

OBSERVER

Happy New Year!!



Planetary "SkyJam"

The moon, Venus and Jupiter get up close and personal in this beautiful conjunction on December 1, 2008. Ron shot this image with his Canon Xti with a 105mm lens at f/1 and 800 ISO, from his backyard in Evergreen, Colorado.

Image copyright 2008 Ron Pearson

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JANUARY SKIES

If you receive the magazine *Astronomy Technology* you might want to check out OMI's article on p. 11 and maybe participate in their five-year study on mirror coating longevity. If you're interested I can lend you the magazine. OMI does mirror aluminization and finished mirrors and even finished telescopes. The study does not involve whole mirrors, but small sample mirrors that OMI prepares.

So what happens in January? In the January *S&T* a company that supposedly doesn't sell scopes in the U.S. has a six page spread, more than even Meade has. Of course *S&T* is sold world-wide, so maybe that explains the economics of this phenomenon.

Okay, but what happens in the sky? Well, Perseus is here to save the day once more, as he did thousands of years ago riding the winged horse Pegasus in the Andromeda story, a source of six of our constellations! Perseus saves Andromeda from Cetus the sea-monster. The latter gets turned to stone by our hero's burlap bag hiding Medusa's head (sorry, no constellation for her) and Cetus sinks out of sight whilst A's folks, Cepheus and Cassiopeia, continue their reign as king and queen of someplace. P and A marry, and despite the economic uncertain times he gets a raise! Ta-da!

Continued on Page 3

PRESIDENT'S CORNER

With the holidays behind us, we are looking forward to elections in February and the Banquet in March. Nominations are open. You may nominate yourself or others, with their approval, for office. We hold elections annually and all offices are open.

We are starting the International Year of Astronomy (IYA) with its theme of "The Universe is Yours to Discover". The basic goal of IYA centers on public outreach, something that is right up our alley. With the recent renovation of the University of Denver's Historic Chamberlin Observatory, we are in a great position to devise exhibits, presentations and posters to encourage people to get involved as observers and amateur scientists. This has two sides: one is presenting interesting aspects of astronomy to the public and the other, more important for me, is the chance to have some fun building the exhibits!

You should have received your new annual renewal notice. This year they are pro-rated to catch every one up to a January renewal cycle. This new approach makes the job of treasurer and the ALCOR much easier. People joining for the first time will pay the full dues at the time of joining—and will receive a pro-rated notice during the next renewal cycle.

My renewal notice started me thinking about what the dues actually support! We spend on average \$13.00 for each member that receives a paper newsletter. This only covers the cost of the printing and the stamps. These are folded and mailed by Darrell Dodge and Loraine Krezner. We chip in costs amounting to approximately \$1.00/member for the picnic and this year we chipped in around another \$0.75 per member to support the potluck. We pay \$5.00/member for each member's Astronomical League dues. Other costs



include printing literature to promote our outstanding public outreach program. We support a \$4 member insurance policy to cover outreach activities and the dark site. We pay around \$1.25/member in Dark Site support costs—



DAS President Wayne Green

while the bulk of improvements are covered by users and donations for the site. We pay around \$0.75/member for speakers. This totals close to \$27/member on basic activities. Other expenses push this number over the total amount we charge in dues.

We are able to support this process by a small income from our weekly public outreach efforts. Most of that income is spent to support outreach in the form of equipment and in small grants we are awarding to Dr. Stencel to help keep Chamberlin Observatory a great venue for this work.

There are too many people to thank for their tireless and timely support of DAS, our programs and the outreach work that we do! I especially thank our long-standing members for their continued support. As you can see, the activities of the society are here for you and all you have to do is join us in all the fun things we do throughout the year!

Please remember that we offer the VanNattan/Hansen Scholarship Fund to the tune of \$1,000 for at least one student per year. All applicants need do is to apply!

Remember DAS and the Van Nattan/Hansen fund with your year end donations and. . .

Have a Happy New Year and Clear Skies!—
Wayne Green.

Society Directory

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 Steve Solon, Past President
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The Executive Board conducts the business of the DAS at 7:30 p.m. at Chamberlin Observatory. Please see the Schedule of Events for meeting dates. All members are welcome.

www.denverastro.org

FEB. 6 SPEAKER: DR. DOUGLAS DUNCAN

*Astronomer, Faculty Member in Astrophysical & Planetary
Sciences
Director of Fiske Planetarium, Univ. of Colorado*

by Dr. Douglas Duncan

Dr. Douglas Duncan comes to the University of Colorado from the Department of Astronomy and Astrophysics of the University of Chicago and Chicago's Adler Planetarium, where he helped begin a trend of modernizing planetariums which has spread to New York, Denver, and beyond. He served as national Education Coordinator for the American Astronomical Society, the society which represents the 6,000 professional astronomers in the US. In that capacity he led efforts for better teaching and public communication for astronomers throughout the United States. Dr. Duncan has also been an astronomer on the staff of the Space Telescope Science Institute. There he was responsible for one of the Hubble Space Telescope's original instruments. He and his research team currently study the composition of the oldest known stars - "fossil stars" - which date back almost to the time of the Big Bang. Their discoveries have provided direct evidence of the explosive birth of our Milky Way galaxy, and shed light on conditions at the time of the Big Bang which began the universe itself.

Dr. Duncan is also a specialist in the behavior of stars like the sun: what they are made of, how they are born and evolve, and the "blemishes" and eruptions which mark their surfaces -- sunspots and flares. He has worked at the Lick Observatory in California, developing a method for determining the ages of stars like the sun, and later at California's Mt. Wilson and Palomar Observatories and at Las Campanas Observatory in Chile. He was part of a group which

discovered sunspot cycles on other stars, similar to the 11 year spot cycle seen on the sun. It is these spots and flare eruptions which are the cause of the earth's aurorae—the Northern and Southern lights. Some of Dr. Duncan's most interesting work involved the discovery that when the sun was young it may have been spinning much faster than it is today, throwing off large amounts of material, and radiating strong ultraviolet and x-rays into space. This may well have affected the earth when it was young, and possibly even the development of life.

Dr. Duncan is a national leader in presenting the excitement of scientific discoveries to the general public and a popular speaker. At the age of 19 he became the youngest planetarium speaker ever hired at the Griffith Observatory in Hollywood, California. He has appeared on BBC television and served extensively as science commentator on National Public Radio, where he has made 50, hour-long live radio broadcasts. He has led groups of people in photographing Halley's Comet in South America, to many total eclipses, and into the Arctic to photograph the aurora. His photography has been published by *National Geographic*.

Duncan continues to work with those improving science teaching in the US. He has recently written a book, "Clickers in the Classroom," describing the remarkable way in which inexpensive wireless technology is being used to greatly enhance the interaction between professors and students in lecture classes, and how it can increase enthusiasm and learning. The publisher is Addison Wesley.

Among his avocations, Dr. Duncan counts hiking and exploring, mountaineering, and photography. He "grew up in" the Sierra Nevada mountains in California, and has traveled in the Alps, the Chilean Andes, the Himalayas and the Brazilian Amazon, as well as sea-kayaked along the coast of Alaska. In April, 1993, he traveled to the North Pole, and was elected to The Explorers Club (of New York).

His Internet home page may be found at <http://casa.colorado.edu/~dduncan>.

DECEMBER SKIES (CONTINUED FROM PAGE 1)

Last month we mentioned Eta Persei as a double star at the north point of Perseus. Drift down from the point along the left side of the constellation to its alpha star Mirfak. Mirfak is surrounded by a large, loose star cluster called Melotte 20. This is a gravitationally-relaxed grouping that is actually called an association, a good binocular object. Straight east from Mirfak the Eta-Mirfak distance is cluster NGC1528 which is visible to the naked eye on a good night. Farther down and on the other side of Perseus is the famous variable star Algol (*S&T* p. 74). The cluster M34 is off to the right and up a bit from the Demon Star, the first discovered variable, which was a

scary thing in the old days. Below, south of Perseus are the Pleiades, also known as the Seven Sisters and Subaru, another binocular object which looks better in the finder than in your scope. Now ooze back up towards Perseus, shooting for Epsilon Persei on the left side of the constellation opposite Algol. Halfway there and bit to the right is the bright diffuse nebula IC348, and three-fourths of the way to Epsilon you'll cross, and probably won't notice, the California Nebula, a photographic object.

Back down to the Pleiades. Down and to the left you'll see the vee of Taurus and a bunch of stars embedded therein called the Hyades. Find the Delta and Epsilon

stars of Taurus defining the arm of the vee opposite bright Aldebaran. A line from Aldebaran, which is closer to us than the Hyades cluster, towards and then between Delta and Epsilon will lead shortly to Hind's Variable Nebula, NGC1554-55, which has dimmed and brightened again since its discovery.

Errata: last month I said the December Open House was on the 8th but it was on Saturday the 6th. The Open Houses are always Saturday. I hope my misinformation didn't inconvenience anybody. This month we have two OHs and they are Saturday, Jan 3. and Jan. 31st. Bundle up bodaciously!—Dennis Cochran.

THE ATACAMA LARGE MILLIMETER ARRAY (ALMA): PART TWO

by Ron Mickle

Herein begins Part Two of Ron's excellent article. Ron used numerous citations and references. Please contact him if you're interested in seeing them.—Ed.

TECHNOLOGICAL CHALLENGES

While the high Atacama Desert was chosen for its lack of water vapor, other factors had to be considered. The ALMA site is a seismically active zone, but the source is the tectonic plate over 100 km below the surface. For this reason, the specifications for the radio antenna required 0.3G acceleration in both the horizontal and vertical axis to compensate for seismic events (ALMA Construction).

One of the most significant challenges for the design teams involves the fabrication of the antennas by three manufacturers representing North America, Europe and Japan/East Asia. The result will be the complicated task of combining their electronic signals. There are three manufacturers of the 12 m antennas, representing the three major ALMA partners:

- General Dynamics C4 Systems/VertexRSI (GDweb),
- Alcatel Alenia Space, consortium composed of European Industrial Engineering/Italy and MT Aerospace/Germany (AlcatelWeb), and
- Mitsubishi Electric Co. (NRAO eNews)

Once the antennas are manufactured, they must be delivered to the ALMA site in Chile. Two large transporters were built specifically for the task of moving the antennas up to the array site. Each transporter (Fig. 3) is 20 m long, 10 m wide, weighs 130 tonnes and is capable of transporting each 115 tonne radio antenna on 28 wheels up to the 5000 m site (BBC & NRAO eNews).

The spectrum ALMA will be use to explore includes the coldest regions in the Universe. To achieve this, as much excess thermal radiation as possible needs to be eliminated in the detector. ALMA antennas will incorporate cryostats (Fig. 2), each housing the receivers for the 10 bands, cooled to 4 K (ALMA NA). The design specification for the cryostats considers heat loads, leak rates, and a built in safety factor of 2. The operational plan calls for each cryostat to be serviced every 12 months (Memo 547).

PROGRESS TO DATE

ALMA is scheduled for completion by 2012 (Lo 2008). In January 2008, the UK project manager for 45 cryostats stated that the cryostats would take four years to complete (Science & Technology Facilities Council). This would place the completion date for the cryostats in 2012, allowing for transporting, installing and charging the containers.

To get to this point, political and economic hurdles had to be overcome. Initial concept involved partners from North America and Europe, has since been extended to include East Asia and Chile. Since the antennas for ALMA are the single largest investment in the project, each of the host governments, for



Figure 3. After moving Vertex antenna #2 from the Assembly Building, the transporter sets it down beside #1 on a pad (NRAO eNews, August 2008).

economical reasons, wants part of the construction costs spent within their countries. Prior to production, three antennas were constructed, one each by partners of East Asia, Europe and North America, and tested at the Very Large Array (VLA) in New Mexico, USA to determine which design would be chosen for ALMA. In the end, all three partners will fund production of a portion of the antennas. The disadvantage is when a project of this enormity utilizes different contractors, the economics of producing a smaller number of antennas by each partner increases costs. If the costs increase, there is the very real possibility of a delay (ALMA brochure & EuroNewsletter 2005).

The Operations Support Facility Technical Building (OSF-TB), located at 2900 m, will house offices and sleeping quarters. The Array Operations Site (AOS), located at 5000 m, serves as the equipment installation and retrieval facility for antennas (ALMA NA). Thus far (August 2008), four antennas from Japan and six from North America have been delivered to Chile (NRAO eNews).

NEW SCIENCE FROM ALMA

Within 500 light years, ALMA should provide a better understanding of the physical properties of the gas surrounding protostars and protoplanetary disks around young solar type stars (Tarengi 2008). Simulations (Fig. 4) show that the planet-disk interactions usually result in voids and spiral density waves created within the circumstellar disk. Structures within the disk may be detected through high spatial resolution mapping of the thermal dust reemission. Associated with newly formed stars, and a target for ALMA, are jets and outflows from compact circumstellar cores and disks, particularly emissions from large scale molecular clouds (Shepherd 2008).

Previous discoveries using deep submillimeter surveys of dusty star forming galaxies at high-z are prime candidates for ALMA.

ALMA Band	Frequency Range
1	31.3 - 45 GHz
2	67 - 90 GHz
3	84 - 116 GHz
4	125 - 169 GHz
5	163 - 211 GHz
6	211 - 275 GHz
7	275 - 373 GHz
8	385 - 500 GHz
9	602 - 720 GHz
10	787 - 950 GHz

Figure 1. De Breuk (ESO), presentation on requirements of ALMA. BOLD indicates ACA bands.

These evolving galaxies comprise a significant number of the far IR/submm background. The identification of these galaxies are difficult, in that identification is done using optical and/or near IR, with poor resolution, which renders their distance at $z > 2.4$ as uncertain. ALMA will build upon existing science by probing in greater detail than has ever been possible. ALMA will be used to explore the spectral line emission detection of the cold dust continuum from evolving galaxies at high- z . It will be able to accomplish this in less time and greater resolution than was previously possible (De Breuck 2004). ALMA will also have the ability to detect the carbon monoxide (CO) molecule, and both molecular and ionized carbon (CI, CII) at $z = 3$ in less than 24 hours of observations, whereas previous detection of emissions from high- z galaxies could take one to two days of total observing time (Tarenghi 2008).

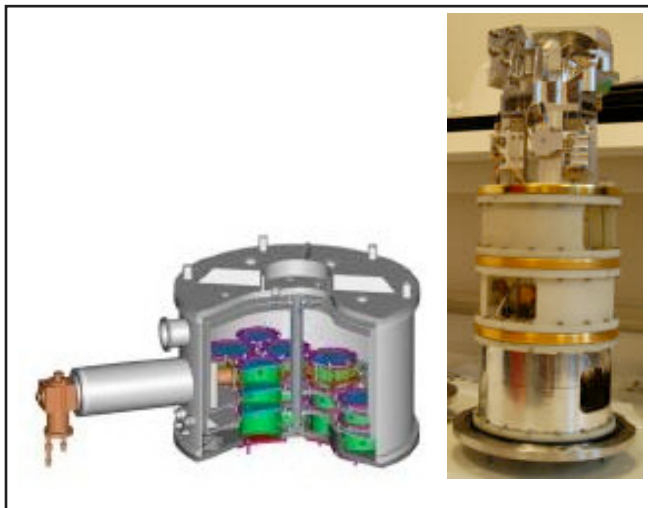


Figure 2. The frequency Band 9 receiver cartridge (right) contains two receivers. Receivers for each antenna utilize superconducting mixers operating at 4 K. The receivers are housed in the cryostat (left) which is located at the Cassegrain focus of each antenna (Tarenghi 2008).

A major goal of ALMA will be studying objects at extreme redshifts, beyond the period of reionization at $z > 7$, where it should be able to detect spectral emissions from CII as well as rotational transitions in CO at $J > 7$. Narrow band surveys conducted in recent years have shown populations of Lyman Alpha Emitters (LAE) at distances beyond $z = 6.6$. LAE's, are distant galaxies that emit Lyman radiation and indicate the objects are undergoing star formation. Based on their far UV (130 - 180 nm) luminosities and star formation rates at $\sim 10 M_{\odot} \text{ yr}^{-1}$, this places their redshift at the end of reionization. At the high- z shifts of the LAE's, the CII line is within the 1 mm Band 6 (Fig. 1) (211 - 275 GHz) of ALMA (Walter & Carilli 2007).

CONCLUSION

When fully operational, ALMA will be unsurpassed in angular resolution. But many hurdles had to be overcome. The consortium to develop ALMA, initially two geographic regions, grew to three. The development and manufacturing of the antennas went from one design to three designs and three manufacturers. The 5000 m observing site on the Chajnantor plain, high in the Atacama Desert in northern Chile poses its own problems for construction crews and scientists. The fact that the ALMA site is a seismically active zone required the design teams to build the antennas, which weigh 115 tonnes each, to specifications allowing for a 0.3G acceleration in both the horizontal and vertical axis.

ALMA will allow astronomers to probe further back in time and in greater detail than ever before, to the very moments before the Big Bang. And it will provide scientist their best views into the workings of protostar formations and the circumstellar dust disks that hide newly formed planets. Prior to ALMA, distant galaxies at extreme redshifts, reaching beyond $z = 6.6$ hints at star formation, but details are beyond the grasps of existing telescopes. ALMA will change that.

ACKNOWLEDGEMENTS

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Figure 4. Simulation of ALMA 900 GHz observations of a circumstellar disk with an embedded planet of 1 MJ around a 0.5 M_{\odot} star (orbital radius: 5 AU). The assumed distance is 50 pc (left)/100 pc (right). Only structures above the 2σ -level are shown. The size of the synthesized beam is symbolized in the lower left edge of each image. Note the reproduced shape of the spiral wave near the planet and the slightly shadowed region behind the planet in the left image (Wolf & D'Angelo 2005)

A NEW OBSERVATORY AT COMMUNITY COLLEGE OF AURORA

by Jerry M. Sherlin



Since 2001 I've been an astronomy teacher at the Community College of Aurora (CCA). For years if we wanted to use our C-8 SCT we had to bring it from the astronomy-geology store room, set up and align it somewhere outside, then take it back in when finished—a tedious and time consuming procedure. In 2007 I proposed acquiring a small observatory to house our scope and was overjoyed when the proposal was enthusiastically supported by our college president, science department chair, and the financial foundation. We were suddenly on our way to an incredible enhancement of our astronomy program at CCA.

When the plans and funding were eventually finalized we were able to go

beyond my initial modest goals by acquiring a Technical Innovations, 15 ft. Pro-Dome observatory. Through a generous bequest, the observatory also acquired a Celestron C-14, Paramount mount, and a top of the line Apogee CCD camera. The instrumentation is now going through a final “shakedown cruise” and will be available for regular use in early 2009.

As you can see from the photos, the complete (disassembled) observatory arrived in a 500 cubic foot box. Prior to its arrival a 400 sq. ft. concrete pad had been poured and complete underground electrical wiring installed: the foundation was ready to receive the building when it arrived. We unpacked the crate at the

construction site and proceeded, as weather and teaching time permitted, to put the observatory together. Members of the college's grounds and maintenance department helped with the unpacking and the initial construction. In addition, the astronomy faculty and the science department chairperson herself were on hand to unpack and help with construction.

The Technical Innovation buildings are made of fiberglass resin and the observatory building consist of a series of rings mounted on top of each other and surmounted by a dome. How tall you want the building to be is determined by the number of rings you purchase and how much you want to spend (you pay for

ABOUT THE DAS

Membership in the Denver Astronomical Society is open to anyone wishing to join. The DAS provides trained volunteers who host educational and public outreach events at the **University of Denver's Historic Chamberlin Observatory**, which the DAS helped place on the National Register of Historic Places. First light at Chamberlin in 1894 was a public night of viewing, a tradi-



tion the DAS has helped maintain since its founding in 1952.

The DAS is a long-time member in good standing of the **Astronomical League** and the **International Dark Sky Association**. The DAS' mission is to provide its members a forum for increasing and sharing their knowledge of astronomy, to promote astronomical education to the public, and to preserve Historic Chamberlin Observatory and its telescope in cooperation with the University of Denver.

The DAS is 501 (c)(3) tax-exempt corporation and has established three tax-deductible funds: the Van Nattan-Hansen Scholarship Fund, the Public Outreach Fund and the Edmund G. Kline Dark Site Fund. To contribute, please see the bottom of the membership form for details (found on the DAS website: thedas.org).

More information about the DAS, its activities and the special tax-deductible funds is available on the DAS website at www.denverastro.org.

each ring). Two things we found out "right out of the box" were that (1.) you're not going to build this in a day by yourself and (2.) these *semi*-rigid rings and dome sections flex so construction on a windy day can be dicey. Trying to maintain a perfect (or as near as possible) circular configuration during assembly is NOT easy and requires several hands. These buildings are also not completely weather tight so some amount of time has been spent sealing the seams. The observatory dome and shutter are fully motorized and may be slaved to a computer. If you purchase one of these observatories it will certainly help to have a work crew with someone assisting who has done this before!

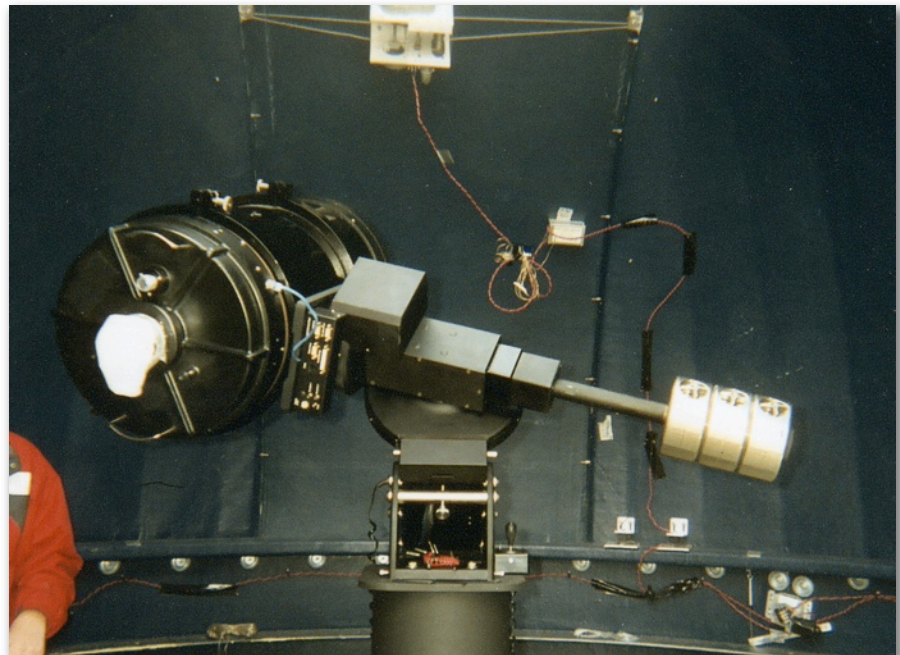


Above: The complete (disassembled) observatory arrived in a 500 cubic foot box.



Left: Assembling the observatory on the grounds of the Community College of Aurora.

Finally, we expect the observatory to be completely operational in early 2009. Once this is accomplished we plan to have a special evening of observing for the DAS. We'll see you then.



Right: The observatory was given a Celestron C-14 telescope, a Paramount mount and top of the line Apogee CCD camera.

S&S OPTIKA HAS MOVED TO:

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www.sandsoptika.com

DAS SCHEDULE

JANUARY

- 3 Open House at Chamberlin Observatory (Begins at 5:00 P.M.)
- 9 General Meeting at D.U.'s Olin Hall (Begins at 7:30 P.M.)
- 16 E-Board meeting at Chamberlin Observatory (Begins at 7:30 P.M.)
- 23-25 EGK Dark Sky weekend
- 31 Open House at Chamberlin Observatory (Begins at 5:00 P.M.)

FEBRUARY

- 6 General Meeting and elections at D.U.'s Olin Hall (Begins at 7:30 P.M.)
- 13 E-Board meeting at Chamberlin Observatory (Begins at 7:30 P.M.)
- 20-22 EGK Dark Sky weekend

Public nights are held at Chamberlin Observatory every Tuesday and Thursday evenings

beginning at the following times:

March 9 - April 14 at 8:00 p.m.

April 15 - September 1 at 8:30 p.m.

September 2 - March 8 at 7:00 p.m.

Costs to non-members are: \$3.00 adults, \$2.00 children.

Please make reservations via our website (www.denverastro.org) or call (303) 871-5172.



The Denver Astronomical Society
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