

Review on "High-latitude crochet: solar flare-induced magnetic disturbance independent from low-latitude" by Yamauchi et al.

A crochet is a type of geomagnetic disturbance that is typically observed at low and middle latitudes following a solar flare. This paper describes characteristics of a new type of geomagnetic crochet at high latitudes (65–75N). It is shown that the new crochet differs from ordinary ones at lower latitudes in terms of its intensity and duration. The new crochet is also shown to be different from previously reported crochets in the auroral and cusp regions. The paper contains new and exciting results that make a good addition to the understanding of the geomagnetic field. As such, I recommend this paper for publication. Below are my comments and suggestions that could further improve the quality of the paper.

1. "Sq (ion) convection" (l.12,13,167,171,172,282), "Sq" (l.236)  
In my opinion, the term Sq should not be used when referring to quiet-day electric fields or currents at high latitudes. Sq electric fields and currents at middle and low latitudes are produced by the wind dynamo. At high latitudes, daily variations in electric fields and currents are not due to the wind dynamo but due to the magnetospheric convection, thus calling them Sq can be confusing. My suggestion is as follows:

- l.12 Remove "Sq".
- l.13 Replace "Sq" with "background".
- l.167 Remove "Sq".
- l.171 Replace "Sq" with "background".
- l.172 Remove "Sq".
- l.236 Replace "Sq" with "background".
- l.282 Replace "Sq" with "background".

2. l.1 "Solar flare-induced High latitude"  
"High" should be in the lower case.

3. l.36 "it is simple called crochet"  
Replace "simple" with "simply".

4. l.70 "The other data are described"  
What are "the other data"?

5. l.126 "Equivalent ionospheric current"  
Please briefly describe how the baseline was determined. The baseline matters for equivalent currents.

6. l.162 "daily neutral convection starting from subsolar region"  
This entire phrase can be replaced by "tidal winds".

7. l.164 "EISCAT VHF radar"  
What is the antenna direction? The Figure 5 caption says that the radar was looking northward with 30° angle. Is this from the vertical or local magnetic field line, or something else?

8. Table 1  
I do not understand this table. For example, for ASY, I see that a

crochet was detected in 52 flare events; not detected in 5 events; and unclear in 6 events. Additionally, there were 5 events where a crochet was unclear because of substorm-related disturbances. But they do not add up to the total 73 events. "+5" in the "yes" category is unexplained.

Also, it is strange to see that the number of "substorm" is different for ASY, AU, and AL. Would not it be more straightforward if the table is created only for the 62 events which are not concurrent with a substorm?

9. l.187 "There are about 10 events are during substorms"  
Insert "that" between "events" and "are".

10. l.192 "they are either auroral"  
Or what?

11. l.208 "This suggest that AU signature is most likely caused by this crochet rather than auroral crochet."  
This is difficult to say without data from other LT. I suggest to replace "is most likely" with "could be". Also, replace "suggest" with "suggests".

12. l.232 "if intensification of the Sq current is important, the new crochet might be the equinox phenomenon"  
This may be removed. Sq currents at middle and low latitudes exist not only during equinox but also during solstice.

13. l.236 "through the enhancement of both the ion/electron density and ion velocity"  
The enhancement of plasma density can be understood as a result of increased ionization during the solar flare, but how do the authors explain the enhancement of ion velocity (i.e., electric field)?

14. l.242 "Such a work also probably give some hints"  
Replace "give" with "gives".

15. l.249 "and traditional explanation of the trigger is IMF changes"  
I do not understand what was meant by this. Remove or rephrase.

16. l.261 "on that day"  
Please clarify which day.

17. l.264 "mediation"  
"modulation"?

18. l.268 "4.4 Relation to space weather"  
This subsection, consisting of two sentences, can be removed. It does not add any new information or insight.

Finally, please check the numbering of sections and subsections, which is currently as follows:

1. Introduction

2. High-latitude crochet for X9.3 flare on 6 September, 2017
  - 2.1 Subsolar crochet after X9.3 flare
  - 2.2 New crochet after X9.3 flare
  - 2.3 Equivalent ionospheric current
  - 2.4 EISCAT data
3. Preliminary survey results
  - 3.1 Discussion and future tasks
  - 3.2 Why not found in the past?
4. Need solid statistics and global perspective
  - 4.1 What is the main driver of the new crochet?
  - 4.2 Can crochet trigger a substorm or M-I coupling?
  - 4.3 Modulation of Pc5?
  - 4.4 Relation to space weather
5. Conclusions

Subsection 3.1 has no content. Perhaps, Subsection 3.1 was meant to be Section 4, and

3.2 -> 4.1

4. -> 4.2

4.1 -> 4.3 and so on?