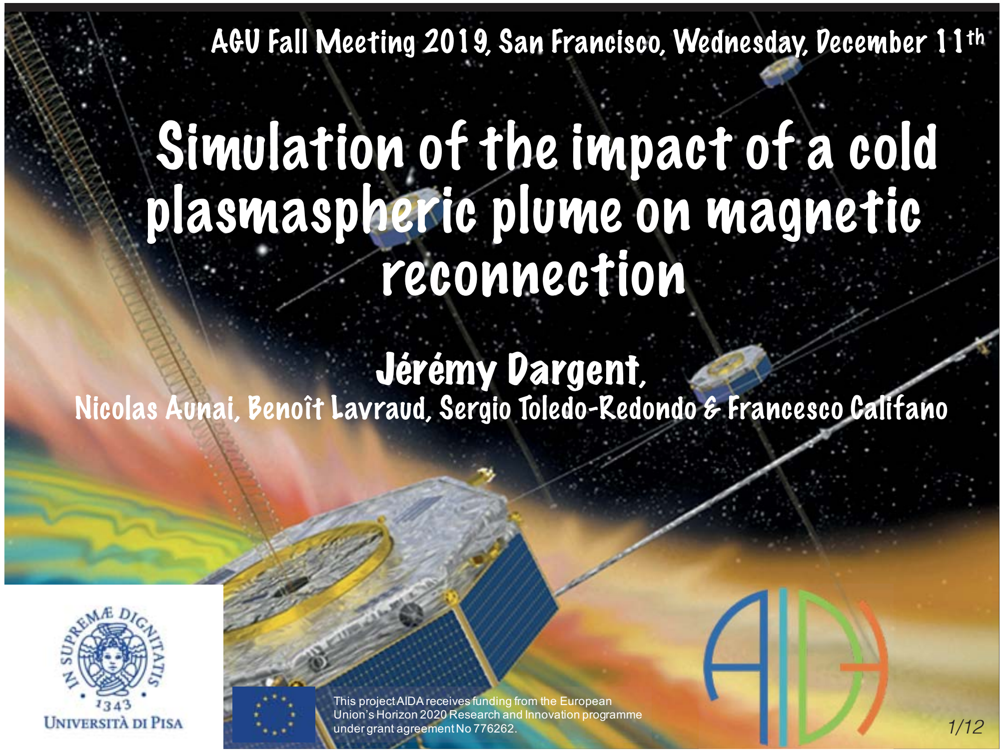

AGU Fall Meeting 2019, San Francisco, Wednesday, December 11th

Simulation of the impact of a cold plasmaspheric plume on magnetic reconnection

Jérémy Dargent,
Nicolas Aunai, Benoît Lavraud, Sergio Toledo-Redondo & Francesco Califano

Università di Pisa

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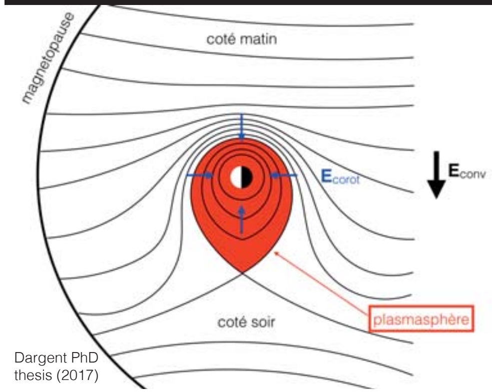
Context of this study

Formation of a **plasmaspheric plume**



Dargent PhD thesis (2017)

Context of this study

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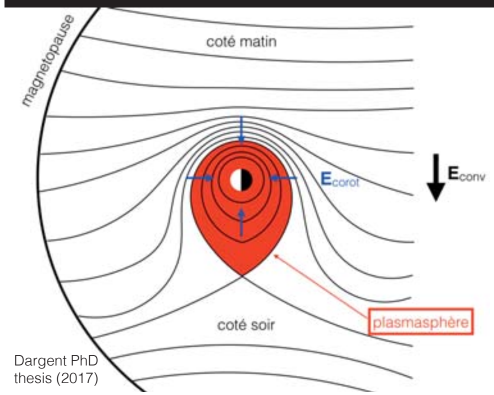
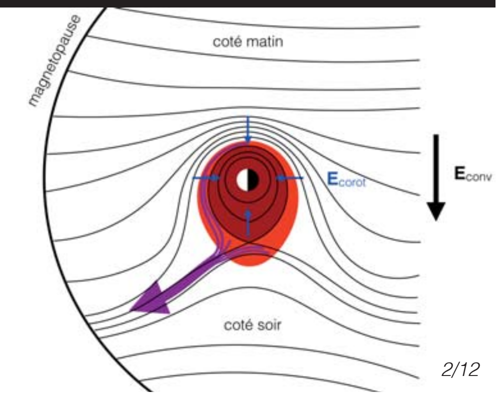




Dargent PhD thesis (2017)

Context of this study

Consequences in the magnetosphere:

Formation of a **plasmaspheric plume**

↓

Mass loading of the magnetic reconnection (Borovski & Denton GRL 2006)

Context of this study

Consequences in the magnetosphere:

Formation of a **plasmaspheric plume**

↓

Mass loading of the magnetic reconnection (Borovski & Denton GRL 2006)

↓

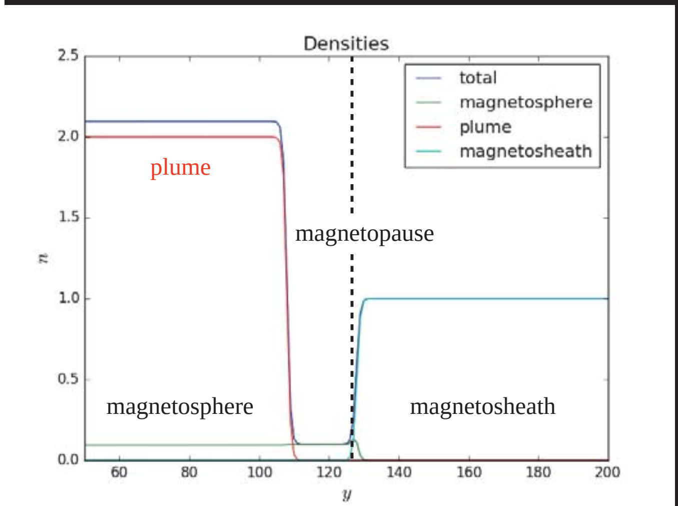
Decrease of the magnetic reconnection rate

Question

What are the **impacts of plasmaspheric plumes** on the dayside magnetopause?

In particular, how does **their low temperature** impacts magnetic reconnection?

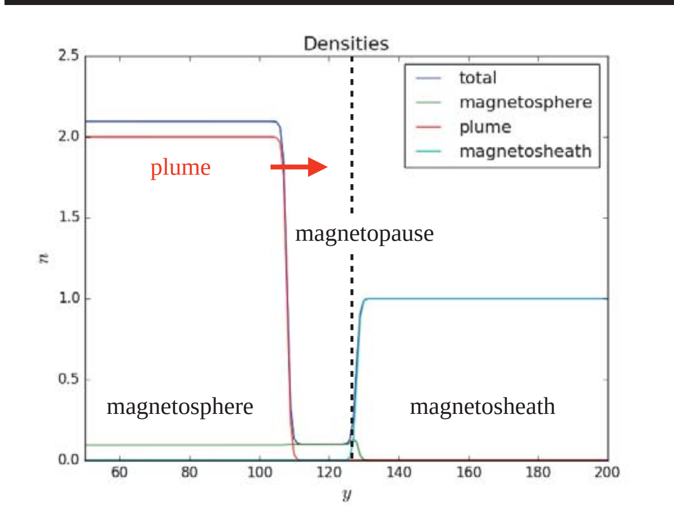
Initial setup



- One huge 2D fully kinetic simulation in three steps:
  - Reconnection without cold ions
  - Impact of the plume
  - Reconnection of the plume

$m_i/m_e = 25$ $T_e/T_i = 0.2$ $T_{hot}/T_{cold} = 500$

Initial setup



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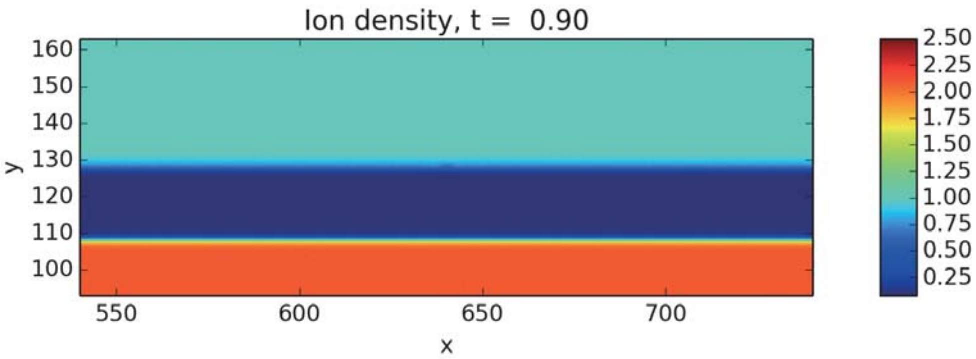
The plume simulation

Dargent et al. (submitted)



Three steps:

• Reconnection without cold ions • Impact of the plume • Reconnection of the plume

The plume simulation

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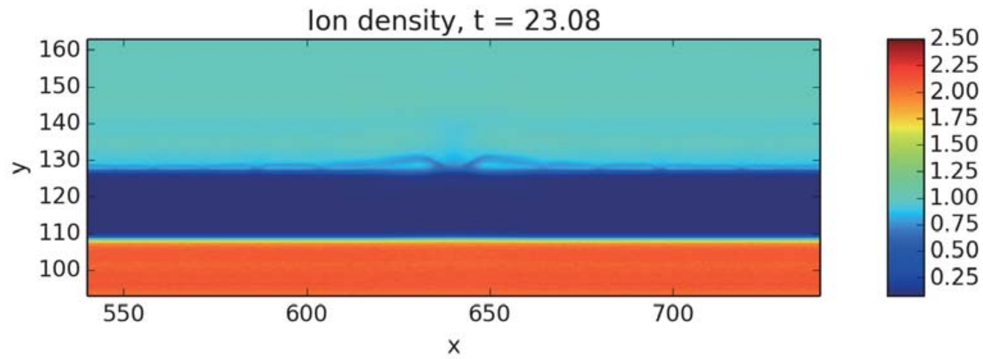

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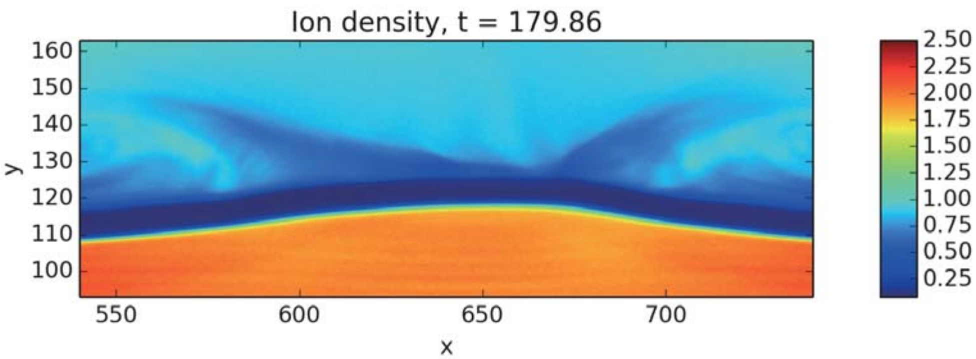

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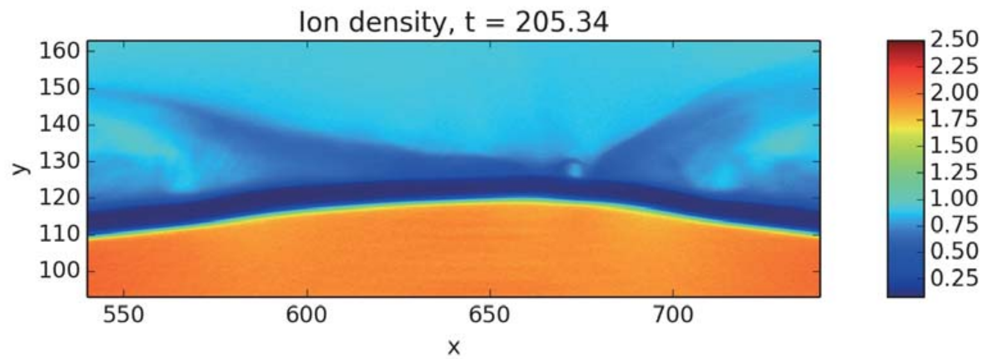

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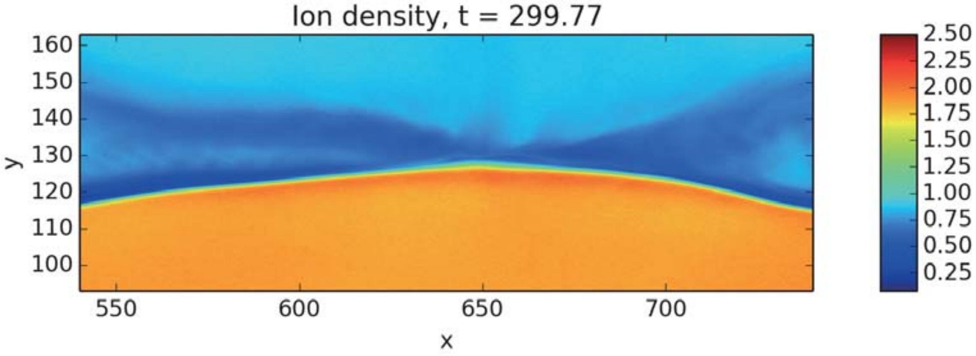

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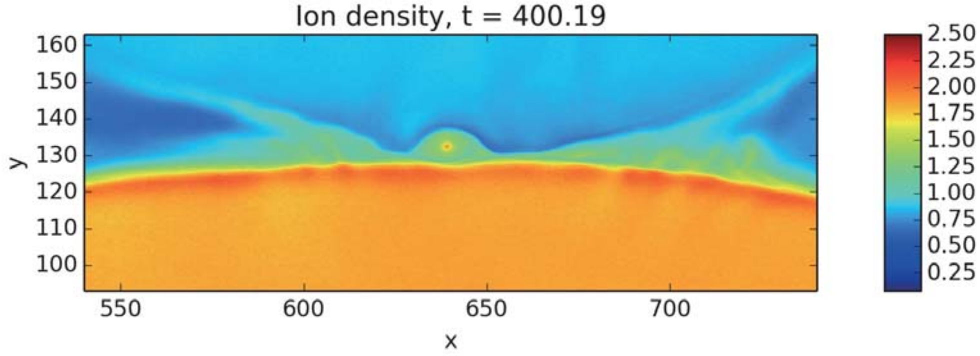

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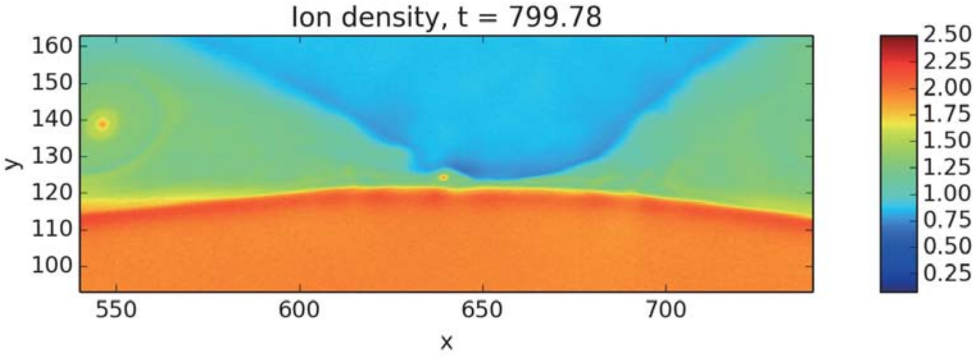

Three steps:

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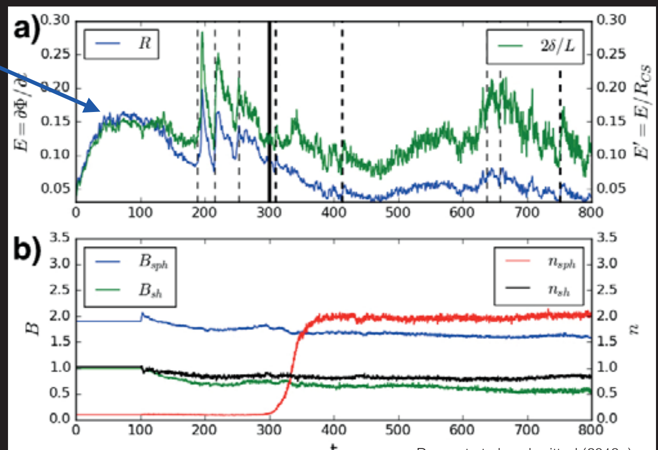
Evolution of the reconnection rate

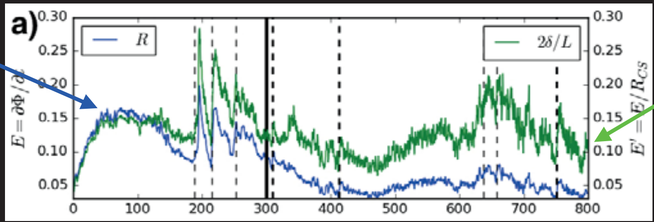
« raw » reconnection rate



Dargent et al., submitted (2019c)

Evolution of the reconnection rate

« raw » reconnection rate



normalized reconnection rate

Dargent et al., submitted

Normalization factor (Cassak & Shay PoP, 2007):

$$R_{CS} \sim \frac{B_1 B_2}{B_1 + B_2}\sqrt{B_1 B_2 \frac{B_1 + B_2}{B_1 n_2 + B_2 n_1}}\,\frac{2\delta}{L}$$

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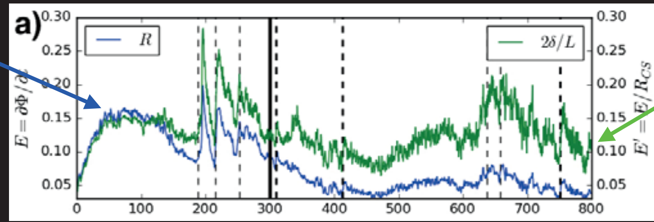

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Normalization factor

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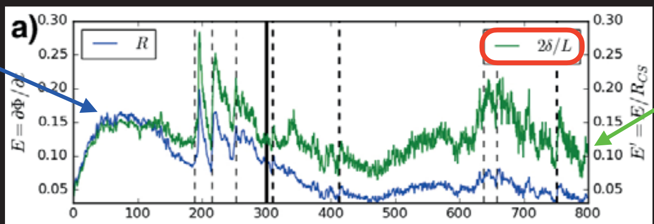

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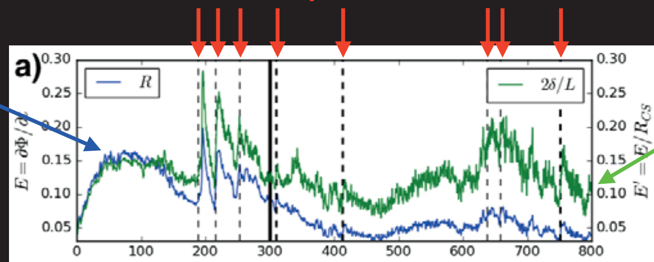
equivalent

Evolution of the reconnection rate

plasmoids

« raw » reconnection rate



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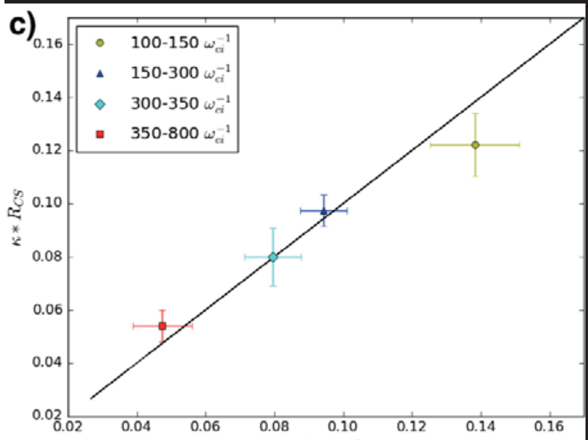
Evolution of the reconnection rate



Dargent et al., submitted

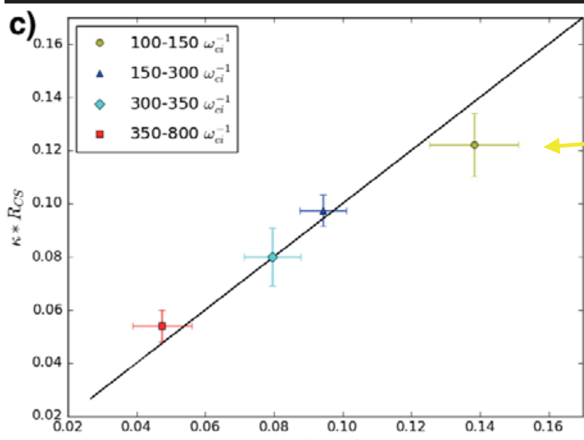
Comparison:

Reconnection rate

VS

CS scaling law

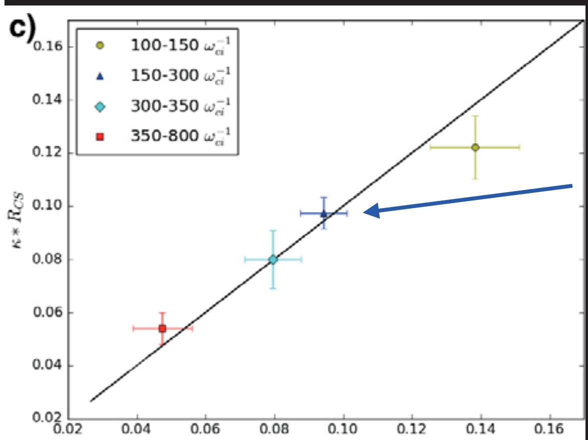
Evolution of the reconnection rate



Dargent et al., submitted

Overshoot (not steady state)

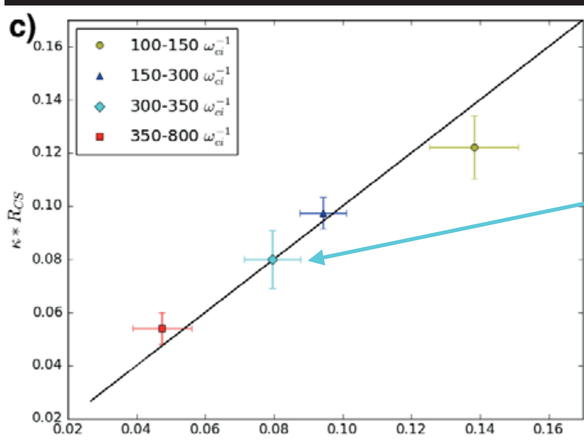
Evolution of the reconnection rate



Dargent et al., submitted

Magnetic reconnection before the plume

Evolution of the reconnection rate



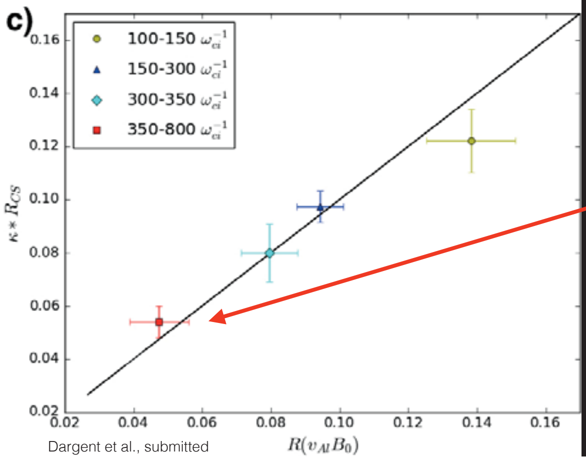
Dargent et al., submitted

Impact of the plume

-

transition

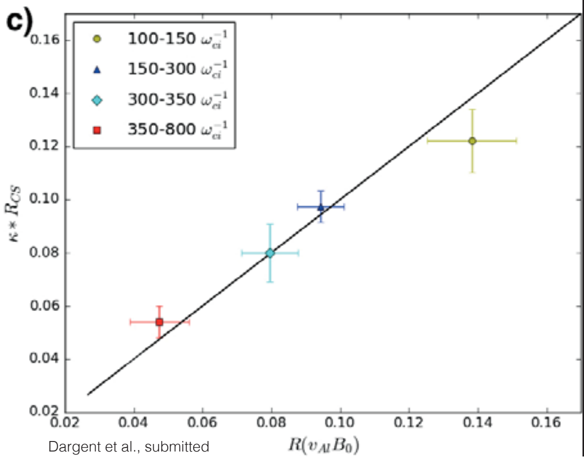
Evolution of the reconnection rate



Dargent et al., submitted

Magnetic reconnection with the plume

Evolution of the reconnection rate



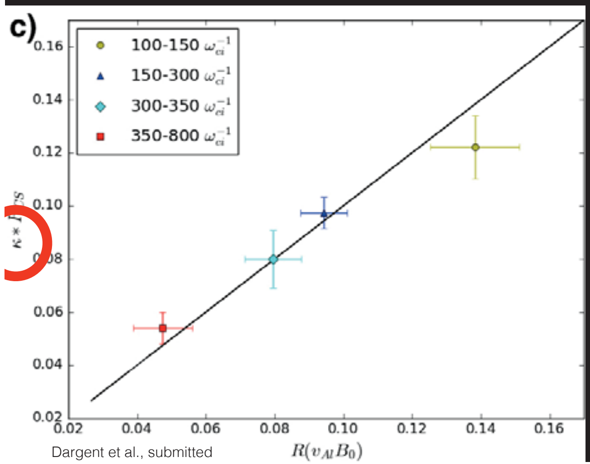
Dargent et al., submitted

In average, the **normalized reconnection rate is constant**.

↓

The temperature does not impact the reconnection rate (no kinetic effect)

Evolution of the reconnection rate



Dargent et al., submitted

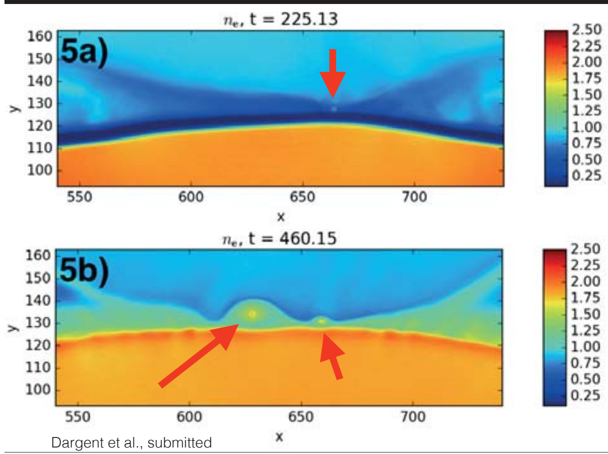
$$\kappa = 0.127$$

↓

Consistent with Liu et al PRL (2017)

Other perspectives

What changes when cold ions become dominant ?



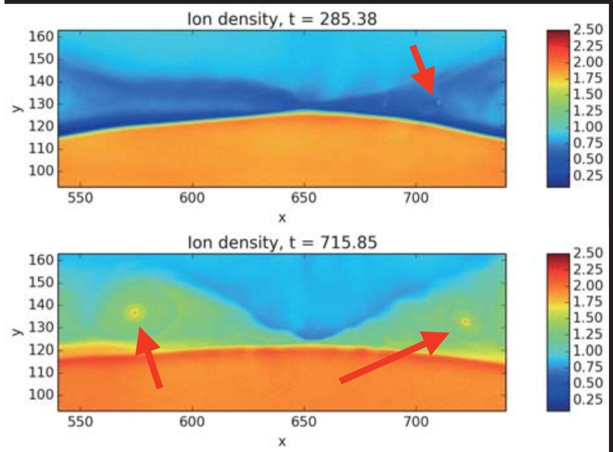
Dargent et al., submitted

<u>Prospective:</u>
The formation and growth of plasmoids

<u>With the plume:</u>
- bigger plasmoids
- different structure

Other perspectives

What changes when cold ions become dominant ?



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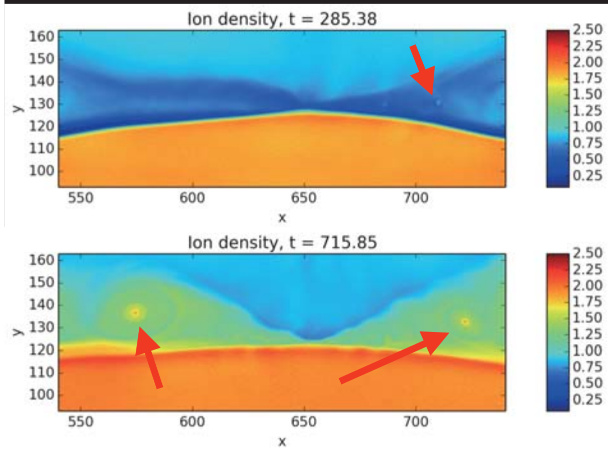


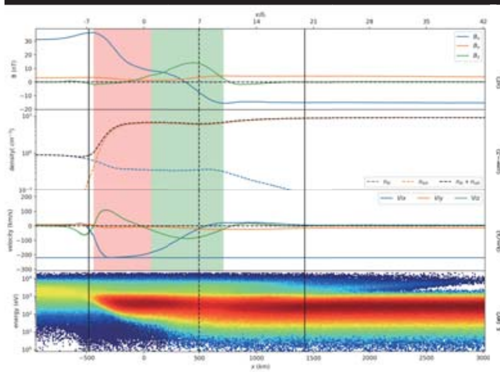
Prospective:
The formation and growth of plasmoids

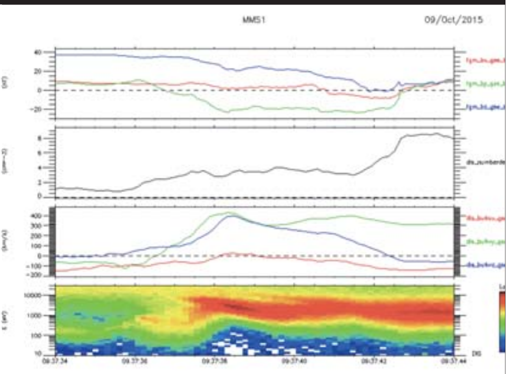
With the plume:
- bigger plasmoids
- different structure

Possible explanation:
- jet slower
- less steady layer

Other perspectives

Virtual spacecraft observation





from the simulation

from the observations

Conclusion

- The averaged magnetic reconnection rate is not affected by the temperature.
- Other events at the magnetopause (plasmoids, waves, etc.) are affected by the plasmaspheric plume temperature.

Thank you for your attention