. Galileo was appointed philosopher and mathematician to the Grand Duke, and chief mathematician at the University of Pisa.

It was after he took the job for the Grand Duke that he made another significant discovery. The planet Venus was observed to have phases, like those of Earth's moon, from a crescent to a full circular disc. These observations confirmed that Venus shines by reflected sunlight, not from its own light, and that it must orbit the sun. This led to his belief, like Copernicus, that all of the planets orbit the sun, and that set him on a collision course with the Church.

A second book published in 1613 had definite Copernican overtones, and Galileo was summoned to face the Inquisition. He recanted, but popular legend has it that he muttered "Eppur si muove!" (Nonetheless, it moves) as he left. He was held under house arrest from 1633 until his death in January of 1642.

Almost by himself, he opened up a vast new area of science, and paved the way for the other giants who would follow him.

2010 Programs

Reservations can now be taken for 2010's first Friends of Palomar Observatory observing event: Saturday, May 1 we will have a tour of the 200-inch Hale Telescope to be followed by observing with the 60-inch telescope (weather permitting).

Remember that a Friends of Palomar Observatory membership is required to attend. Space for our 60-inch nights is *very* limited. Advance reservations are required for all events!

Call (760) 742-2131 or e-mail friendsofpalomar@astro.caltech.edu to make reservations.

Mark your calendars for Saturday, June 5 as we will be offering a talk on the Thirty Meter Telescope. Details are not 100% finalized, so check the Friends of Palomar Observatory website in a week or two for the details as they become finalized.

Effective June 15th there will be a rate increase (our first ever) on some of our membership levels and some new membership levels as well. You can beat the price increase by renewing your membership today!

Hale Telescope Mirror Support Engineering Project Completed

At the end of February the Palomar staff, with support from engineers based at Caltech in Pasadena, completed an overhaul of the Hale Telescope's 36 mirror supports. The five-week project required a complete shutdown of the telescope as each of the mirror supports was pulled from the telescope for servicing. The servicing was scheduled to overlap with our most likely time to have clouds and weather that might have interrupted observations anyway. To combat the cold temperatures the inside of the dome was heated to make it easier for the staff to handle the work.

In case you don't know, the mirror supports "float" the 14.5-ton mirror to keep the force of gravity from deforming the glass no matter which way the telescope is pointed. Recently it became obvious that the supports were binding up and not consistently doing their job. Each of the 36 supports has over 1,000 parts. They were taken apart, cleaned and had their bearings replaced. Over 1,400 bearings were replaced on the project.

The mirror supports haven't had this kind of maintenance for sixteen years. Thankfully there was some carryover of staff and knowledge from 1994, the last time the mirror supports received major servicing. That coupled with excellent pre-planning made the recent work go very smoothly. The telescope went back on sky February 28 and all indications so far are that the supports are working as they are supposed to.

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