# Session MP60S-3

## Mardi 15 mars 2016 de 9h00 à 9h30

## Poster 4.5 à Poster 7.1

PNST
Programme National Soleil-Terre

# POSTER 4.5

## Equilibre dynamo-Alfvén dans la zone inertielle du vent solaire

Roland GRAPPIN

# 4.5 Equilibre dynamo-Alfvén dans la zone inertielle du vent solaire

R. Grappin (LPP) A. Verdini W.-C. Müller

•Observations/simulations turbulence: **énergie magnétique > énergie cinétique**

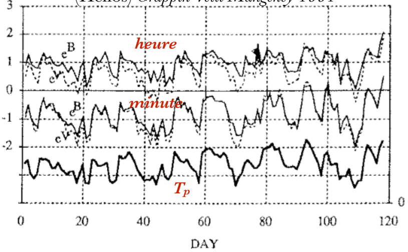
•Mesure excès magnétique *Chen et al 2013* → ***variation corrélée des pentes*:** $m_T = f(m_R)$

•Théorie de l'équilibre Alfvén-dynamo: $E_k^R = (1/b_0)k^{1/2}(E_k^T)^{3/2}$

soit pour les pentes **résiduelle/totale**: $\mathbf{m_R = -1/2 + 3/2\, m_T}$

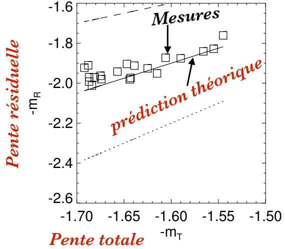
**Energies magnétique et cinétique**

(Helios) *Grappin Velli Mangeney 1991*



**Pentes spectrales**

*Chen et al 2013*



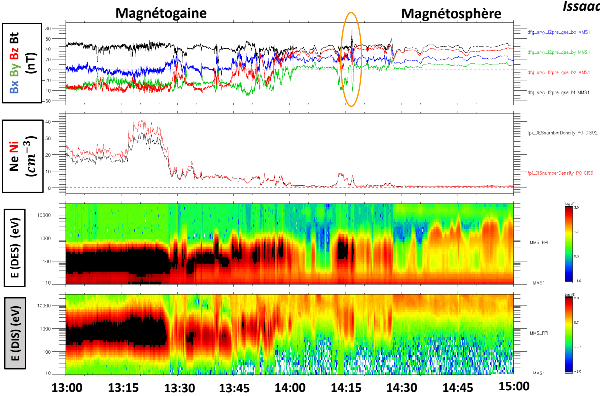
# POSTER 4.6

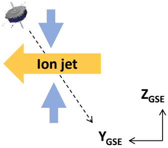
## Current and plasma structures associated with FTEs observed in the magnetosheath by MMS

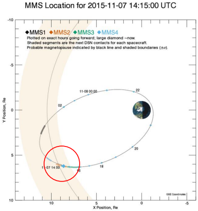
Issaad KACEM

# Structures de courant et de plasma associées à des événements à transfert de flux

***Issaad kacem, MMS team, IRAP***






MMS Location for 2015-11-07 14:15:00 UTC

# POSTER 4.7

## A non-Gaussian Universal Description of Solar Wind Magnetic Field Fluctuations

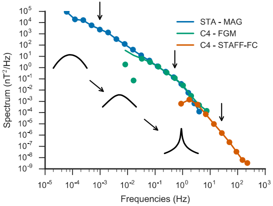
Sonny LION

# 4.7 Sonny Lion

# A non-Gaussian Universal Description of Solar Wind Magnetic Field Fluctuations

Laboratoire d'Études Spatiales et d'Instrumentation en Astrophysique

## 1) The solar wind turbulent cascade:

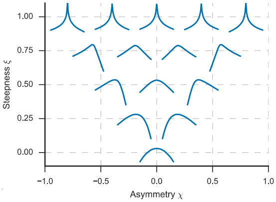


Gaussian distributions at low frequency

Intermittency → Heavy-tailed distributions at high frequency

## 2) The Normal-inverse Gaussian distribution:

$$p(x;\alpha,\beta,\mu,\delta)=\frac{\alpha\delta K_1(\alpha\sqrt{\delta^2+(x-\mu)^2})}{\pi\sqrt{\delta^2+(x-\mu)^2}}e^{\delta\gamma+\beta(x-\mu)}$$



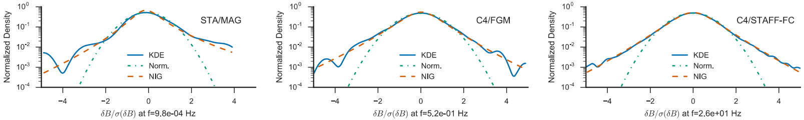
Steepness:

$$\xi=\frac{1}{\sqrt{1+\delta\sqrt{\alpha^2-\beta^2}}}$$

Asymmetry:

$$\chi=\frac{\beta}{\alpha}\xi$$

## 3) Universal Description of Solar Wind Magnetic Field Fluctuations



# POSTER 4.8

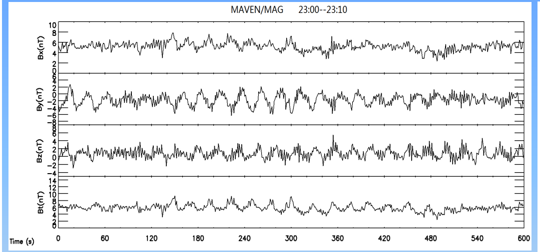
## ULF waves in the Martian foreshock: MAVEN observations

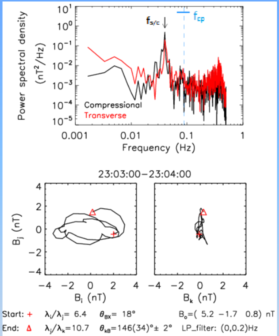
Christian MAZELLE

Programme National Soleil-Terre

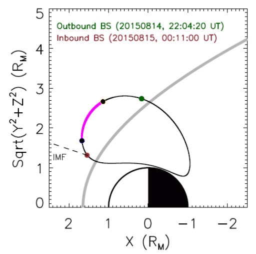
# Foreshock ULF waves at Mars: MAVEN observations

Lican Shan, Christian Mazelle *et al*.





Wave period: 25 s (**2.2 $T_{cp}$**).
LH elliptical polarization with B .



1 Hz MAG data
In the Ion foreshock
(shown by higher freq.
waves superimposed).

1. **First clear observations at Mars**,
2. Enough foreshock space for ULF wave generation.

Likely source: backstreaming ions reflected at the bow shock, clearly by pickup ion protons.

# POSTER 4.9

## Le chauffage turbulent dans le vent solaire: comment le modéliser?

Victor MONTAGUD

# 4.9 Chauffage turbulent dans le vent solaire

Victor Montagud Camps

On a besoin de chauffage dans le vent solaire (modèle fluide !)

a) Pour l'accélérer (chauffage de la couronne)

b) Pour le chauffer une fois accéléré

La dissipation via la cascade turbulente des fluctuations peut-elle le faire?

Deux exemples de modèles possibles de dissipation turbulente:

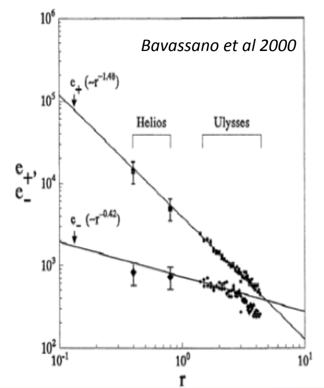
Sans expansion: $du^2/dt = -u^3/L$

Avec expansion: $du^2/dt = -u^3/L - (U°/R)\, u^2$

On veut tester systématiquement ce type de modèle via des simulations directes *incluant* l'expansion anisotrope (« EBM »)

*L = taille du tourbillon, u=vitesse du tourbillon*

*R = distance au soleil, U° = vitesse du vent*



*Bavassano et al 2000*

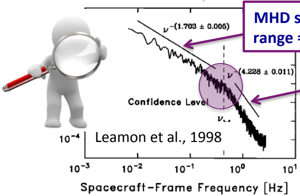
# POSTER 4.10

## Compressible coherent structures in slow solar wind turbulence at ion scales

Denise PERRONE

# 4.10 – PERRONE: Compressible coherent structures in slow solar wind turbulence at ion scales

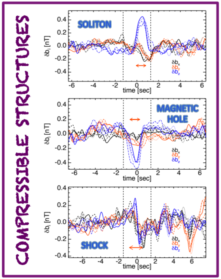
## *Solar-wind turbulent spectrum*

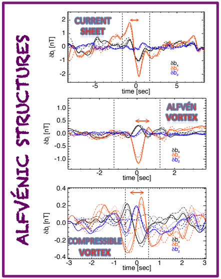


Leamon et al., 1998

**MHD scales: inertial range ≈ Kolmogorov**

**Sub-ion scales**



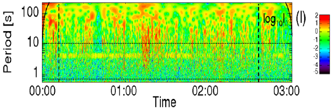


## NATURE OF MAGNETIC FLUCTUATIONS?

**In a stream of *slow solar wind*, using *CLUSTER* data:**

① **Increase of *compressibility* around ion scales**

② ***Non-homogeneous* distribution of magnetic energy**



③ **Presence of *coherent structures* of different nature...**

# POSTER 4.11

## Solar wind turbulence anisotropy, from large to small scales

**Andrea VERDINI**

Programme National Soleil-Terre

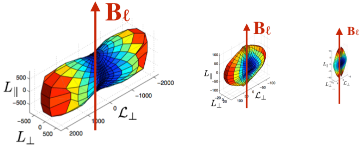
# 4.11 Solar wind turbulence anisotropy, from large to small scales

Verdini A., Grappin R., Alexandrova O.

Projet PLAS@PAR => Simulations + Mesures

## Mesures Vent Solaire @ 1AU

(Chen et al. 2012 ApJ)



. . . ?

Filament

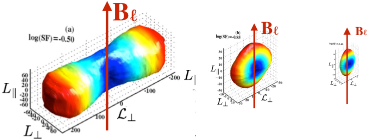
(Balance Critique)

Ruban

(Balance Critique + Alignement Dynamique)

## Simulations Expanding Box Model

(Verdini & Grappin 2015 ApJ)



# POSTER 4.12

## Turbulence in the solar wind: what controls the slope of the energy spectrum ?

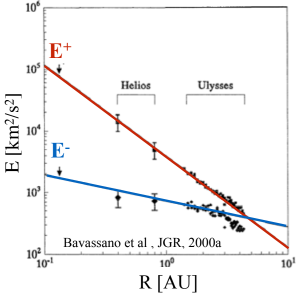
Andrea VERDINI

# 4.12 Turbulence in the solar wind: what controls the slope of the energy spectrum?

Verdini A., Grappin R.

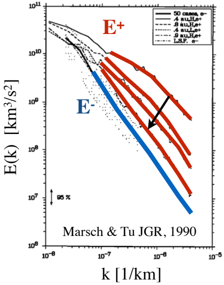
## A numerical investigation

*énergie à l'échelle d'une heure vs distance R*



Bavassano et al , JGR, 2000a

*Spectres de $E^+(k)$ et $E^-(k)$ à plusieurs distances $0.4AU < R < 1AU$*



Marsch & Tu JGR, 1990

**Il y a t-il un cascade quand $E^- \ll E^+$ ?**

- turbulence homogène NON
- vent solaire OUI

# POSTER 5.1

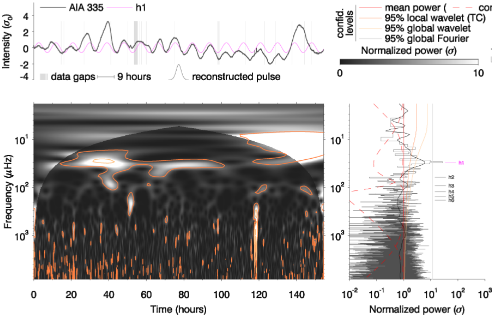
## Periodic Pulses or Random Amplitudes in Coronal Loops as Signatures of Thermal Non-Equilibrium

Frédéric AUCHÈRE

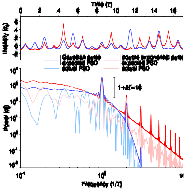
# Thermal Non-Equilibrium Revealed by Periodic Pulses of Random Amplitudes

IAS
Institut d'Astrophysique Spatiale
Orsay

**F. Auchère, C. Froment,
K. Bocchialini,
E. Buchlin & J. Solomon**



**What is a random pulse train anyway?**



Expected Fourier spectra for Gaussian and double exponential pulses

$$f(t) = \overbrace{\sum_{m=0}^{M-1} \underbrace{a_m}_{\substack{\text{Random}\\ \text{amplitudes}}} \underbrace{p(t-mT)}_{\substack{\text{Individual}\\ \text{pulse}}}}^{M \text{ pulses equally spaced by } T}$$

(variance $\sigma^2$, mean $\mu$)

$$\psi(\nu) = \underbrace{|P(\nu)|^2}_{\substack{\text{Individual}\\ \text{pulse}\\ \text{power}}} \underbrace{\left\{ \underbrace{M\sigma^2}_{} + \underbrace{\mu^2 \left(\frac{\sin(\pi\nu TM)}{\sin(\pi\nu T)}\right)^2}_{} \right\}}_{\times\{\text{Continuum} + \text{discrete harmonics}\}}$$

# POSTER 5.2

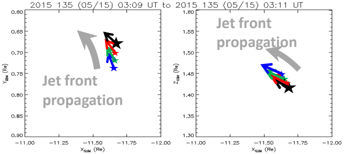
## Multi-Spacecraft Analysis of Plasma Jet Events and Associated Whistler-Wave Emissions using MMS Data

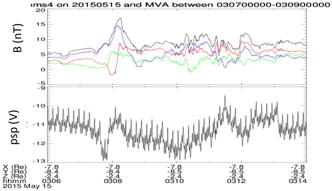
Hugo BREUILLARD

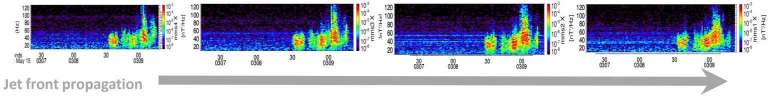
# Multi-Spacecraft Analysis of Plasma Jet (BBF) Events and Associated Whistler-Wave Emissions using MMS Data

H. Breuillard, O. Le Contel, A. Retino, A. Chasapis, T. Chust and the MMS team

- **Multi-SC (Δd~150 km) analysis of the DF :**
  - Using MVA, DF propagates from the equator towards Earth and its front normal rotates over a spatial scale < 600 km (below the ion Larmor radius)
  - Normal rotates twice: « finger-like » structures ?
- **Associated whistler-waves analysis:**
  - Parallel whistlers observed behind DF with different properties (Poynting flux reversal)
  - Within < 5 s, whistlers dynamics evolve drastically : a new source of whistler waves appears, filling the gap between lower and higher spectral band
- **Comparison of the nature of the 2 DFs:**
  - Density dip observed ahead of first DF, contrary to second DF (~03:12 UT)
  - After crossing another front oblique whistlers are observed.







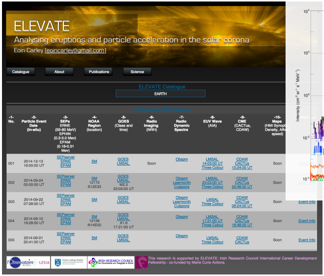
# POSTER 5.3

## The ELEVATE Catalogue: Understanding the coronal origins of solar energetic particles

Eoin CARLEY

# 5.3: The ELEVATE Catalogue: Understanding the coronal origins of solar energetic particles

Eoin Carley
Trinity College Dublin and Paris Observatory



ELEVATE

Analysing eruptions and particle acceleration in the solar corona

Eoin Carley (eoincarley@gmail.com)

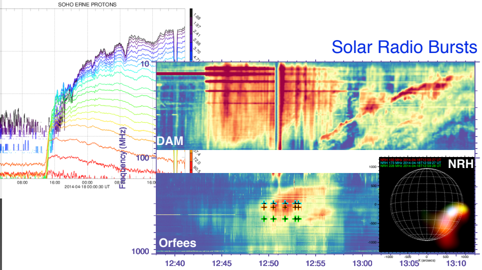
ELEVATE Catalogue

EARTH

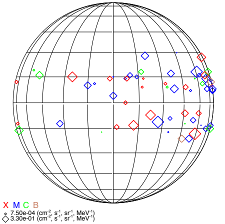
Earth-based Observations

| -1- No. | -2- Particle Event Date (In-situ) | -3- SEPs ERNE (55-80 MeV) EPHIN (0.3-3.0 Mev) EPAM (0.18-0.31 Mev) | -4- NOAA Region (location) | -5- GOES (Class and time) | -6- Radio Imaging (NRH) | -7- Radio Dynamic Spectra | -8- EUV Wave (AIA) | -9- CME (CACTus, CDAW) | -10- Maps (HMI Synoptic, Density, Alfven speed) | |
|---|---|---|---|---|---|---|---|---|---|---|
| 001 | 2014-12-13<br>16:00:00 UT | SEPserver<br>ERNE<br>EPAM | SM | GOES<br>LMSAL | Soon | Obspm | LMSAL<br>14:03:00 UT<br>Three Colour | CDAW<br>CACTus<br>15:24:00 UT | Soon | Event Info |
| 002 | 2014-09-24<br>00:05:00 UT | SEPserver<br>ERNE<br>EPAM | SM<br>12172<br>S12E33 | GOES<br>LMSAL<br>M2.3<br>23:03:00 UT | | Obspm<br>Learmonth<br>Culgoora | LMSAL<br>23:03:00 UT<br>Three Colour | CDAW<br>CACTus<br>23:48:00 UT | Soon | Event Info |
| 003 | 2014-09-22<br>07:28:00 UT | SEPserver<br>ERNE<br>EPAM | SM | GOES<br>LMSAL | | Obspm<br>Learmonth<br>Culgoora | LMSAL<br>Three Colour | CDAW<br>CACTus<br>06:24:00 UT | Soon | Event Info |
| 004 | 2014-09-10<br>19:28:00 UT | SEPserver<br>ERNE<br>EPAM | SM<br>12158<br>N14E02 | GOES<br>LMSAL<br>X1.6<br>17:21:00 UT | | Obspm | LMSAL<br>17:21:00 UT<br>Three Colour | CDAW<br>CACTus<br>18:48:00 UT | Soon | Event Info |
| 005 | 2014-09-01<br>20:41:00 UT | SEPserver<br>ERNE<br>EPAM | SM | GOES<br>LMSAL | | Obspm | LMSAL<br>Three Colour | CDAW<br>CACTus | Soon | Event Info |

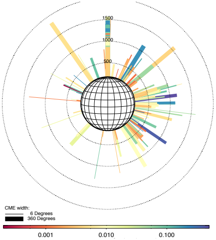
This research is supported by ELEVATE: Irish Research Council International Career Development Fellowship - co-funded by Marie Curie Actions.



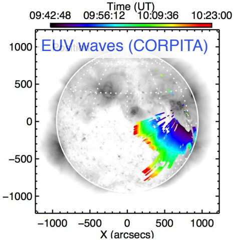
Flares



CMEs



EUV waves (CORPITA)



# POSTER 5.4

## Recent Advances in Terrestrial Gamma ray Flashes and Their Effects in the Near-Earth Environment

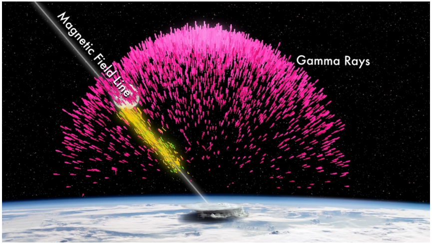
Sébastien CÉLESTIN

# Recent Advances in Terrestrial Gamma ray Flashes and Their Effects in the Near-Earth Environment

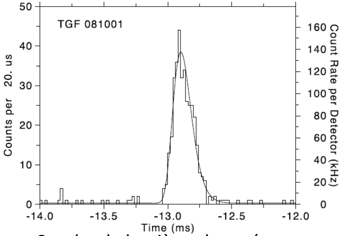
Thème 5

*S. Celestin, LPC2E, Université d'Orléans, CNRS*

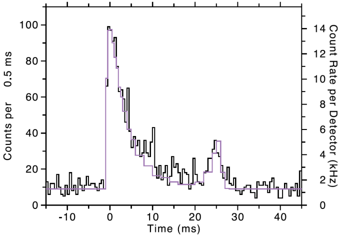
TARANIS. Crédit: CNES/D. Ducros.



Crédit: NASA/GSFC, J. Dwyer, FIT.



Courbe de lumière observée par Fermi-GBM.



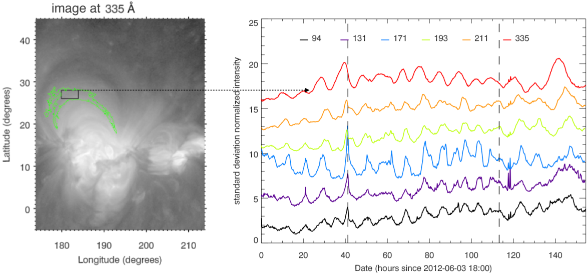
*Terrestrial Electron Beam* et miroir magnétique.

# POSTER 5.5

## Evidence for highly-stratified and quasi-steady heating of solar coronal loops

Clara FROMENT

# Pulsations d'intensité dans les boucles coronales solaires : signature d'un chauffage très stratifié et quasi-constant



Un évènement typique étudié avec SDO/AIA (***Froment et al, 2015***)

- ➡ pulsations d'intensité avec une période de **9.0 h**

Pulsations de la **structure thermique** ($T_e$,$n_e$) de ces boucles : **Thermal non-equilibrium**

➡ **Signature observationnelle d'un chauffage quasi-continu, localisé à basse altitude**

**Qu'est ce qui distingue ces boucles ?**
**Pourquoi ces cycles ne se produisent-ils pas partout ?**

Etude de la **topologie magnétique** (extrapolations) et **simulations 1D hydrodynamiques**

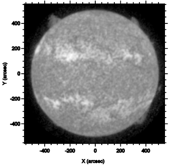
➡ **comprendre les conditions d'apparition de ces pulsations (*Froment et al, 2016, in prep*)**

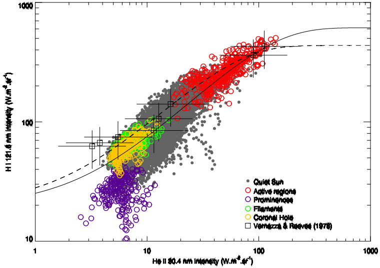
# POSTER 5.6

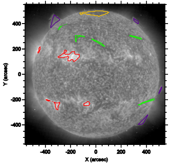
## Empirical relations between the Lyman line intensities of H I and He II

Miguel GORDINO

# Préparation des observations pour Solar Orbiter : FSI et METIS


MXUVI H I Ly α




EIT He II Ly α

- Détermination d'une relation entre H I Ly α et He II Ly α
- Relation utile pour la simulation d'image

Gordino Miguel PNST 2016

# POSTER 5.7

## Lifecycle of a large-scale polar pseudostreamer

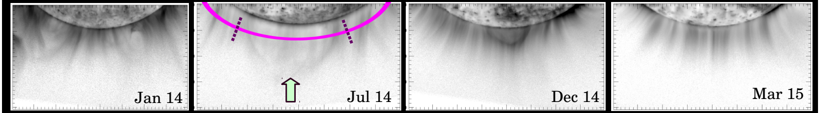
Chloé GUENNOU

# Lifecycle of a large polar coronal Pseudostreamer/cavity system

Observatoire royal de Belgique

*C. Guennou, L. A. Rachmeler, D. Seaton, F. Auchère*

*Proba2/SWAP*



DEM → $T_e, n_e$

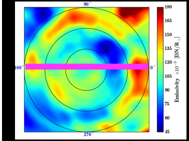
Tomography → $x, y, z$

Coupling Tomography/DEM

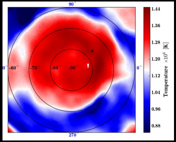
✓ $x, y, z$ / $T_e, n_e$

***Full 3D diagnostic !***

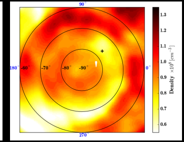
*SWAP emissivity*



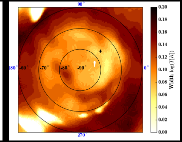
*AIA temperature*



*AIA density*



*Thermal width*



***Cavity and Pseudo-streamer thermal properties evolution over 15 months of observations***

# POSTER 5.8

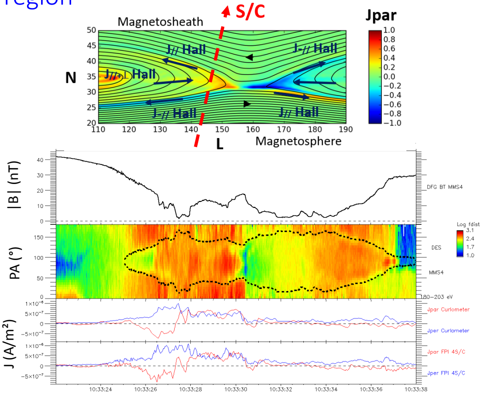
## The fine structure of the magnetosheath boundary layer during magnetic reconnection at the Earth's magnetopause

Benoît LAVRAUD

Programme National Soleil-Terre

# Hall currents and associated electron scattering and bouncing near the magnetic diffusion region

*B. Lavraud et al.*



- Observation of Hall current electron dynamics near the diffusion region
- Simultaneous inflowing and outflowing, bouncing populations
- Low energy electron scattering by curved field lines

# POSTER 5.9

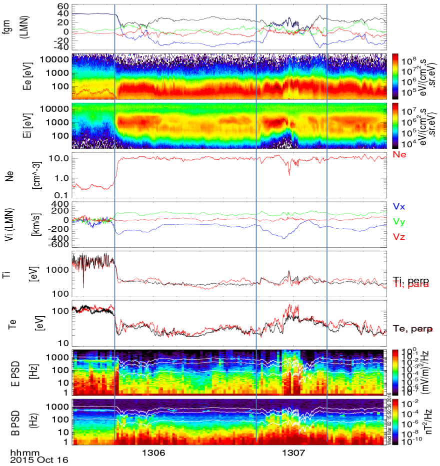
## Etude de l'activité électromagnétique détectée par MMS au voisinage de la magnétopause et de son rôle possible dans le chauffage et l'accélération des électrons

Olivier LE CONTEL

# 5.9 Etude de l'activité électromagnétique détectée par MMS au voisinage de la magnétopause et de son rôle possible dans le chauffage et l'accélération des électrons

O. Le Contel, A. Retinò, H. Breuillard, M. Berthomier,
L. Mirioni, F. Sahraoui, T. Chust, A. Chasapis, N. Aunai,
B. Lavraud, C. Jacquey et l'équipe MMS

- Traversées complète et partielle de la magnétopause
- Détection de jets de plasma
- Chauffage des électrons
- Activité électromagnétique intense



Colloque du PNST, 14-16 Mars, Hendaye, 2016

# POSTER 5.10

## Particle Acceleration and Shock Structures in Shock-Shock Interaction

Christian MAZELLE

# Particle Acceleration and Shock Structures in Shock-Shock Interaction

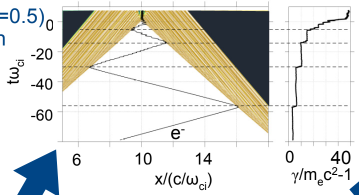
M. Nakanotani[1,2,3], C. Mazelle[1,2], S. Matsukiyo[3] & T. Hada[3]

(1) IRAP, CNRS, Toulouse, France (2) IRAP, University of Toulouse, Toulose, France (3) Kyushu University, Fukuoka, Japan

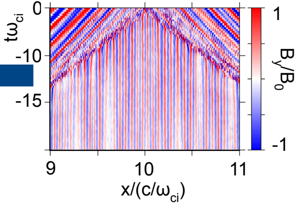
> 1D full PIC simulation ($M_A$=13, $\theta_{Bn}$=60°, $\beta_{i,e}$=0.5)

> efficient $e^-$ acceleration before collision

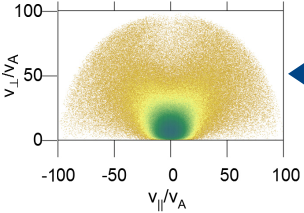
$e^-$ reflection and acceleration



wave excitation (firehose insta.)



pitch angle scattering



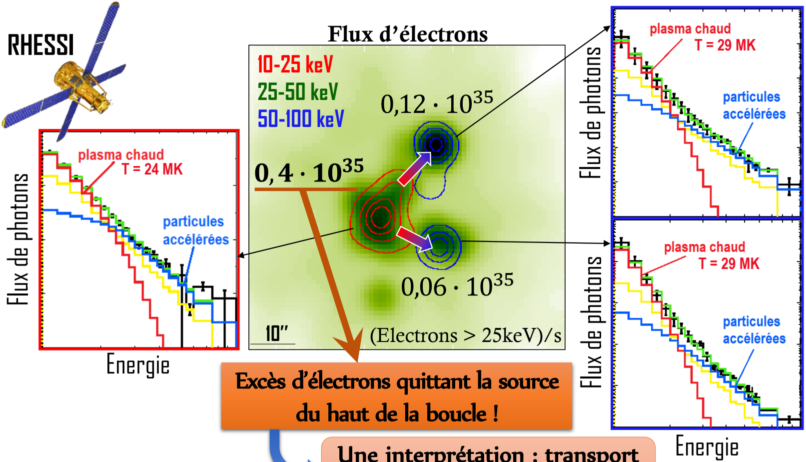
# POSTER 5.11

## Diffusive transport of energetic electrons in the 2004, May 21 solar flare

Sophie MUSSET

# Diffusive transport of energetic electrons in the 2004, May 21 solar flare

**Sophie Musset**
**LESIA**
**Observatoire de Paris**



**Excès d'électrons quittant la source du haut de la boucle !**

**Une interprétation : transport diffusif des électrons**

Musset, Kontar, Vilmer, in prep

# POSTER 5.12

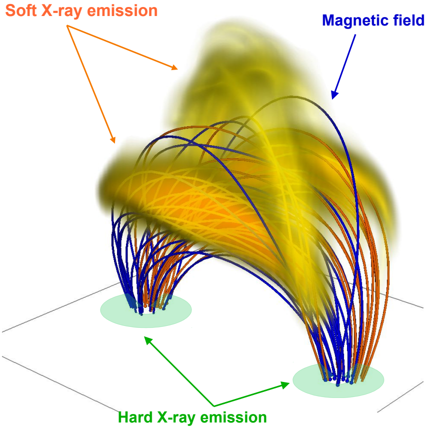
## X-ray emission in simulations of flaring coronal loops

Rui PINTO

# X-ray emission in simulations of flaring coronal loops

**Poster 5.12**

**R. F. Pinto, M. Gordovskyy, P. Browning N. Vilmer**



**Solar flares (kink instability)**

↓

**Plasma heating,
particle acceleration**

↓

**Synthetic X-ray emission**

- ✓ **Magnetic twist ≠ emission threads**
- ✓ **Broad DEM** (multi-temperature plasma)
- ✓ **Distributed heating and acceleration**, but volume-filling SXR, localised HXR
- **Neupert effect** (HXR ∝ d/dt SXR)

# POSTER 5.14

## Chauffage impulsif des boucles coronales et pulsations en intensité de longues périodes: approximation analytique

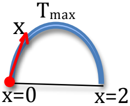
Jacques SOLOMON

## PNST mars 2016-Poster 5.14

# Chauffage impulsif des boucles coronales et problème des pulsations en intensité de longues périodes: approximation analytique

J. Solomon, C. Froment, F. Auchère, K. Bocchialini, E. Buchlin
Institut d'Astrophysique Spatiale, CNRS-Univ. Paris-Sud, Université Paris-Saclay, 91405 Orsay

- Données SoHO/EIT et SDO/AIA
- Simulations numériques hydro 1D



$$\frac{\partial T(x,t)}{\partial t} \sim \frac{\partial}{\partial x}\left(T^{\frac{5}{2}} \frac{\partial T}{\partial x}\right) - \Lambda(T) + Q(x,t)$$

**T Température; x=s/L; Flux de chaleur;**
**Λ Pertes par Rayonnement; Q Chauffage**

- Solutions analytiques par perturbation d'une situation stationnaire avec des conditions aux limites données
- Comparaisons aux simulations numériques et rôle des paramètres physiques

# POSTER 5.15

## Small-scale topological changes associated with magnetic reconnection during Kelvin-Helmholtz instability at the Earth's Magnetopause

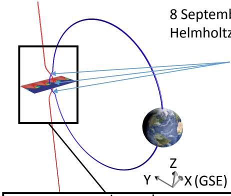
Yoann VERNISSE

Programme National Soleil-Terre

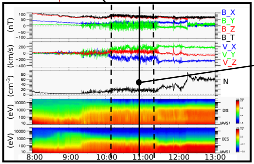
Small-scale topological changes associated with magnetic reconnection during Kelvin-Helmholtz instability at the Earth's Magnetopause: Observation of multiple population from local and mid-latitude reconnections.

Vernisse et al.
IRAP, UPS, Toulouse

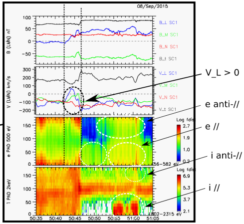
8 September 2015: Kelvin-Helmholtz event at Dusk side



Three area of reconnection, multiple configuration for plasma entry in the magnetosphere / out in the magnetosheath



One hour of high resolution data recorded by the MMS spacecrafts



Example of a multiple reconnection case: Reconnection in the equatorial plane and reconnection at mid-latitude

Showed by:
Local exhaust with V_L > 0 consistent with parallel electrons boundary layer

Double population observed in the sheath

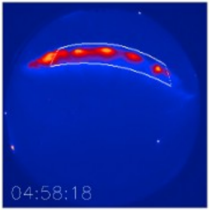
# POSTER 6.1

## Instabilité électrostatique dans une couche de courant- Interaction avec les électrons piégés

**Gabriel FRUIT**

# Instabilité électrostatique dans une couche de courant
# Rôle des électrons piégés

*G. Fruit, Ph. Louarn, A. Tur* – ***IRAP***

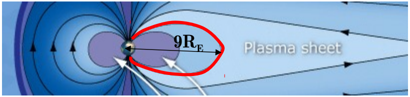


Kalmoni et al. 2015 : arc auroral (02/10/2011) observé par les caméras plein-ciel au dessus du Canada

Structures en forme « perles » de 30 km de large

Temps de croissance instabilité ~ 1 min

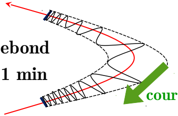
Source des particules : région 9-12 $R_E$ dans la queue magnétique



**Origine de l'instabilité produisant ces précipitations de particules ?**

Une possibilité : Instabilité de dérive électrostatique (gradient de densité) en résonance avec le mouvement de rebond des électrons piégés forts taux de croissance

Période rebond
~ qq s à 1 min



On obtient un $\gamma \sim 0{,}1\ s^{-1}$ (1 min growth time) avec $\lambda \sim \rho_{Li} \sim 600$ km, si l'échelle d'inhomogénéité de la densité de l'ordre du $R_E$.

# POSTER 6.2

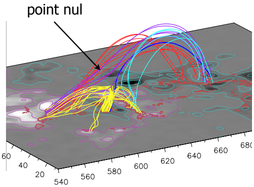
## Les flares confinés et éruptifs sont-ils si différents ?

Sophie MASSON

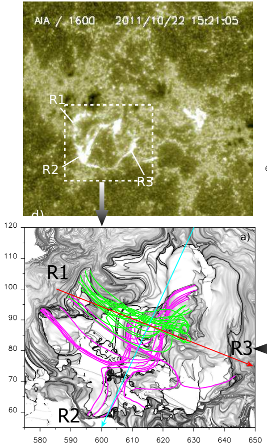
# Les flares confinés et éruptifs sont-ils si différents ?

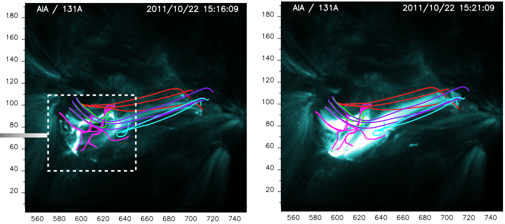
S. Masson, E. Pariat, G. Valori, N. Deng, C. Liu, H. Wang & H. Reid

Poster 6.2



Tube de flux torsadé présent pour les flares confinés & éruptifs





Tube de flux torsadé et son tube de flux hyperbolique

Eléments topologiques associés aux boucles post-eruptives

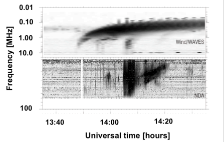
# POSTER 6.3

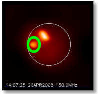
## CME-related particle acceleration regions during a simple eruptive event near solar minimum

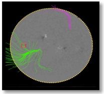
Carolina SALAS MATAMORAS

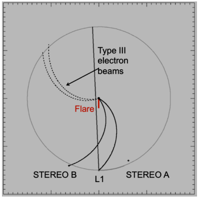
# Régions d'accélération de particules pendant un simple événement éruptif près du minimum solaire

(C. Salas-Matamoros, K-L. Klein et A. Rouillard; LESIA, IRAP)









## Trois zones d' d'accélération des particules liées à l'événement du 26 Avril 2008

**I.** **Lieu éloigné de la région active** → interaction latérale du flanc de la CME avec la couronne (suivie par une onde EUV) → Reconnexion magnétique ou acc. betatron

**II.** **Onde de choc coronale quasi-perp (flanc de la CME, radio type II)** → pas de connexion magnétique avec des satellites

**III.** **Choc frontal de la CME** → accélération tardive des SEPs (STB,SoHO) lorsque le choc intercepte la spirale de Parker connectée avec le satellite

**Il est trompeur d'interpréter les mesures multi-instrument des SEPs en termes d'une seule région d'accélération des particules dans la couronne**

# POSTER 6.4

## Prominence plasma and magnetic field structure - A coordinated observation with IRIS, Hinode and THEMIS

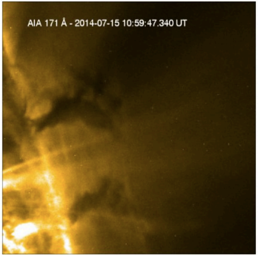
Brigitte SCHMIEDER

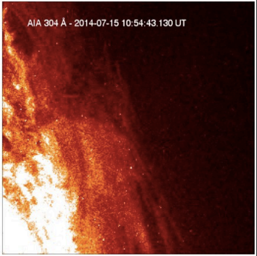
# Prominence plasma and magnetic field structure - A coordinated observation with IRIS, Hinode and THEMIS

P. Levens, 1 N. Labrosse, 1  B. Schmieder 2 , A. López Ariste 3

University of Glasgow (Scotland)
LESIA, Observatoire de Paris
IRAP, Toulouse

Tornado!





# POSTER 7.1

## Planetary SpaceWeather Services for the Europlanet 2020 Research Infrastructure

Nicolas ANDRE

PNST
Programme National Soleil-Terre

# Planetary Space Weather Services for the Europlanet 2020 Research Infrastructure

N. André (IRAP), Coordinator

The overall objectives of PSWS will be to review, test, improve and adapt methods and tools available within the partner institutes in order to **make prototype planetary event and space weather services** operational in Europe at the end of the programme.