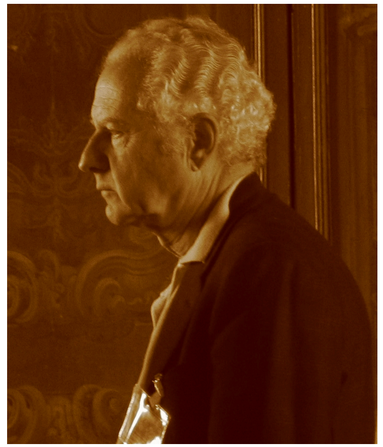
Using magnetic compressibility to characterize plasma turbulence from fluid to kinetic scales

ou mes souvenirs de Catherine et nos collaborations scientifiques

- *Lacombe, Alexandrova, Matteini et al., ApJ 2014*
- *Matteini, Alexandrova, Chen and Lacombe, MNRAS 2016*
- *Lacombe, Alexandrova and Matteini, ApJ 2017 (the "LAM" paper)*
- *Matteini, Franci, Alexandrova, Lacombe et al. Frontiers, 2020*

Lorenzo Matteini, 9 Septembre 2024

c’était l’année 2003



Claudio Chiuderi

Marco Velli

Simone Landi

Filippo Pantellini

Milan Maksimovic

Stage de maitrise:
“Etude du choc en amont de la Terre avec Cluster”

Context:
Olga Alexandrova and Yannis Zouganellis in their first year of PhD

Chadi Salem just left
J.L. Bougeret directeur

At first, shared office with André Mangeney

With Franco Valentini

c’était l’année 2003

the parties…

The volleyball group…

… and nice people!

Note: Pictures courtesy of F. Valentini, that’s why he’s on every picture!

2006/2007 (thèse)

2009/2010 postdoc


Observatoire de Paris-Meudon
en lutte pour sauver la Recherche
toilettes
Accès gratuit
toilettes
TAXIS

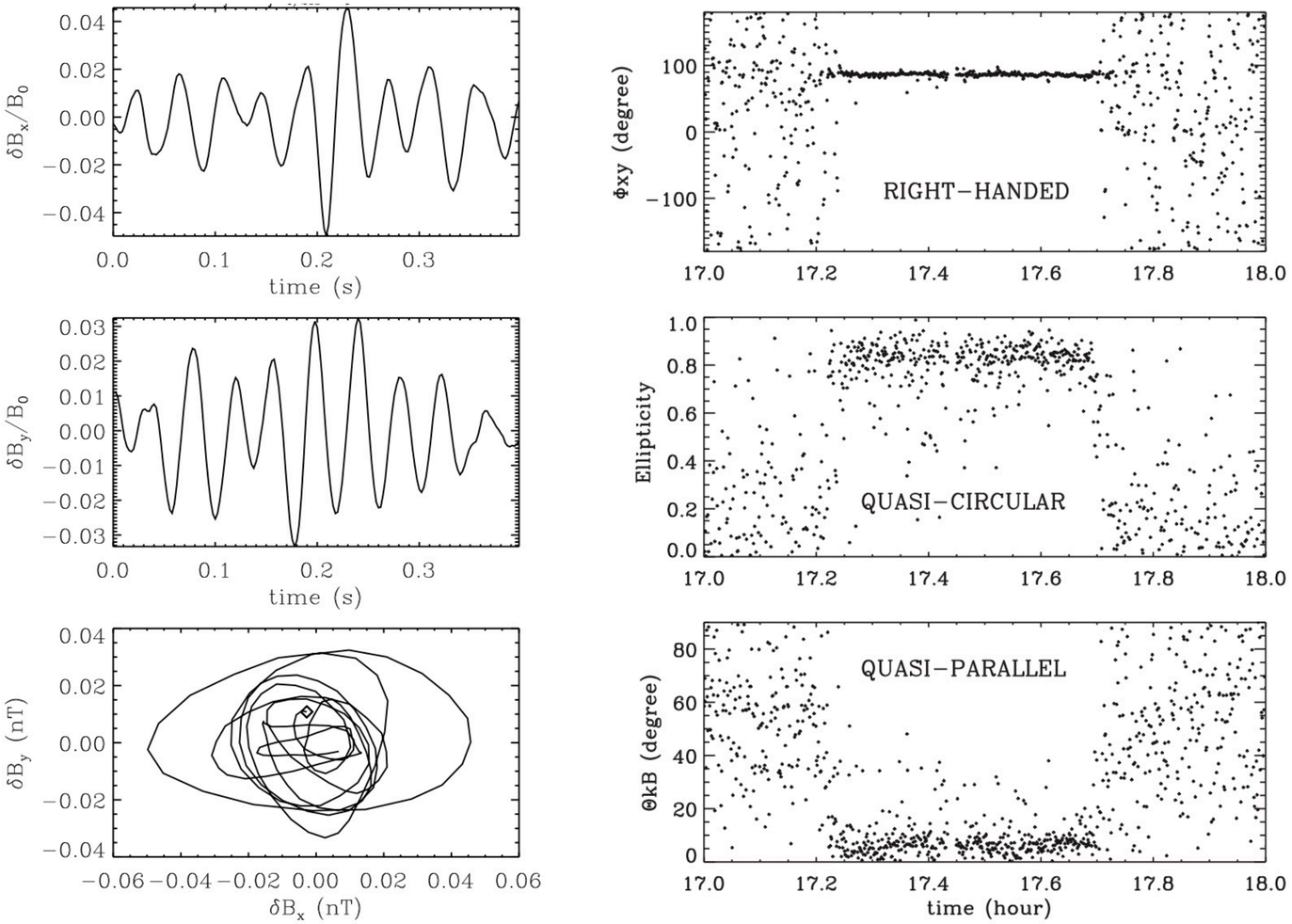
Manif Sauvons la Recherche - Février 2009

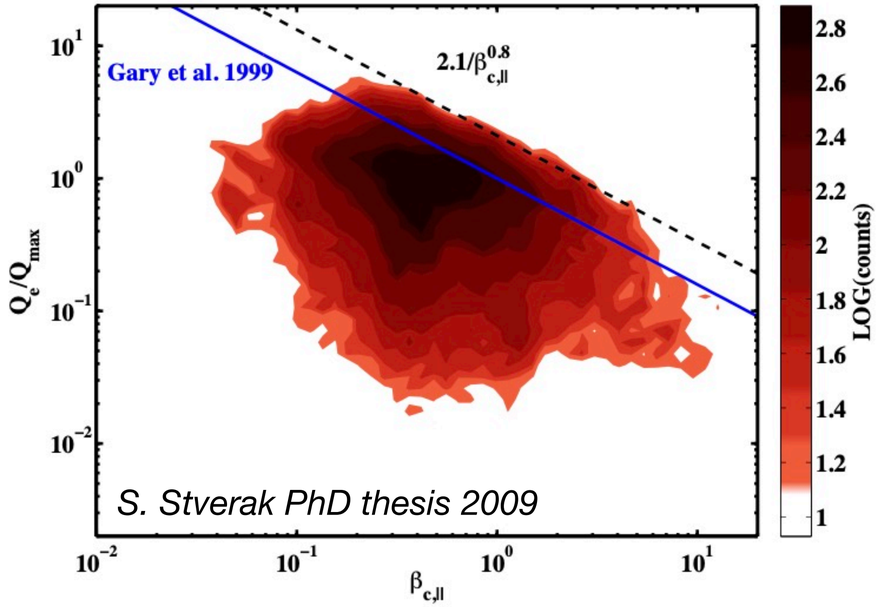
Maintenant les papiers…

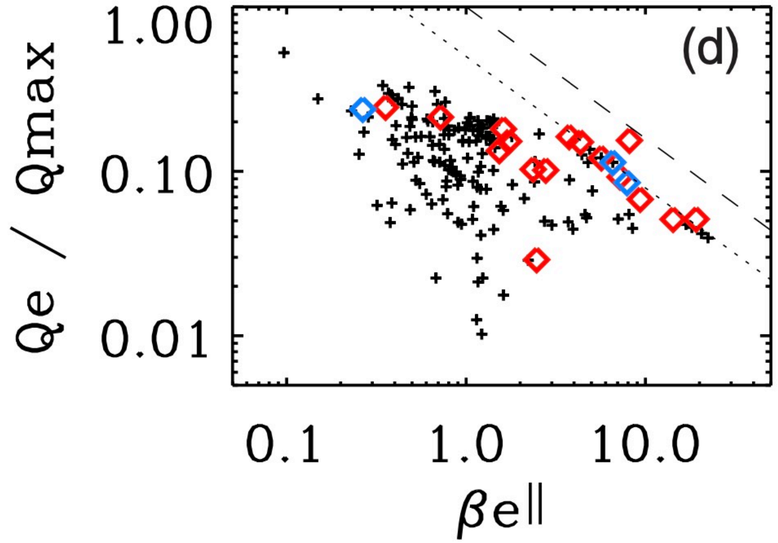
The Astrophysical Journal, 796:5 (11pp), 2014 November 20 doi:10.1088/0004-637X/796/1/5

WHISTLER MODE WAVES AND THE ELECTRON HEAT FLUX IN THE SOLAR WIND: *CLUSTER* OBSERVATIONS

C. Lacombe[1], O. Alexandrova[1], L. Matteini[2], O. Santolík[3,4], N. Cornilleau-Wehrlin[1,5], A. Mangeney[1], Y. de Conchy[1], and M. Maksimovic[1]
[1] LESIA, Observatoire de Paris, PSL Research University, CNRS, UPMC Université Paris 06, Université Paris-Diderot, 5 Place Jules Janssen, F-92190 Meudon, France
[2] Imperial College, London SW7 2AZ, UK
[3] Institute of Atmospheric Physics ASCR, 141 31 Prague, Czech Republic
[4] Faculty of Mathematics and Physics, Charles University in Prague, 180 00 Prague, Czech Republic
[5] LPP, CNRS, Ecole Polytechnique, UPMC, Route de Saclay, F-91128 Palaiseau, France
Received 2014 July 12; accepted 2014 September 12; published 2014 October 29







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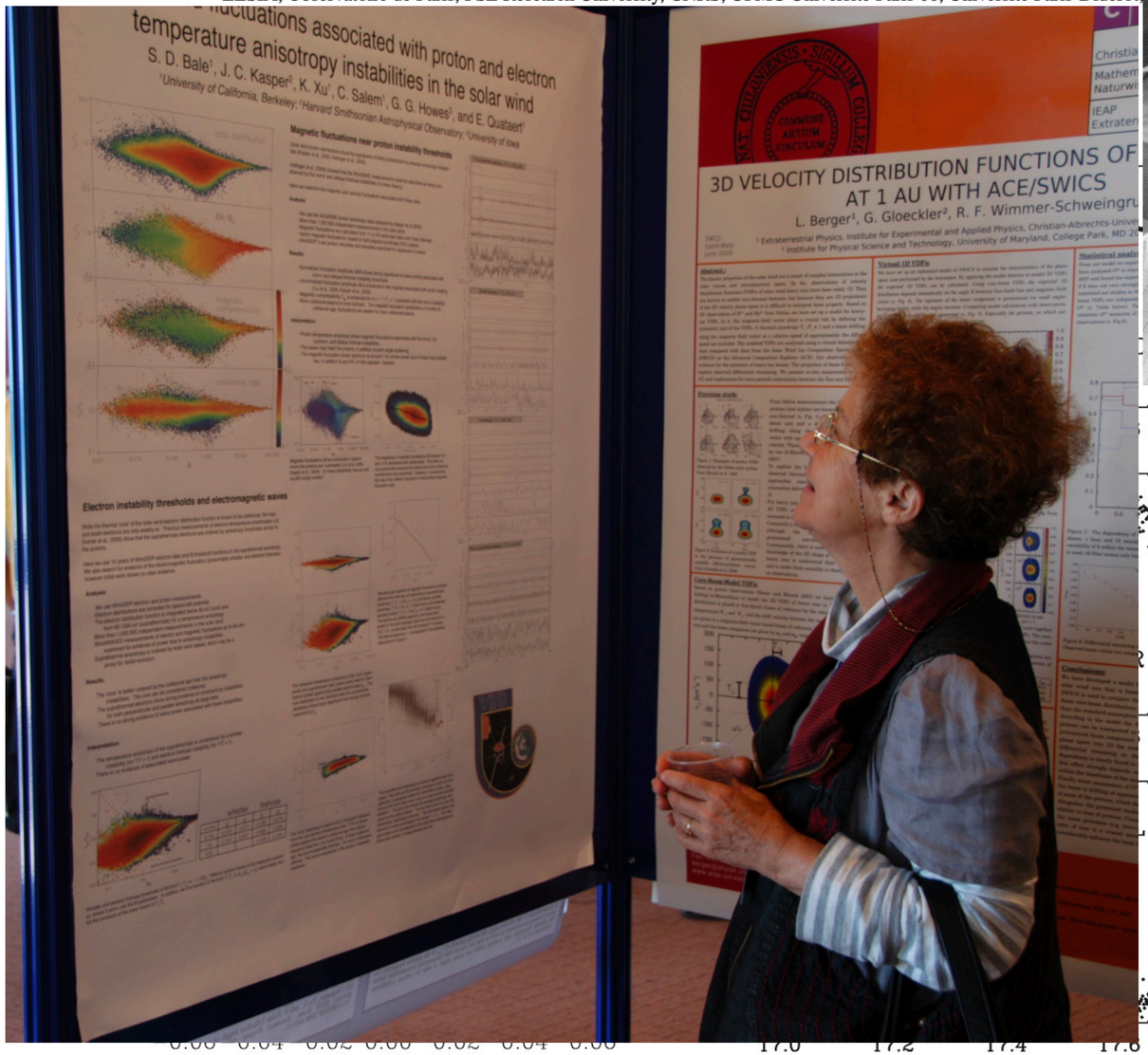
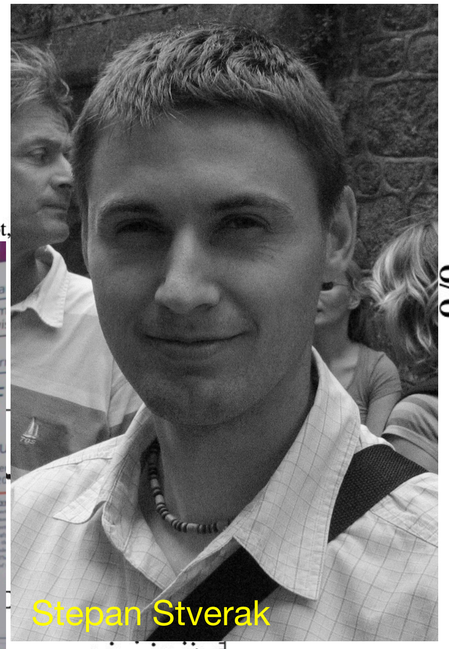
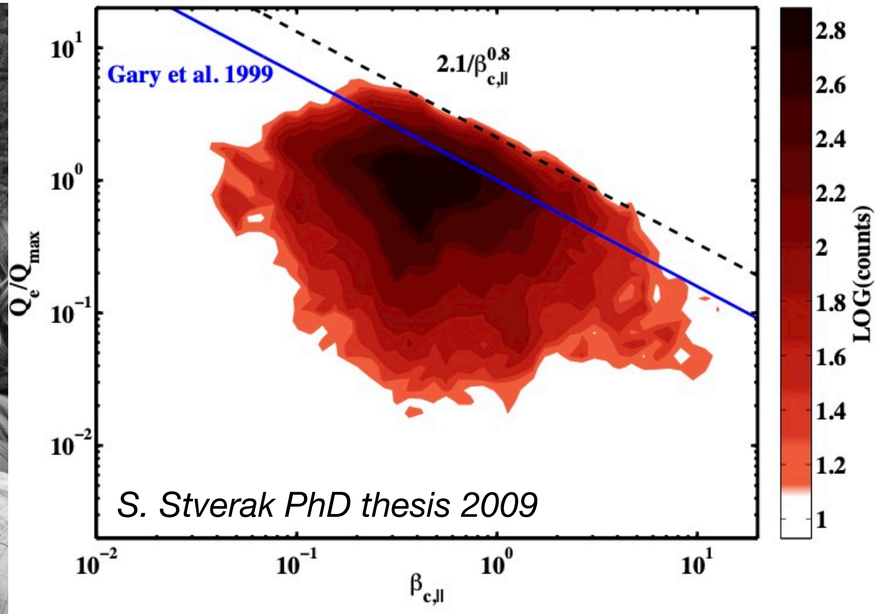
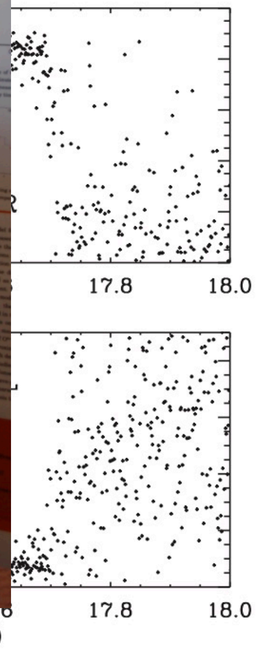
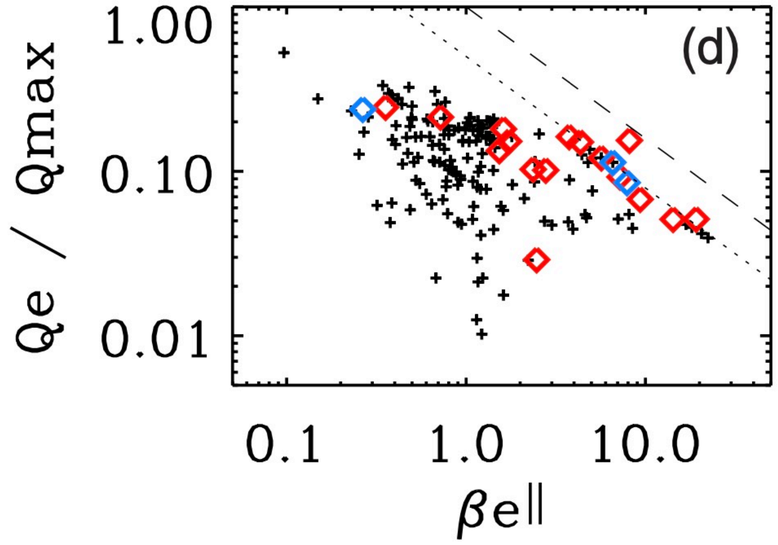
[1] LESIA, Observatoire de Paris, PSL Research University, CNRS, UPMC Université Paris 06, Université Paris-Diderot,











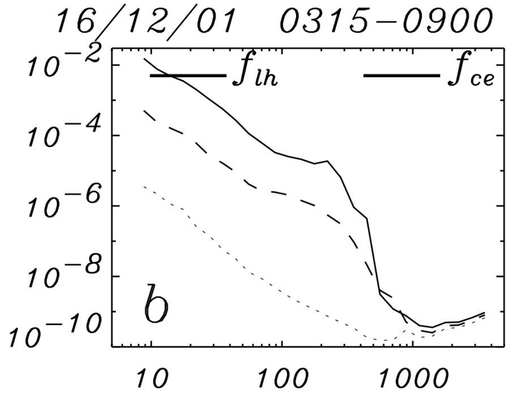
Monthly Notices of the ROYAL ASTRONOMICAL SOCIETY

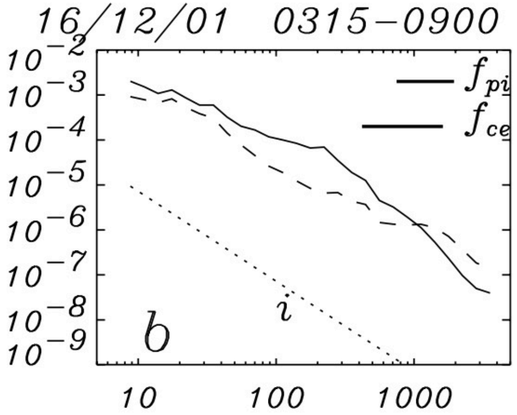
MNRAS **466,** 945–951 (2017)
Advance Access publication 2016 December 9

Electric and magnetic spectra from MHD to electron scales in the magnetosheath

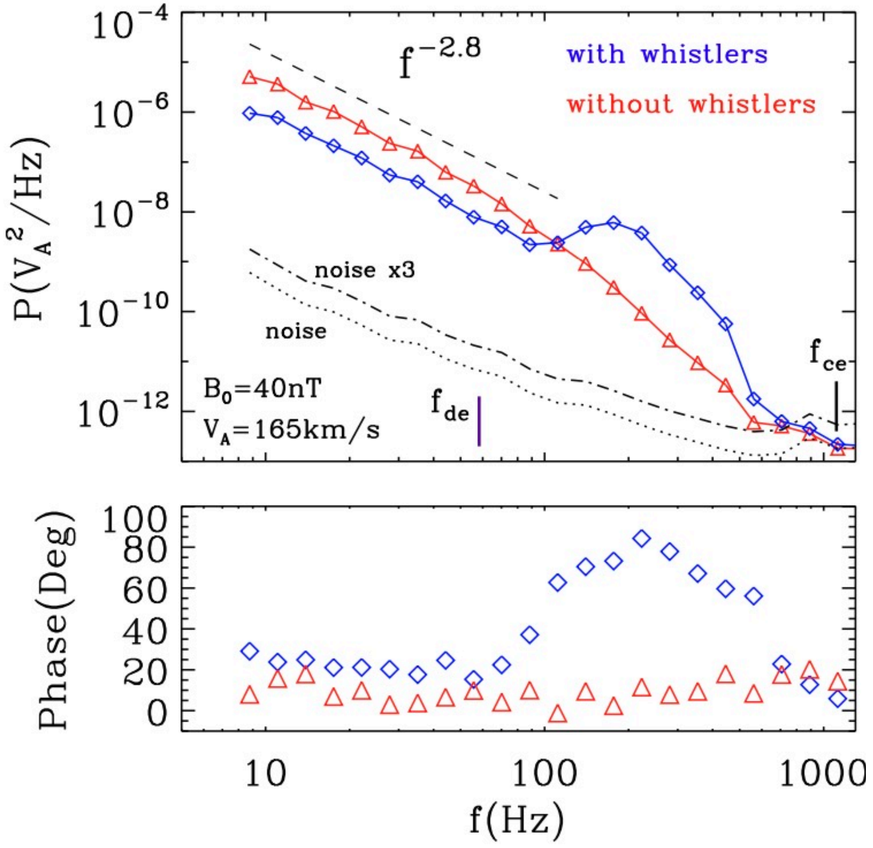
L. Matteini,[1]★ O. Alexandrova,[2] C. H. K. Chen[1] and C. Lacombe[2]

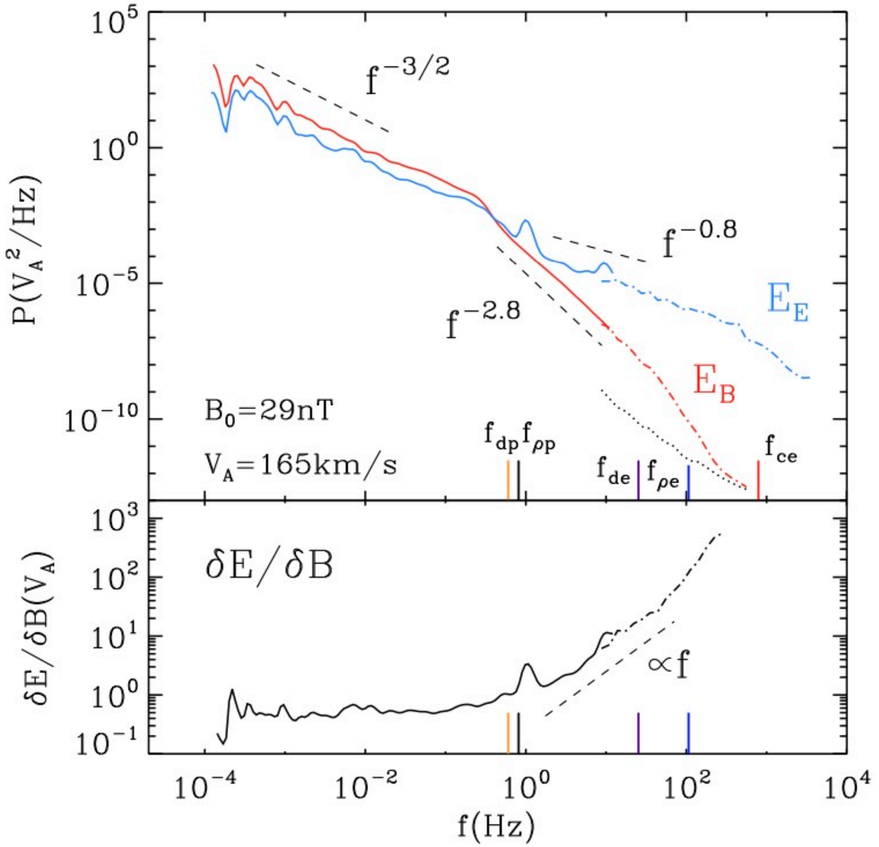
[1]*Department of Physics, Imperial College London, London SW7 2AZ, UK*
[2]*LESIA-Observatoire de Paris, PSL Research University, CNRS, UPMC Université Paris 06, Université Paris-Diderot, 5 place Jules Janssen, F-92190 Meudon, France*





(Anne) Mangeney, Lacombe et al. 2006
Lacombe et al. 2006





$E=-VxB \Rightarrow \delta E \sim \delta V * B_0$

for Alfvénic fluctuations: $\delta B \sim \delta V$

then: $\delta B^2 \sim \delta E^2$

At ion scales, VxB=>0 and electric field dominated by Hall effect:

$E=JxB \Rightarrow \delta E \sim k * \delta B * B_0$

for ion-scale fluctuations: $\delta E \sim k * \delta B$

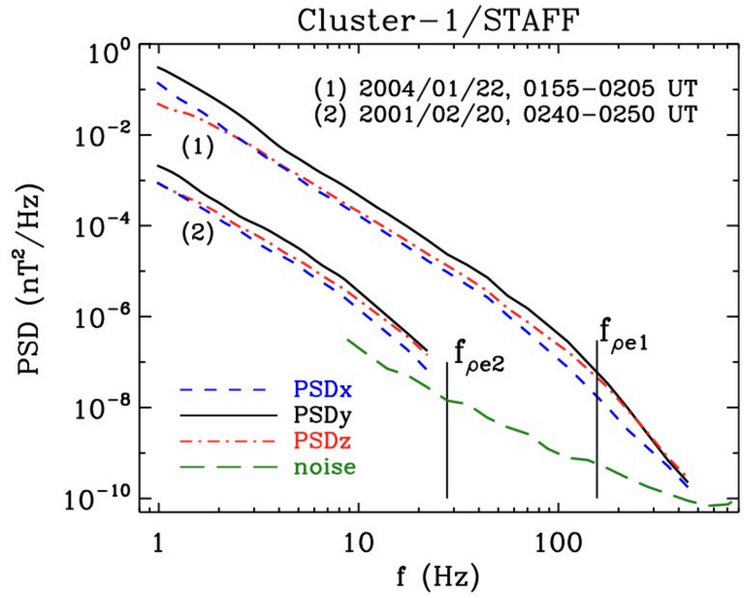
then: $\delta E/\delta B \sim k$

The Astrophysical Journal, 848:45 (13pp), 2017 October 10
https://doi.org/10.3847/1538-4357/aa8c06

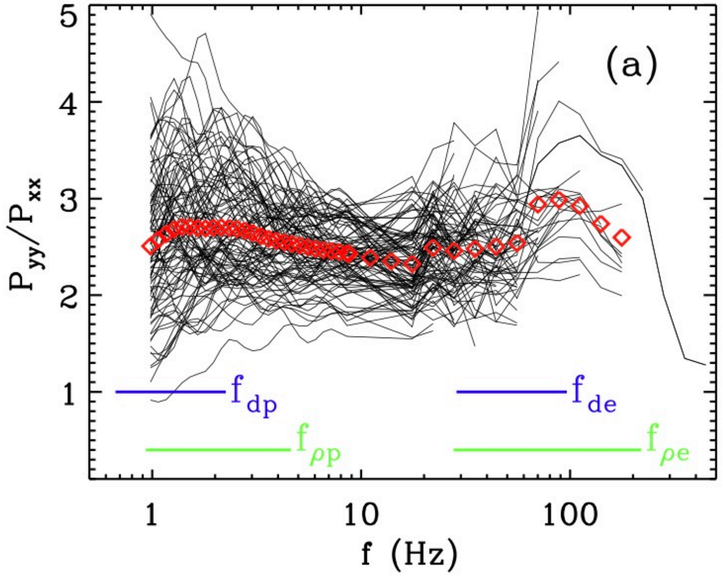
Anisotropies of the Magnetic Field Fluctuations at Kinetic Scales in the Solar Wind: Cluster Observations

Catherine Lacombe[1], Olga Alexandrova[1], and Lorenzo Matteini[1,2]
[1] LESIA-Observatoire de Paris, PSL Research University, CNRS, UPMC Université Paris 06, Université Paris-Diderot, 5 place Jules Janssen, F-92190 Meudon, France
[2] Department of Physics, Imperial College London, London SW7 2AZ, UK
Received 2017 March 30; revised 2017 July 12; accepted 2017 July 25; published 2017 October 10

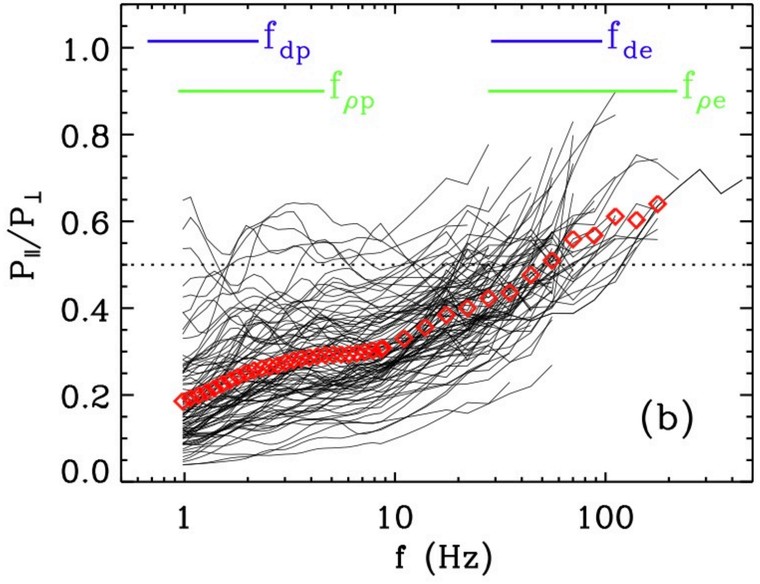
The "L.A.M." paper



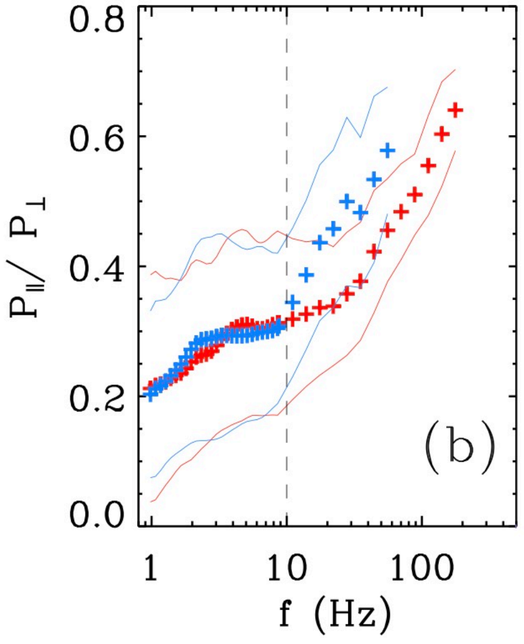
Cluster STAFF-SA data



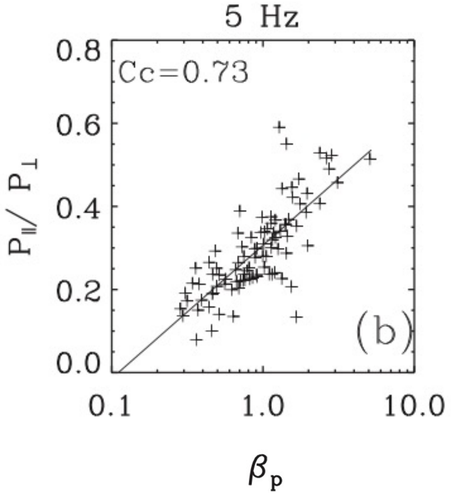
Anisotropy of k-vectors:
describes the geometry of the turbulence
(perp. vs. parallel k-vectors)



Anisotropy of components:
describes the nature of the modes
(level of magnetic compressibility)



A plateau at ion scales

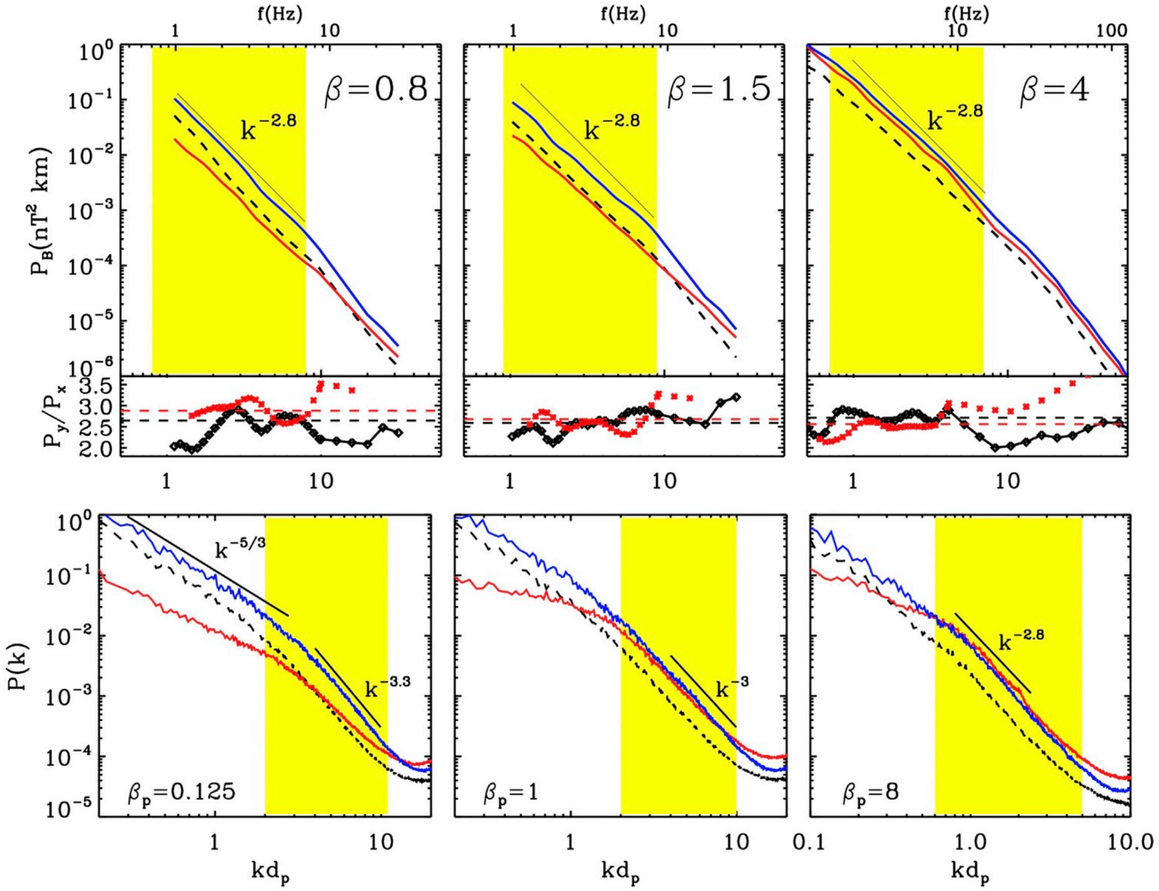


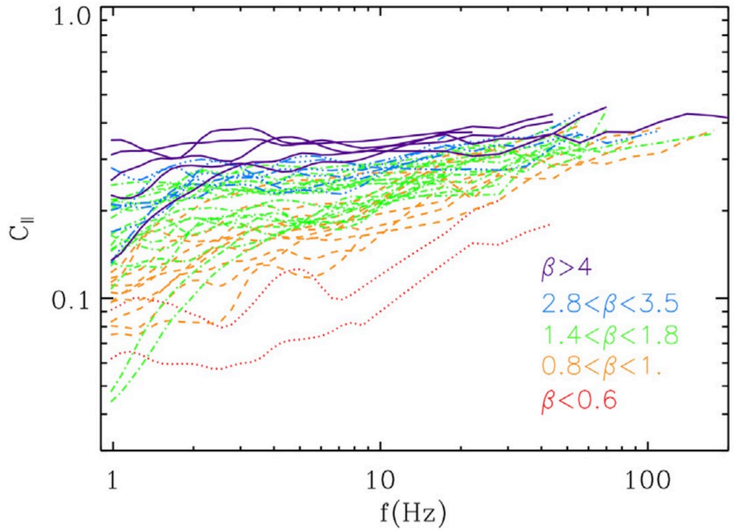
Compressibility depends
on (proton) beta

frontiers
in Astronomy and Space Sciences

Magnetic Field Turbulence in the Solar Wind at Sub-ion Scales: *In Situ* Observations and Numerical Simulations

L. Matteini[1,2,3], L. Franci[4,3], O. Alexandrova[2], C. Lacombe[2], S. Landi[5,3], P. Hellinger[6], E. Papini[5,3] and A. Verdini[5,3]*

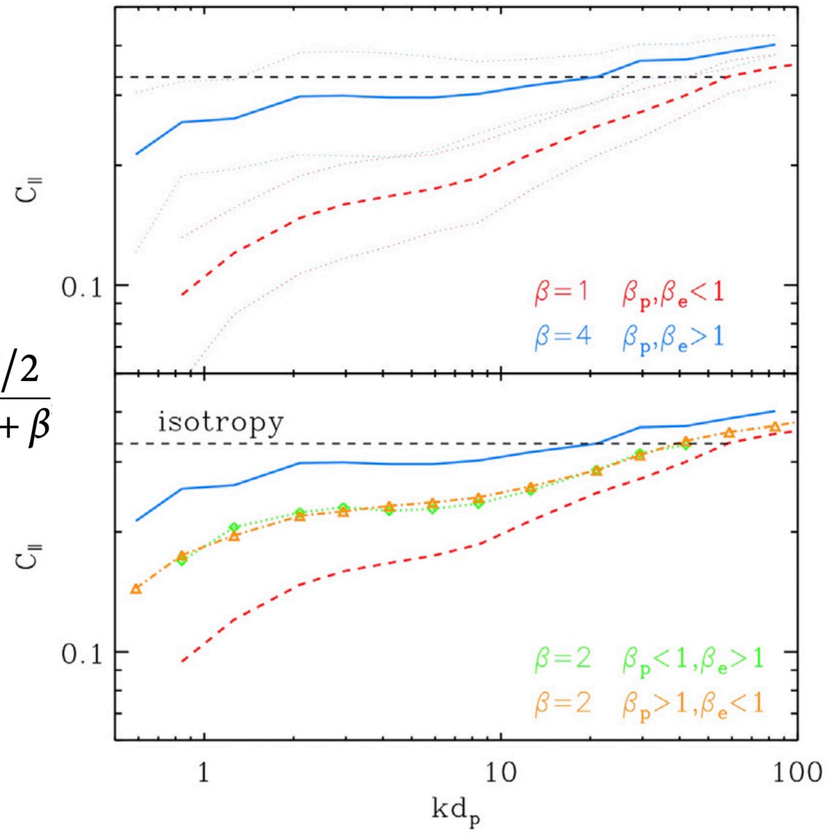


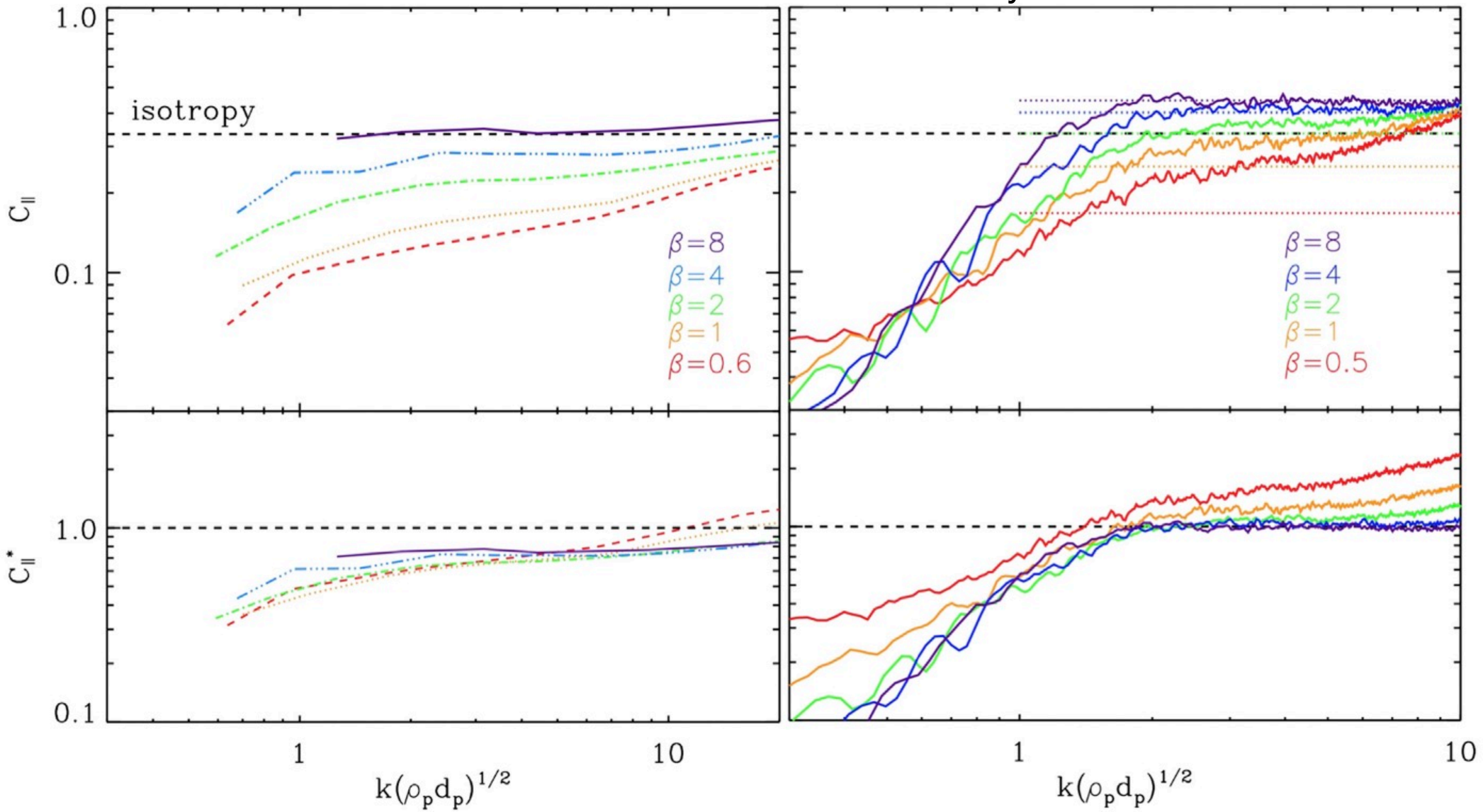


$$C_\parallel = \delta B_\parallel^2 / \delta B^2$$

$$\delta B^2 = \delta B_\parallel^2 + \delta B_\perp^2$$

$$C_\parallel = \frac{\beta_p/2\left(1+T_e/T_p\right)}{1+\beta_p\left(1+T_e/T_p\right)} = \frac{\beta/2}{1+\beta}$$





$$C_{\parallel} = \frac{\beta_p/2\left(1+T_e/T_p\right)}{1+\beta_p\left(1+T_e/T_p\right)} = \frac{\beta/2}{1+\beta}$$

Consistent with almost non-propagating modes (highly oblique KAWs?),
in pressure balance. Better agreement with prediction at high beta than low beta.