TRINITY COLLEGE DUBLIN

Automated Detection of δ–spots

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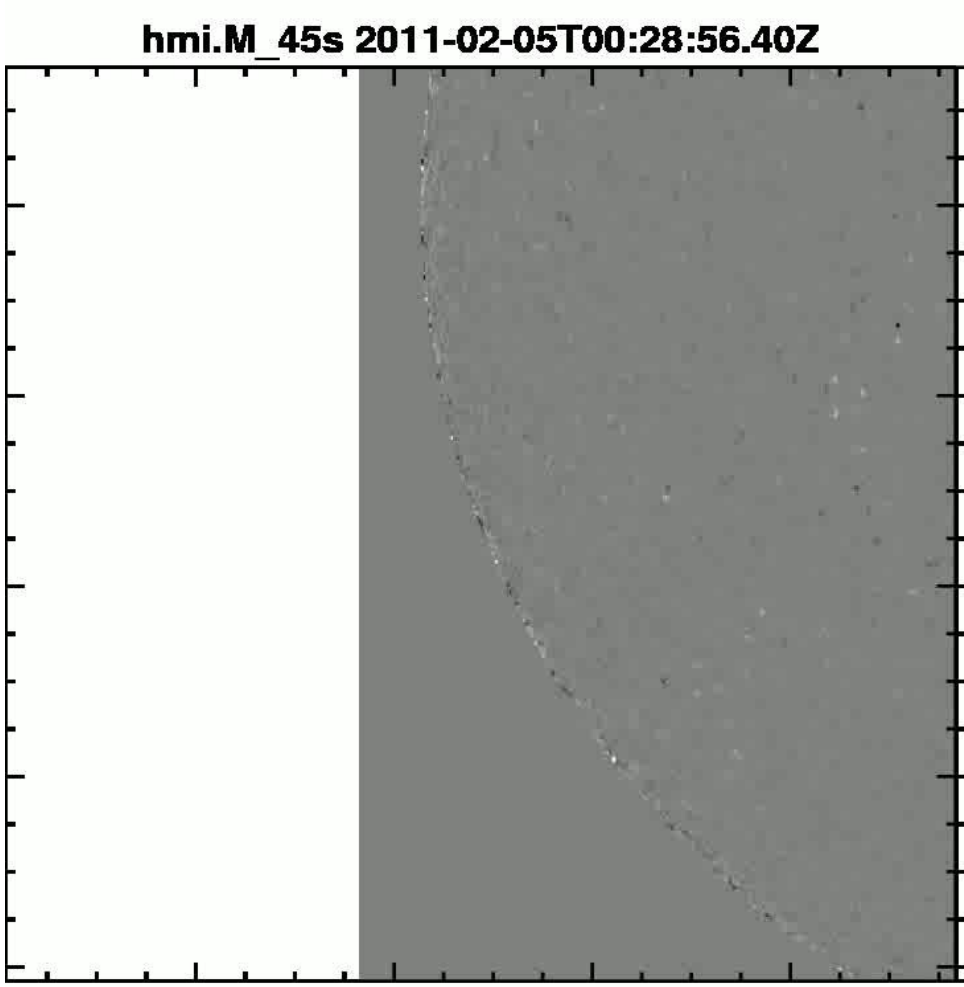
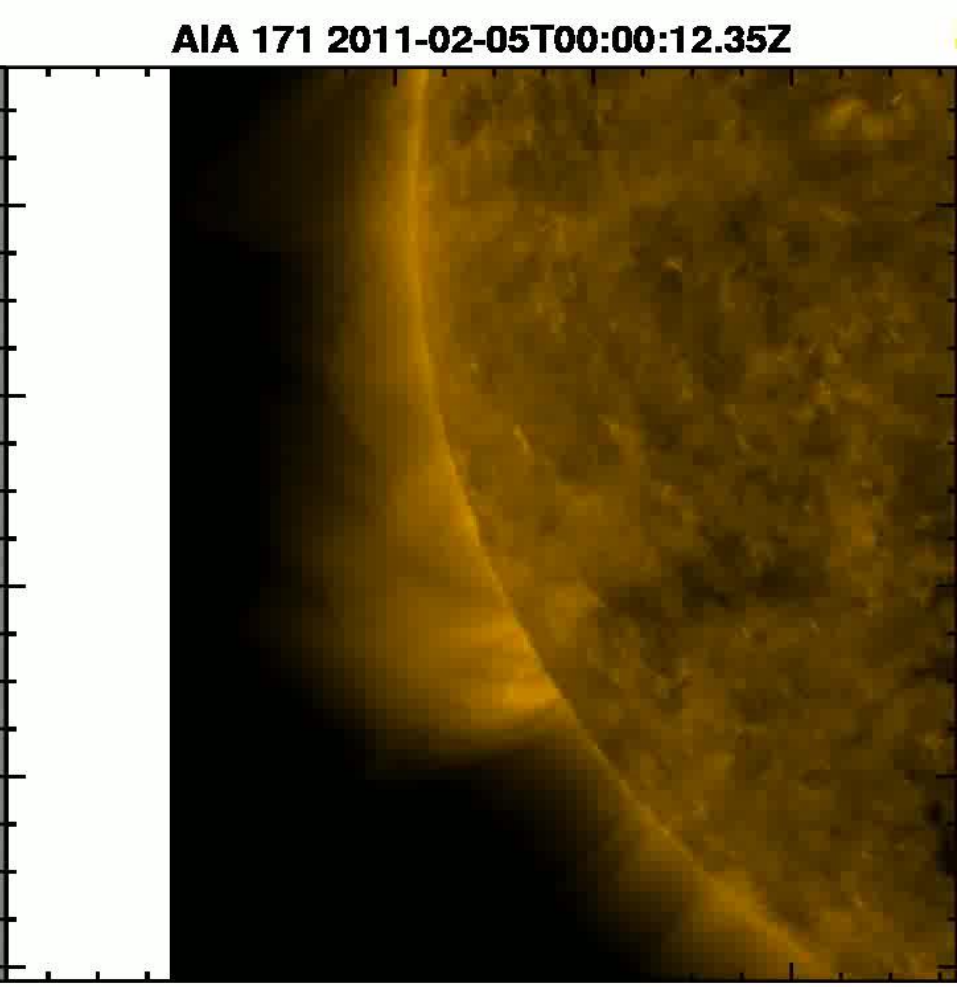
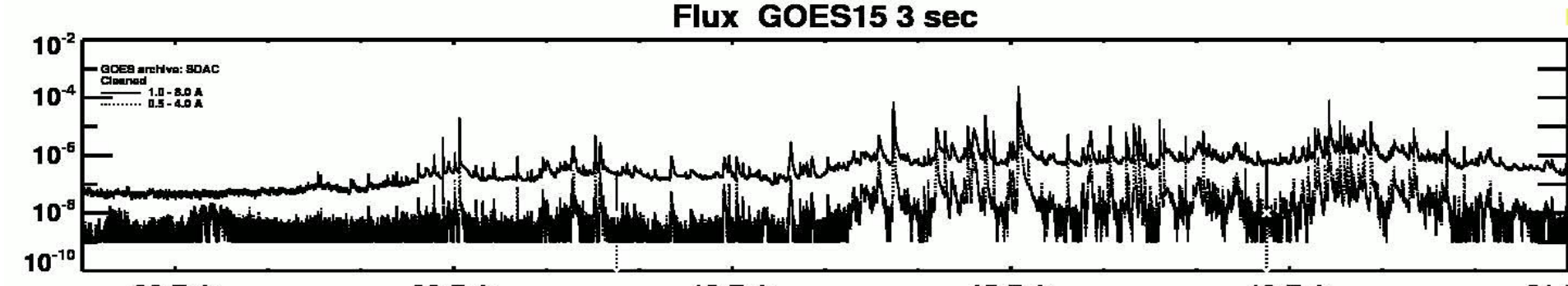
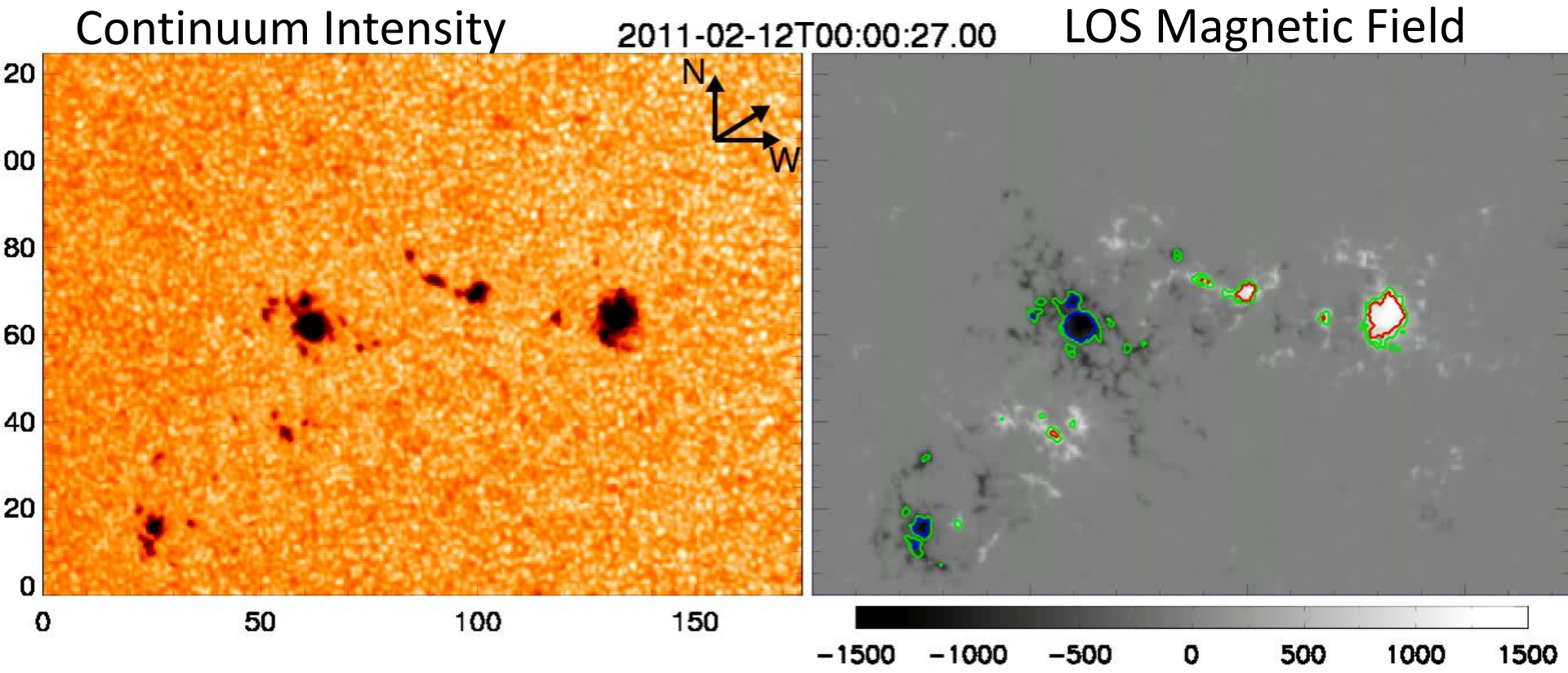
The famous AR-11158







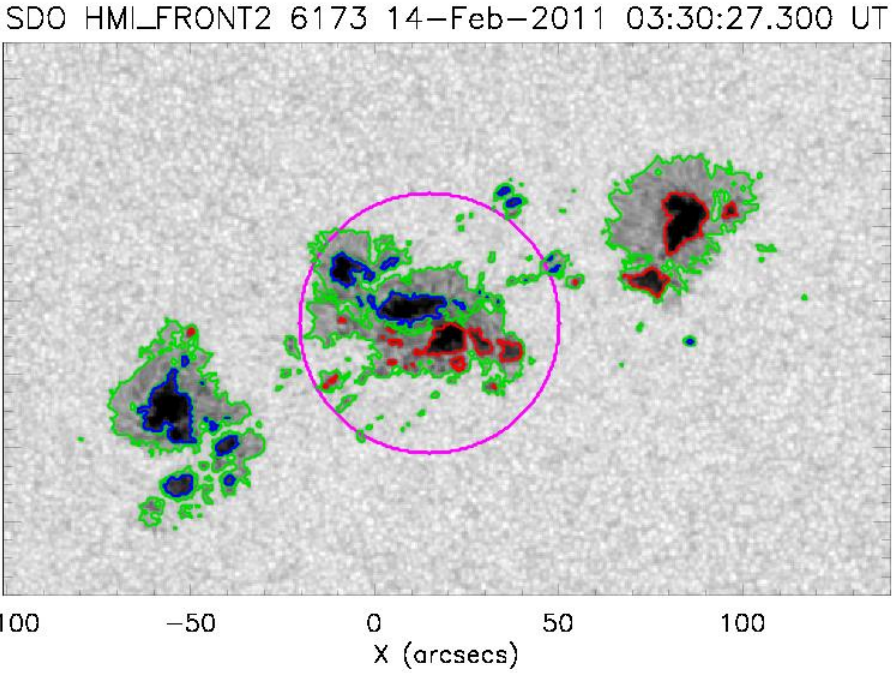
AR-11158

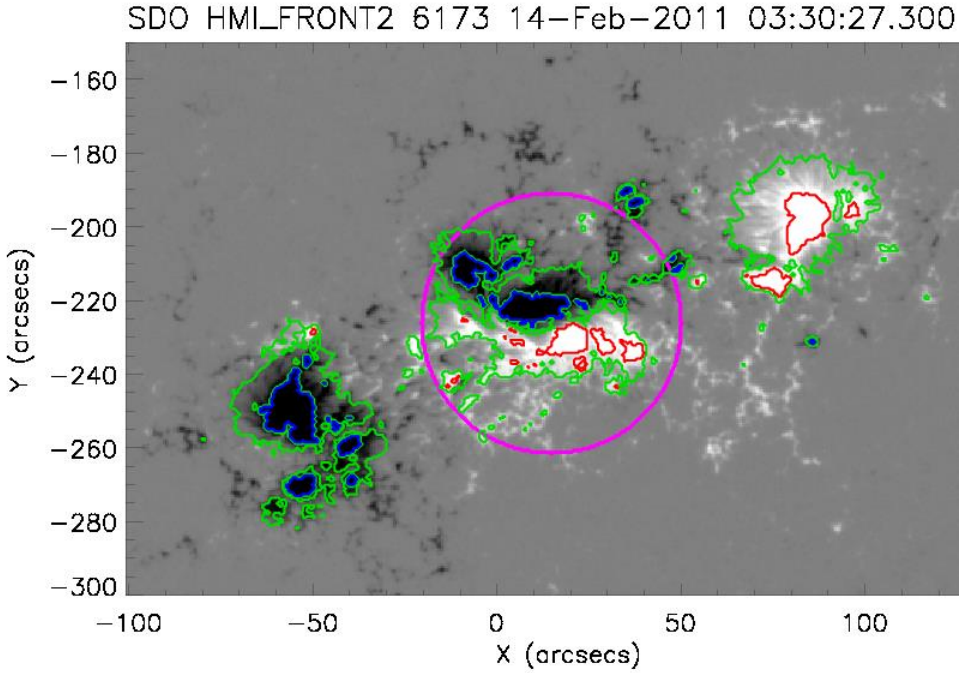


Observed using HMI/SDO

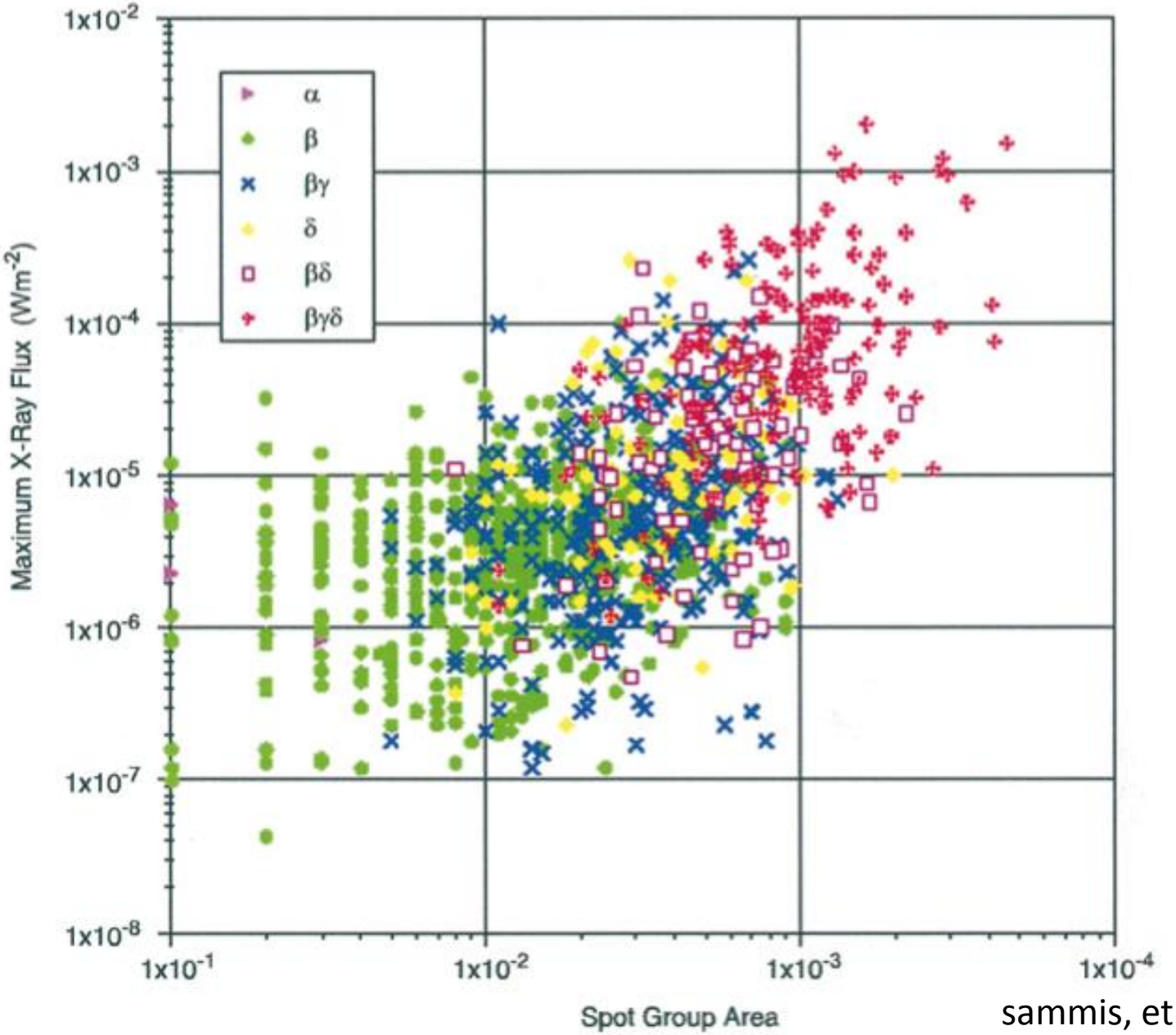
δ–spots

δ-spots are a particular configuration as described by the Mount Wilson scheme, where a common penumbra encloses opposite polarity umbrae





δ–spots & Flares

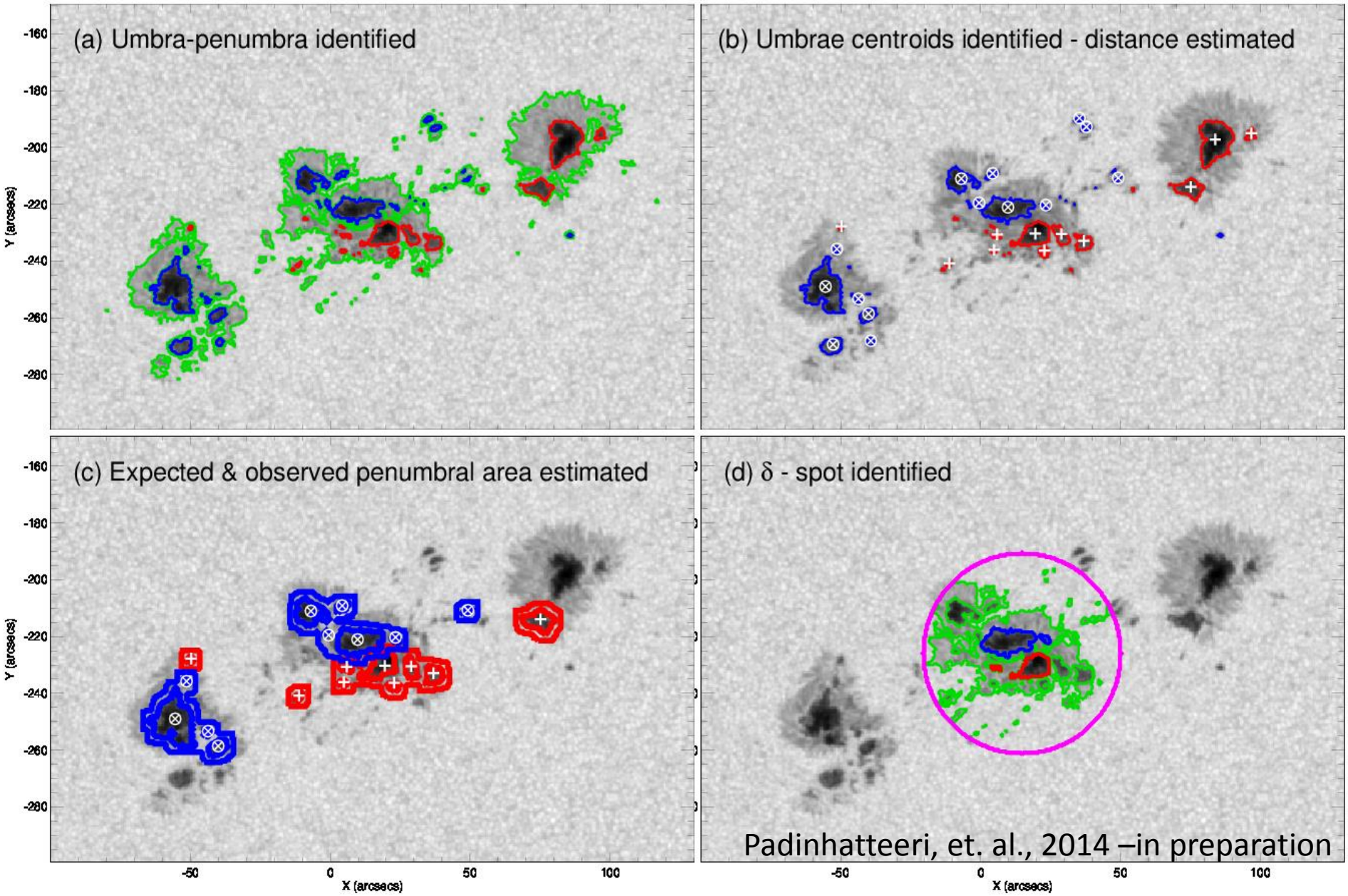


sammis, et. al., 2000

Need for a automated δ–spots detection.

- NOAA – Solar Region Summary (SRS) is released only once per day at 00.30 UT
- NOAA-SRS is based on the previous whole day's observation data
- Near Real Time (NRT) detection of δ–spots can be useful in flare-forecasting.

SMART-Delta Finder (SMART-DF)



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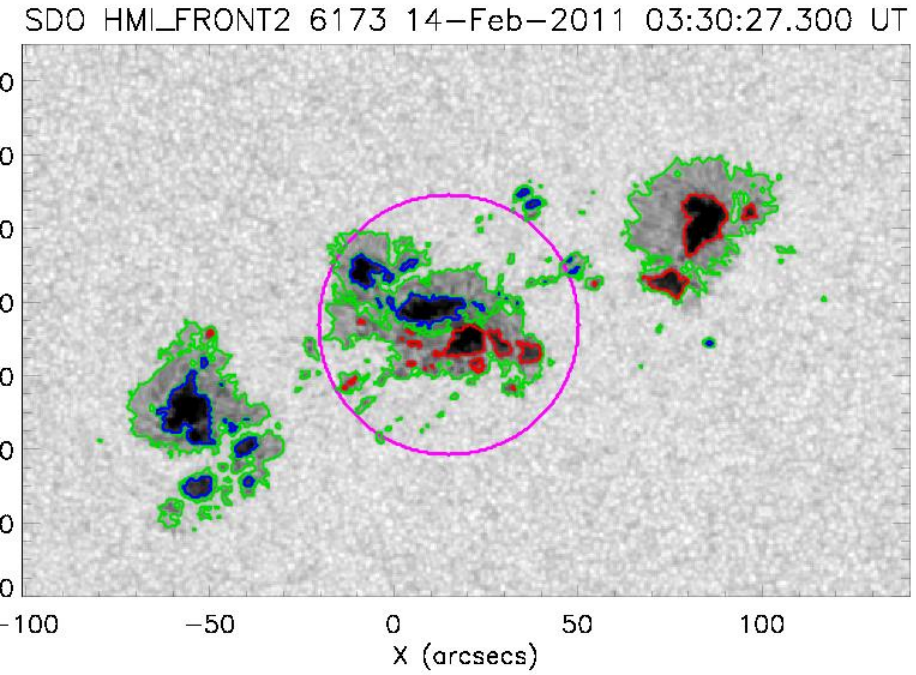
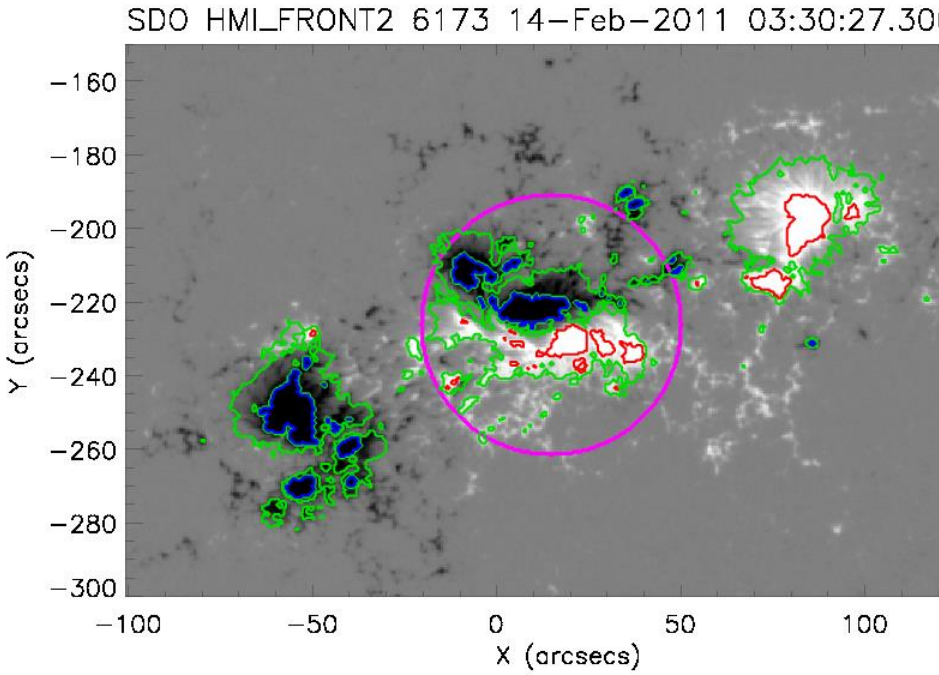
Results – NOAA AR 11158





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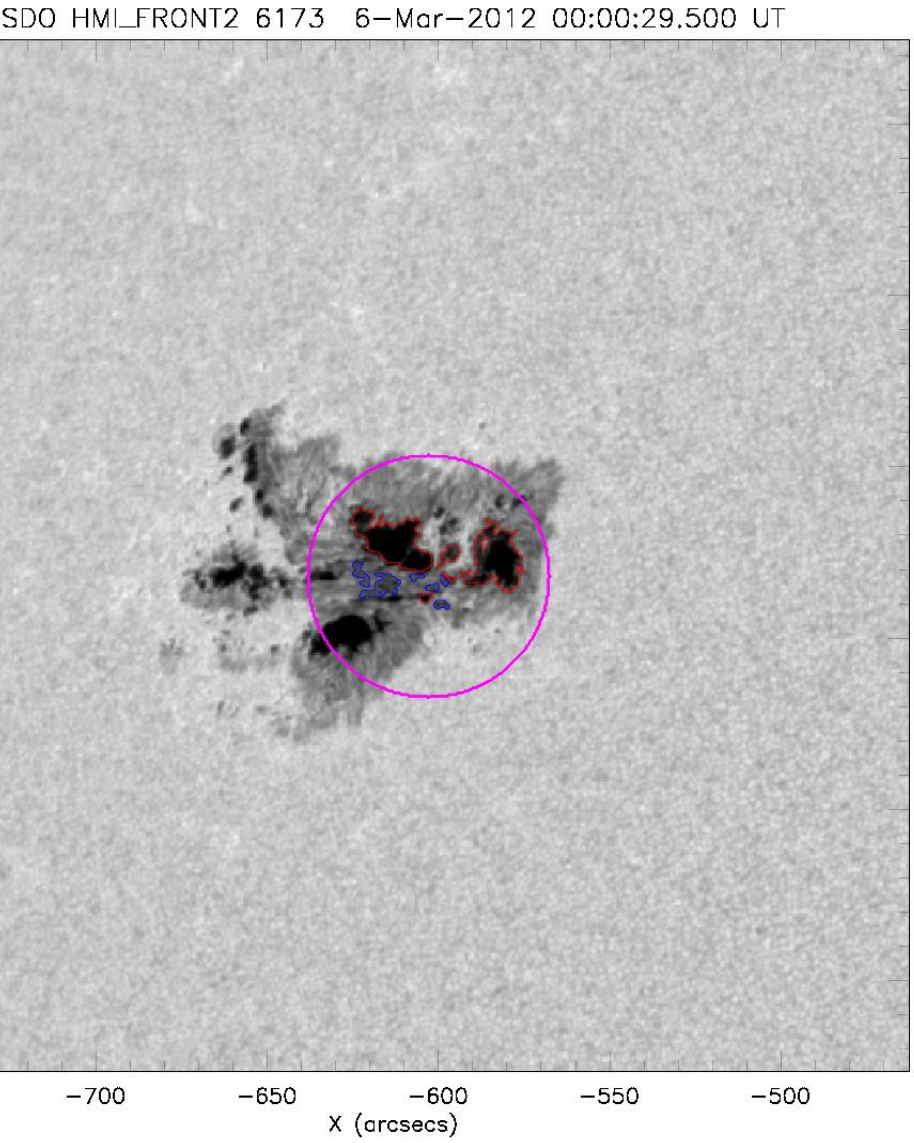
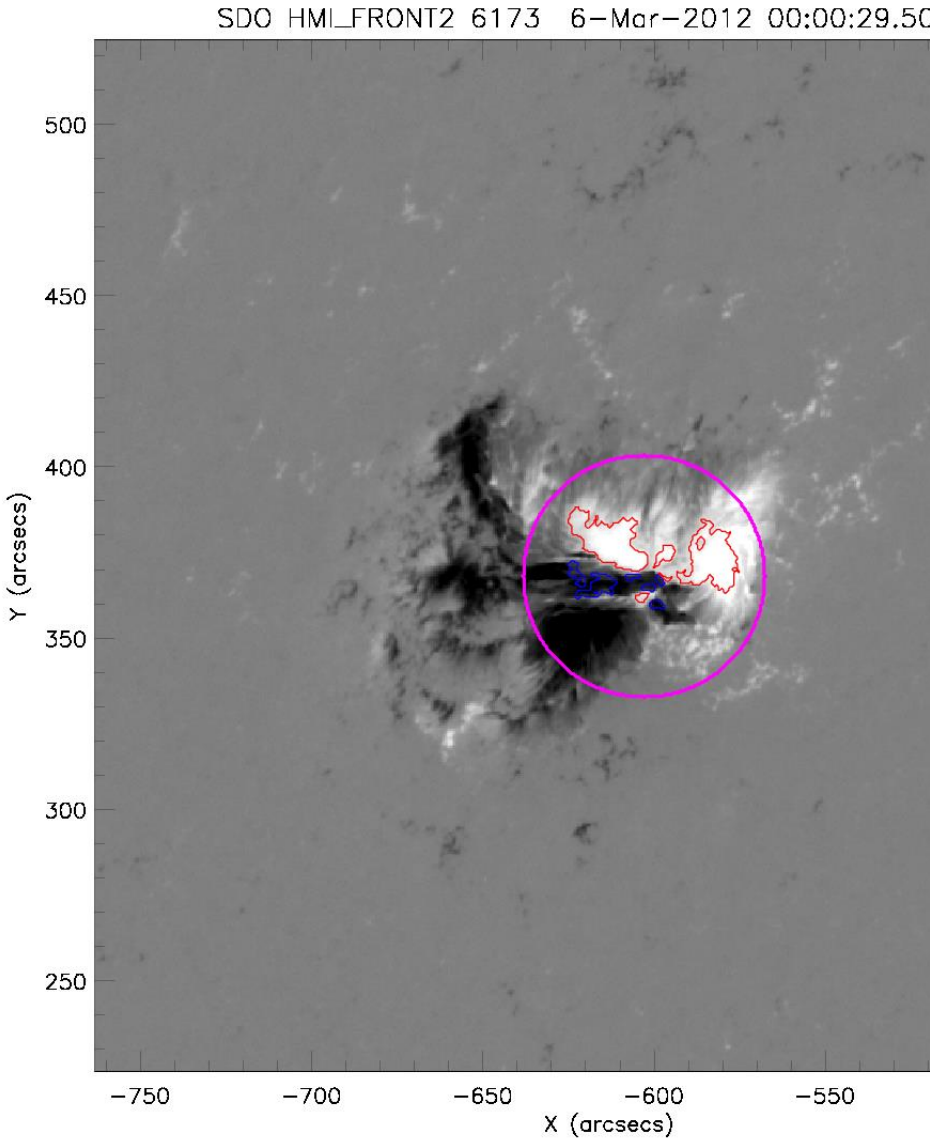
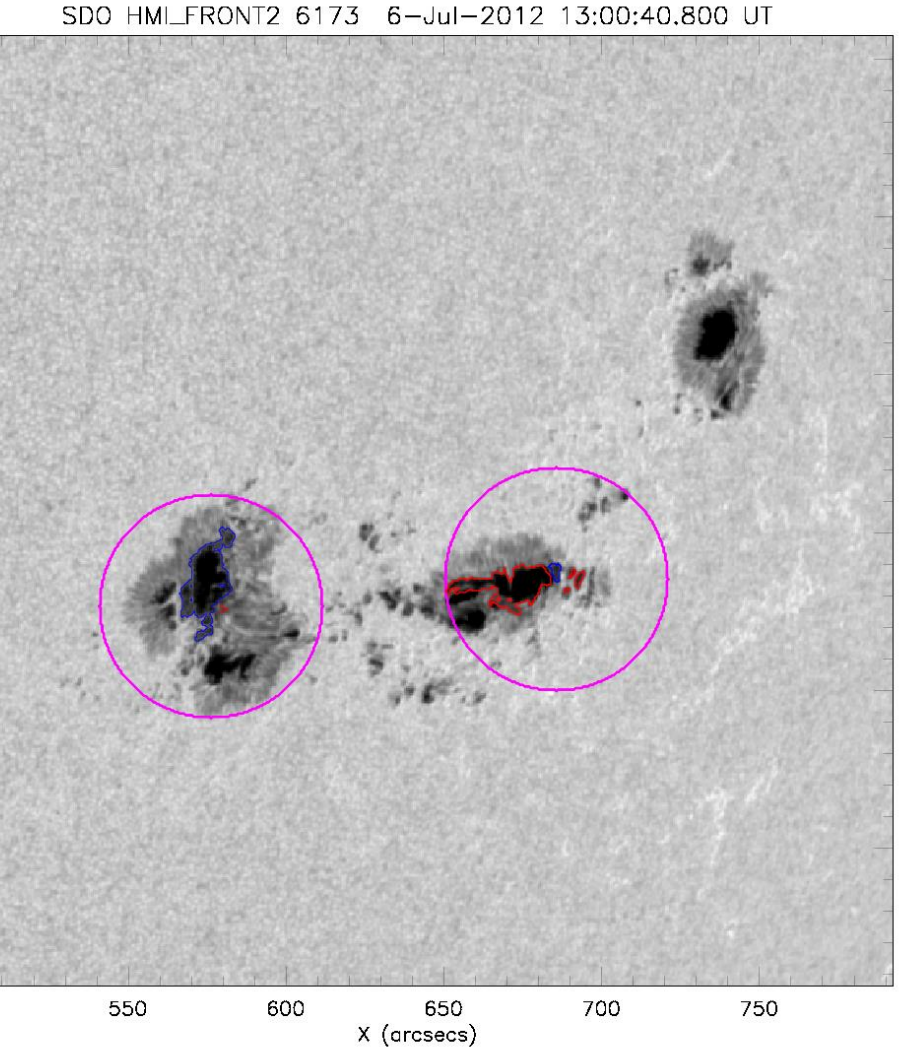
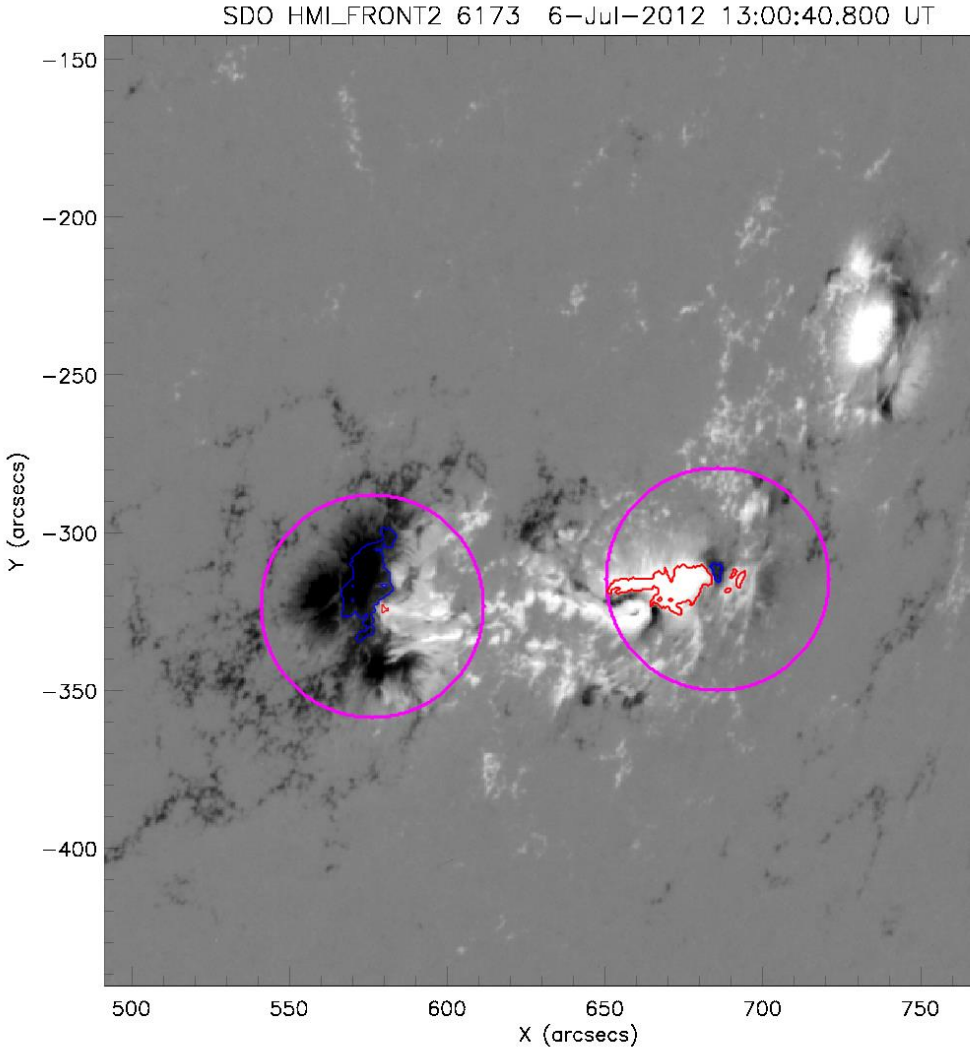
NOAA AR 11429



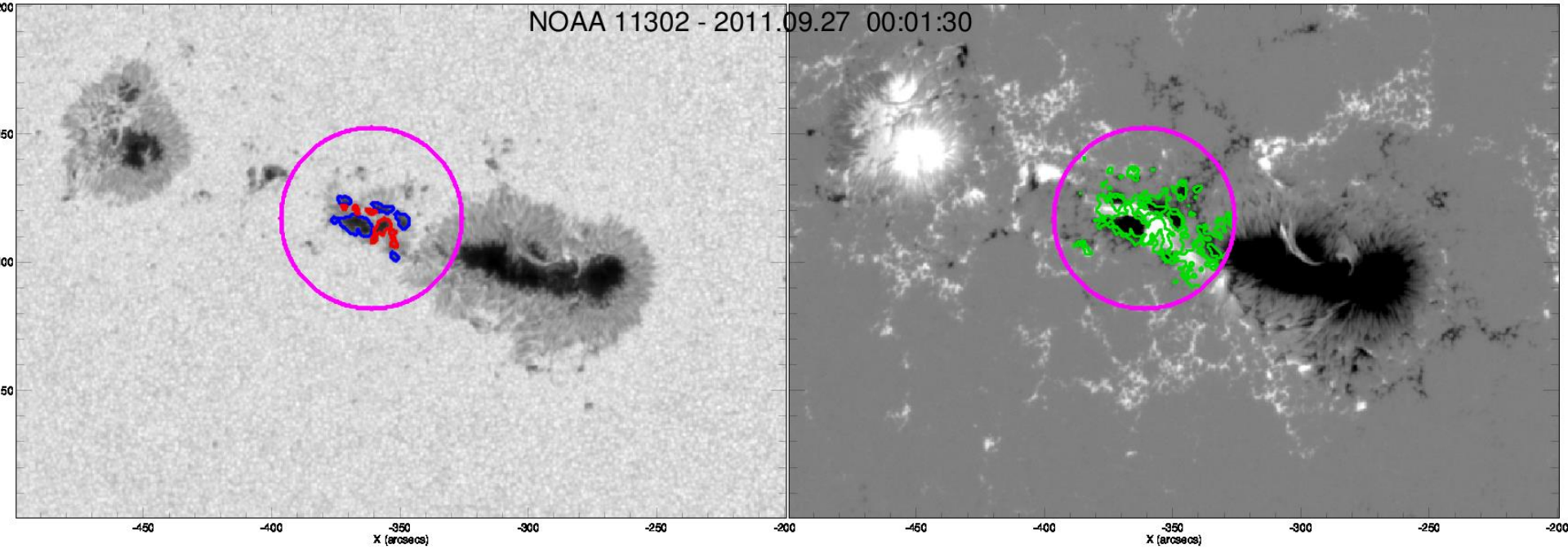


NOAA AR 11515





NOAA AR 11302



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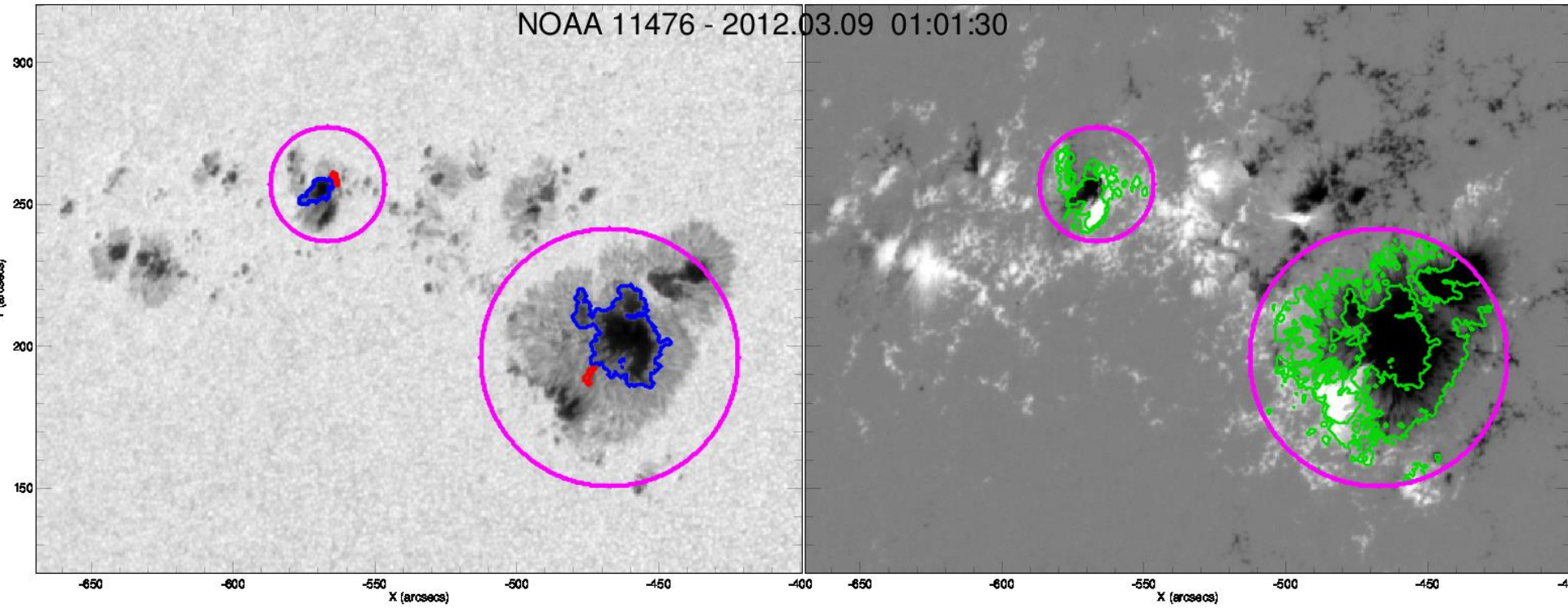
NOAA AR 11476



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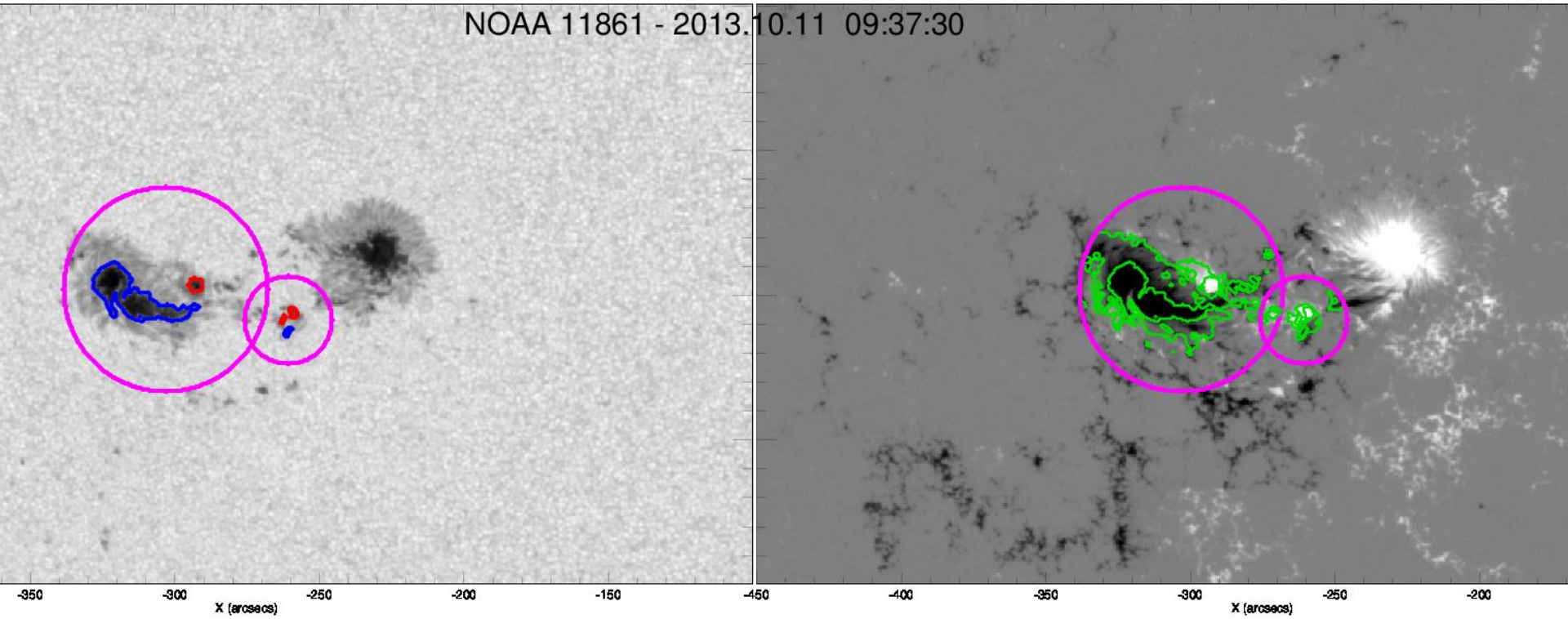
NOAA AR 11861



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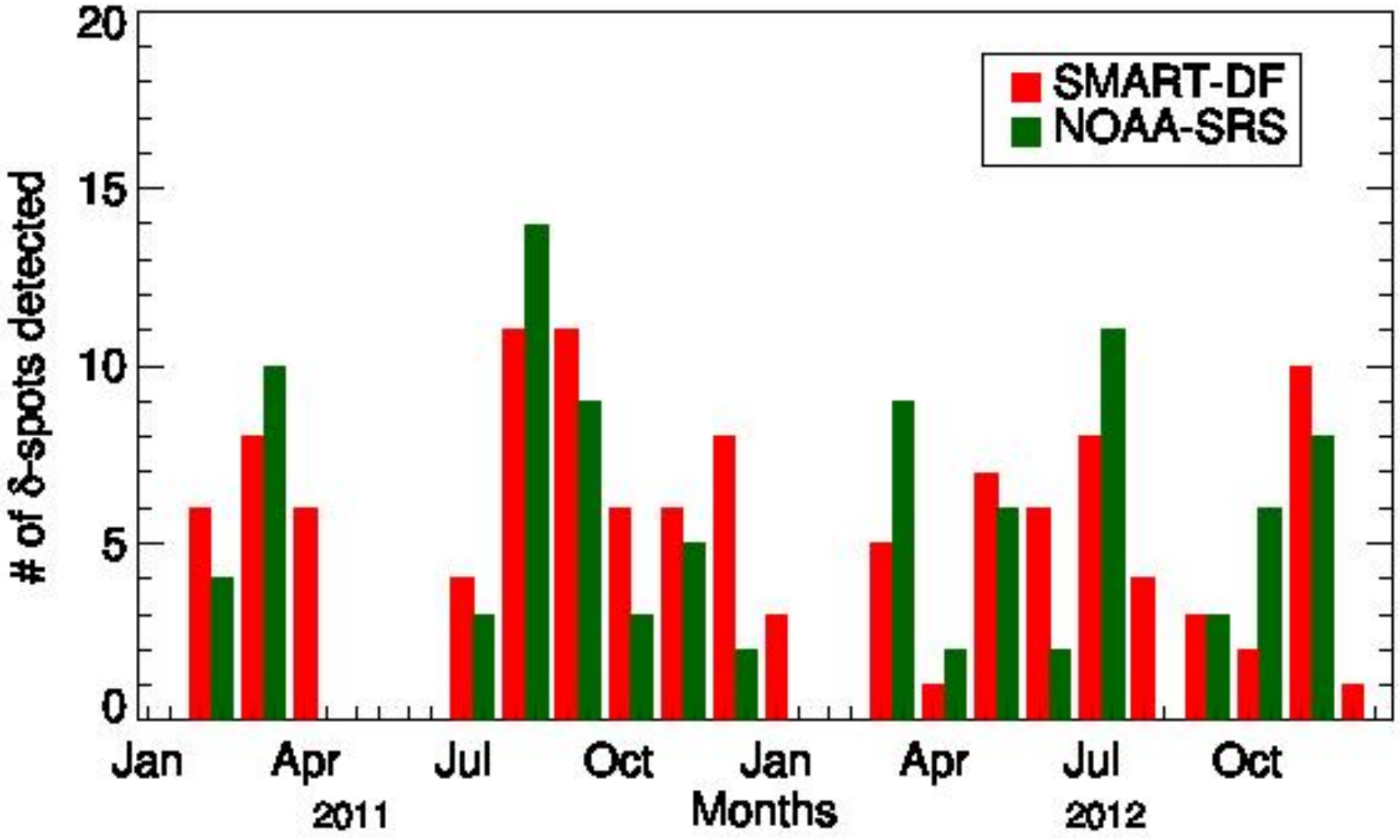
Results – Comparison with NOAA-SRS

- Observation period: 1 Jan 2011- 31 Dec 2012
- Instrument (SMART-DF) : HMI/SDO, 12 hour cadence.
- NOAA-SRS : One SRS per day (at 00.30 UT)
- NOAA : 33 ARs marked as δ-spots
- NOAA: 23 ARs were first marked as δ in the region between +/- 60 degrees longitude
- SMART-DF : 21 out of 23 were detected before SRS release.
- with a cadence of 1/day, NOAA detected 97 instances of δ-spots formation, SMART-DF recorded 116 instances

NOAA-SRS Vs SMART-DF



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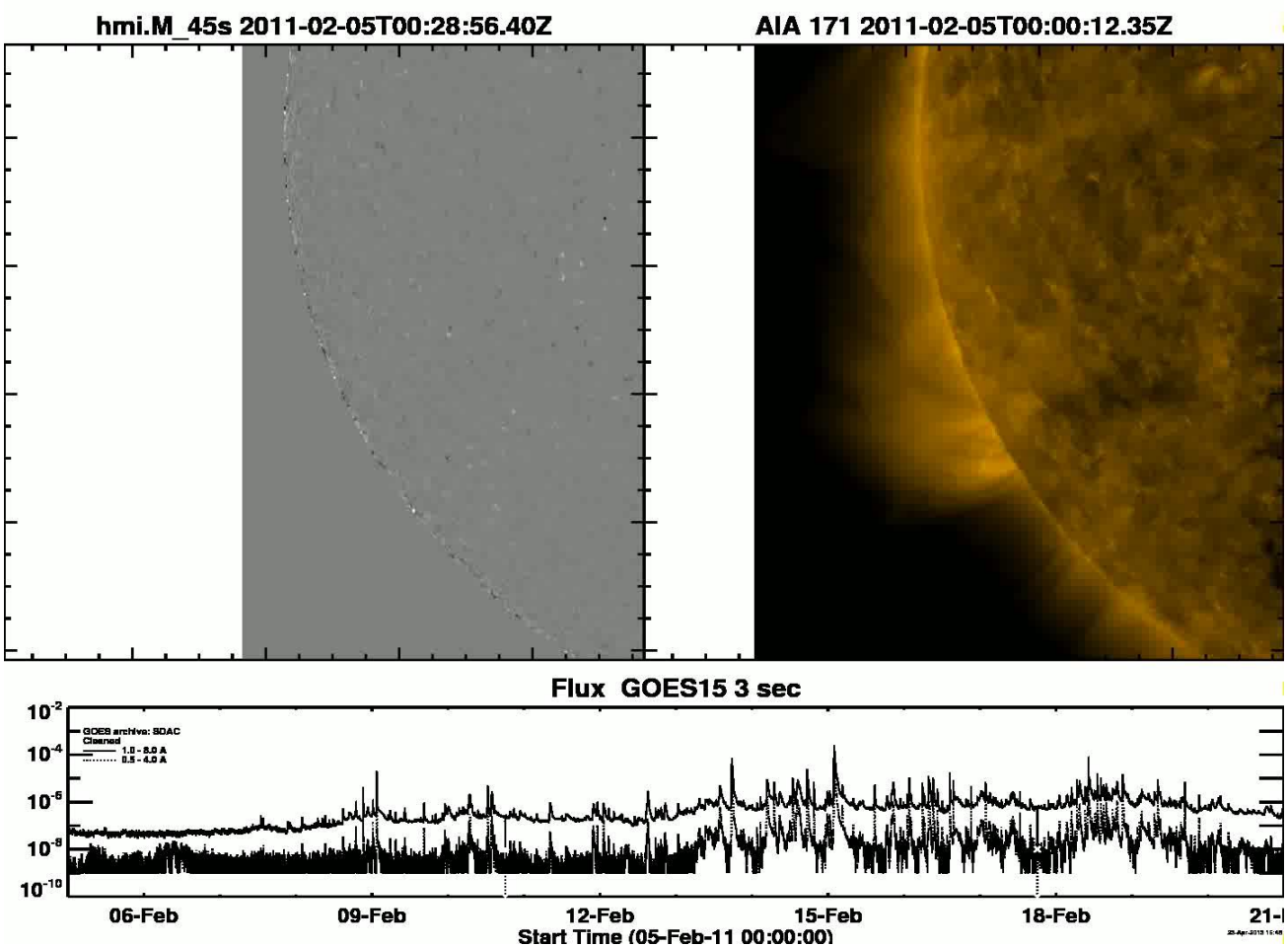
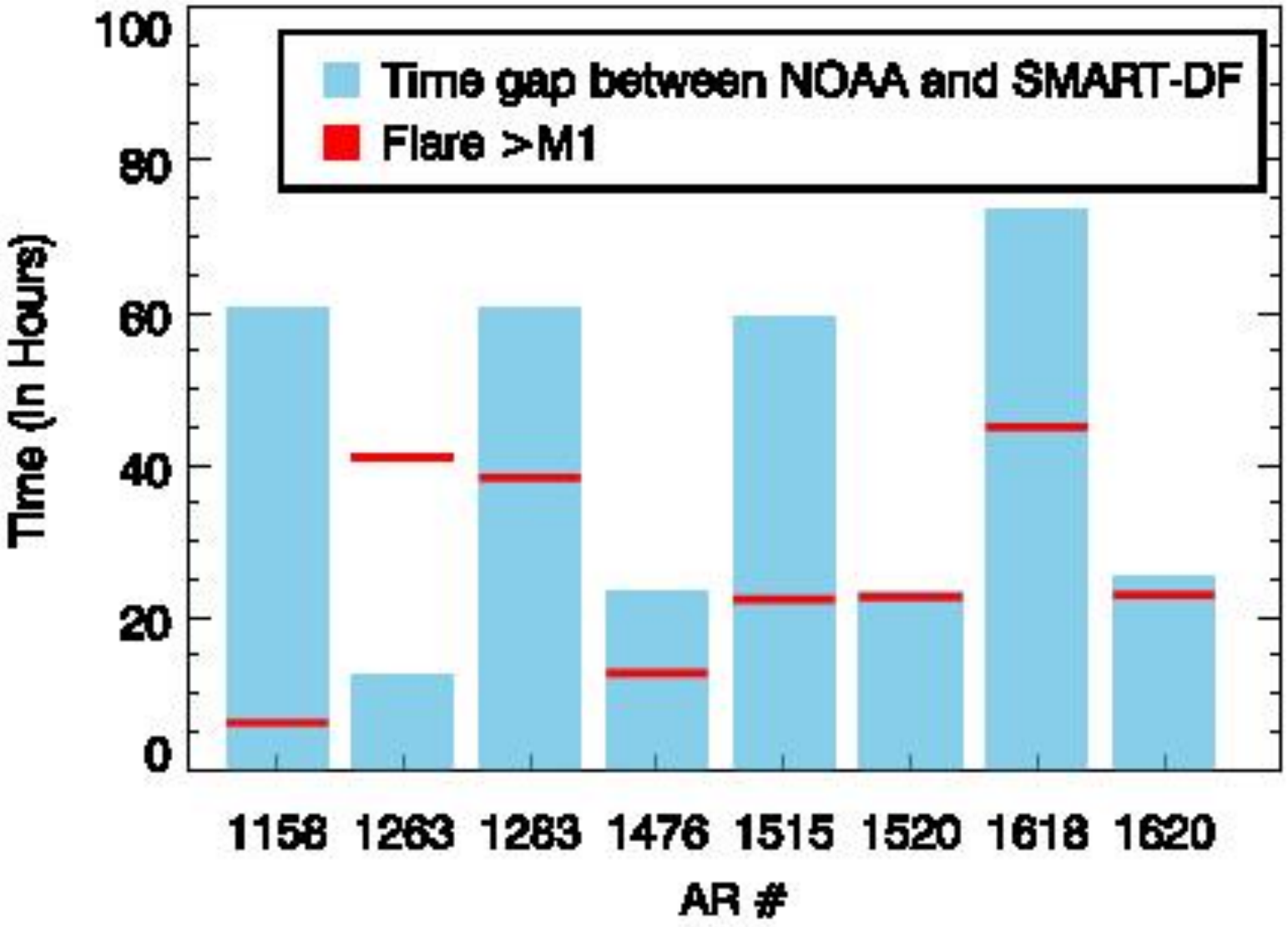
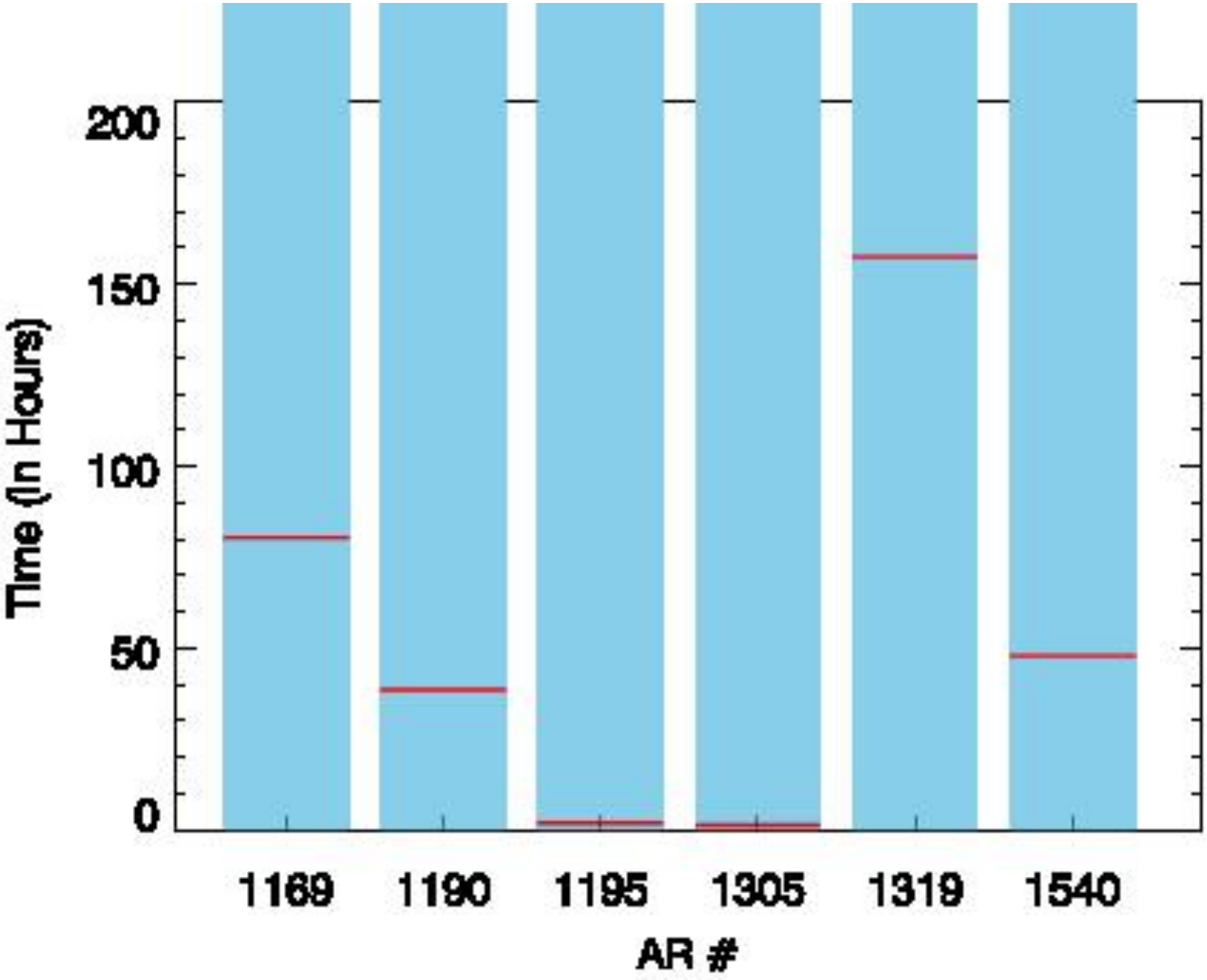
SMART-DF and Flares

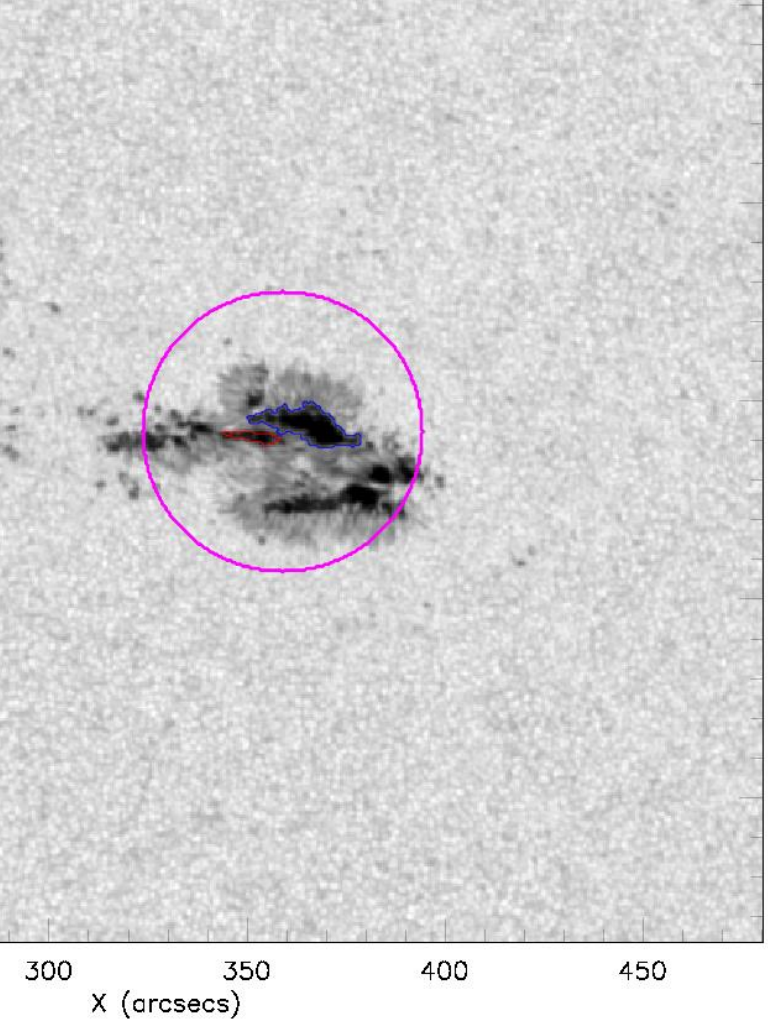


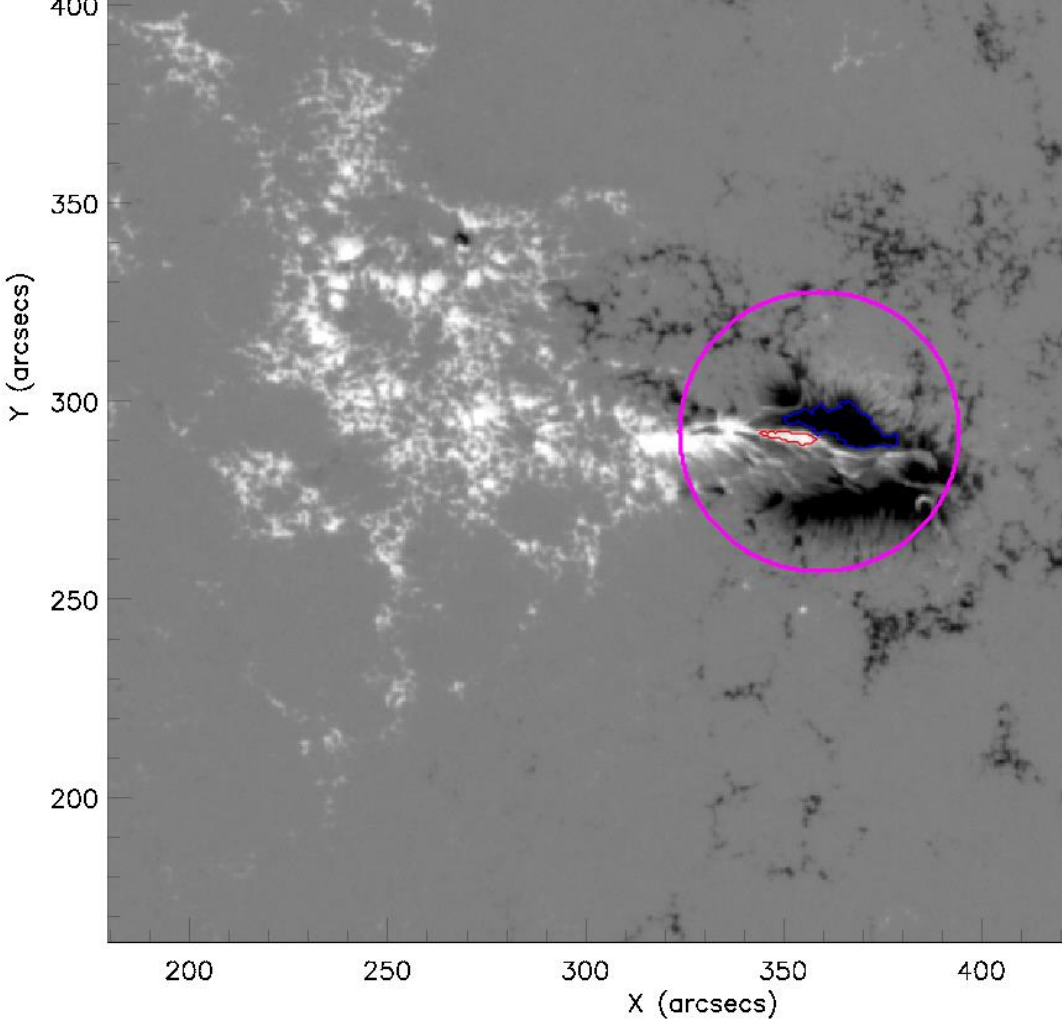
- δ-Region on AR11158 was detected by SMART-DF at least 5 Hours before the first M-class Flare.

SMART-DF vs NOAA-SRS




200
150
100
50
0
Time (In Hours)
1169
1190
1195
1305
1319
1540
AR #





- First M-class flare from AR 11190 a day after marked as δ by SMART-DF. Where as NOAA never marked AR 11190 as δ!

Conclusion

- A new automated δ-spots detection code named SMART-DF is developed and tested.
- The code is tested by comparing with NOAA's detection and found to be working good.
- NRT detection of δ-spots will be useful in flare-forecasting
- SMART-DF will be soon integrated to www.solarmonitor.org, and will be soon made available to public.

Thanks.