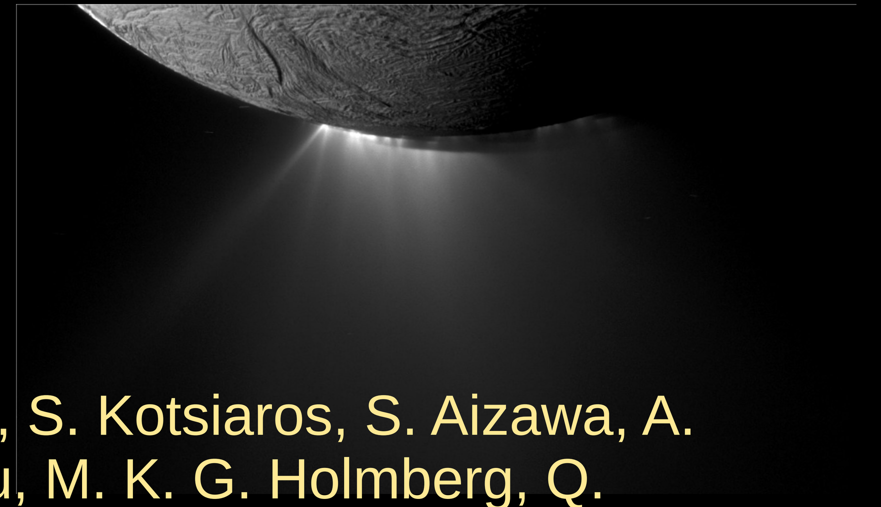
Evidence of an extended Alfvén wing system at Enceladus: Cassini's multi-instrument observations



L. Z. Hadid , T. Chust, J.-E. Wahlund, M. W. Morooka, O. Witasse, E. Roussos, J. Rabia, D. Pisa, N. J. T. Edberg, S. Kotsiaros, S. Aizawa, A. Jeandet, R. Modolo, N. André, C. F. Bowers, K. Kim, A. Parsec-Wallis, A. J. Coates, A. Rymer, O. Agiwal, P. Canu, M. K. G. Holmberg, Q. Nénon, H. Cao, X. Jia, G. H. Jones, L. Lamy, W. S. Kurth, and M. K. Dougherty

Take-home message

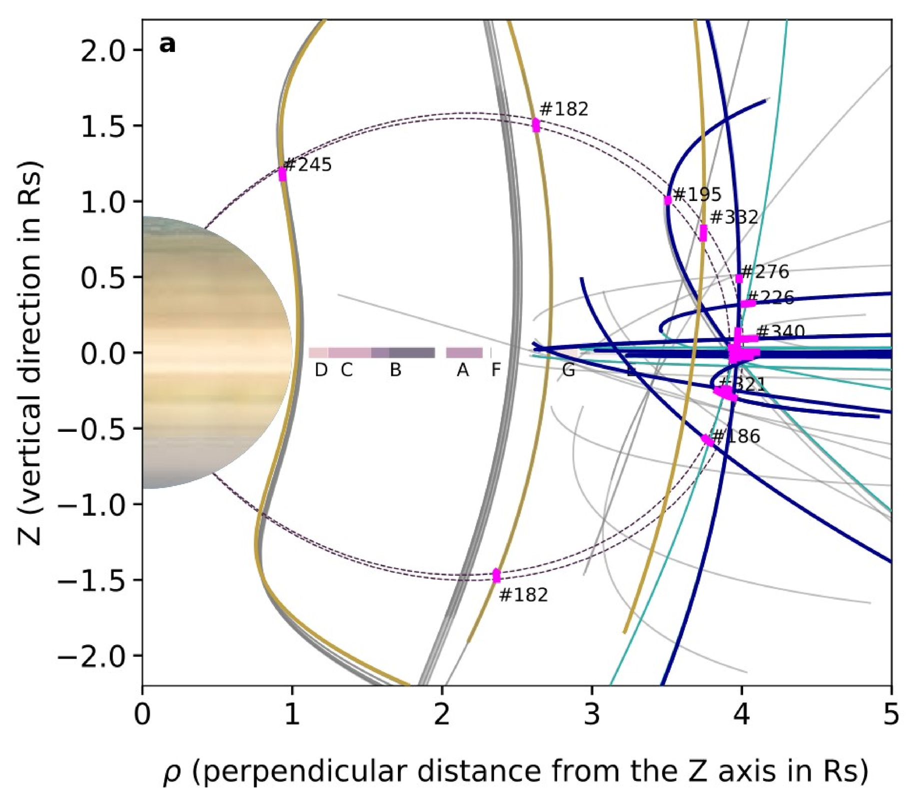
→ Enceladus' main Alfvén wings must sustain an **extended Alfvén wing system** with numerous reflections within its torus and at kronian ionosphere.

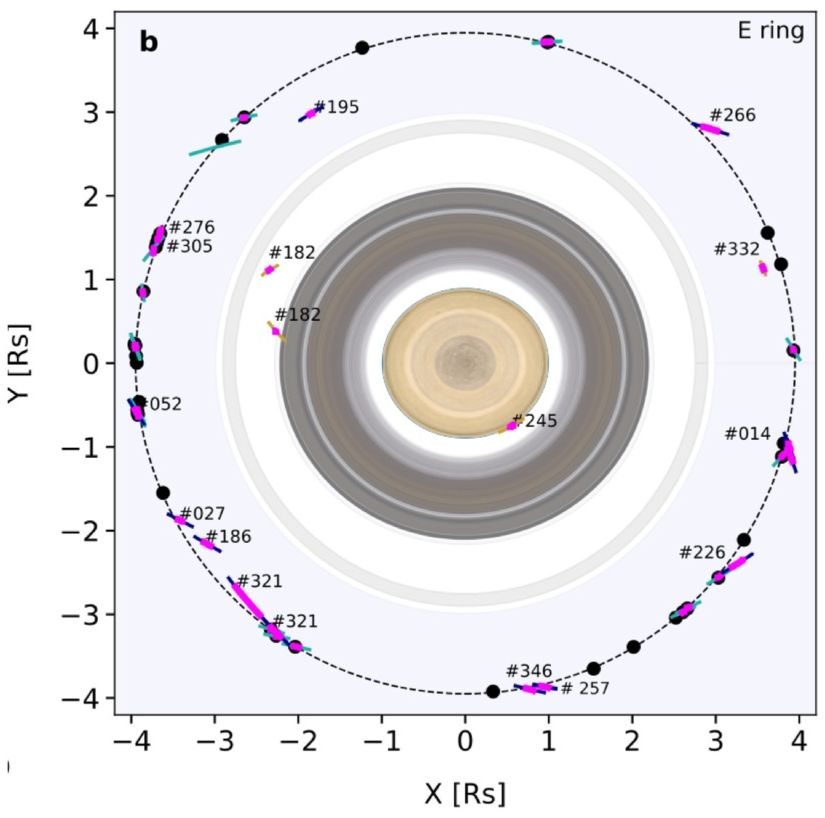
→ Enceladus' electromagnetic interaction with Saturn's rotating magnetosphere extends up to **at least 120 degrees downstream of the moon**.

→ The large-scale Enceladus' Alfvén wing perturbations are **systematically filamented** during their propagation at any distance from their source. L. Z. Hadid, et al. JGR 2926.

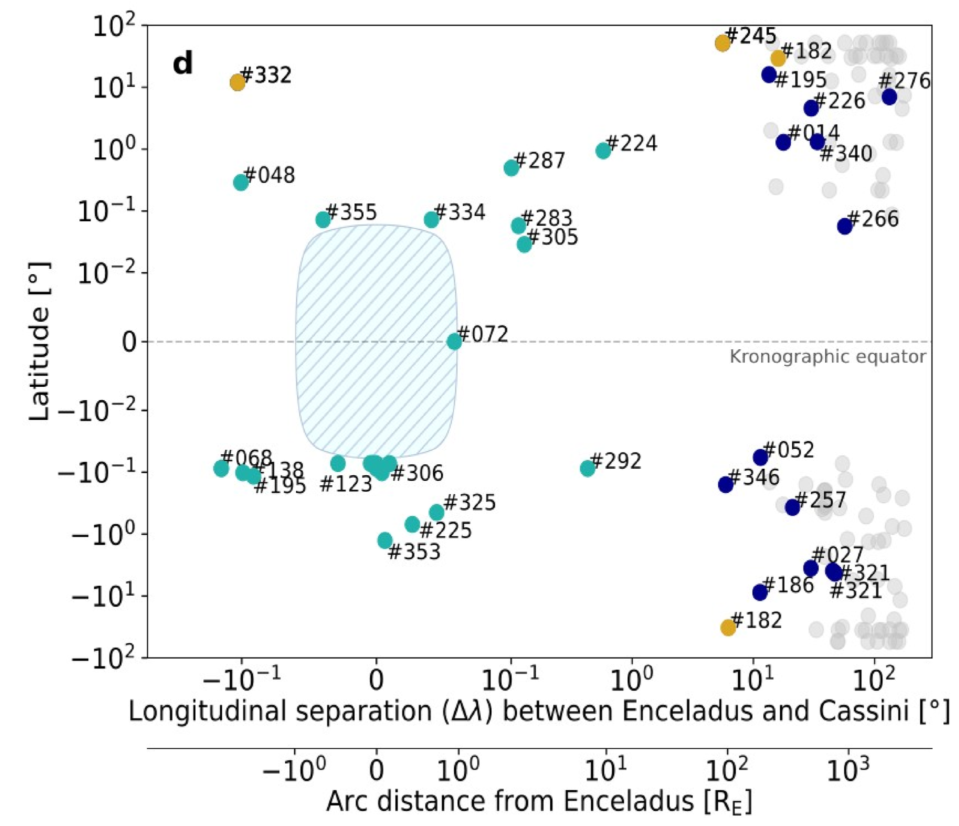
Spatial Distribution of Enceladus–Saturn electrodynamically coupled events

Identified events connected along Enceladus' L-shell



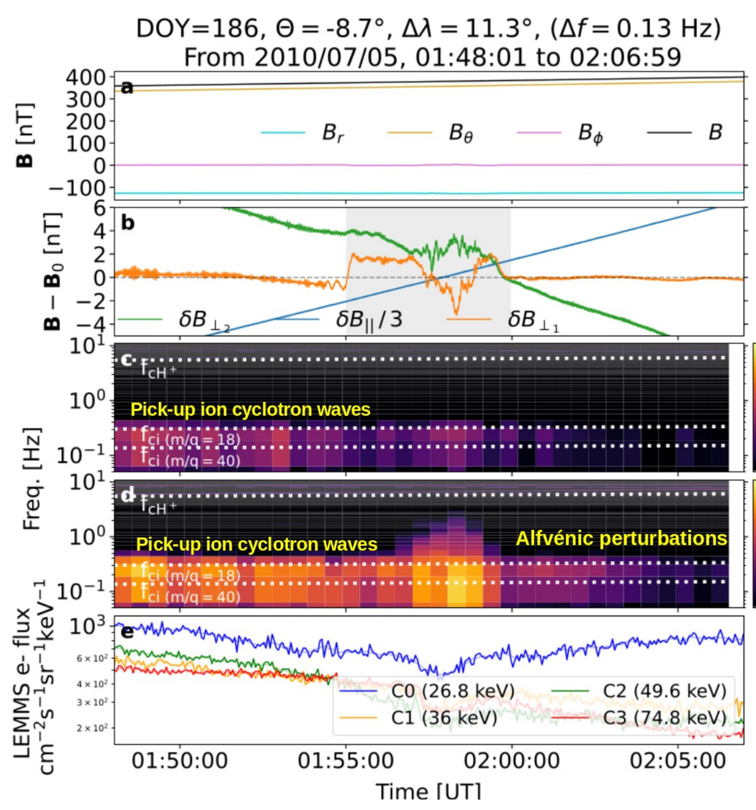


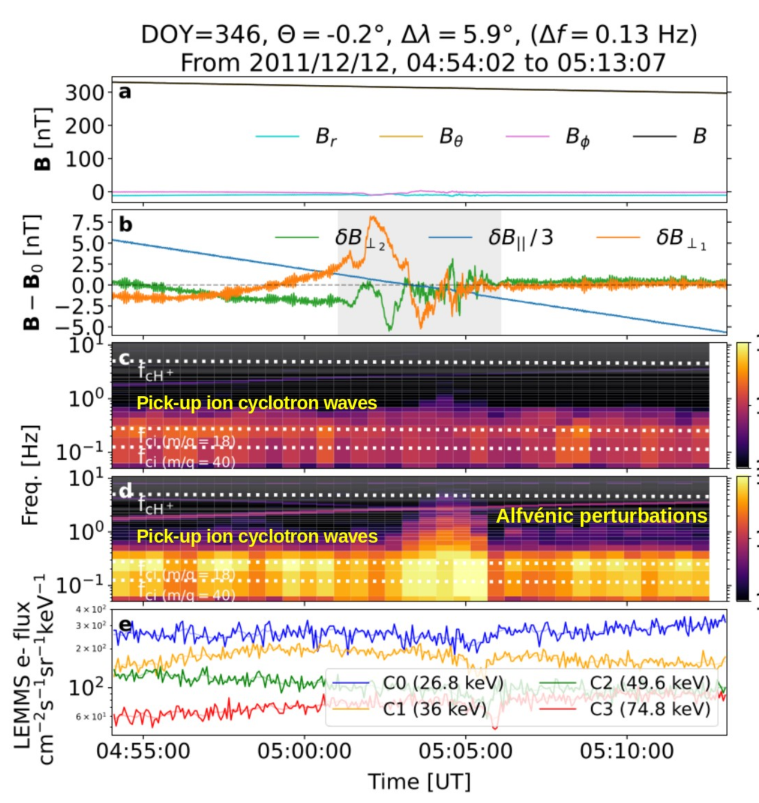
Electrodynamic interaction between Enceladus and Saturn extends up to 133° (~2185 R_E) downstrea. → Signatures of Reflected Alfvén Wings (RAWs) ?



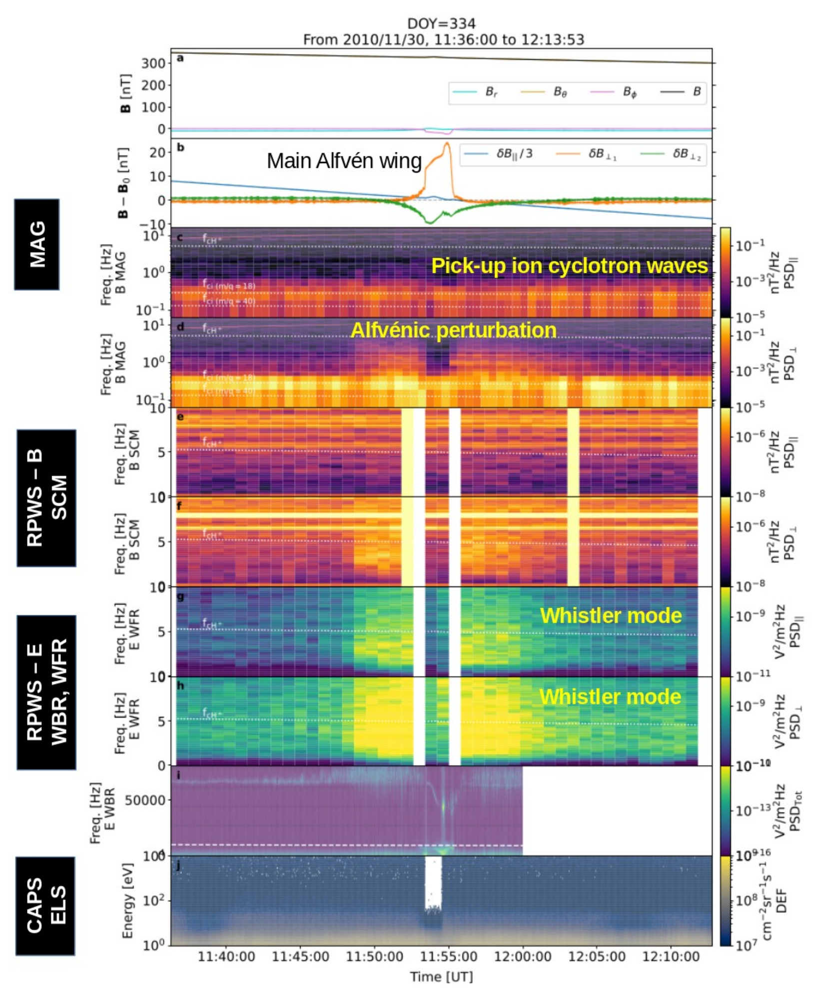
Case study examples

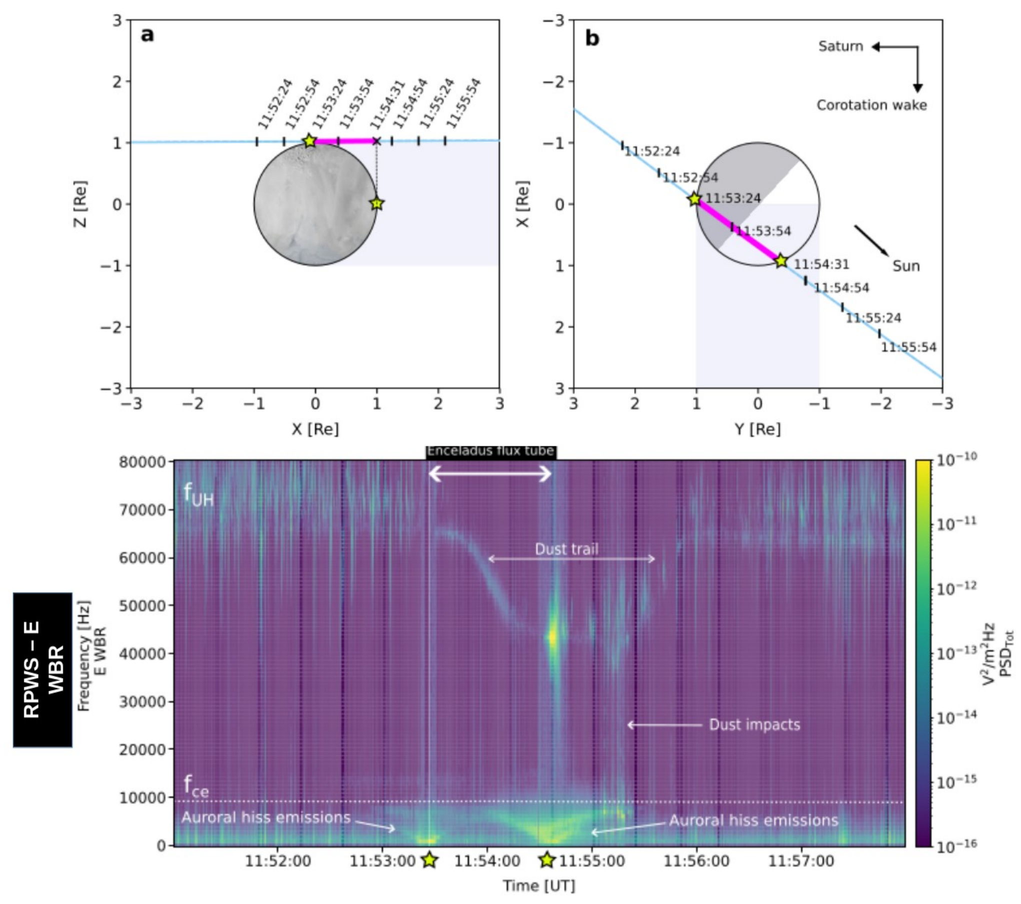
NON-TARGETED EVENTS (Reflected Alfvén Wing)



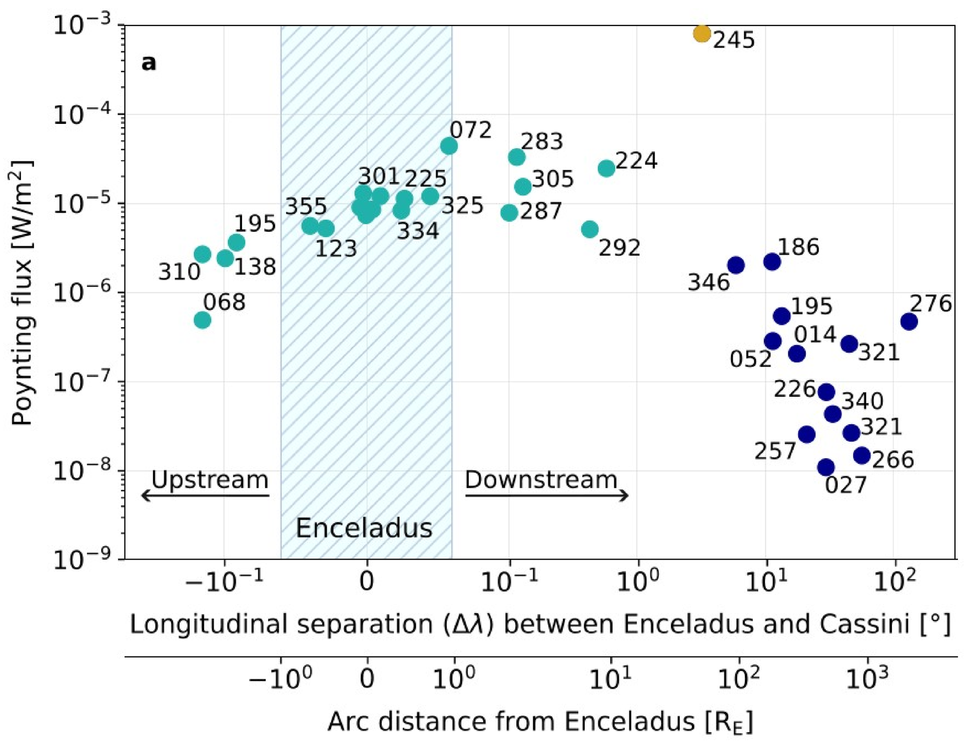


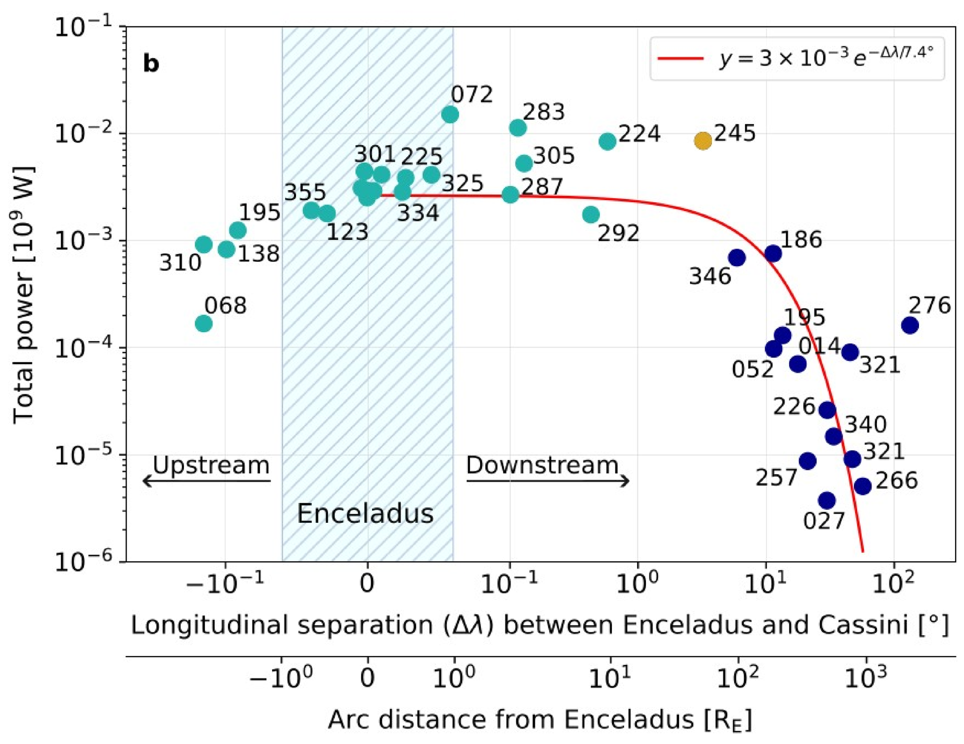
TARGETED FLYBY EVENT (Main Alfvén Wing)





Large-scale Alfvénic perturbations: Poynting flux and total power



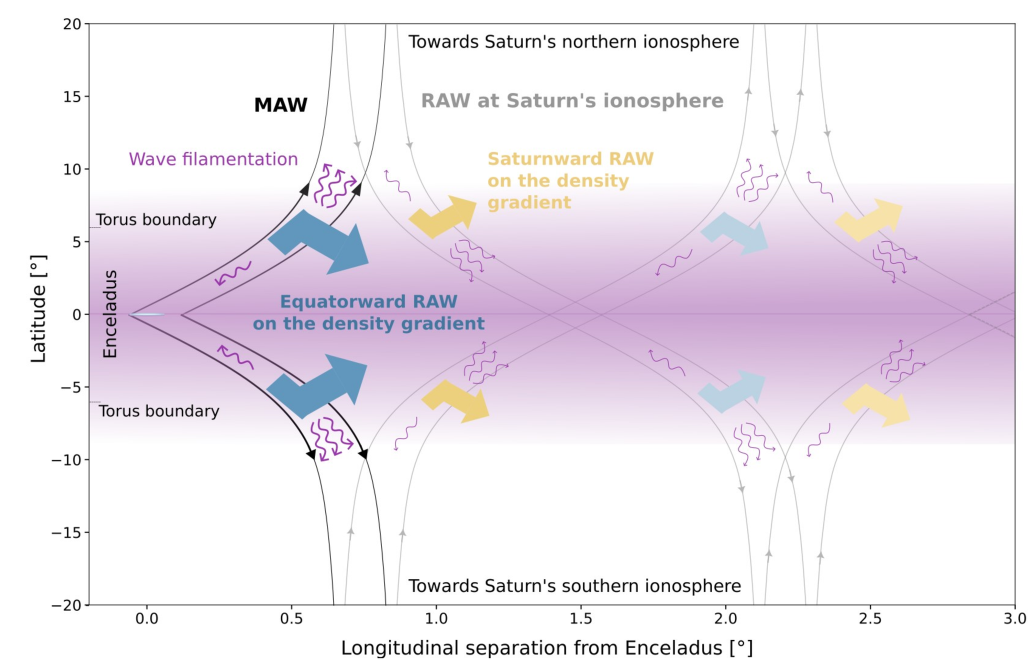


→ Poynting flux peaks near Enceladus ~ 4×10^{-5} W/m² to ~ 9×10^{-9} W/m² downstream

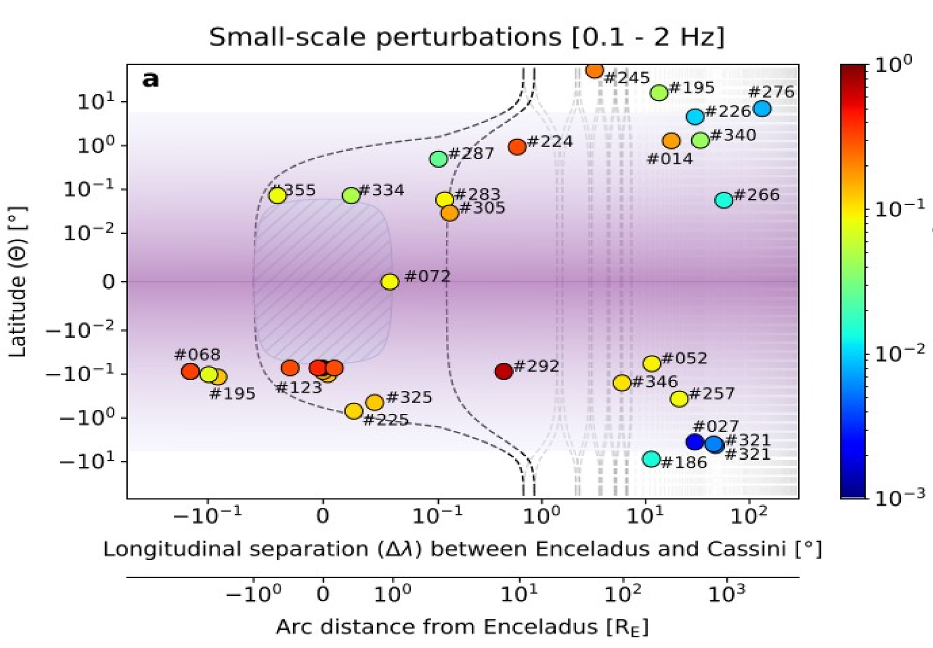
→ Power near Enceladus ~ 1.5×10^{7} W to ~ 3×10^{3} W downstream

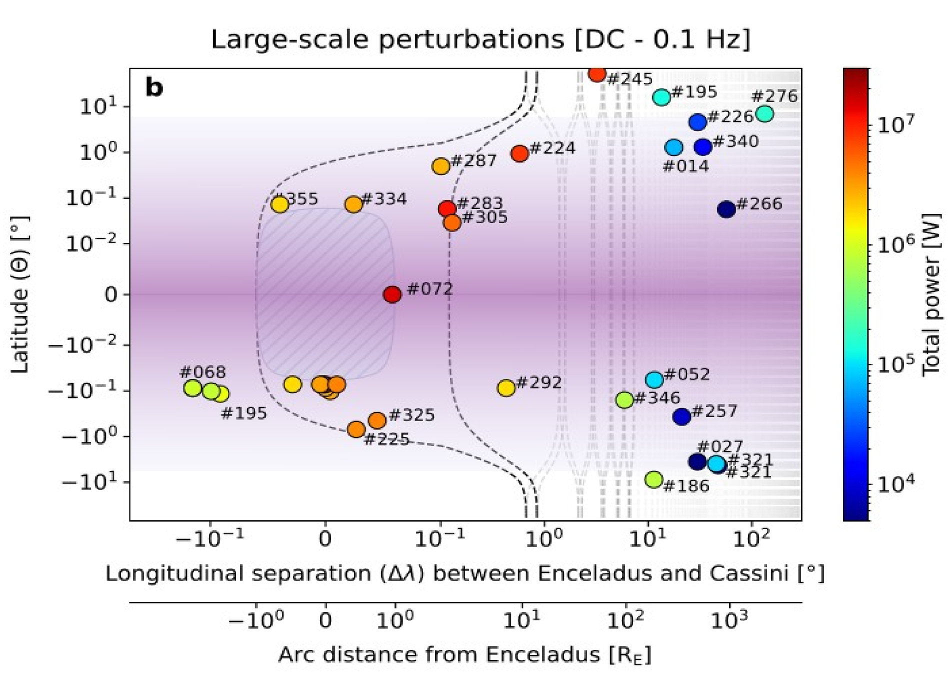
→ Consistent with upper theoretical limit (2×10^{8} W, Saur et al. 2013)

Schematic summary



Small-scale Alfvénic perturbations: wave filamentation

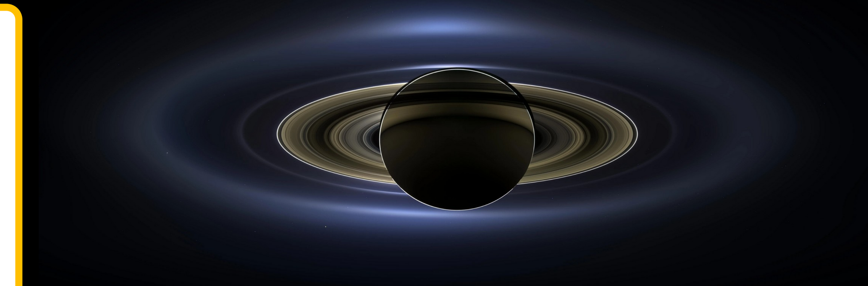




→ Wave PSD and total power peak within ~10 R_E and decrease farther downstream at about 2000 R_E.

→ A systematic correlation between the existence of large-scale and small-scale Alfvénic perturbations at any distance.

→ Filamentation process occurs along the whole propagation of the MAWs and their corresponding reflected parts (and not only before their first reflection as previously supposed by Chust et al. (2005) for the Io/Jupiter case).



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