Solar Cycle 25 Started on Remarkable Times

(2020-02-02 by P.A.Semi - πα½)

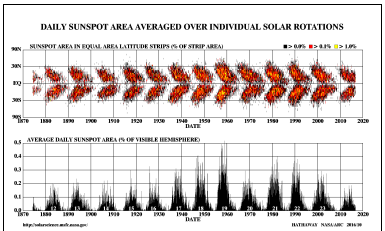
Abstract:

First sunspots of solar cycle 25 appeared already in year 2019. This work lists their dates, with some introduction about sunspot cycle and magnetic "color" (polarity) of sunspots.

Sunspot Cycle

Solar magnetic activity has a cycle of approximately 11 years. But since the polar field of the Sun changes around time of solar maximum, and direction of sunspots is different in each cycle, it can be better understood as **22 year** cycle (Hale cycle).

First sunspots of the cycle start appearing at high latitudes, and then the sunspot belt shifts continually toward the solar equator, which produces the well-known **butterfly diagram**, which is linked to the faster-moving belt of torsional oscilation.



Butterfly diagram from Dr. David Hathaway, NASA MSFC ...

First sunspots of new cycle often appear, while there are still some sunspots of the old cycle.

Since 1874, sunspot positions were recorded at Greenwich observatory and then since 1977 continued by USAF by Solar Optical Observing Network.

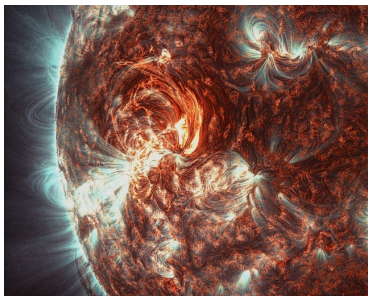
I determined solar cycle starts by first appearance of high-latitude in that dataset, and since magnetic observation is available, from SOHO/MDI and SDO/HMI instruments:

Cycle	Starting time	Possibly other starting time
SC 12	1879-04-15	
SC 13	1890-03-04	
SC 14	1902-03-06	
SC 15	1913-10-08	1913-02-22
SC 16	1923-09-04	
SC 17	1934-02-01	
SC 18	1943-05-20	
SC 19	1954-10-05	1954-07-16
SC 20	1963-10-11	
SC 21	1975-10-02	1975-08-21
SC 22	1986-07-07	1984-11-21
SC 23	1996-05-07 (SOHO/MDI)	1997-03-29
SC 24	2008-09-23 (SOHO/MDI)	
SC 25	2019-02-12 (SDO/HMI)	

Table 1 - probable starts of sunspot cycles, as determined by first high-latitude sunspots.

Most people (who know about sunspots) think, that sunspots are dark and color-less, but actually they are very colorful, but in different part of light spectrum, in extreme ultra-violet and X-ray part of spectrum.

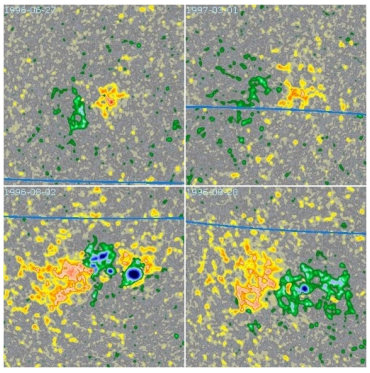
Normal solar surface has black-body radiation around 6,000°K, but magnetic loops above Sunspots are almost 1,000,000°K hot.



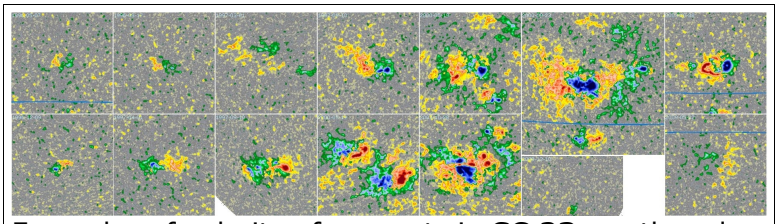
Sunspot in EUV spectrum shifted to visible colors by modified PM-NAFE +DoG algorithm (video)

Color scale used for magnetograms from JSOC.

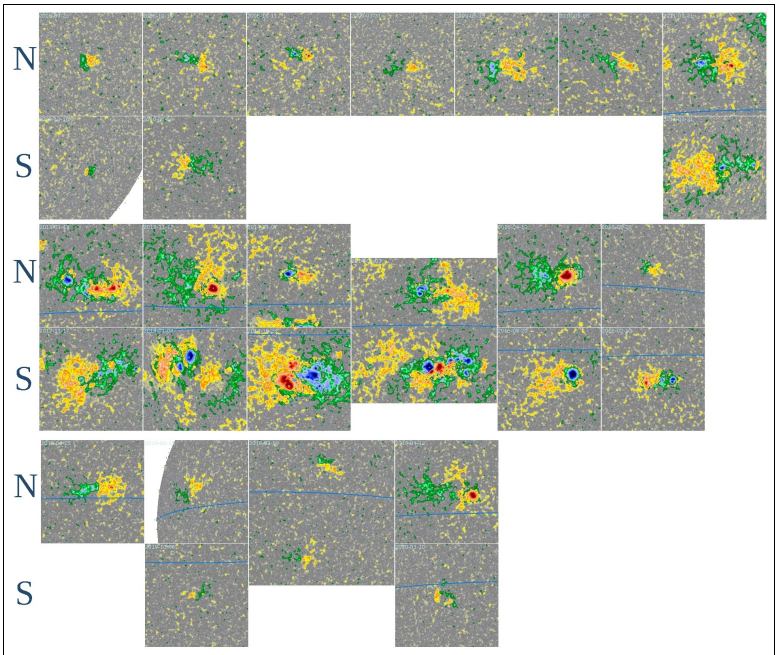
But sunspots also have a "magnetic color", or rather a polarity of their strong magnetic field. Sunspots of each new cycle have oppositely oriented their positive and negative ends, and sunspots on northern hemisphere are oppositely oriented than sunspots on southern hemisphere:



Examples polarity of sunspots in late **SC 22**, north and south hemispheres



Examples of polarity of sunspots in **SC 23**, north and south hemispheres



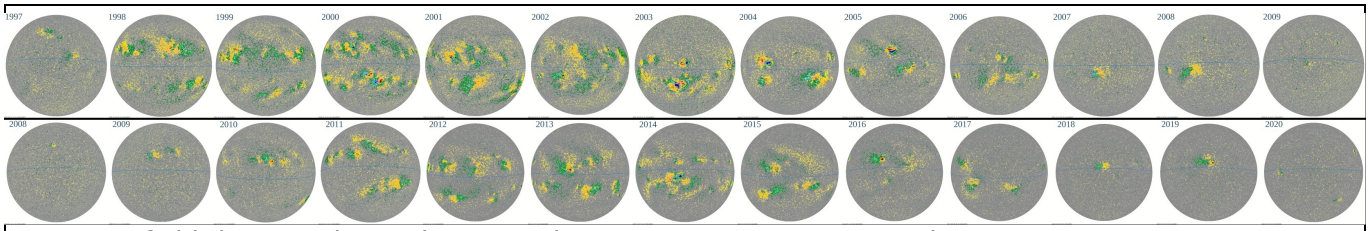
Examples of polarity of sunspots in **SC 24**, north and south hemispheres

These magnetograms are filtered with low-frequency filter (FFT-2D) to remove noise in SOHO/MDI magnetograms, and same is applied on SDO/HMI magnetograms for visual unification, and equator is drawn as a blue line.

In SC22 and SC24, northern sunspots have negative field on leading (right) side (yellow color), positive field on trailing (left) side (green color), and southern sunspots are opposite.

In SC23 and SC25, northern sunspots have positive field on leading (right) side (green color), negative field on trailing (left) side (yellow color), and southern sunspots are opposite.

Note, that SC24 (2008-2020) has been noticeably weaker than SC23 (1996-2009).



Magnetic field during solar cycles 23 and 24, one image per year, selecting some more active time of that year.

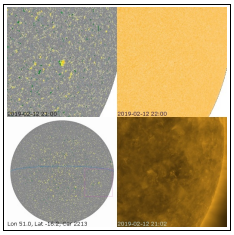
Some Active Regions evolve stronger and there appears a sunspot in visible spectrum, some do not.

Sunspot Cycle 25

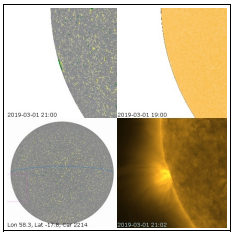
Sunspot minimum after SC 24 has been unusually deep, calm and long, similarly as sunspot minimum between SC 23 and SC 24, both being deepest minimums in at least a century...

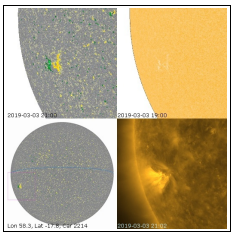
First sunspots or active regions of SC 25 appeared in early 2019 year, as determined by their polarity, different from SC 24 sunspots, which also still occur in early 2020...

Probably first sunspot of SC 25 appeared on Darwin Day, on 2019-02-12 near western limb. It's polarity was not well recognizable, since a sunspot viewed on magnetograms from right side sometimes appears to have an opposite polarity due to some effect of Doppler measurement of magnetic field.

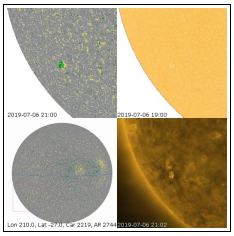


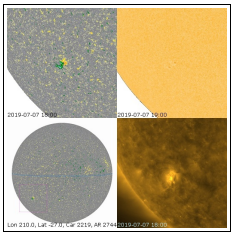
But the same Active Region (without a sunspot) rolled into view on eastern limb at start of Roman New Year, on 2019-03-01 from East side, on same place as moved by a differential rotation.
(At Roman antiquity times, year started in March, as is still evidenced by month names September to December being named by latin numerals 7 to 10, while the first months are named by Roman Emperors - Marcus Aurilius Maius Junus Julius Augustus...)



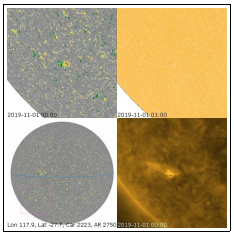


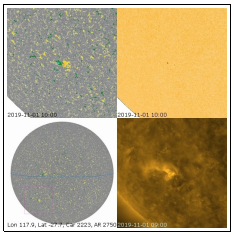
Next Sunspot of SC 25 (AR 2744) appeared on anniversary of Martyrdom of Master Johannes Hus, on 2019-07-06, which is a national holiday in Czech Republic...
As Jan Hus appealed his condemnation by a rogue council, which was quarreling for a political might at the time of three popes, to the Jesus Christ himself, no-one on Earth could arbitrate his case or holiness before, even when pope Jan Paul II. appologized for his execution at year 2000.
But this time the arbitration in favour of sanctity of Jan Hus came undeniably from the Sun from God and 24 "old ones"...



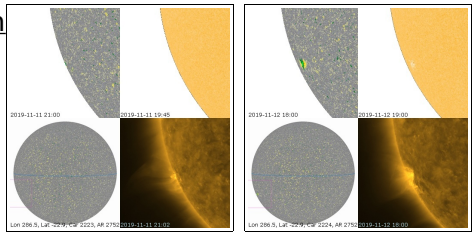


Next Sunspot of SC 25 (AR 2750) appeared on All Saints Day, on 2019-11-01. Active region started at late Halloween night, and Sunspot appeared on early All Saints Day.

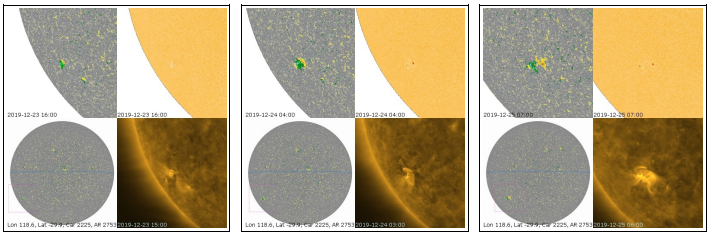




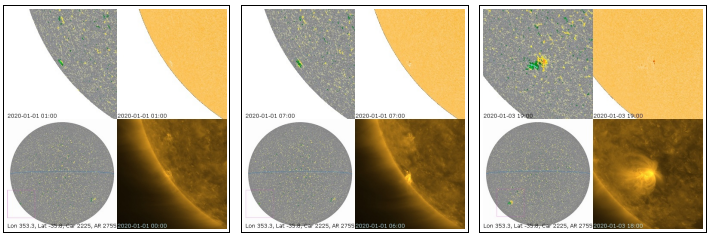
Next Active Region rolled into view on eastern limb at Saint Martin anniversary on 2019-11-11, evolving into tiny sunspot the day after...
Earlier on this day 2019-11-11, between 12:40 UTC and 18:07 UTC occured transit of Mercury over Sun.
A short sunspot also appeared in this Active Region around midnight between 2019-11-17 and 2019-11-18 ...



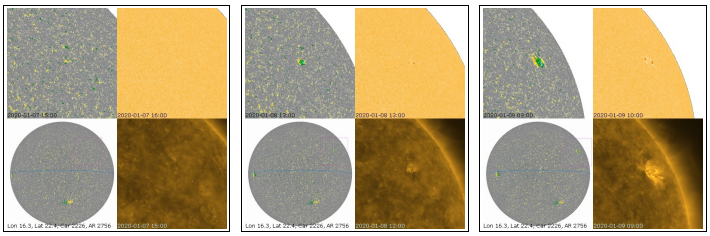
Next Active Region appeared on 2019-12-23 and Sunspot appeared there on Christmas Day on 2019-12-24.



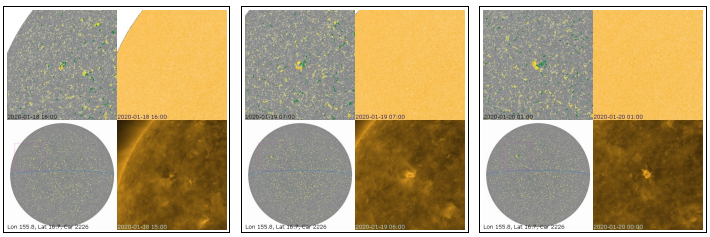
Next Active Region of SC 25 appeared on late 2012-12-31 and sunspot appeared after midnight 2020-01-01 on New Year Day .



First Active Region of SC 25 on northern hemisphere appeared on Orthodox Christmas Day on 2020-01-07, with a sunspot appearing the next day...



Next northern active region with sunspot of SC 25 appeared on 2020-01-18 and then again on midnight between 2020-01-19 and 2020-01-20 ...



Conclusion

While on former years, sunspots seemed to appear in relation with planetary positions (Apparent Relations between Solar Activity and Solar Tides, Ching-Cheh Hung 2007), or at random, this time their correspondence with times of Christian holidays and starts of Calendary does not appear random at all and is hardly deniable...

Video is available with the Sunpots...