Summary of WG5 Activities during ISEST 2017

Spiros Patsourakos, University of Ioannina, Greece

Overarching Goals of WG5

Observe (infer) the magnetic field of CMEs in the corona and in the inner heliosphere and understand the related physics

Predict CME magnetic field at 1 AU

Combination of observations, modeling and theory

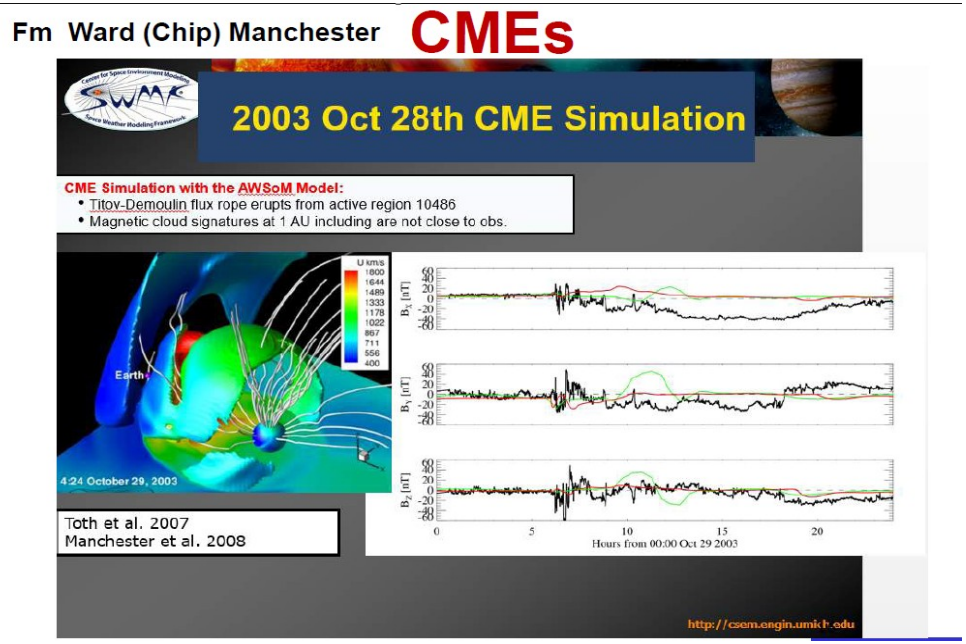
Spiros Patsourakos

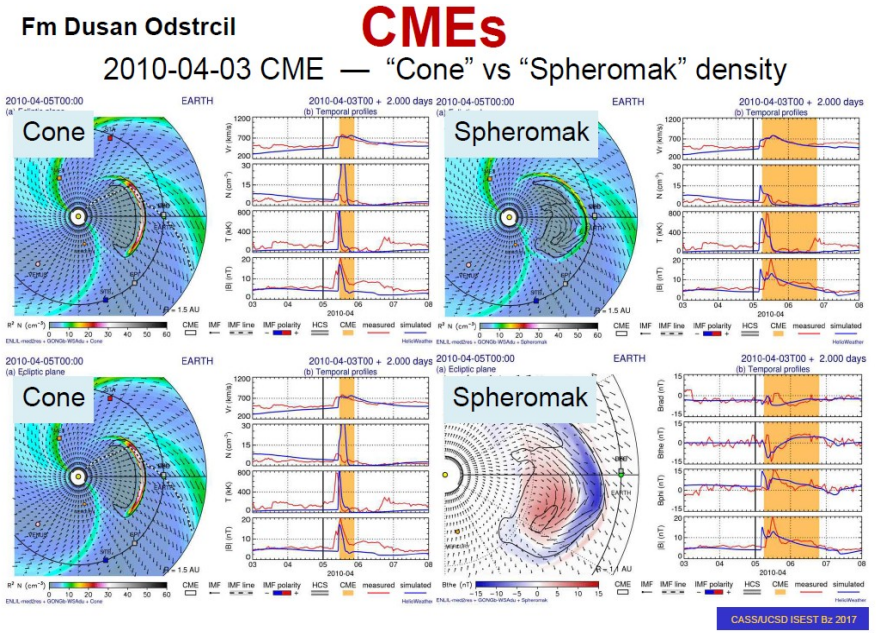
Report of various methods of CME magnetic field inference

H-CME method: coronal CME magnetic field from magnetograms WL images & Hm conservation in flux-rope CMEs

All methods have prons+cons

Bernie Jackson(theme-setting) I





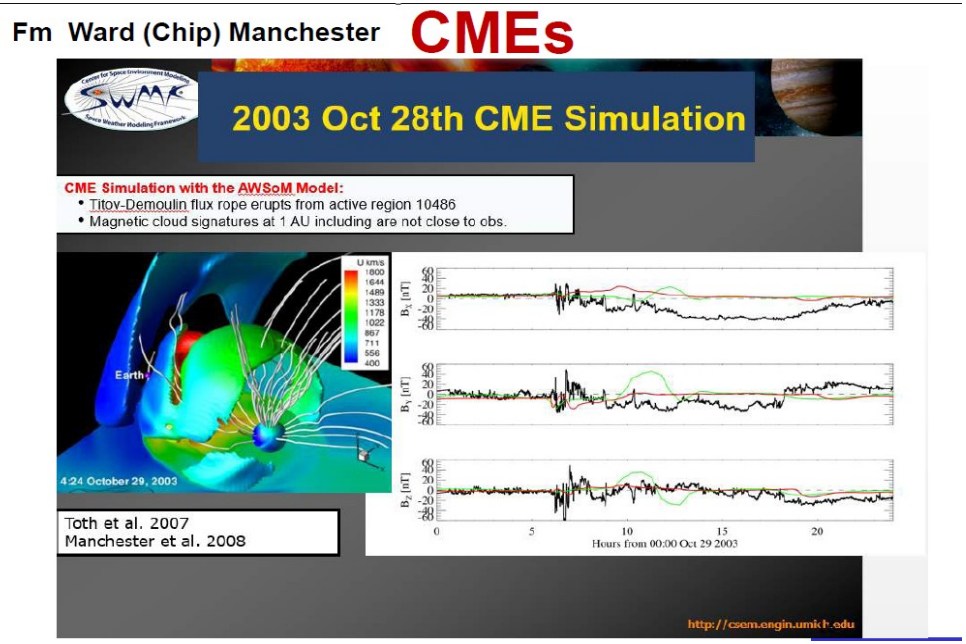
Review of recent advances in measurements of Bz in background solar wind and CMEs

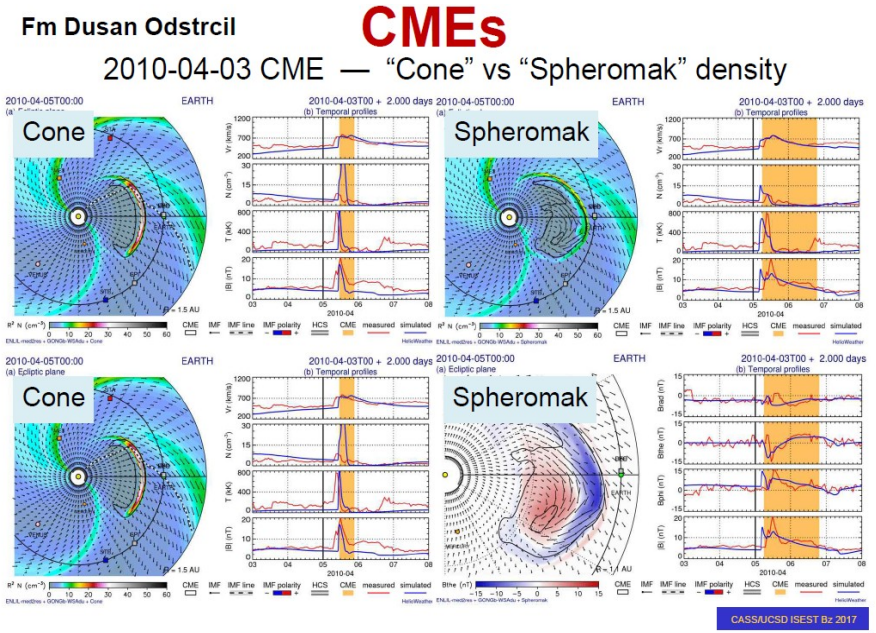
MHD models

"end-to-end": corona—>IP--> 1 AU & beyond

Heliospheric: 0.1 AU ---> 1 AU & beyond

Bernie Jackson(theme-setting) I





Review of recent advances in measurements of Bz in background solar wind and CMEs

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"end-to-end": corona—>IP--> 1 AU & beyond

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Bernie Jackson II

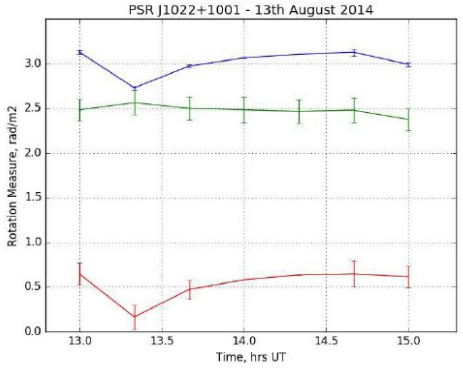
Fm Mario Bisi

Heliospheric FR Observations (3)

Time	Observed RM	Ion RM	Total RM
13:00	3.12722 ± 0.02	2.48140 ± 0.12264	0.64582 ± 0.12426
13:20	2.72809 ± 0.02	2.56207 ± 0.13366	0.16602 ± 0.13515
13:40	2.97102 ± 0.02	2.49809 ± 0.12492	0.47293 ± 0.10598
14:00	3.06306 ± —	2.48251 ± 0.14120	0.58055 ± —
14:20	3.10321 ± —	2.46633 ± 0.12987	0.63688 ± —
14:40	3.12737 ± 0.04	2.47916 ± 0.13886	0.64821 ± 0.14451
15:00	2.99077 ± 0.02	2.37482 ± 0.11960	0.61595 ± 0.12126

Fm Richard Fallows **Heliospheric Remote Sensing**

RM Calculations – Current Estimates



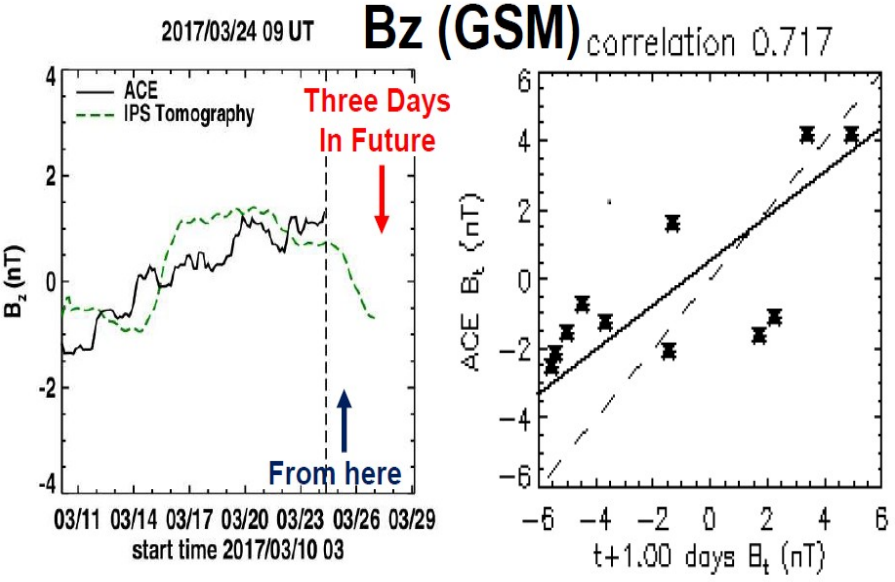
Measured RM (ISM subtracted)

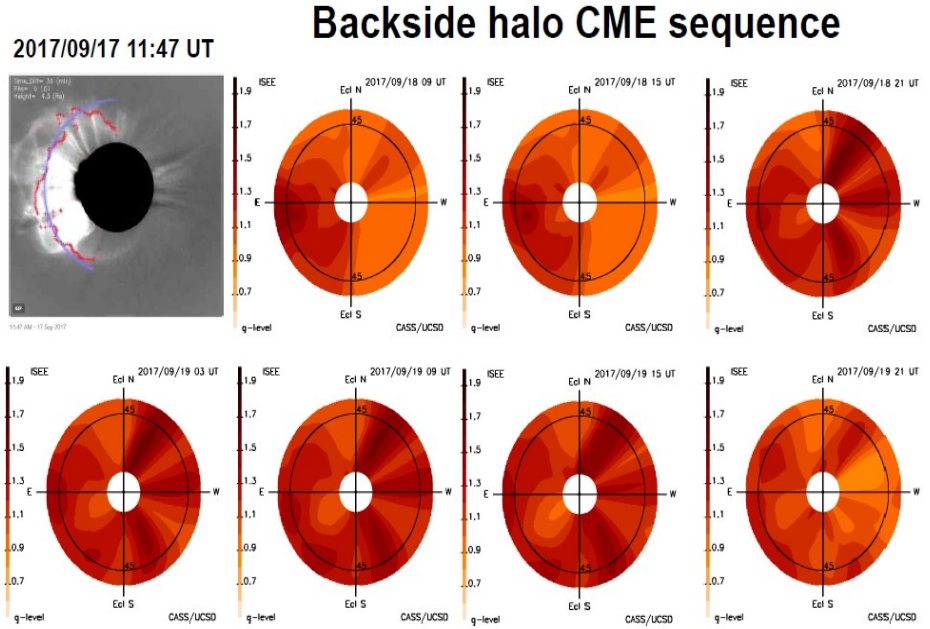
Calculated Ionospheric RM

RM difference

Encouraging results on possible Faraday Rotation rotation IP detection in CMEs by LOFAR

Bernie Jackson III



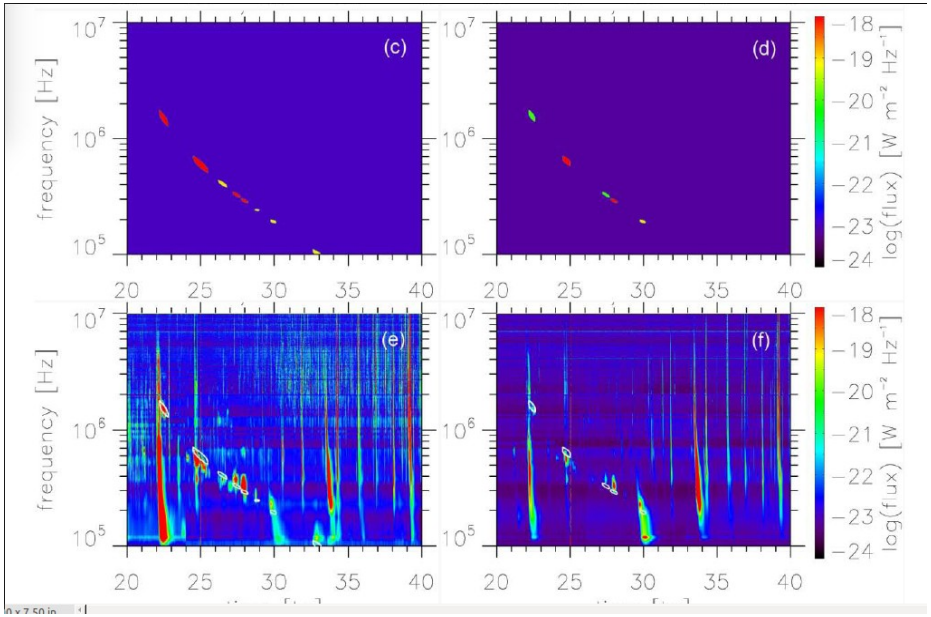


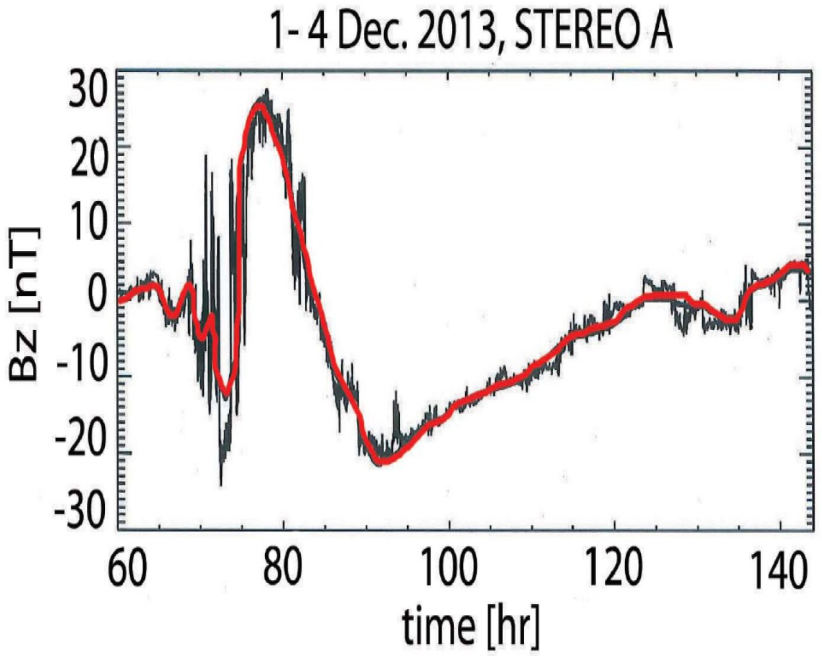
UCSD predictions based on IPS tomography & CSSS model --> good correlation between predicted Bz and in-situ observations for 1d resolution

IPS tomography captures CMEs

Encouraging results on Faraday Rotation in CMEs by LOFAR&MWA

Iver Cairns



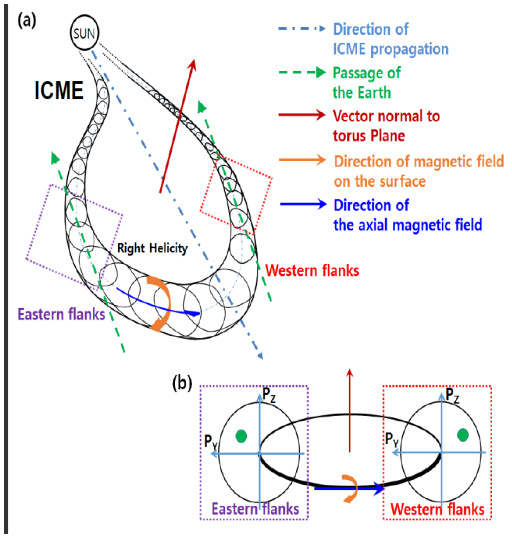


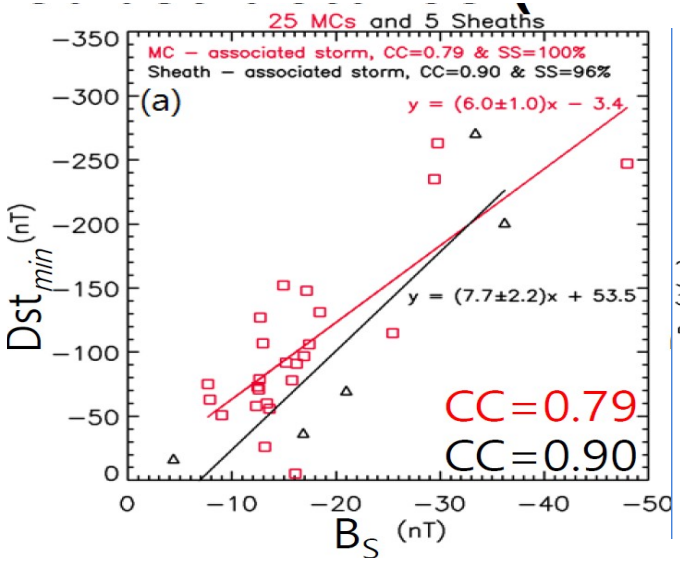
MHD model of the 29 Nov 2013 CME with the BATS-R-US code;CME properties constrained by STEREO observations

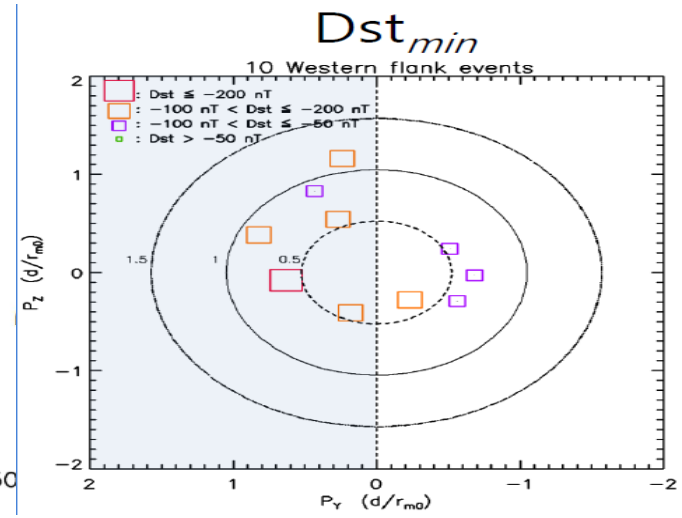
Couple MHD with analytic kinetic theory of type II's

Synthetic II, WL images and Bz at 1 AU in agreement with the observations

Jae-Ok Lee





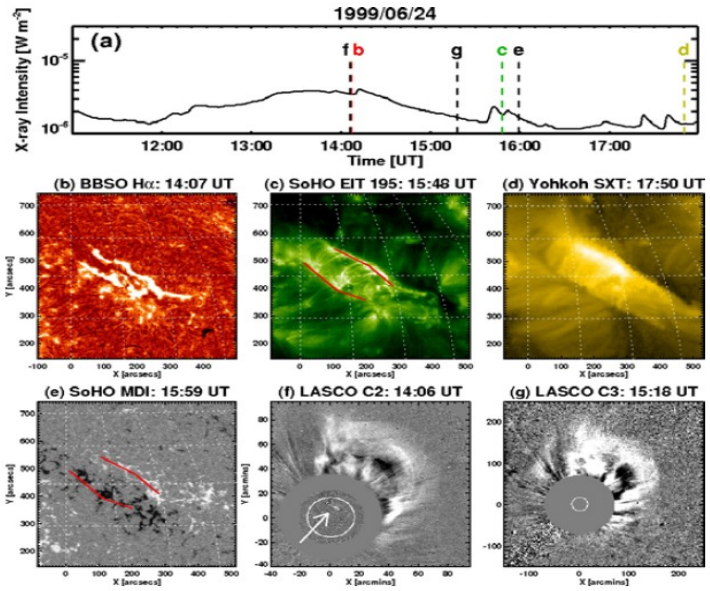


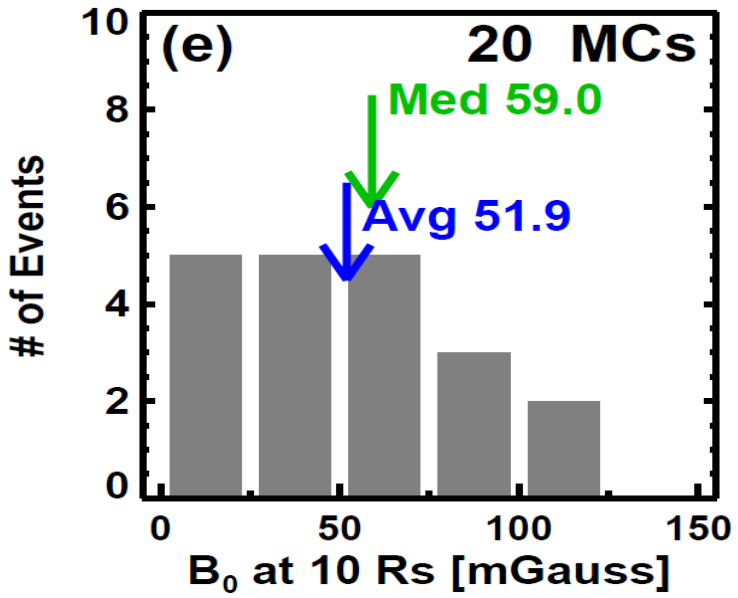
Fit a toroidal MC model to 59 ICMEs

Stronger correlation between solar wind params and Dst for sheaths than for Mcs

Geomagnetic storms occur for specific impact geometries

Nat Gopalswamy



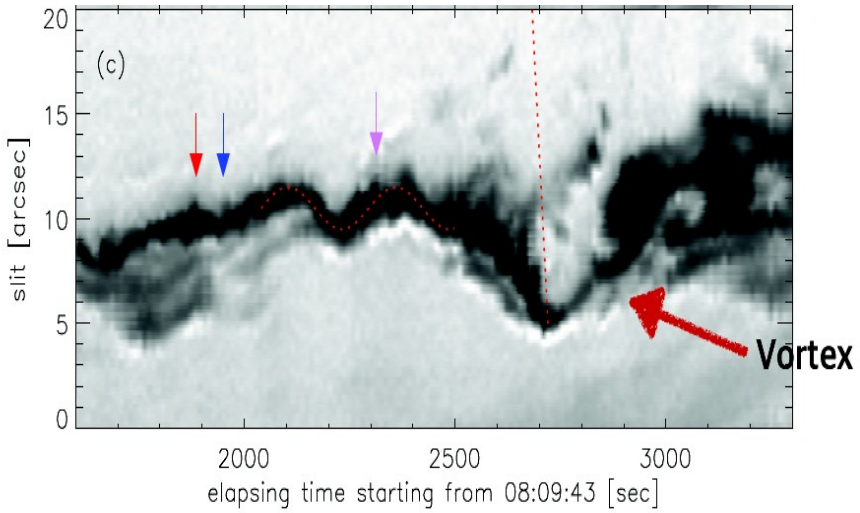


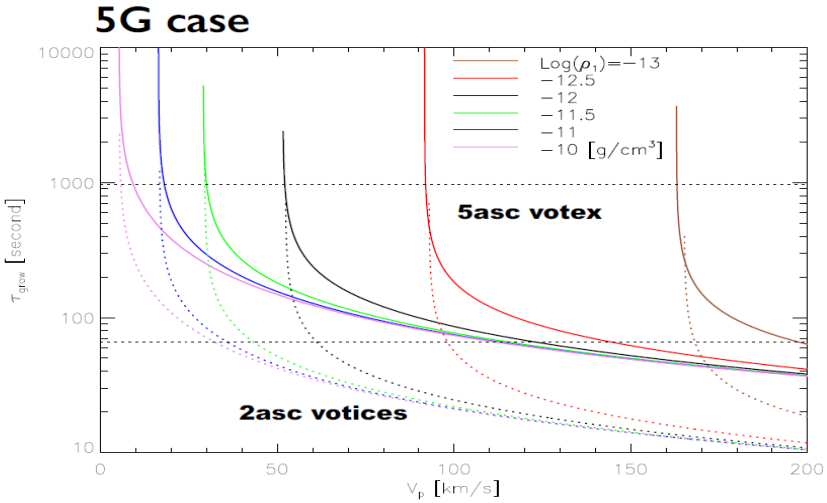
New method (FRED) of inference of CME magnetic field in the corona based on observations of the reconnected flux in post-eruption arcades and coronagraphic imaging applied to LFF flux ropes

Applied to 54 CMEs observed by LASCO ---> correlation between coronal and MC magnetic field

Applied to campaign event of 12 July 2012 with consistent results in the corona and at 1 AU

Heesu Yang





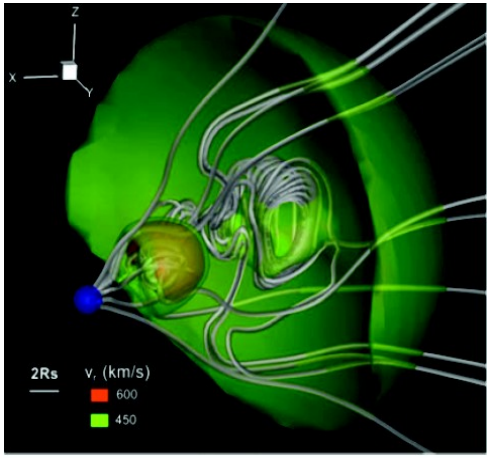
NVST observations of a prominence

Oscillations ---> vortex formation:
streaming kink instability

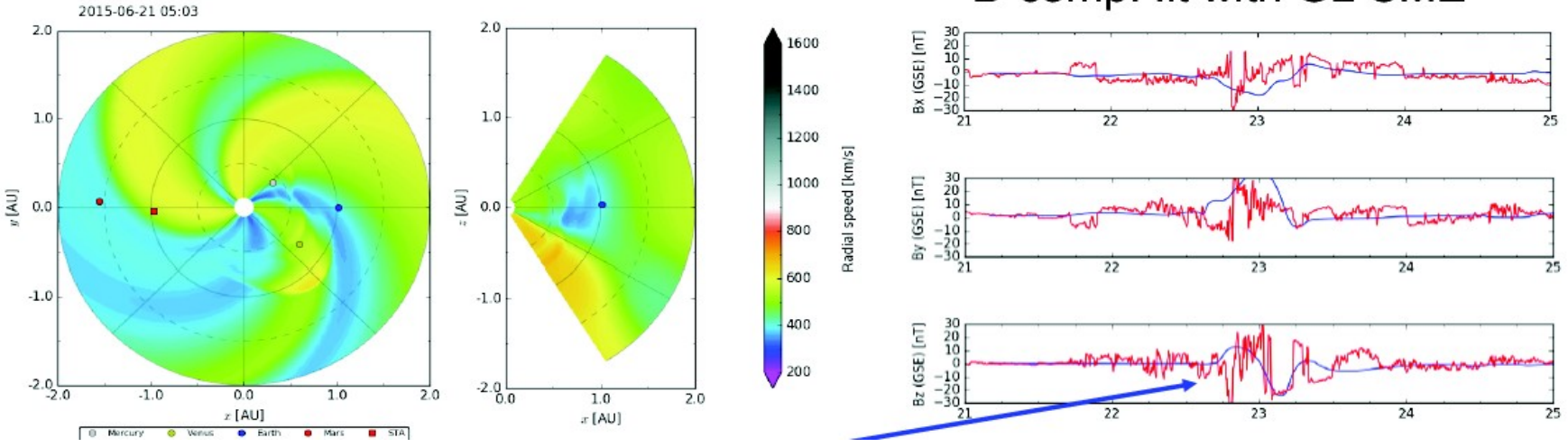
Linearized theory --> density > 10^-11-10^-12 g/cm3

Some Pertinent Inputs from other Groups

Fang Shen: COIN-TVD blob heliospheric CME model

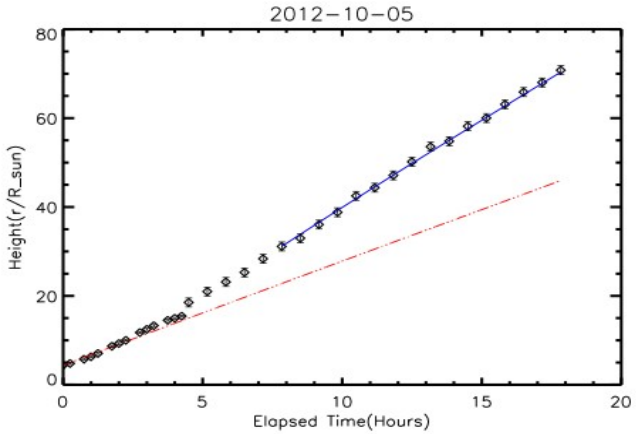


Christine Verbeke: EUHFORIA flux rope heliospheric CME

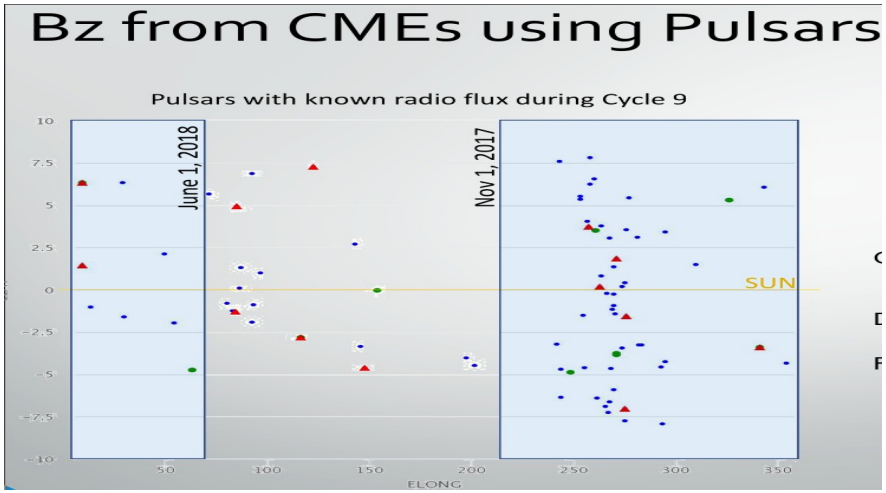


Some Pertinent Inputs from other Groups

Nishtha Sachdeva: method to infer bgk B from CME h-t



Pietro Zucca: future LOFAR observations of coronal IV's and Faraday rotation



Some Pertinent Inputs from other Groups

Yuming Wang, Chenglong Shen Fang Shen, Andrei Zhukov, Katsuhide Marubashi :

CME rotation from Sun/Corona to 1 AU could be significant ...

The Big Picture

Growing **interest and efforts in heliophysics for now and for the future**

Encouraging developments from radio observations (IPS, LOFAR, MWA,...)

Advent of methods to infer the CME magnetic field in the corona

Emergence of magnetized CME heliospheric models for Space-weather predictions (EUHFORIA, COIN-TVD, ENLIL, SUNSANOO)

How about CME orientation from Sun/Corona ---> 1 AU ?

Actions I

exchange info

CME b-field observers (radio + inference): **CMEr, CMEi**
CME modelers: **CMEm**

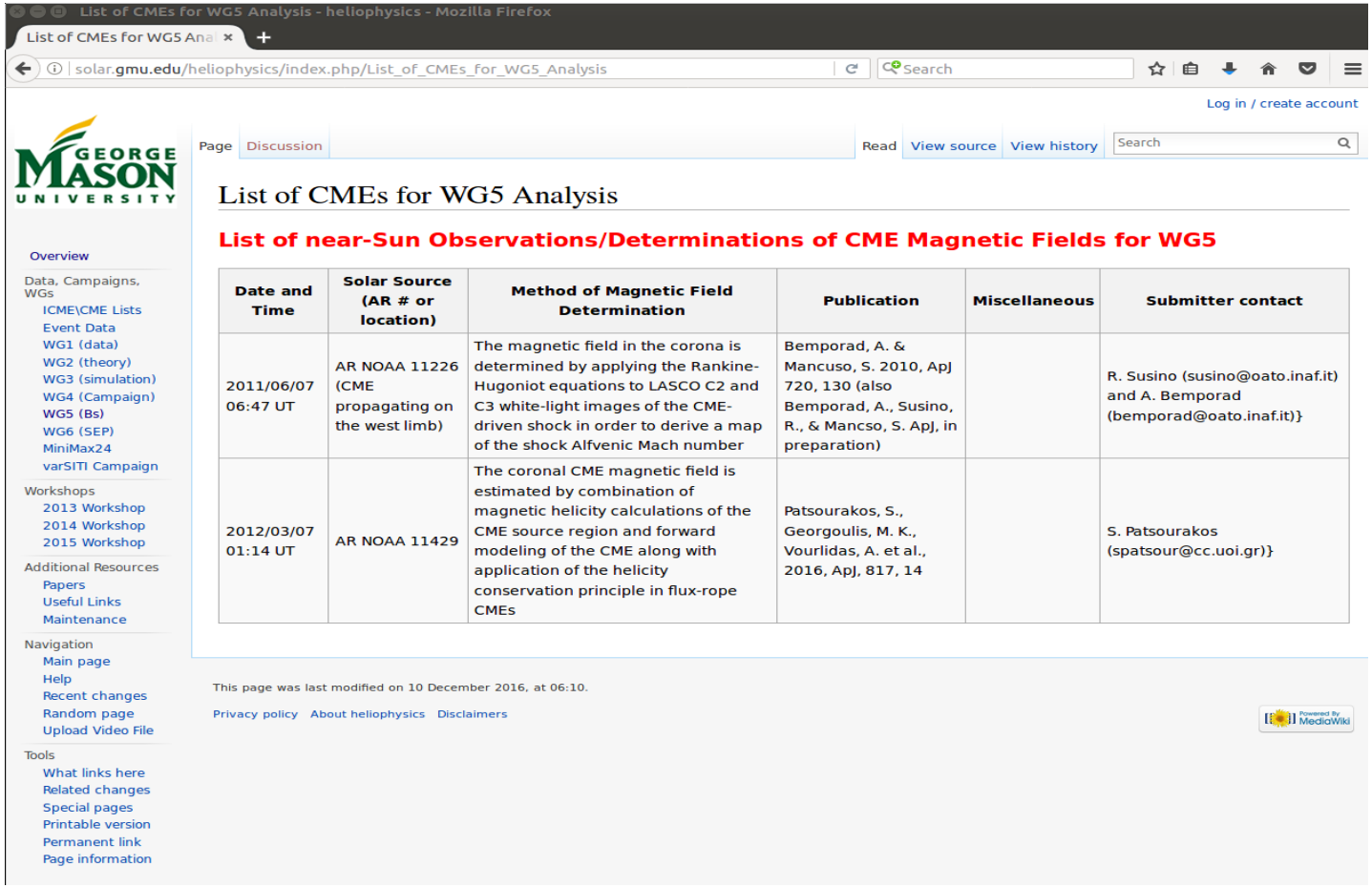
CMEi: easy
CMEr & CMEm: difficult

When CMEm decides to model an event ---> CMEr, CMEi

When CMEr observes ---> CMEm, CMEi

Actions II

Compare Near-Sun CME |B| for different methods: FRED+H-CME.... add more methods



Date and Time	Solar Source (AR # or location)	Method of Magnetic Field Determination	Publication	Miscellaneous	Submitter contact
2011/06/07 06:47 UT	AR NOAA 11226 (CME propagating on the west limb)	The magnetic field in the corona is determined by applying the Rankine-Hugoniot equations to LASCO C2 and C3 white-light images of the CME-driven shock in order to derive a map of the shock Alfvenic Mach number	Bemporad, A. & Mancuso, S. 2010, ApJ 720, 130 (also Bemporad, A., Susino, R., & Mancso, S. ApJ, in preparation)		R. Susino (susino@oato.inaf.it) and A. Bemporad (bemporad@oato.inaf.it)}
2012/03/07 01:14 UT	AR NOAA 11429	The coronal CME magnetic field is estimated by combination of magnetic helicity calculations of the CME source region and forward modeling of the CME along with application of the helicity conservation principle in flux-rope CMEs	Patsourakos, S., Georgoulis, M. K., Vourlidas, A. et al., 2016, ApJ, 817, 14		S. Patsourakos (spatsour@cc.uoi.gr)}

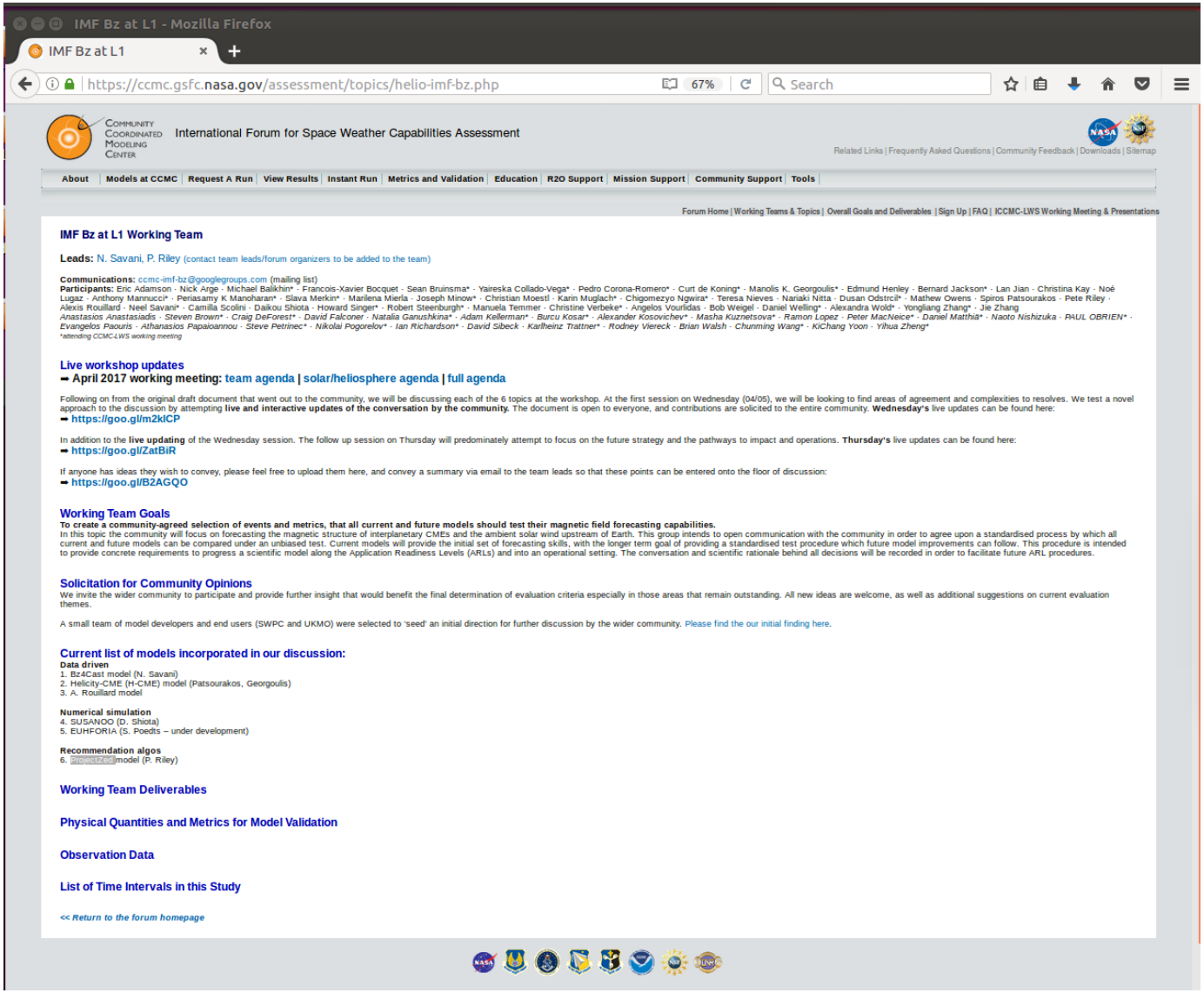
Actions III

CME rotation: theory & simulation group

Actions IV

Coronal CME B from CMEi useful for CMEr predictions of coronal Faraday rotation

Actions V-Collaboration with other teams



What else ???