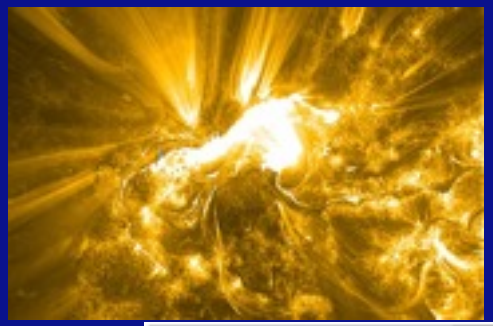
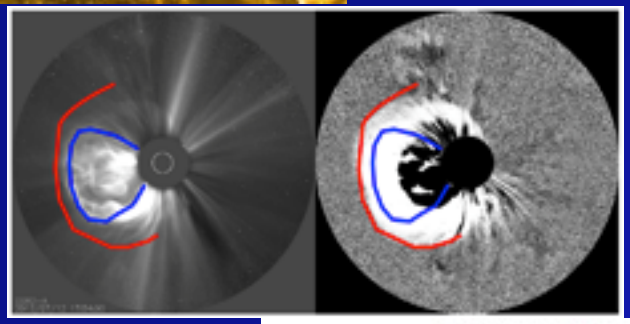
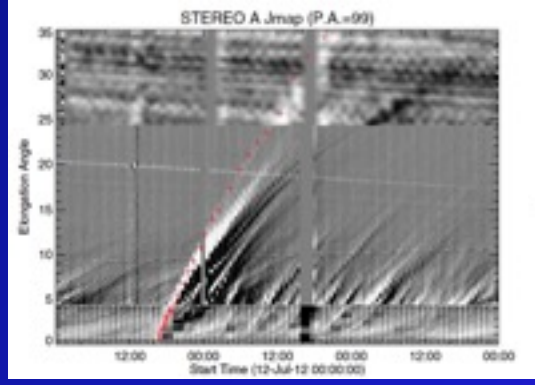
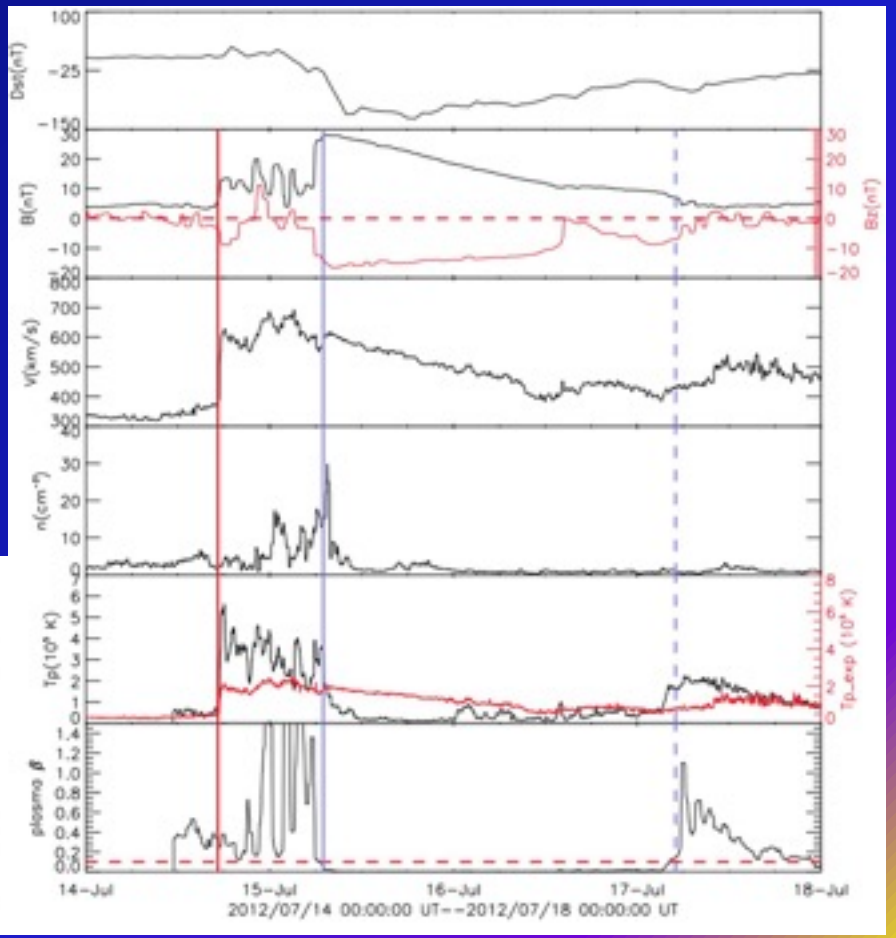
ISEST WG1 Summary: Data Group (Jie Zhang)









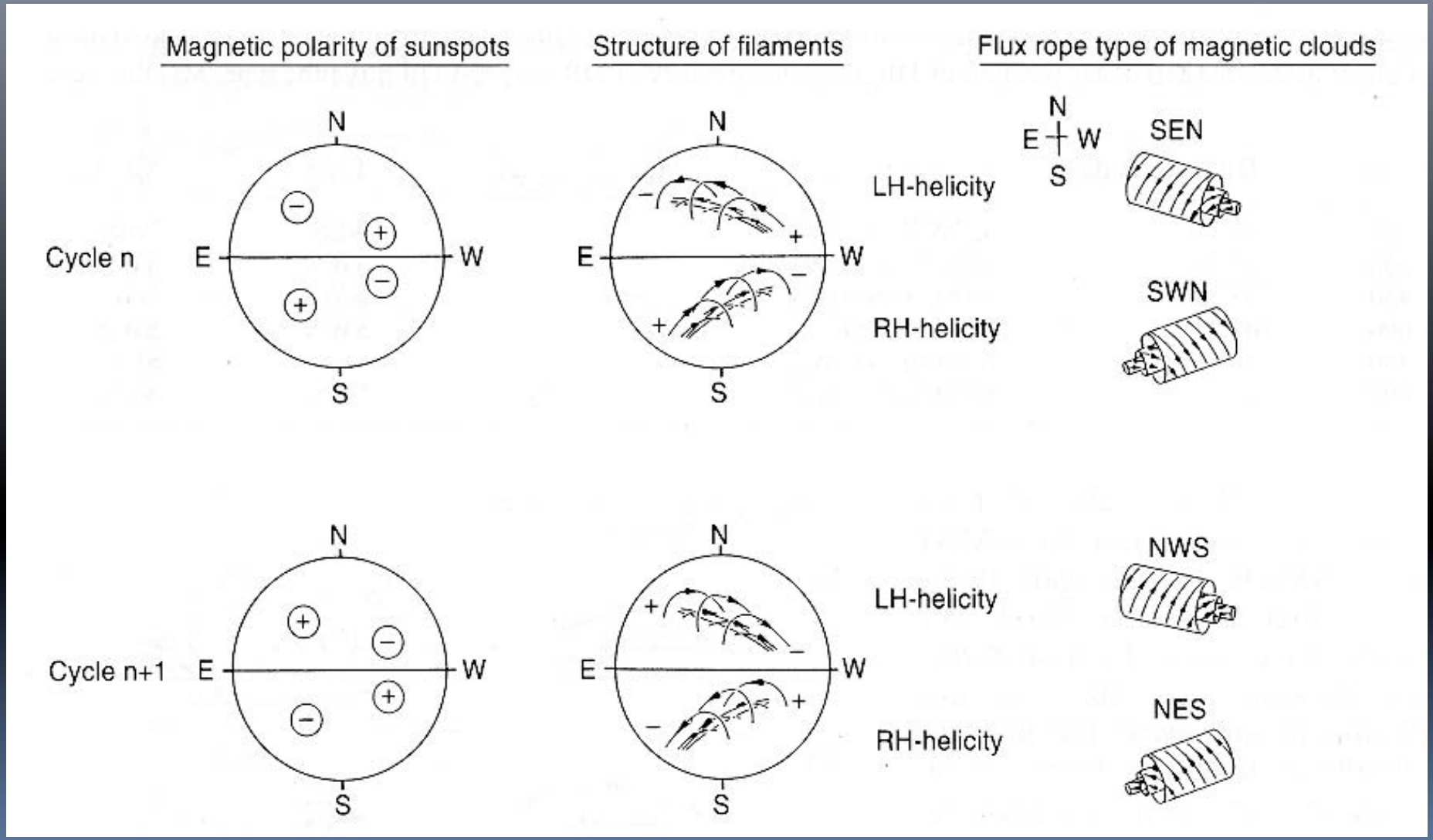
Bothmer (Invitation Talk)

- The magnetic field configuration of CMEs can be predicted from solar magnetograms based on the Bothmer-Schwenn Scheme (1998)

- The BS scheme provides the baseline prediction of magnetic configuration in CMEs. Additional consideration is needed when quadruple magnetic field is involved in the eruption.

- Complexity of CME magnetic field structure arises from multiple sources: source region photospheric field complexity, lateral expansion, defection, and non force-free CME evolution

Scheme of the Dependence of CME Magnetic Cloud Configurations on the Solar Cycle



No consideration of quadrupolar fields

Bothmer & Schwenn, 1998

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http://www.affects-fp7.eu/weather

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AFFECTS

- **Advanced Forecast For Ensuring Communications Through Space** - is a space research project under the 7th Framework Programme of the European Union.

AFFECTS will provide advanced early space weather warning to protect communication systems.

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THE FOLLOWING INSTITUTIONS ARE INVOLVED IN AFFECTS:

Ben. No.	Country	Institution	Short Name	Scientific Contact
1	Germany	Georg-August-University Göttingen	UGOE	Dr. Volker Bothmer, project coordinator
2	Belgium	Royal Observatory of Belgium	ROB	Dr. Ronald Van der Linden, Dr. Cis Verbeeck
3	Ukraine	Space Research Institute	SRI NASU-NSAU	Dr. Aleksei Parnowski
4	Germany	Fraunhofer IPM	FHG	Dr. Raimund Brunner
5	Norway	University of Tromsø	UoT	Prof. Chris Hall
6	Germany	German Aeropace Center	DLR	Dr. Norbert Jakowski, Dr. Jens Berdermann
7	Germany	Astrium GmbH	ASTRIUM ST	Wilfried Pfeffer
8	U.S.A.	Space Weather Prediction Center of NOAA	NOAA-SWPC	Dr. Rodney Viereck
9	Germany	Planetarium Hamburg	Planetarium HH	Thomas W. Kraupe

For more information about the AFFECTS project partners please look at *Project -> Partners*

LATEST NEWS

13/01/2015: The update of the **AFFECTS iOS App** is now available on the App store.

07/01/2015: The **AFFECTS iOS App** upgrade is currently being tested. The upgrade will resolve also issues with website access of STEREO images and general functionality of push alerts.

18/12/2014: The **AFFECTS Website** has been upgraded to accomplish the new NOAA SWPC website structure. The **AFFECTS iOS App** has been upgraded as well and will soon be available through the App store. Due to the holiday season it will be released in January.

26/11/2014: The new version of the **AFFECTS Android App** is now online available under *-> SERVICES* .

14/11/2014: The **AFFECTS Print Brochure** and **Interactive Service Guide** are now online available at *-> SERVICES* - click on Services - and at *-> PR*. For hardcopy requests please contact the AFFECTS coordinator.

13/11/2014: Latest space weather news about solar storms caused by the **reappearing sunspot group 2192** can be found under "Weather".

10/07/14: The **AFFECTS iOS Space Weather App** is now available on the App Store.

11/02/14: The next **AFFECTS General Meeting incl. Steering Committee Meeting** takes place in Brussels from February 17-19, 2014. Further information can be found at *-> PROJECT -> MEETINGS -> 3rd GM.*

10/02/14: Recently, we created a **YouTube channel** showing our AFFECTS preoject trailer. The channel can be

Nitta (Invitation Talk)

Sun-Earth “dis”-connection

1. **Stealth or stealth-like CMEs: CMEs are observed by a coronagraph, but low corona manifestation on solar disk could not (or barely) be found**

2. **Clearly identified front-side halo CMEs do not arrive at the Earth**

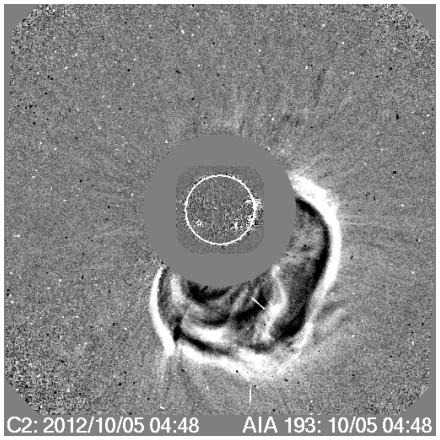
3. **An ICME is observed at 1 AU, but there is no CME on the Sun within a reasonable time window**

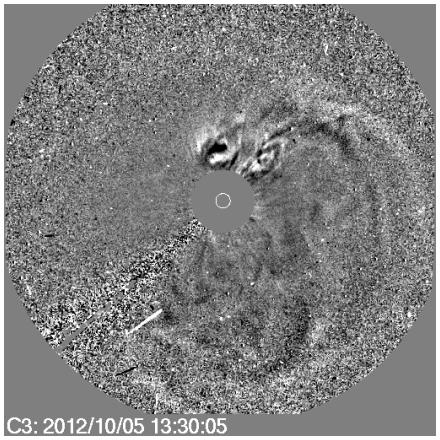
4. **A candidate CME may be found for an ICME, but the source location appears to be “unreasonable”**

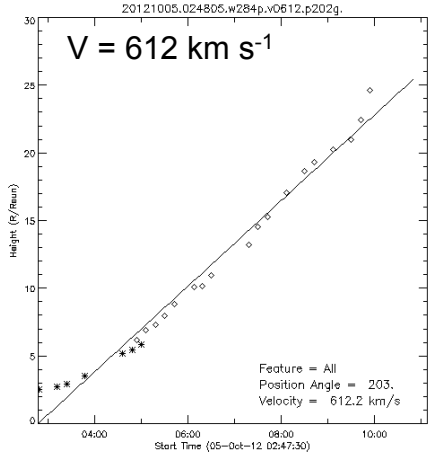
2012-10-08 ICME, 2012-10-05 CME

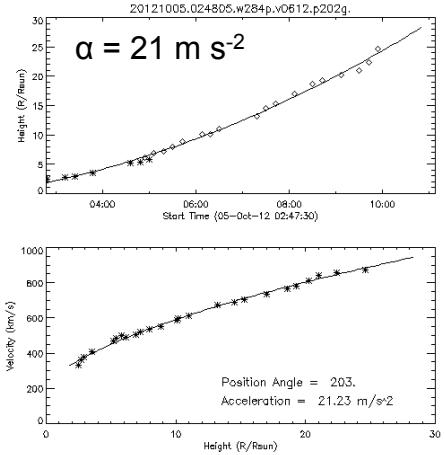
This was first selected by ISEST because of a possible stealth CME.

The only halo CME in the possible time window that may account for the ICME is:







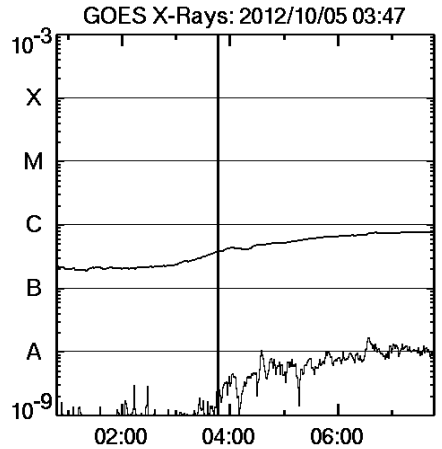


But How can this be a stealth CME?

The CME is quite bright.

It is not slow.

It is associated with a slow B8 flare.



Summary

Helped by STEREO observations, especially during 2010−2012, SDO AIA can *in principle* observe the nascence of all CMEs from the visible side. In reality, however, there are still many CMEs, whose coronal signatures do not come out with standard analysis procedures.

Some of them could be found out by expanding the time ranges, changing the sampling, comparing different channels (temperatures) and using difference and ratio techniques.

These “stealth-like” CMEs tend to occur close to a coronal hole, and interchange reconnection may play a role in their initiation. They may also manifest in minor flux ropes sometimes seen embedded in CIRs, also partly account for the mismatched sector boundaries.

The origins of the remaining “real stealth CMEs” may be found out with particular attention to their possible proximity to a coronal hole. Eventually we will be able to address the question of whether the stealthiness depends largely on the CME’s initiation height or there are other important factors.

Stealth and stealth-like CMEs may contribute to the orphan ICMEs whose corresponding CME is not unambiguously found.

Nitta (Invitation Talk)

Sun-Earth “dis”-connection

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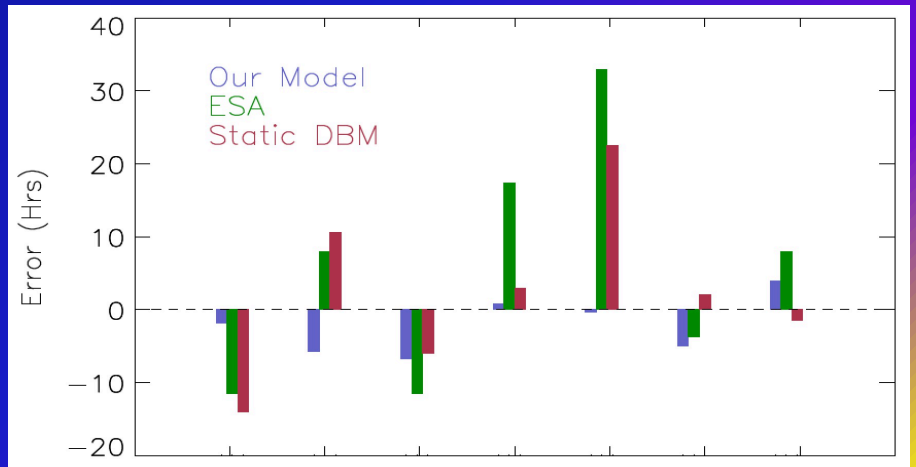
Hess: TOA prediction

Much improved prediction scheme with TOA error of only two hours (Hess & Zhang 2015)

- **Use advanced drag-based model: drag parameter is a function of distance, and initial drag parameter is determined from very early observation**
- **Accurate and 3D early measurement of CME direction and velocity**
- **Correction for geometric effects (1) CME nose deviates from the Sun-Earth line, (2) CME front is partly flattened from a semi-circle**

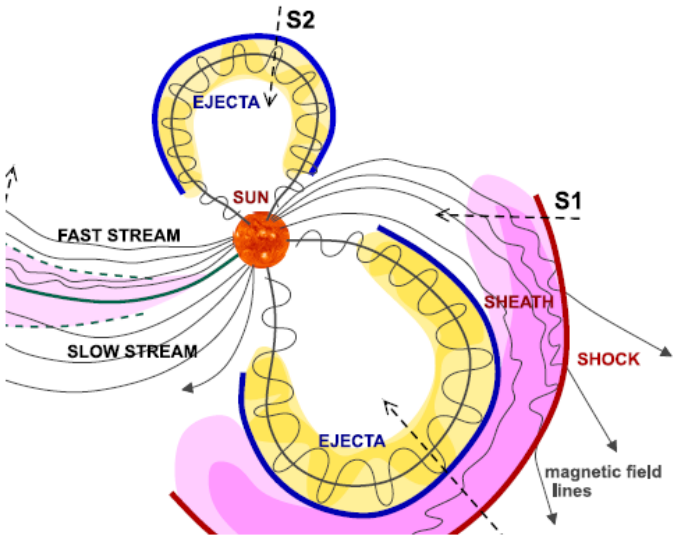


Yermolaev: disturbed solar wind

SW types and interaction between them

- we separately analyze the following sequences of the phenomena:

(1) SW/CIR/SW,
(2) SW/IS/CIR/SW,
(3) SW/Ejecta/SW,
(4) SW/Sheath/Ejecta/SW,
(5) SW/IS/Sheath/Ejecta/SW,
(6) SW/MC/SW,
(7) SW/Sheath/MC/SW, and
(8) SW/IS/Sheath/MC/SW



Yermolaev: disturbed solar wind

Conclusions

- Evidences of interaction of the disturbed SW types among themselves and with undisturbed SW.
- The speed angle ϕ *in ICME changes from 2 to* -2° *while* in CIR and Sheath it changes from -2 to 2°, i.e., the streams in CIR/Sheath and ICME deviate in the opposite side.
- CIR and Sheath before ICME are very similar SW types.
- Sheath can contain large value of magnetic field and be very geoeffective.

Other talks

Mostly working in progress

Small Transients in the Solar Wind --- by Cynthia López Portela*

* **Small Transients in the Solar Wind --- by Cynthia López Portelal**

* **Interplanetary Coronal Mass Ejections and Interplanetary Shocks at Venus, Earth and Mars --- by Primoz Kajdic***

* **The Role of the Solar Wind on the Dust Levitation Effect on the Surface of Small Bodies --- by Alberto Flandes***

The Plan for the Next Year

Main Scientific Tasks

- **(1) Identify** all Earth-Affecting solar transient events, mainly CMEs, during the STEREO era (2007- up to date)

- (2) **Track** these events from the Sun to the Earth, and fully measure, **characterize** and quantify their evolutional properties from the Sun to the Earth

- Provide a comprehensive event **database** for statistical study, for creating empirical evolution and thus prediction models, for theoretical understanding, and for comparing with and validating numerical models — a legacy data asset for the community

- CIRs
- SEPs

Existing Event Catalogs

- **Hess & Zhang ICME catalog**
  - Available at http://solar.gmu.edu/heliophysics/index.php/The_ISEST_Event_List
  - 64 ICMEs from 2007 to 2014 based on ACE
  - Tracking in 3D for about 10 events
- **Richardson & Cane ICME Catalog**
  - Available at http://www.srl.caltech.edu/ACE/ASC/DATA/level3/icmetable2.htm
  - 139 ICMEs from 2007 to 2014 based on ACE and WIND
- **Jian ICME Catalog**
  - Available at http://ww-ssc.igpp.ucla.edu/forms/stereo/stereo_level_3.html
  - 145 ICMEs from 2007 to 2013 from STA
  - 123 ICMEs from 2007to 2013 from STB
- **USTC (China) List**
  - **147 events from 2007 to 2014 based on WIND and ACE**
- **Mostl ICME List**
  - Available at http://www.uni-graz.at/~moestlc/events/chris_list_v1.htm
  - 24 events from 2008 to 2012-Jul
- **Y.-Liu List (NSSC, China) for highly selected events**

Event Catalogs – Action Items

- Merge and clean the catalogs to make a unified ISEST ICME/CME catalog
  - Identify Solar and CME sources for these ICMEs
- How many ICMEs in various lists could not be identified with a counterpart CME? Considering STEREO excludes the visibility effect, and is thought that nothing can be hidden.
- Populate the list up to date
- For each event, add relevant data. For instance, ion charge state (by Vladimir Slemzin)
- The policy of usage and reference raised by Nitta

Tracking – Action Items

- Track the evolution in 3D for as many events as possible (will be a small number)
  - Kinematic evolution in 3D (free of projection effect): height-time profile, velocity-time profile
  - Morphological evolution in 3D: angular width, shape
  - Separation between wave/shock front and the ejecta front: the standoff distance

- If you are a CME tracking, provide the following benchmark for cross-comparison
  - Time and Velocity at multiple milestone locations: 5 Rs, 10 Rs, 20 Rs, 40 Rs, 80 Rs, 160 Rs, 1 AU and Earth

Technique Question for Tracking?

What are the best ways of measuring ICMEs in 3D at different distances from the Sun with STEREO observations?

- **GCS model (Thernisien et al. 2006)**
- **GCS + spherical model (Hess et al. 2014)**
- **J-map: fixed-ϕ (Rouillard et al. 2008)**
- **J-map: fixed-ϕ and triangulation (Liu et al. 2010)**
- **J-map: harmonic mean (Lugaz et al. 2010)**
- **J-map: Self-similar expansion (SSE) (Davies et al. 2012)**

Scientific Question - 1

1. What kind of CMEs would reach the Earth and be geo-effective? (from solar observations alone)?

- Source location distribution on the solar disk?
- Why so many halo CMEs missed the Earth?
- What is the true nature of halo CMEs? Is merely a projection effect?
- How significant is the CME deflection?
- What are the causes of CME deflection?
- What about the effect of CME rotation?
- Stealth CMEs?
- Problem ICMEs?
- In particular, how to predict the magnetic configuration in CMEs? The Bs issue

Scientific Question - 2

2. **How do CMEs propagate in the interplanetary space? (mainly on interplanetary observations)**

- **How do CMEs accelerate or decelerate in the interplanetary space through interaction with the ambient solar wind? The drag parameter?**
- **How does the CME morphology change, e.g., pancaking?**
- **How does the shock front separate from the ejecta front, i.e., the evolution of the standoff distance with time?**
- **Effects of CME interaction with preceding CME?**
- **Effects of CME interaction with preceding and trailing CIRs?**
- **CME erosion due to magnetic reconnection**

Scientific Question - 3

3. **Can we predict the (1) time of arrival (TOA), (2) hit or miss (H/M) and (3) geo-effectiveness (PDST, predicted DST index)?**

- **How accurately do we predict the TOA of an ICME?**
- **How accurately do we predict the TOA for both shocks and ejecta separately ?**
- **How can we improve the prediction of TOA?**
- **How to predict the hit or miss (H/M)?**
- **How to predict the geo-effectiveness of CMEs from solar observation, e.g., Bz?**

Thanks