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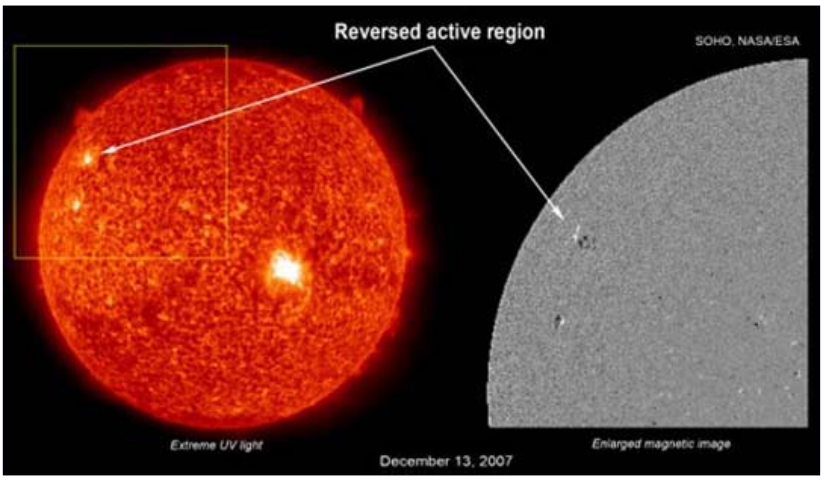
Still No Sunspot Action on the Sun

"I am surprised that if it's going to be big solar cycle 24, it's taking this long for sunspots to get started."
- David Hathaway, Ph.D., Solar Physics Team Leader, NASA Marshall Space Flight Center, Huntsville, Alabama

No sunspots on sun, August 28, 2008, and the sun has been going spotless for weeks at a time. The minimum of solar cycle 23 was 1996 and NASA says solar cycle 24 began on December 11, 2007 (see images below). Image courtesy SOHO.



On left, is Extreme UV-wavelength image of the sun and on right, a B&W magnetogram showing positive (white) and negative (black) magnetic polarities. On December 11, 2007, this new high-latitude active solar region was magnetically *reversed* from sunspot magnetic directions in the previous Solar Cycle 23. So, this new sunspot officially marks the beginning of Solar Cycle 24. Images courtesy SOHO/NASA/ESA.

August 29, 2008 Huntsville, Alabama - On July 11, 2008, NASA headlined one of its press releases as, "What's Wrong with the Sun? (Nothing)." The featured scientist in the

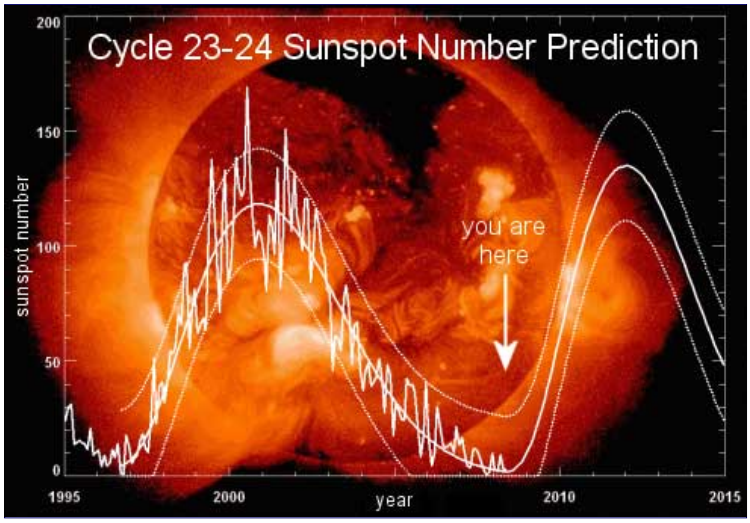
news release was solar physicist David Hathaway, Ph.D., Solar Physics Team Leader, NASA Marshall Space Flight Center in Huntsville, Alabama. Dr. Hathaway received his Ph.D. in Astrophysics from the University of Colorado - Boulder in 1979.

The sunspot cycles of our sun is his passion. He even made a bet two years ago with a team of scientists at the High Altitude Observatory in the National Center for Atmospheric Research, known as NCAR, also located in Boulder, Colorado. The scientist Dr. Hathaway was betting against is Peter Gilman, Ph.D., Senior Scientist at HAO, who is teamed with Mausumi Dikpati, Ph.D., the creator of a computer model known as the Predictive Flux-transport Dynamo Model. Their theory is that sunspots are caused by a current of electrified gaseous plasma that circulates between the Sun's equator and its poles over a period of 17 to 22 years. That current, the scientist theorize, acts like a conveyor belt for sunspots from the equator to the poles.

According to a news release from Drs. Dikpati and Gilman in March 2006, that their computer model was proving to be so accurate in its reproduction of the last eight solar cycles with 98% accuracy, the science team was going on the record to forecast that the next solar cycle 24 “will be 30 - 50% stronger than the last one and will begin as much as a year late.”

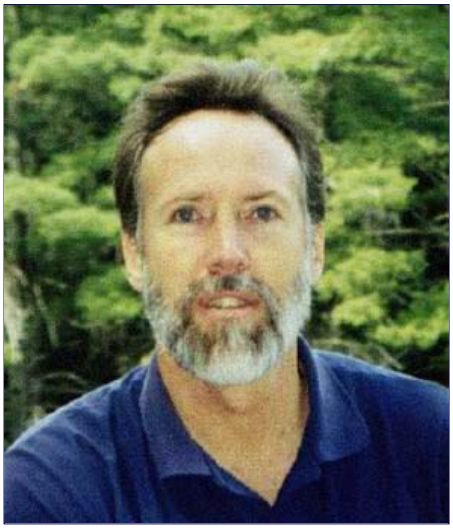
That forecast is what provoked Dr. Hathaway at NASA's Marshall Space Flight Center to bet Dr. Gilman that solar cycle 24 was going to come on quickly in 2006 because it was going to be so strong - perhaps the strongest solar cycle on record.

Two now years later in August 2008, the sun is still extremely quiet. It was only nine months ago on December 11, 2007, that a patch of magnetism on the sun was declared by NASA to be the first official sunspot of the new Solar Cycle 24. The spot was in a high-latitude on the sun with reversed polarity compared to the previous Solar Cycle 23. The expectation was that meant after a very long time without sunspots, the sun would finally become active again. But that has not happened and this week I talked with Dr. Hathaway about what's happening on the sun - and his bet with Dr. Gilman - who is on vacation and unavailable until September for an interview. My first question to Dr. Hathaway was: Did solar cycle 24 really begin in January?



The solar cycle, 1995-2015. The “noisy” curve traces measured sunspot numbers; the smoothed curves are predictions. Credit: D. Hathaway/NASA/MSFC.

Interview:



David Hathaway, Ph.D., Solar Physics Team Leader,
NASA Marshall Space Flight Center, Huntsville, Alabama

David H. Hathaway, Solar Physics Team Leader, NASA Marshall Space Flight Center, Huntsville, Alabama: "It's started, but it has not overtaken 23 yet (laughs)! We've seen new spots from cycle 24 with new magnetic activity that is definitely Cycle 24. It has started, but it has not produced enough sunspots to take off and take us out of minimum yet. So, we're still in minimum by almost any count.

IT HAS BEEN A NAKED SUN WITHOUT SUNSPOTS NOW FOR A LONG TIME.

There has not been a spot on the sun for at least a month and this is about the third rotation of the sun this cycle where we have not seen any sunspots at all. It is suggesting that the next cycle 24 might be a small cycle - much to my consternation! - since I've been predicting a big cycle. But the fact that it's taking this long to get started and that it's starting out so slowly are hallmark signs of a small solar cycle.

On the other hand, there are other factors I looked at that suggested solar cycle 24 ought to be a big cycle. So, I'm confused! (laughs)

When you think you've got the sun figured out, it does things like this and it's like, 'Boy, there's more to this thing than we know! (laughs)

\DO YOU STILL HAVE – I THINK IT WAS DINNER AND A $100 BET WITH PETER GILMAN AT THE HIGH ALTITUDE OBSERVATORY (NCAR, Boulder, Colorado)?

I've conveniently forgotten the nature of the bet! I saw Peter just last week. In fact, we had a meeting in Boulder at NCAR a week ago about the workings of the solar dynamo. Yeah, when they had their press conference two years ago in March 2006, Gilman and Dikpati said solar cycle 24 was going to start late. And I said, 'Nah! It's going to start early.' I definitely lost that one. There's no doubt about it. But I don't remember what I owe him and he didn't bring it up. Maybe he's being too much of a gentleman. (laughs)

WELL, YOU MIGHT OFFER HIM A DINNER AT ONE OF THESE MEETINGS. BUT WHAT IS THE CURRENT DISCUSSION BEWEEN YOU AND PETER GILMAN ABOUT THE SUN?

HAO's Dynamo Model of Sun
98% Accurate So Far

HAO has a model that matched the sun even before they even tried predicting with about a 98% accuracy. Then they tried prediction and showed they could get the last eight solar cycles better than any other technique. Given that, we project into the future and the next cycle is going to be big and it's going to start late.

THAT APPEARS SO FAR TO BE WHAT'S HAPPENING.

Well, the late start is definitely there. Yeah, I can no longer claim that this is an early starting cycle. That definitely is not happening this time around.

They are still predicting a big cycle. But in their model, it ought to start late. And that's odd because most big cycles start early.

Dikpati and Gilman are quite comfortable with what's happening. In fact, they suggested that it would be some time in late 2008 that we'd end up coming out of minimum, so it's all going according to their plan. It's just that their plan was a little surprising since if you look at the past 20 some sunspot cycles, usually big ones start early and the minimum is high in sunspot numbers because they start early.

But this one, minimum leading to solar cycle 24, is low. The number of sunspots are few and far between and it's taking a long time for this cycle to get started. Those are usually the hallmarks of a small cycle, not a big one. It still fits in with their prediction. The NCAR team is still happy with this, but I'm getting worried!

SO, YOU ARE GENUINELY SURPRISED?

I am surprised that if it's going to be big solar cycle 24, it's taking this long for sunspots to get started.

IF DIKPATI AND GILMAN ARE RIGHT AND IT ENDS UP BEING A BIG CYCLE THAT DOESN'T START UNTIL LATE IN 2008, OR EVEN 2009, WHAT SORT OF DATA HAVE THEY FOCUSED ON THAT IS DIFFERENT FROM YOURS?

It's not so much the data as the model. HAO has an actual dynamo model for the sun that includes the magnetic field flows we observe on the surface of the sun and in the interior of the sun. They put magnetic fields in their model and have shown in the past that their model can produce an 11-year cycle with sunspots starting out in the mid-latitudes and the band of sunspots drifting towards the equator over time. So, their model has produced a lot of what we actually see for solar activity and what they put into their prediction are sunspot areas – such as where there were actual sunspots over the past 12 solar cycles.

When they put that data into their model on the surface, it's the way a weatherman would put in, 'It's raining here and there are clouds there.' When they put those things in the HAO model and run it ahead in time, they found that if they backed up eight cycles, the HAO model could predict the amplitude of the last eight cycles and if they put in the sunspots seen over the past two cycles, their prediction is that the next cycle 24 ought to be a big cycle – it ought to be as big as the last one. In fact, I think they said it ought to be 50% bigger than the last one.

50% BIGGER?

As I recall, it was 30% to 50% bigger, yes.

WE HAD 40X OFF THE CHART SOLAR FLARES IN THE LAST CYCLE?

Yes, we had some big flares, but you can get a big flare every time you get an angry sunspot. So that's not really a great measure of the sunspots. The number of sunspots is a really good indicator of how big the solar cycle is. Since 1947, we've measured radio noise from the sun that's a very quantifiable measure of solar activity.

The radio measurements are given high regard and according to those, the last cycle 23 was bigger than average, but not very big. It was smaller than the two cycles prior to 23. What Gilman/HAO is predicting for cycle 24 is as big as the two previous cycles. So in the last cycle, the number of sunspots was 120 for its maximum. HAO is suggesting solar cycle 24 ought to be 160 or more sunspots. And that's about the same size as cycles 21 and 22 that were second and third largest on record.

SO FROM THE HIGH ALTITUDE OBSERVATORY POINT OF VIEW, THIS IS LIKE THE CALM BEFORE A BIG STORM ON THE SUN?

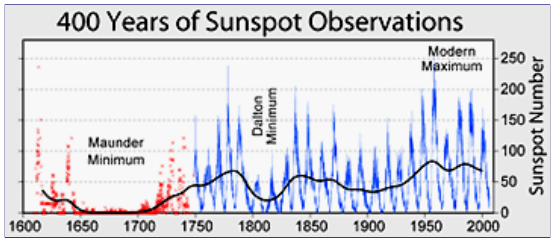
Yes. The new cycle would be off and running some time in 2008, while I expected it to happen in 2006. So, we're about two years behind where I thought we would be for a new cycle getting going.

For cycle 23, we had minimum back in 1996 for cycle 23. And here we are in 2008, coming up on twelve years along for this cycle. But that's still within the normal range. Twelve years between minimums is still in normal behavior. The average solar cycle is 11 years, but the range is plus or minus more than one year. 66% of solar cycles have a period that goes from less than 10 years to slightly more than twelve years.

Any Link Between Sunspot Activity and Earth's Temperature?

As far as years without sunspots, we had the Maunder Minimum when we went nearly 70

years without sunspots from 1645 to 1715, the Little Ice Age.



Maunder Minimum anomaly (red) was a "bare faced sun," with few sunspots between 1645 and 1715, a period that overlapped with the Little Ice Age. Solar cycles since then (blue) have been rising in intensity. The four greatest solar maximums in sunspot and flare numbers have occurred in the last fifty years. Graph courtesy Hathaway/NASA.

But again, the direct heating from the brightness of the sun is only about one-tenth of one percent, so it's a small change. The people who model the Earth's climate, when they add that in there – 1/10th% change in brightness over a ten year period – they have a hard time reproducing the temperature changes that are seen, other than noting when the sun has been active in periods of activity like we are now, surface temperature (of the Earth) seems to be warmer.

> [Editor's Note: A 2006 study and review of existing literature, published in Nature, determined that there has been no net increase in brightness since the mid- 1970s, and that changes in solar output within the past 400 years are unlikely to have played a major part in global warming.]

I KNOW THERE ARE A LOT OF PEOPLE WONDERING NOW IF THE SUN CONTINUES WITHOUT SUNSPOTS, WILL IT GET COOLER ON EARTH?

It wouldn't cause cooling, it just might decrease the rate at which the Earth is heating. Once the cycle gets started in earnest – and already we've seen three or four sunspots from cycle 24 and lots of electromagnetic activity from cycle 24. But it hasn't really taken off yet. And once it takes off, usually it's like popcorn popping. We've heard the first couple of pops (January 2008). But once it takes off, BAM!, it really takes off. We haven't seen that yet.

WHEN DOES THE HAO MODEL EXPECT THAT?

Their model expects it to be some time this year of 2008. To the month, I can't say. They suggest that given the strength of the magnetic flows on the sun during cycle 23, that cycle 23 should be a long cycle and cycle 24 should start late in 2008.

WE'RE IN AUGUST, SO THERE ISN'T MUCH TIME LEFT.

Yeah, there are lots of reasons why I'm worried. We have an experiment on a rocket that's sitting on a launch pad out in White Sands, New Mexico, just a little south of you there. And they would like there to be a sunspot on the sun since they are measuring magnetic fields and we're getting worried we're going to sit there waiting and we're not going to have a sunspot. If they wait too long past September, then we have other problems with just how high in the sky the sun is. That means they might have to wait many months.

SO, THE LACK OF SUNSPOTS IS BEGINNING TO AFFECT SCIENTIFIC RESEARCH NOW!

Yes, it's sunspots and magnetic fields on the sun that makes it so interesting. So, yeah, we want to see some sunspots!

RIGHT NOW, YOU REALLY DON'T KNOW WHAT IS GOING TO HAPPEN?

Yes, I think that is a correct assessment. In fact, that became clear in the meeting in Boulder. There still are aspects of the sun that we thought we understood, but further evidence and modeling are showing us we still have a lot to learn here.

WHAT DO YOU AND PETER GILLMAN PLAN TO DO WHEN THE SUN STARTS POPPING SUNSPOTS AGAIN?

If it's a big cycle, we'll be going around to a lot of our friends and saying, 'We told you so!' (laughs) On the other hand, if it's a little cycle, we'll get a little sheepish (laughs).

WELL, BOTTOM LINE: CYCLE 24 ON OUR SUN IS GOING TO BE TEACHING YOU A LOT.

Yes, that's exactly the conclusion I've come to – that there is no doubt we're going to

learn important things about the sun from this cycle 24. We have very significant disagreements about how big it's going to be.

AND CONFUSION ABOUT WHY IT'S TAKING SO LONG.

Confusion – but Gilman would say this is exactly what we said because of the slow meridianal flow. That's why it's taking so long. But there are others who say, 'There's more to it than that!' So this cycle will help us to understand the sun. There's no doubt about it.

Dr. Hathaway told me that solar cycle 4 back in 1783 to 1801, went fourteen years between minimums. So, from NASA's December 2007 start date for the magnetic field change of cycle 23 to 24, that's the typical average of 11 years between minimums. But if the sunspots don't appear by December 2008,some will begin to wonder if we're going into another Maunder Minimum. That's when there were no sunspots for 70 years between 1645 and 1715. During that same period without sunspots, the Earth experienced what is called the Little Ice Age of very bitter winters in the Northern Hemisphere.

Was the ice age and lack of sunspots a coincidence? Or an insight to a causal relationship between sunspots and solar heating of Earth? Dr. Hathaway does not think there is a significant change in the sun's energy output when sunspots are low. That percentage, he argues, would have very little impact on our planet today, which is already warming too rapidly from the greenhouse gases blanket that human industry has created over the past century.

More Information:

For further reports about solar cycles, sunspots and solar flares, please see **Earthfiles Archive**:

- 01/10/2008 — Solar Cycle 24 Has Begun
- 01/13/2007 — Confusing Sun: Will Solar Cycle 24 Be Most Intense On Record?
- 08/23/2006 — Solar Cycle 24 - Headed for Intense X Flares by 2010-2012?
- 03/17/2006 — Planet Earth's Ice Melt
- 09/23/2005 — 9 X-Class Solar Flares Between September 7 - 19, 2005.
- 02/11/2005 — Sunspot Region 720 Emitted Strongest Solar Radiation Since October 1989.
- 08/08/2007 — 2007's Warm, Erratic Global Weather
- 07/11/2007 — Mystery of Night Shining Clouds - Another Global Warming Change?
- 06/21/2007 — Large Lake in Southern Chile Has Disappeared
- 06/01/2007 — Is Earth Close to Dangerous Tipping Point in Global Warming?
- 02/23/2007 — Scientists Hope "Amphibian Arks" Can Save Frogs and Toads
- 01/13/2007 — Confusing Sun: Will Solar Cycle 24 Be Most Intense On Record?
- 01/10/2007 — 2006: USA's Warmest Year On Record
- 12/07/2006 — Earth Headed for Warmest Period in 55 Million Years?
- 09/09/2006 — Methane - Another Threat in Global Warming
- 08/23/2006 — Solar Cycle 24 - Headed for Intense X Flares by 2010-2012?
- 07/18/2006 — 2006 - Hottest Year So Far in U. S. History
- 11/18/2005 — Is the Sun Heating Up?
- 09/23/2005 — 9 X-Class Solar Flares Between September 7 - 19, 2005.
- 03/20/2005 — Astronaut John Young: "The Moon Can Save Earth's Civilization."
- 02/11/2005 — Sunspot Region 720 Emitted Strongest Solar Radiation Since October 1989.
- 10/29/2003 — Fifth Intense Solar X-Flare - What's Happening On the Sun?
- 03/07/2003 — Scientist's Record Sun's Plasma Interaction with Comet NEAT
- 11/01/2001 — Astronomy News
- 10/25/1999 — A Blast of Solar Wind Provokes Aurora Over Northern U. S.

Websites:

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David Hathaway, Ph.D.: http://science.nasa.gov/headlines/y2006 /10may_longrange.htm

http://gammaray.nsstc.nasa.gov/colloquia/abstracts_summer06/dhathaway.html

High Altitude Observatory (HAO): http://www.hao.ucar.edu/

SSRC: http://www.spaceandscience.net/id16.html

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