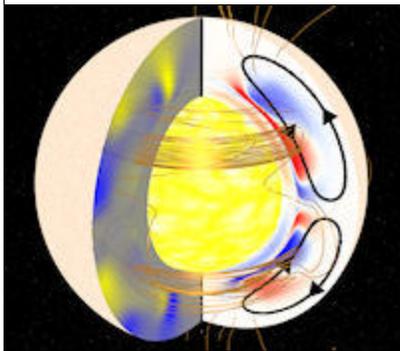


Researchers Crack the Mystery of the Missing Sunspots

In 2008-2009, sunspots almost completely disappeared for two years. Solar activity dropped to hundred-year lows; Earth's upper atmosphere cooled and collapsed; the sun's magnetic field weakened, allowing cosmic rays to penetrate the Solar System in record numbers. It was a big event, and solar physicists openly wondered, *where have all the sunspots gone?* Now they know. An answer is being published in the March 3rd edition of *Nature*.



In this artistic cutaway view of the sun, the Great Conveyor Belt appears as a set of black loops connecting the stellar surface to the interior. Credit: Andrés Muñoz-Jaramillo of the Harvard CfA.

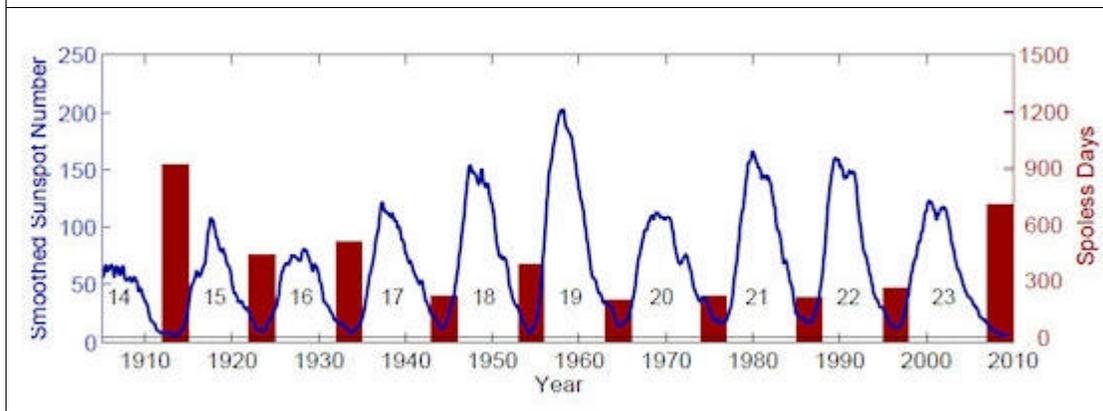
"Plasma currents deep inside the sun interfered with the formation of sunspots and prolonged solar minimum," says lead author Dibyendu Nandi of the Indian Institute of Science Education and Research in Kolkata. "Our conclusions are based on a new computer model of the sun's interior."

For years, solar physicists have recognized the importance of the sun's "Great Conveyor Belt." A vast system of plasma currents called 'meridional flows' (akin to ocean currents on Earth) travel along the sun's surface, plunge inward around the poles, and pop up again near the sun's equator. These looping currents play a key role in the 11-year solar cycle. When sunspots begin to decay, surface currents sweep up their magnetic remains and pull them down inside the star; 300,000 km below the surface, the sun's magnetic dynamo amplifies the decaying magnetic fields. Re-animated sunspots become buoyant and bob up to the surface like a cork in water—voilà! A new solar cycle is born.

For the first time, Nandi's team believes they have developed a computer model that gets the physics right for all three aspects of this process--the magnetic dynamo, the conveyor belt, and the buoyant evolution of sunspot magnetic fields.

"According to our model, the trouble with sunspots actually began in back in the late 1990s during the upswing of Solar Cycle 23," says co-author Andrés Muñoz-Jaramillo of the Harvard-Smithsonian Center for Astrophysics. "At that time, the conveyor belt sped up."

The fast-moving belt rapidly dragged sunspot corpses down to sun's inner dynamo for amplification. At first glance, this might seem to boost sunspot production, but no. When the remains of old sunspots reached the dynamo, they rode the belt through the amplification zone too hastily for full re-animation. Sunspot production was stunted.



Sunspot cycles over the last century. The blue curve shows the cyclic variation in the number of sunspots. Red bars show the cumulative number of sunspot-less days. The minimum of sunspot cycle 23 was the longest in the space age with the largest number of spotless days. Credit: Dibyendu Nandi et al.

Later, in the 2000s, according to the model, the Conveyor Belt slowed down again, allowing magnetic fields to spend more time in the amplification zone, but the damage was already done. New sunspots were in short supply. Adding insult to injury, the slow moving belt did little to assist re-animated sunspots on their journey back to the surface, delaying

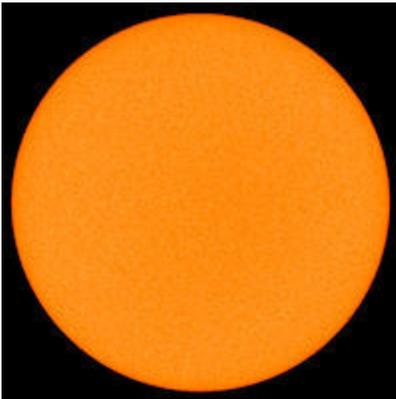
the onset of Solar Cycle 24.

"The stage was set for the deepest solar minimum in a century," says co-author Petrus Martens of the Montana State University Department of Physics. Colleagues and supporters of the team are calling the new model a significant advance.

"Understanding and predicting solar minimum is something we've never been able to do before---and it turns out to be very important," says Lika Guhathakurta of NASA's Heliophysics Division in Washington, DC.

While Solar Max is relatively brief, lasting a few years punctuated by episodes of violent flaring, over and done in days, Solar Minimum can grind on for many years. The famous Maunder Minimum of the 17th century lasted 70 years and coincided with the deepest part of Europe's Little Ice Age. Researchers are still struggling to understand the connection.

One thing is clear: During long minima, strange things happen. In 2008-2009, the sun's



Three years ago on March 2, 2008, the face of the sun was featureless--no sunspots. Credit: SOHO/MDI

global magnetic field weakened and the solar wind subsided. Cosmic rays normally held at bay by the sun's windy magnetism surged into the inner solar system. During the deepest solar minimum in a century, ironically, space became a more dangerous place to travel. At the same time, the heating action of UV rays normally provided by sunspots was absent, so Earth's upper atmosphere began to cool and collapse. Space junk stopped decaying as rapidly as usual and started accumulating in Earth orbit. And so on...

Nandi notes that their new computer model explained not only the absence of sunspots but also the sun's weakened magnetic field in 08-09. "It's confirmation that we're on the right track."

Next step: NASA's Solar Dynamics Observatory (SDO) can measure the motions of the sun's conveyor belt--not just on the surface but deep inside, too. The technique is called helioseismology; it reveals the sun's interior in much the same way that an ultrasound works on a pregnant woman. By plugging SDO's high-quality data into the computer model, the researchers might be able to predict how future solar minima will unfold. SDO is just getting started, however, so forecasts will have to wait.

Indeed, much work remains to be done, but, says Guhathakurta, "finally, we may be cracking the mystery of the spotless sun."

Credits: This research was funded by NASA's Living With a Star Program and the Department of Science and Technology of the Government of India.

Author: [Dr. Tony Phillips](#) | Credit: Science@NASA

NEAF's Solar Star Party

Planning for the North East Astronomy Forum's Solar Star Party (NSSP) is in full swing with a full line up of activities planned. This free event, held in association with NEAF, features dozens of solar telescopes covering the visual wavelengths of the sun from white light to Calcium K to Hydrogen-Alpha (and possibly a couple more). Get expert information on solar observing, imaging and equipment from volunteers and vendors from around the globe.

April 16 - 17, 2011 9AM to 4PM 145 College Road Suffern, New York

See the sun through equipment made by world class vendors:

Lunt Solar Systems	DayStar	Coronado Instruments
Solar Scope	Shelyak Instruments	Questar
Denkmeier	Solarscope	

The 20th Anniversary main stage lights up with presentations from "The Solar Panel" of avid solar enthusiasts. National presenter Gary Palmer, accomplished imager Alan Friedman, outreach specialist Stephen Ramsden and Solar System Ambassador Greg Piepol (me). <http://www.neafsolar.com/neafstage.html>

Also this year, follow Stephen and the adventures of his new outreach mobile - The SUN Specific Public Outreach Truck (THE SUNSPOT) as it makes its way to Suffern and the solar observing field. <http://www.neafsolar.com/sunspot.html>

Last but not least, the sun has started to awaken from its long solar minimum with some nice activity recently. The NSSP offers you one of the most unique settings in which to see the sun - at the eyepiece with the filter manufacturer present. So keep your fingers crossed for a clear sky and an active sun.

Please join us for what Barlow Bob calls "the golden age of solar observing".

From the NEAF floor to the stage to the field outside, this year's NSSP looks to be the most radiant yet!

<http://www.neafsolar.com>

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BARLOW BOB'S CORNER

THE ASTRO LOUNGE

Barlow Bob

Most amateur astronomers are familiar with RAC Rockland Astronomy Club in Suffern, NY, as the presenter of NEAF Northeast Astronomy Forum. NEAF is their annual Expo of amateur astronomy products and related activities. However, RAC also presents their annual SSP Summer Star Party. SSP is a ten day star party.

SSP 2011 will be held from July 29 to August 7th.

<http://www.rocklandastronomy.com/SSP/index.html>

This event is held in the Shady Pines Family Campground in Savoy, MA. Savoy is in the Berkshire Mountain region of western Massachusetts. Shady Pines is a beautifully maintained large campground, with many family oriented camping and summer sports activities. There are regular bathrooms and hot showers that you have at home. There is a large dining and recreation hall. A large gazebo building with many picnic tables is a great place to meet on rainy days. The SSP observing field is a long grassy area with a low southern horizon. The grass is beautifully maintained like a golf course. There are electrical outlets on the edge of the field. Civilization is just a short drive away, in Pittsfield, MA. There are also a variety of other attractions in the Berkshire Mountain region, including Tanglewood and Norman Rockwell Museum.

Amateur astronomers attend SSP for the camaraderie, while observing at this dark sky site. However, to me, the highlight of SSP is Ed Siemenn's Astro Lounge. On Friday afternoon, Ed drives his truck pulling a large cargo trailer filled with a variety of camping gear and a portable vinyl observatory.

He assembles the observatory floor consisting of foam rubber interlocking sections. A heavy duty portable pier mount base is placed in the center of the floor. Next he assembles a PVC pipe frame over the floor. This frame is covered with a white vinyl roof and walls. A long rope of red LED lights is placed around the base of the observatory walls. Several curved tables are placed next to the walls. Several laptop computers and a CD player are placed on the tables. One laptop controls the mount. The others contain every digital star chart known to man. The temperature inside of the observatory is regulated by a climate control system. No fans for Ed. This moves air into or out of the observatory to regulate the temperature inside of the observatory. Dual five and four inch AP refractors are attached to the AP mount.



Once the observatory is assembled, he sets up an extremely large tent next the large round observatory wall entrance. This is the Astro Lounge. Large oriental rugs cover the floor of the tent. A variety of canvas and plastic camping furniture fills the interior. These include chairs, a couch, cocktail table, end tables, potted palm trees, a red light floor lamp, several red lava lamps, a fully stocked bar, a popcorn machine, and a laptop to watch movies on cloudy nights.



An extremely large screened dining tent is placed outside of the entrance to the Astro Lounge, over a campground picnic table. This is the Astro Café. A table cloth covers the table. Meals in the café are served on fine ceramic dinnerware, with silverware and glasses. No paper or plastic dinnerware for Ed. A potted palm, cappuccino machine, and portable refrigerator line the café. Ed prepares gourmet omelets for breakfast.

Next to the Astro Café, is the Astro Kitchen. There are several gourmet stainless steel camp stoves and a stainless steel lobster pot. A large plastic wash sink with a garden hose is used to wash the dinnerware and utensils.

Each year Ralph Marantino and I buy Ed something for his Astro Lounge. We bought him a metal chandelier with red lights and paper star-shaped red lights. We bought gour-

(Continued on page 6)

Mid-Atlantic Mirror Making #11



Magazine Subscriptions

As a paid member of DMSG, you can sign up/renew your S&T or Astronomy mags through the club for a discount over private rate. S&T, reg. \$42.95, is \$32.95 thru DMSG, Astronomy, reg. \$44, is \$34. See Michael Lecuyer for details.

(Continued from page 4)

met cheese cake and ice cream cakes. Ed bought lobster for dinner.

You call Ed on your cell phone from the SSP observing field, to make a reservation in the Astro Lounge. When I leave the Astro Lounge to go to the bathroom, I return to the real world walking across the SSP observing field.

Lenny's Star Geezer Lounge is an alternative to the Astro Lounge. Barlow Bob's agent Len Salvatore and the wife of Barlow Bob's agent Audrey Salvatore place their large tent over a campground picnic table. Lenny's does not have the flashy glitter of the Astro Lounge and Astro Café. Lenny's has the charm of your neighborhood restaurant. The Stargeezer Lounge is the Cheers of SSP, where everybody knows your name.

There is a red LED flashlight hanging from the tent ceiling, casting a faint red glow on the camp picnic table. The aroma of Mister Coffee machine brewing on the corner fills the tent. No cappuccino machine for a real star geezer like Lenny. The green Coleman camp stove sits on the table, with a bottle of wine, cheese, Fruit Loops and Chips Ahoy chocolate chip cookies.

For those who attended the Mirror Making Seminar #11 (and for those who didn't) Below is the recipe for the dessert voted most favorite.

Adam's
Chocolate Eclair Cake

You'll need:

- 2 small packages of instant vanilla pudding
- 3 cups milk
- 1 8oz. tub Cool Whip
- 1 box graham crackers
- 1 tub chocolate frosting

Make the vanilla pudding with milk, then stir in the Cool Whip...

In 13x9 baking/glass dish, layer:

- graham crackers (break along lines)
- 1/2 pudding mixture
- graham crackers
- 1/2 pudding mixture
- graham crackers

Take off the frosting lid and foil seal.

- heat tub in a microwave oven for 30 seconds, just enuf to thin.
(between 30 and 50 seconds, no more than 1 minute!).
- Pour frosting over top layer.
- Chill before serving.

Remember to share, please.

IT'S OVER!!!

Yes, boys and girls, MidAtlantic Mirror Making # 11 is history. I hope all who have a tinge of curiosity about the mysteries of Newtonian mirror making stopped by Mallard Lodge to get a hint of what all the fuss is about.

For the curious, mirror making is only the beginning of a wonderful telescope making experience that begins with mirror making and ends with viewing the heavens thru a home built scope that just happens to have a superior primary mirror made by YOU.

Yes, you should certainly believe there is some pride and satisfaction involved in viewing the wonders of our universe thru a scope you built around a mirror that you also made...especially when the quality of your views exceed those of the "store-bought" variety telescope.

For those unfamiliar with MidAtlantic Mirror Making let me supply a few stats. Number one...this was the ELEVENTH time we have sponsored a mirror making weekend. Number 2, Smyrna, DE, is the only place on EARTH where a person can find a program that begins and completes a Newtonian mirror in just one weekend. This event is staffed by an all volunteer group. In addition to making mirrors, the Mallard Lodge was converted into a mirror making facility, seven meals for 40 people were prepared - and the dishes were washed, a dumpster full of trash was collected and carried from the building, and in the end the building was converted back to it's original condition. Grinding table assembly & disassembly, testing tunnels, pitch lap making station, fish-frying facilities...cleaning...all chores were carried out as needed by volunteers who actually had a weekend of fun by participating in MMM#11.

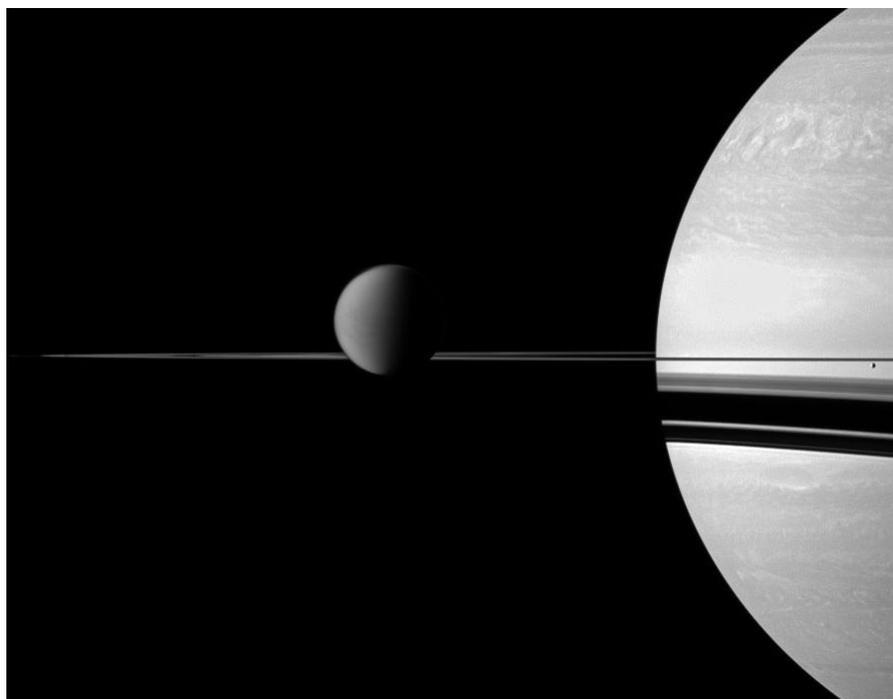
To all who volunteered their time and expertise...THANK YOU! We opened Mallard Lodge on Thursday night for the first time because so many of our attendees were arriving from long distances. This year our long distance people came from London, New Brunswick- Canada, Los Angeles, Portland, Cleveland, Houston and Connecticut. The early arrivers and a few "locals" met for a late supper at Smyrna Diner...we had 18 people at the Diner and our two Canadian friends met us at Mallard Lodge later in the evening-they had to eat at McDonalds...so, we learned there is an interest in beginning the event on Thursday night vs Friday morning. Opening early and going to the Diner for Thursday night dinner and for Friday morning breakfast seemed to be a great way to begin the event...much more relaxed than the Friday morning rush from years past.

Although I offered to make arrangements for the Thursday night muskrat dinner at Smyrna's Wagon Wheel Restaurant there were no takers...maybe next year's participants will be a bit more venturesome meal wise.

Oh, the mirrors - there were 19 of them...three 6"ers, five 8"ers, five 10"ers, four 12.5"rs, one 14" and one 16". Sixteen mirrors were completed; the uncompleted mirrors...one person had to leave early, another decided to quit the program early and the 16"er which we all knew was a bit much to tackle in one weekend. Maybe those folks will return next year to complete their project. One of our "completed" mirrors was begun over 35 years ago. And folks, those 16 completed mirrors are "KEEPERS"!

So, save a weekend in early March 2012 for MidAtlantic Mirror Making #12.

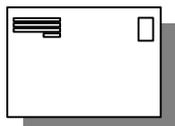
Don...



Titan, Rings, and Saturn from Cassini
Credit: [Cassini Imaging Team](#), [ISS](#), [JPL](#), [ESA](#), [NASA](#)

How thin are the rings of Saturn? Brightness measurements from different angles have shown Saturn's rings to be about one kilometer thick, making them many times thinner, in relative proportion, than a razor blade. This thinness sometimes appears in dramatic fashion during an image taken nearly along the ring plane. The robot Cassini spacecraft now orbiting Saturn has now captured another shot that dramatically highlights the ring's thinness. The above image was taken in mid January in infrared and polarized light. Titan looms just over the thin rings, while dark ring shadows on Saturn show the Sun to be above the ring plane. Close inspection of the image will show the smaller moon Enceladus on the far right. Cassini, humanity's first mission to orbit Saturn, currently has operations planned until 2017.

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