

Reply to comment by N. Gopalswamy et al. on “Interplanetary shocks unconnected with earthbound coronal mass ejections”

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1. Introduction

[1] I have some concerns about some issues raised by *Gopalswamy et al.* [2006]. While our paper [*Howard and Tappin*, 2005], (hereafter referred to as HT) does not draw conclusive results either, I do not believe that those produced in the present paper are any more reliable or conclusive.

[2] Firstly, some general comments. The authors appear to have made a common oversight when comparing data separated by distance and design. Specifically, that is the argument that here is a shock at 1 AU, here is a CME a few days earlier and here is a flare which occurred somewhere on the solar disk at around the same time as the CME onset. Therefore these events must be the part of the same eruption. While they are observationally related their physical relationship has not been clearly established. For example, it may also have rained in New York on 7 April 1998 but this is not related to the phenomena being studied.

[3] We cannot claim that a CME observed in LASCO which has no halo (or partial halo) component is directed along the Sun-Earth line without an attempt to explain how the physics of such a phenomena is possible. If no halo component is observed, then the CME must not have been in the Sun-Earth line when it was in LASCO’s field of view, so we need a mechanism which allows the CME to cross this line in transit.

[4] I offer some possible physical reasons for how such an event could be observed:

[5] 1. The erupting CME (or associated shock, if such a distinction is possible) has one of its flanks directed along or near the Sun-Earth line, which crosses the line as the structure expands. This suggestion has been offered in *Gopalswamy et al.* [2006], but no attempt to physically validate this claim has been made.

[6] 2. The CME structure corotates with the Sun, allowing its structure to move into the Sun-Earth line somewhere between 0 and 1 AU.

[7] 3. Some as yet undefined longitudinal evolution of the erupting CME structure.

[8] 4. There is an invisible halo or partial halo CME. This may have occurred simultaneously with the detected “limb” CME for it is common for HCMEs to be accompanied by a brighter, non-halo component. This is the mechanism proposed by HT and, as with *Gopalswamy et al.* [2006], no sufficient physical validation has been offered.

[9] The point I am trying to make is that we are moving into the realms of speculation. The authors offer one physical explanation for what is causing these events, while we offer another. Neither can be directly proven with the available data and the comments presented by us appear to offer an alternative process for what can drive these structures. Until a physically justifiable claim to support either model is produced, then both (or perhaps all 4) of the aforementioned ideas must be regarded as equally viable.

[10] Also, I feel it’s important to point out that it is not correct to say that active regions or flares are the source of CMEs. They are, at best, a lower-altitude solar response to an as yet unknown driving mechanism, and are typically located at one footprint of the erupting magnetic structure containing the CME.

[11] Now for specifics.

2. Event 1: 7 April 1998

[12] I cannot accept the author’s claim that the CME first observed by LASCO at 18:30 on 2 April 1998 is the cause for the shock at 17:00 on 7 April 1998. As mentioned above, simply connecting a CME of less than 50 degree width in the SE quadrant with one directed along the Sun-Earth line, even if you choose to associate it with an eruption from AR 8190, is inaccurate and potentially misleading. I would request a more detailed description of the physics behind this suggested “limb” CME – IP shock combination or a reconsideration of the potential of this CME to be responsible for the shock.

3. Event 2: 23 October 1998

[13] I accept the authors’ claims that there is a data gap during the event in question and can therefore not rule out that a CME may have occurred during this time frame.

4. Event 3: 18 May 1998

[14] As offered by *Howard and Tappin* [2005], this may be a CIR and I accept the authors’ claim that this may be the case.

5. Event 4 and 5: 23 August 1999

[15] The arguments for these two events are more convincing, but still marginal. While the claim that the shock

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geometry could possibly extend across the Sun-Earth line, the claim remains unsubstantiated in the physical evidence, and the knowledge that the CMEs drove shocks is insufficient to make the conclusive claims offered here. And this is before we begin to consider the potential consequences of the differences between latitudinal and longitudinal structure of the transient geometry.

6. Event 6: 23 December 2001

[16] Of the three types of “evidence for CIRs” indicated by HT, this event appears to satisfy only Number 3 (evidence of equatorial holes). EPAM data for this event show antisunward-traveling particles both before and some time after the event and possibly/probably sunward traveling particles during the passage of the shock. This would appear to be evidence of a standard forward shock passing ACE and in contradiction of Item Number 1 in *Howard and Tappin* [2005]. Also, there is no evidence of a reverse shock, let alone one which is stronger than the forward shock, which would appear to contradict Item Number 2 in *Howard and Tappin* [2005]. With the exception of the coronal hole, all the other evidence proposed by the authors

would appear to be apparent in many types of forward shock.

7. Event 7: 9 November 2002

[17] Once again the knowledge that a “limb” CME produces a shock is not sufficient to claim that it is directed along the Sun-Earth line. As with the 23 August events, the authors are offering an alternative explanation to those of *Howard and Tappin* [2005], but without sufficient physical support. It is suggested that the authors present their case with this in mind.

References

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