The Objective View

December 2003

Newsletter of the Northern Colorado Astronomical Society

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Next Meeting: December 4 7:30 PM
Show and Tell Meeting
NCAS Members

NCAS Business with Officer Nominations
7 PM

Meeting directions Discovery Science Center
703 East Prospect Rd, Fort Collins
http://www.dcsm.org/index.html
In Fort Collins, from the intersection of College Ave and Prospect Rd, head East about 1/2 mile. See the Discovery Center sign to the South. Enter the West Wing at the NE corner. From I-25, take Exit 268, West to Lemay Ave, continue West 1/2 mile, see Discovery Center on the left.

Starwatch at Discovery Science Center
January 30 6:30 pm
February 27 6:30 pm

NCAS Dark Sky Star Party Dates
December 19, 20, 26, 27
Cactus Flats site is on undeveloped parcel of prairie about 6 miles West of Briggsdale. Take Colo Hwy 14 East from I-25 (Exit 269). Go 19 miles East to Ault. Continue 18 miles East of Ault. At County Rd 65 (Milepost 170), turn North, go one mile. Site is through the wire gate on the right, no road, close gate and set up. Beware of the cactus. Our standard nights are the weekend of the New Moon, sometimes a weekend before and after. The site is now officially wheelchair accessible, but there are no facilities so bring essentials. Call **Tom Teters,** tomt@starmon.com **,** with questions about star party status or dates, 482-5702.

NCAS Meetings
January 2 Apollo 13, Jess Hughley

Other Events

Little Thompson Observatory Star Night, Berthoud
December 19 Star Night 7 – 10 pm
Michael Hotka Mars Express
http://www.starkids.org

Cheyenne Astronomical Society, Cheyenne Botanical Garden
December 19 7 pm
Please RSVP 307 635 5944
http://home.bresnan.net/~curranm/

Open House, Chamberlain Observatory, dusk to 10 pm
Dec 27, Jan 24, Feb 28, Mar 27, Apr 24 303 871 5172
http://www.du.edu/~rstencel/Chamberlin/

Longmont Astronomical Society
Dec 18 7 pm Longmont Christian School, 550 Coffman St
http://laps.fsl.noaa.gov/cgi/las.cgi

Global Net of Astronomical Telescopes Needs You
Dr. Culver has short-period variable star candidates which need monitoring. If you can contribute CCD images of selected 15th to 18th magnitude stars, please call Dr. Culver in the Physics Dept, CSU, 491-6206 for more information.

November 6 Program
Our Sun: A "Typical" Star That We Know, But Don't Understand
Dr. Greg Kopp, LASP, CU-Boulder
More on Thursday's program from Dr. Greg Kopp, Instrument Scientist at the Laboratory for Atmospheric and Space Physics at the University of Colorado at Boulder

Our Sun is a typical, 30-something star: past its active adolescence, and expected to be pretty constant until it runs low on energy in its cantankerous old age. Yet even in its current "constant" state, minor variations in its regular heartbeat can have significant impact on the Earth. And as a typical main sequence star, the Sun is an observational laboratory showing us phenomenal detail of what other stars are like. Half-century old solar telescopes show details on the Sun with 5000 times better spatial resolution than today's best adaptive optics telescopes can hope to achieve on the nearest stars; newer ground- and space-based solar instruments are even more impressive.

What does this level of detail provide? We have superb observations of solar storms, and are improving solar activity forecasts. We have long time series of the Sun's variability, and are linking these to the Earth's climate. We even have the ability to "see" inside the Sun, hoping to understand its heartbeat. These current observations of the Sun are improving our understanding of some major solar puzzles of the last few decades.

Kuiper Airborne Observatory is a 1 meter telescope in a C141 transport aircraft. The telescope is isolated by 2 stages of shocks and springs, and a massive air bearing. It tracks with a servo system. It carries infrared instruments above most atmospheric water vapor in the troposphere, flying at 45000 feet. KAO flew to Guam for a total solar eclipse in 1988. Dr. Kopp had his most problematic trip in 18 years, dealing with broken autopilot and an all-night repair of the liquid He cryo system. A mechanic's screwdriver was unaccounted for, threatening to ground the airplane, but the mission was ultimately flown. It was a test of solar atmosphere models, gathering data on solar limb extensions in far IR. The lunar limb moved 0.0512 arcsec per second, allowing a far more detailed plot of the solar limb than direct imaging can. If we know the Sun's behavior in detail, we are better able to plan orbit boosts for satellites and the International Space Station. When the Sun is active, Earth's tenuous ionosphere can exert more drag, and in a couple days the ISS orbit can drop by 15 km. The Sun is a relatively quiet star. It is 4.5 billion years old, has a radius 100x Earth's, and a mass 300,000x Earth's. Total solar energy rate is $3.8x10^{23}$ kW/second. One second of solar output would power the US for 9 million years. The Sun's core is extremely dense. A photon created there takes about a million years to reach the surface. The Sun is nearly all hydrogen. Records of Sun observation date to the earliest eclipse record in 1223 BCE in Syria, sunspot observation in 800 BCE China, first mention of the solar corona in 968, and our Sun-centered system dates from 1543. The new telescope was turned to the Sun by Galileo, Goldschmidt and others around 1610. Galileo thought sunspots were openings in a luminous solar atmosphere. In 1843, Schnable was looking for solar transits by unidentified planets, and noted the sunspot cycle. In 1852 he found the connection with geomagnetic activity. In 1909 the magnetic nature of sunspots was discovered. Solar spectroscopy was born in 1817. Fraunhofer observed dark lines in the solar spectrum, which he used to identify constituent elements. Helium was found first on the Sun. The current model places 1/2 of the Sun's mass in its core, which comprises 2% of the volume. The density is 150 grams/cc, pressure is >200 atm, and temperature is 16,000.000 K. Outside the core is the radiative zone, then the outer 1/4 radius is the convective zone. The visible surface of the outer layer has bubbles which regenerate in about 15 minutes. It is the home of sunspots. The model was pretty good by the 1960s. Oscillation on the surface was discovered then, and about a million modes have been observed. Solar seismology reveals temperature, density, constituents, and gas velocities in the unseen layers. Dr. Kopp's former classmate now does holographic imaging of the far side. This relies on absorbtion or scattering of waves, influenced by features that we can't view directly. The Sun rotates in about 27 days, allowing confirmation. In the 1980s observers went to Antarctica for near continuous observing. Since 1995, spectacular images were relayed by the SOHO mission, from the craft stationed at the L1 Lagrangian point. The GONG project of six stations scattered around the globe usually has 2 gathering data. We have learned that the radiative zone turns as a rigid sphere. Shear is strong at its boundary. This may generate the sunspot cycle. There is a pulsation with a 1.3 year period. Observations are currently way ahead of the astrophysicists. Sunspots have a magnetic field up to 4000 gauss. Strong fields are not always associated with spots. The solar surface magnetic field changes with an 11 year period, and takes 22 years for a complete cycle. The mechanism is unknown. Magnetic polarity of sunspots is opposite, when N and S hemispheres are compared. A spectrograph is scanned across the surface of the sunspot to measure the Zeman splitting, and determine field srength and polarity. Temperature is 4000 K, surrounded by 6000 K on the surface. Spots can last days to months. Flares occur by magnetic loops at the surface. Prominences are gas trapped in magnetic loops. They can look like dark bands. Helioseismology can provide a model for the temperature and flow under spots. Spots lag behind rotation of the surface. Solar irradiance increases a little when the sunspot number increases, about 0.1% brighter at the peak. Viewed in extreme UV or Xray, it is 100x brighter. The chromosphere is visible in H-alpha emission, and is pressure dominated. The corona is 2 millon K, and is magnetic field dominated. The TRACE spacecraft made impressive time-lapse images of coronal loops. A solar flare occurs when a loop breaks, and a plasma tube collapses and strikes the Sun. Flares are brightest at 171 angstroms. These are the most explosive events. Coronal mass ejections occur when magnetic loops buoy up to the surface, and the field causes violent release of plasma from the surface. Mass can be 10e13 kg, and velocity is 100-1000 km/s. Good imaging relies on radial gradient filters in the coronagraph. A particularly impressive SOHO image was recorded on March 20, 2000. Extreme solar activity can trigger aurorae at low latitudes, confusion in migratory birds, damage in power grids, and spacecraft loss. Communications disruptions are common. A historic low in sunspot numbers was associated with the "Little Ice Age" in Europe, 1645-1715. This correlates with a change in the beryllium recovered from ice cores. We recently experienced the largest solar flare on record. A large flare changes the total solar irradiance only 240 ppm. Remaining solar puzzles are the mechanism of coronal heating, the Sun's effect on climate, and the reason for the 22 year sunspot cycle.

Bio: Astronomy is a great excuse to build instruments, and solar physics has some of the most demanding applications of optical systems. Throughout his varied career (PhD at Stanford Univ. & NASA/Ames Research Center, postdoc at the National Solar Observatory, Director of R&D at Meadowlark Optics, Sr. Systems Engineer at Ball Aerospace, and Research Scientist at the Univ. of Colorado), Dr. Kopp has enjoyed building solar instruments and observing with them at facilities such as NASA's Kuiper Airborne Observatory, Kitt Peak, Sac Peak, Mauna Kea, Mauna Loa, Haleakala, and NASA's recently launched SORCE spacecraft. Along the way, he's inadvertently learned a bit about the Sun too…

NCAS Business, October 2 2003

President Dan Laszlo called the meeting to order. Local starwatching events were announced. Recent aurora borealis sightings were described. Max Moe announced upcoming NCAS programs.

Sun-Earth Alert
Solar Terrestrial Dispatch
http://www.spacew.com

Images and Movies of this event are available at:
http://www.spacew.com/astroalert.html

05 November 2003

A RECORD-BREAKING SOLAR FLARE & MID-LATITUDE AURORA WATCH

At approximately 19:47 UTC (2:47 pm EST) on 04 November, active sunspot complex 10486 spawned what is probably the most intense x-ray flare in history. X-ray sensors on-board the GOES spacecraft are only capable of registering x-ray intensities up to a class X17.4 level. X-ray intensities beyond this level saturate the detectors. This solar flare saturated the x-ray detectors for 11 minutes, leaving space weather forecasters and scientists with some work to try and extrapolate the true intensity of the event. Based on a preliminary extrapolation, it appears that this x-ray flare peaked somewhere between the X30 and X40 levels, which was unheard of until yesterday and is possibly as much as twice as energetic as the X17 solar flare observed on 02 November.

To place this event into historic perspective, it very likely ranks as the most powerful x-ray flare ever observed. During the last two weeks, active Region 10486 has produced three x-ray flares that have ranked within the top 10 of the most intense events in history. It has been quite a ride!

Region 10486 has now rotated behind the western limb and out of view. It will now spend the next two weeks traversing the far side of the Sun. Whether it survives its passage on the far-side and returns to the eastern limb in two weeks in a form still capable of producing energetic events remains unknown. It is possible it could return in a form still capable of producing energetic events, but the odds are against it.

Although only time will tell, observers on Earth will be able to monitor its progress indirectly by watching for coronal mass ejections that occur on the far side of the Sun, but are still visible from Earth via the SOHO LASCO cameras.

Spectacular imagery of this solar flare and the associated high velocity coronal mass ejection are available from the SOHO web site: http://soho.nascom.nasa.gov/hotshots

A movie of the event in the light of hydrogen is also available from: http://www.spacew.com/x30ha.gif

It is known that yesterdays remarkable solar flare was associated with a coronal mass ejection. The vast majority of mass thrown out was directed well to the west of the Earth. However, a small portion was also directed Earthward. That portion is expected to impact the Earth on 06 November. After the disturbance arrives, it may be capable of producing periods of minor to major geomagnetic and auroral storm activity. A disturbance as large as was observed on 29 and 30 October is not expected. Nevertheless, auroral activity could become visible from many middle latitude locations.
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=======AstroAlert is a free service of SKY & TELESCOPE, the Essential
Magazine of Astronomy (http://SkyandTelescope.com/).

From DSW:

Fantastic Jupiter Image by Cassini
NASA/JPL just released a fantastic, detailed image of Jupiter, a mosaic, from Cassini's flyby in late 2001. You may want to put this in the newsletter and announce at the club meeting. I'm the webmaster and calibration engineer on the imaging team for Cassini (a way cool job!) so i'm up on
these things ;-)

http://www.ciclops.org/

A direct link to the release page:
http://ciclops.lpl.arizona.edu/PR/2003K13/PR2003K13A.html

Fantastic Mars Site from Tom T:
I'd give this page ****, beauty & science The images look very artistic with scientifically valid data. Including Animations, these are Mars Orbiter Laser Altimeter (MOLA) renderings. These are visualizations of Mars in ancient, today's and future settings. Made with DEM15.6 and Terragen 8.11 and 8.44.
http://www.space4case.com/mars/mars5/mars_5.html

Also from Tom:
Greetings all,
I've added some new weather links,
a little technical and some climatological.

http://ncastro.org/weather.html
(If you have any other weather links you think would be
of a benefit to the group please drop me a line.)

URL for Clear Sky Clocks for Colorado
http://cleardarksky.com/csk/prov/Colorado_clocks.shtml

Best Looks

Moon	By Mars 12/1
	By Saturn 12/10
	By Jupiter 12/15 and 16
	By Venus 12/25
Mercury	Low in SW first 2 weeks, eves
Venus	low in SW at sunset
Mars	Bright in S after sunset
Jupiter	High in E predawn
Saturn	Overhead around midnight
Uranus	In Aquarius evenings
Neptune	In Capricornus evenings

Geminid Meteor Peak on December 12-13, suffers from a very bright Moon.

From: Dan Laszlo
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TO: