

Diferencia de velocidad entre iones y neutros en manchas solares

I. Bonilla, E. Khomenko, M. Collados,
N. Shchukina, C. Quintero

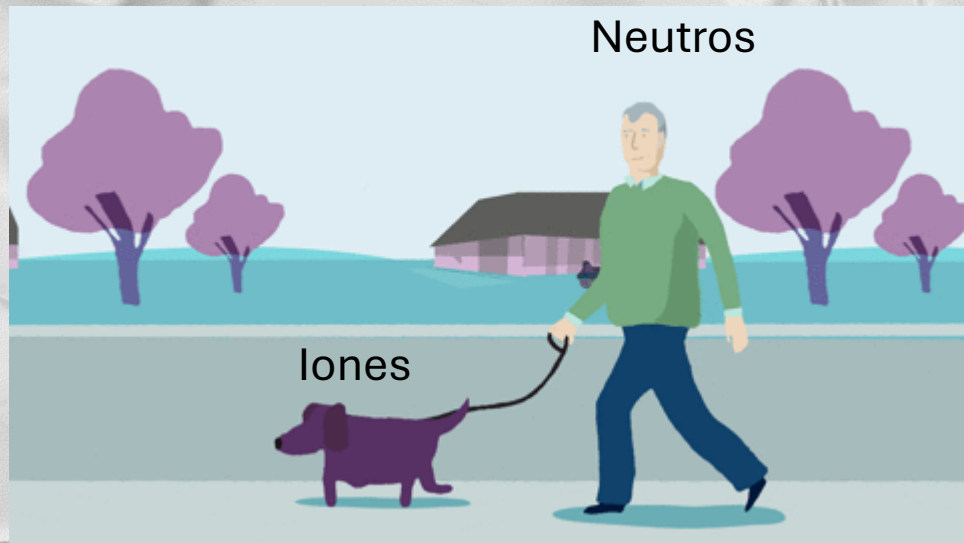
Índice

Marco teórico	3
¿Qué es SIR?	8
Metodología	9
Resultados	10
Bibliografía	24
Conclusiones	25

Marco teórico

Atmósfera **densa** y **caliente**

Fuerte acoplamiento colisional



Atmósfera **poco densa** y **fría**
(fotosfera)

Acoplamiento colisional más débil, pero todavía fuerte



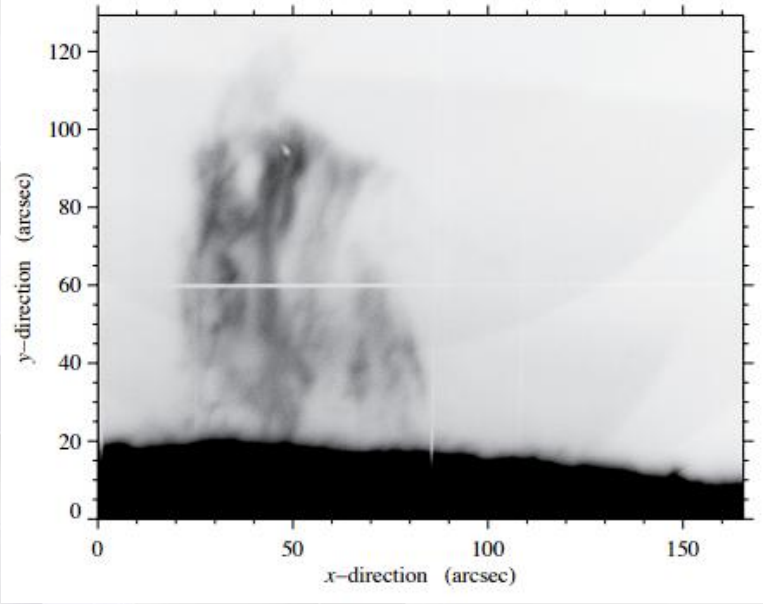


El campo magnético
juega un papel fundamental

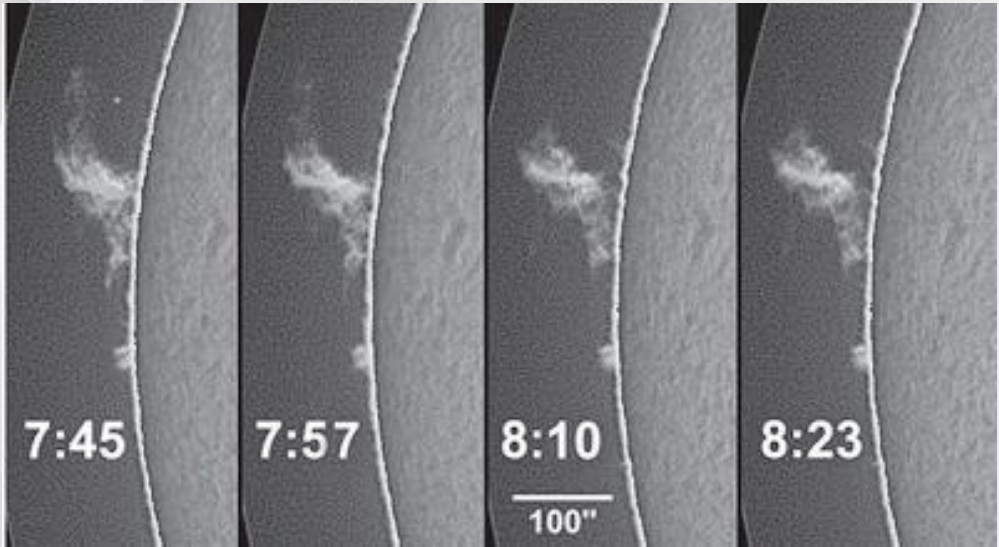
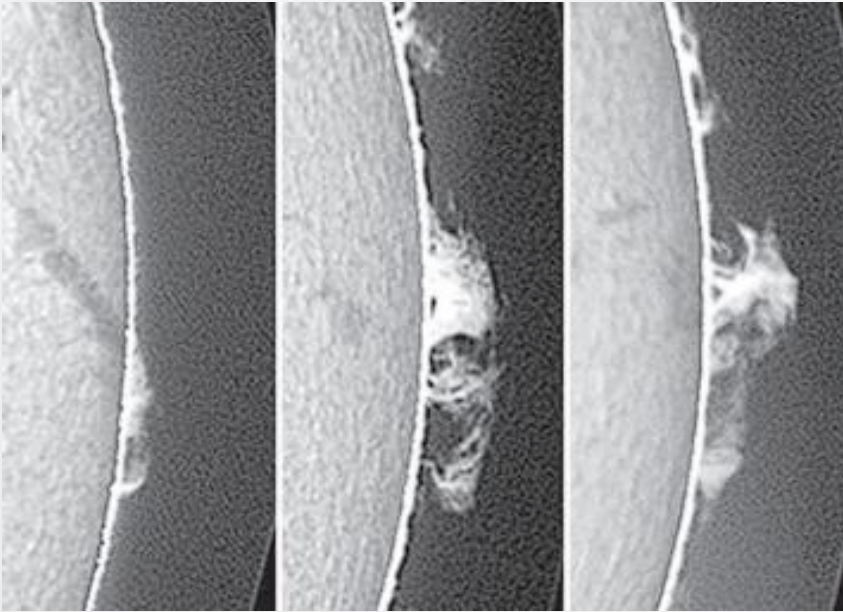
Manchas
solares

Protuberancias

Manrique et al. 2023

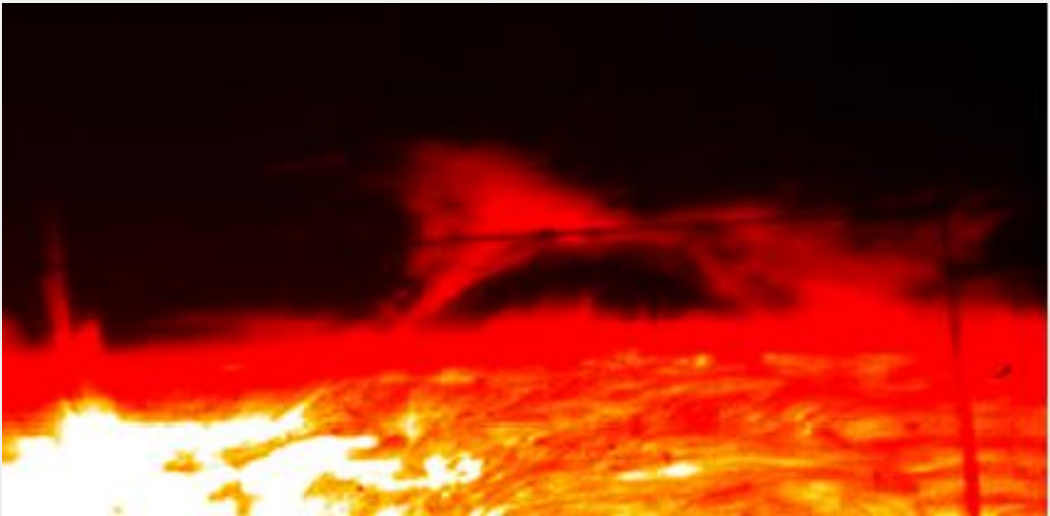
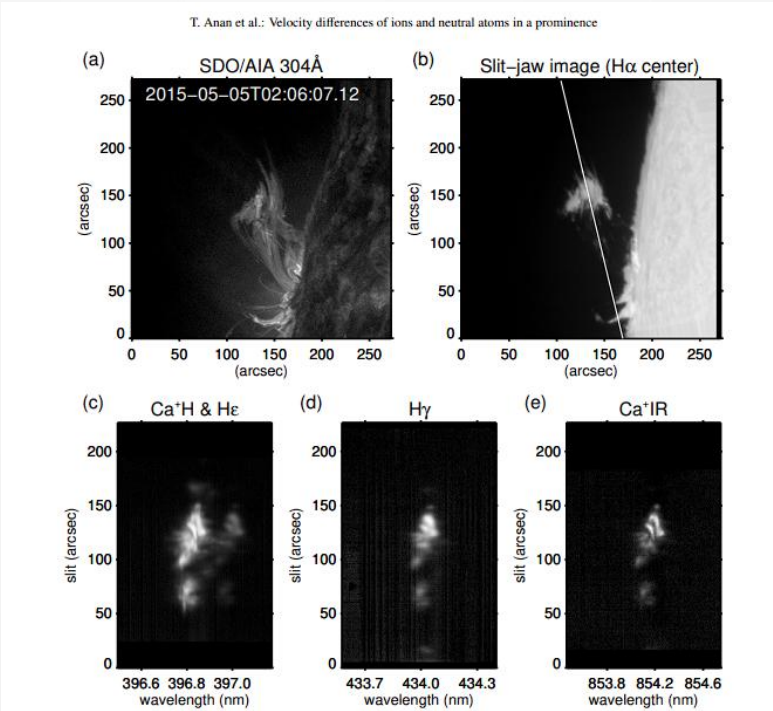


Wiehr et al. 2019



Wiehr et al. 2021

Anan et al. 2017



Khomenko et al. 2016

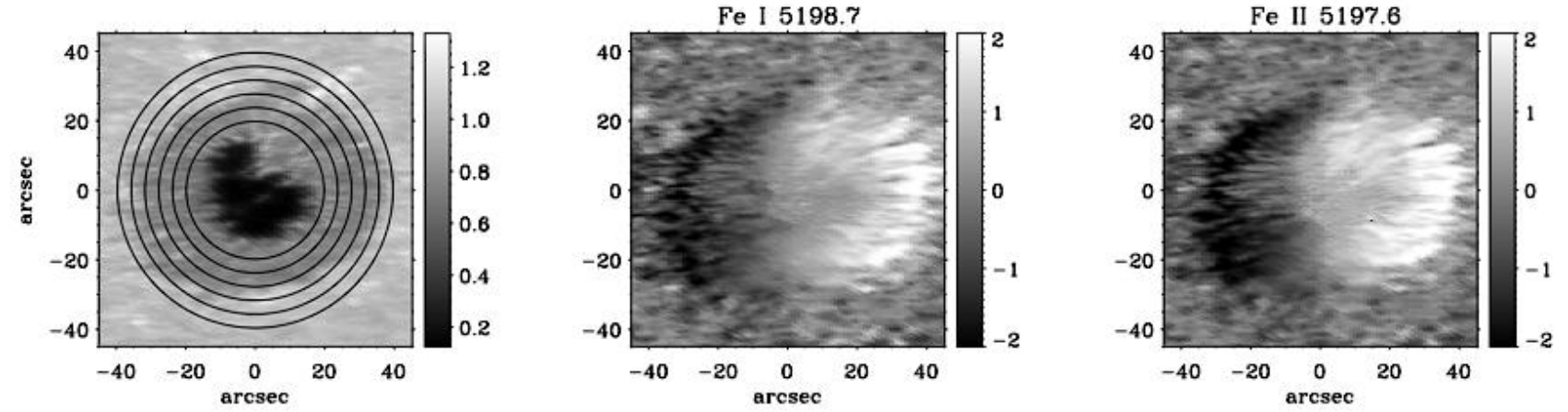


Fig. 2. Continuum image and velocities of the Fe I 5198.71 Å and Fe II 5197.58 Å lines. The velocities are obtained after the λ -meter technique at the position at the wings of each line nearest to the continuum. We note the similarity in the velocity field. The circles in the *left panel* indicate the rings in the penumbra where we performed the fit to the velocities.

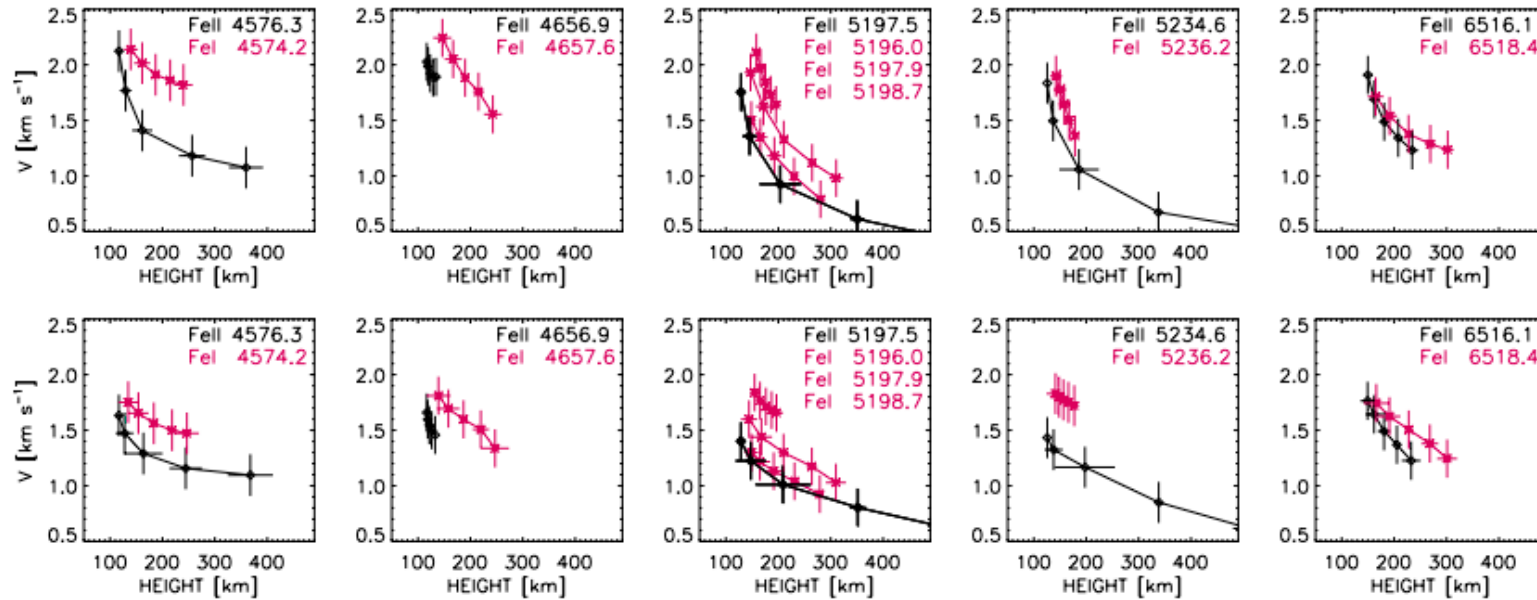
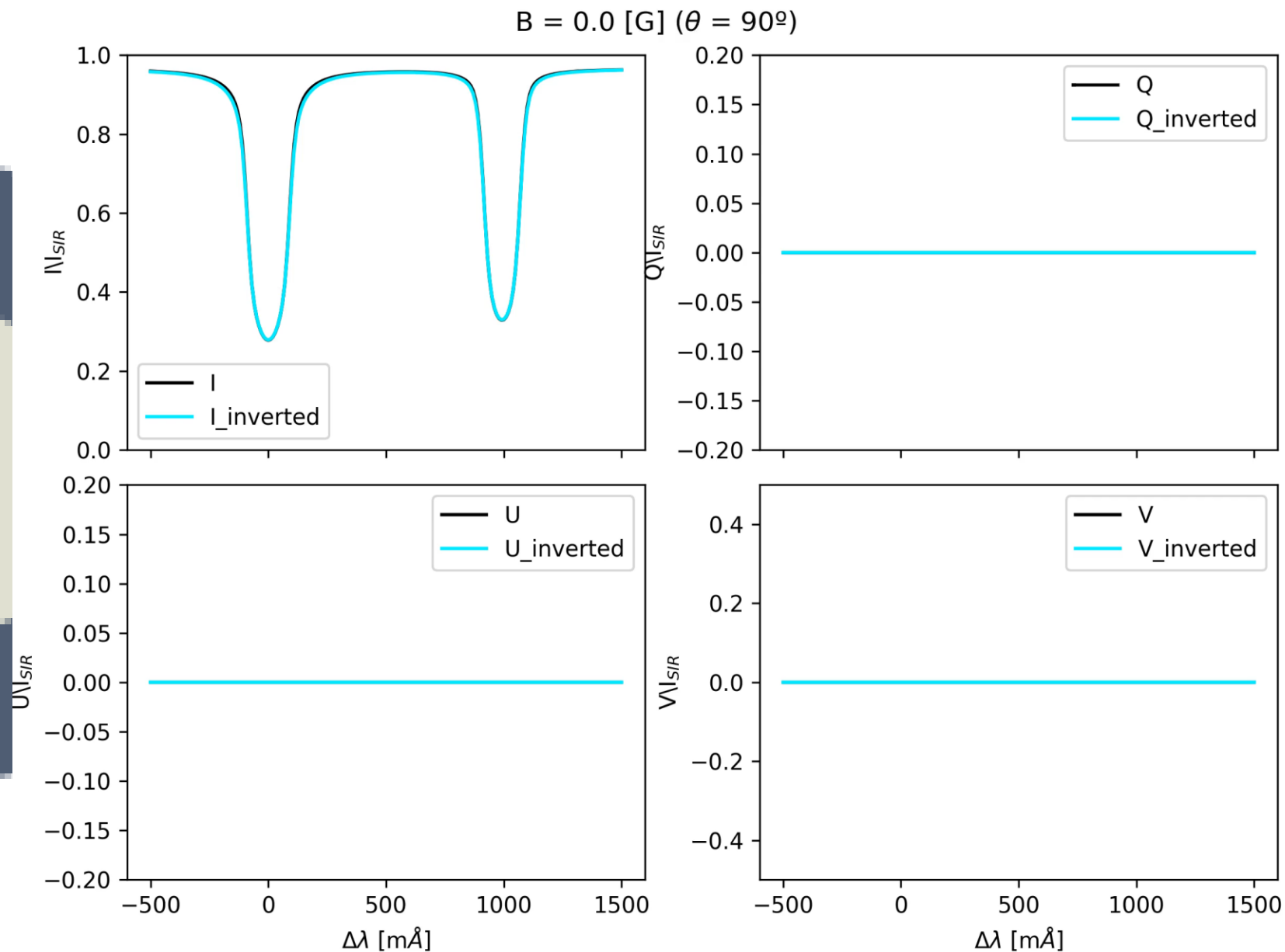


Fig. 5. Height dependence of the radial component of the Evershed flow obtained after the fit to λ -meter velocities for different pairs of lines at different radial distances in the penumbra. The model for heights is model C. The *top row* corresponds to the radial distances 0.45–0.6 R , while *bottom row* corresponds to 0.75–0.9 R .

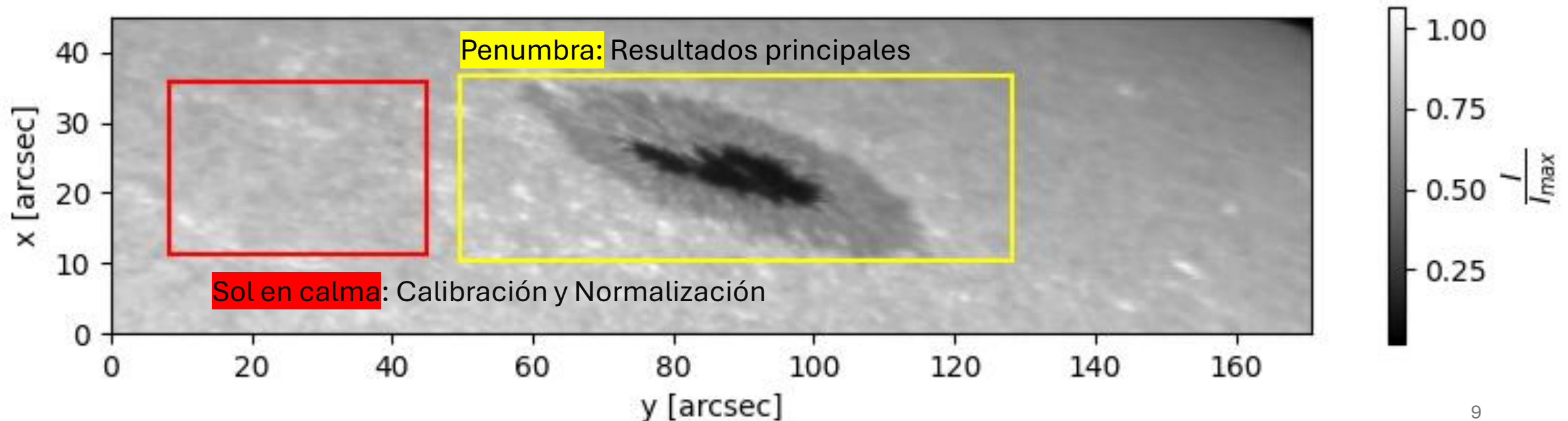
SIR

Stokes Inversion of Response Functions



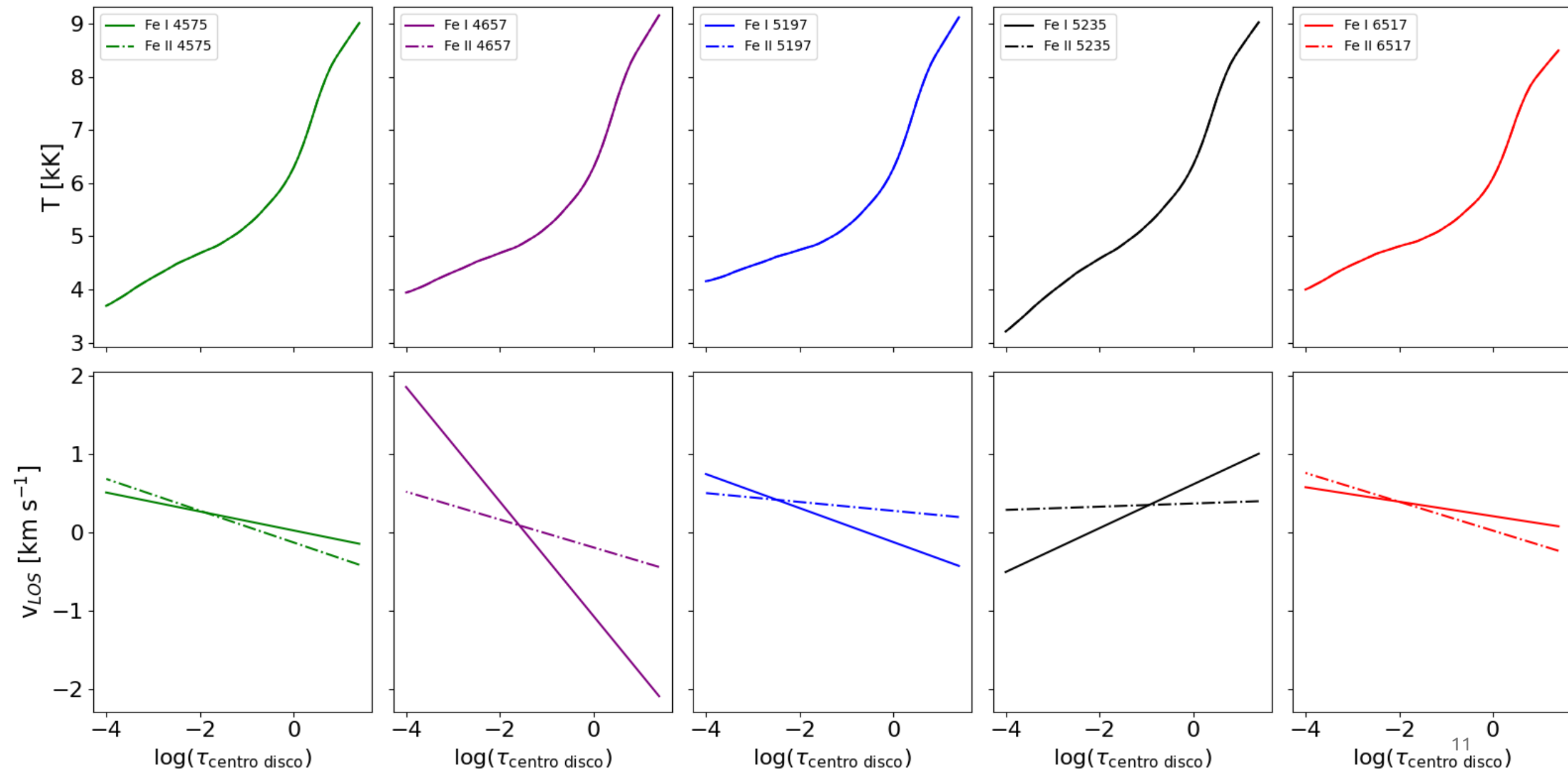
Metodología

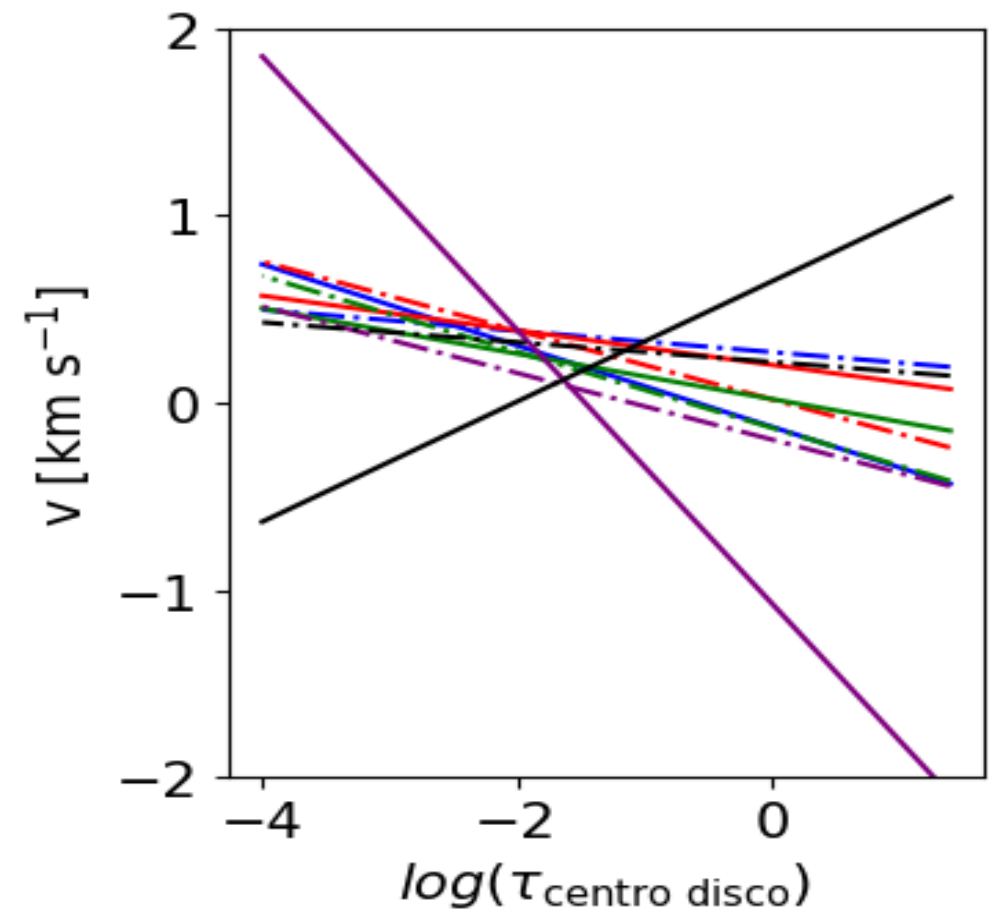
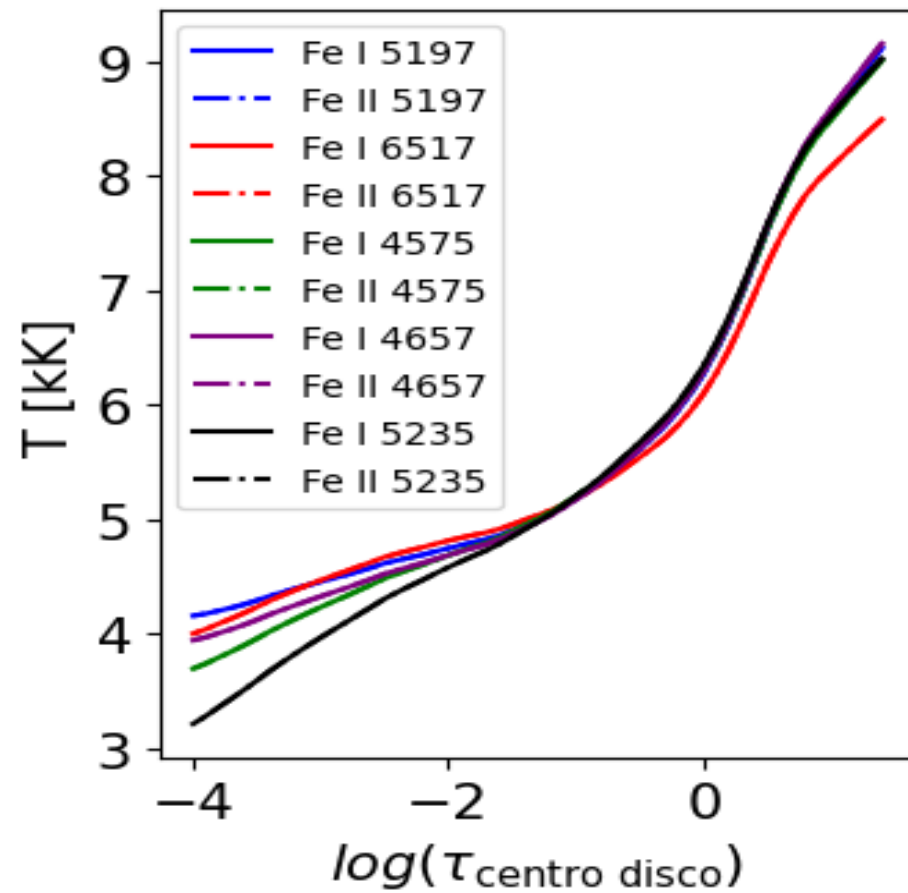
De las 10 regiones espectrales, solamente nos quedaron con 5 de ellas



Resultados:
sol en calma

Resultados: sol en calma





Conclusión:

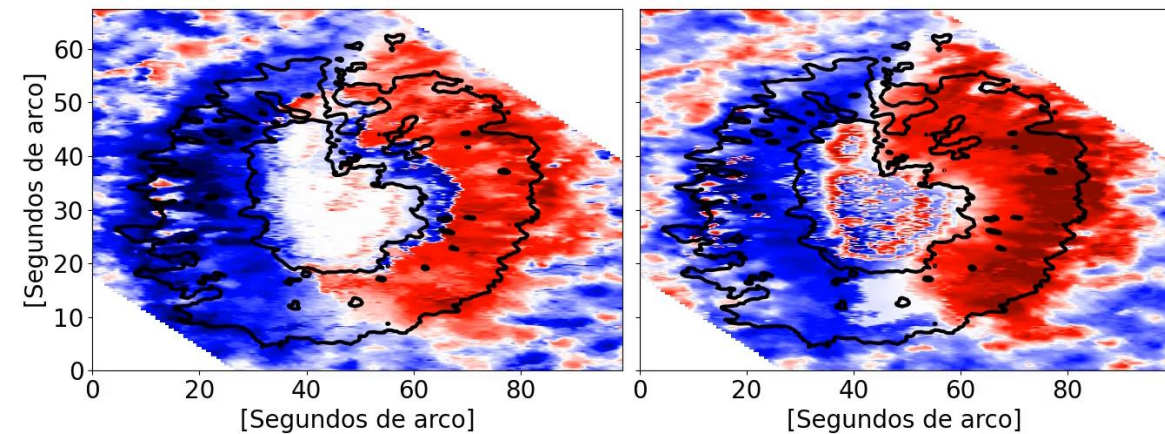
No se detecta velocidad de deriva entre iones y neutros debido a las incertidumbres de este trabajo

iones y neutros se comportan **igual** en el sol en calma

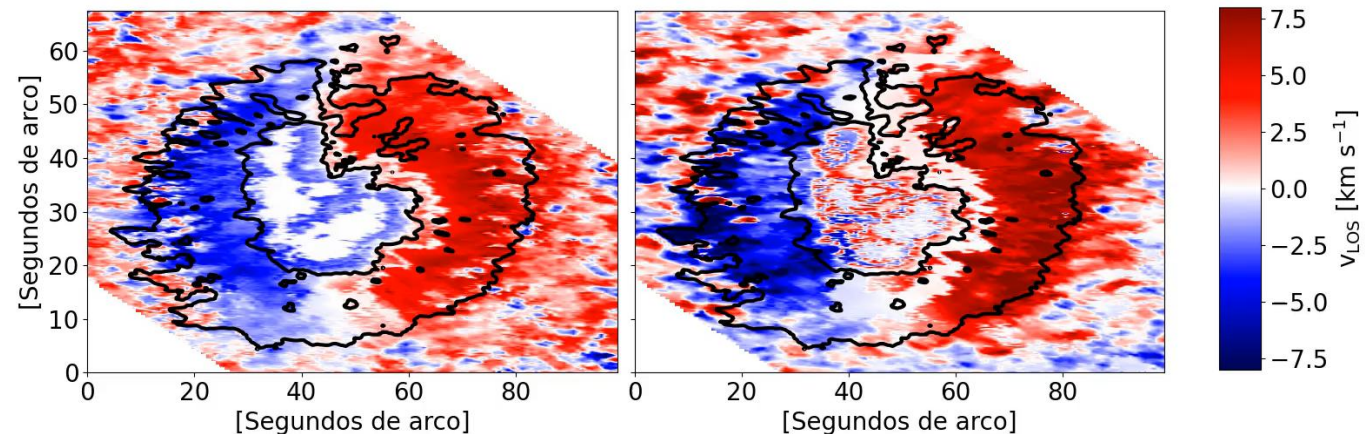
Resultados: penumbra

Resultados: penumbra

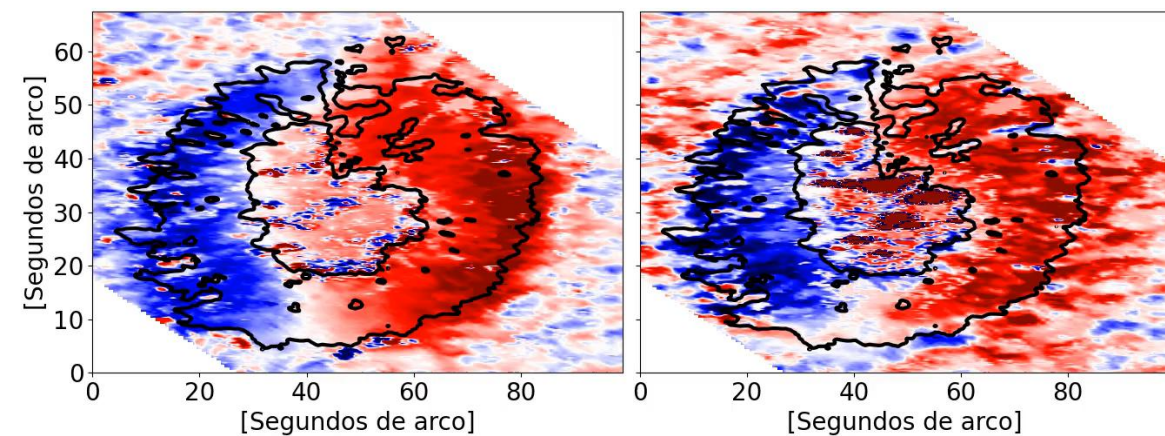
$$\log(\tau_{\text{centro disco}}) = 1.4$$



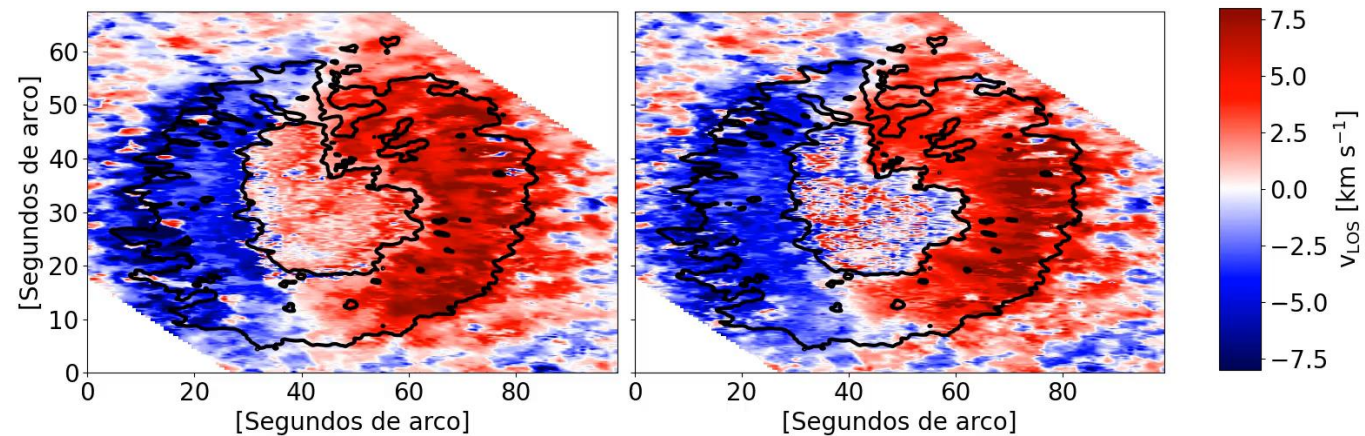
$$\log(\tau_{\text{centro disco}}) = 1.4$$



$$\log(\tau_{\text{centro disco}}) = 1.4$$

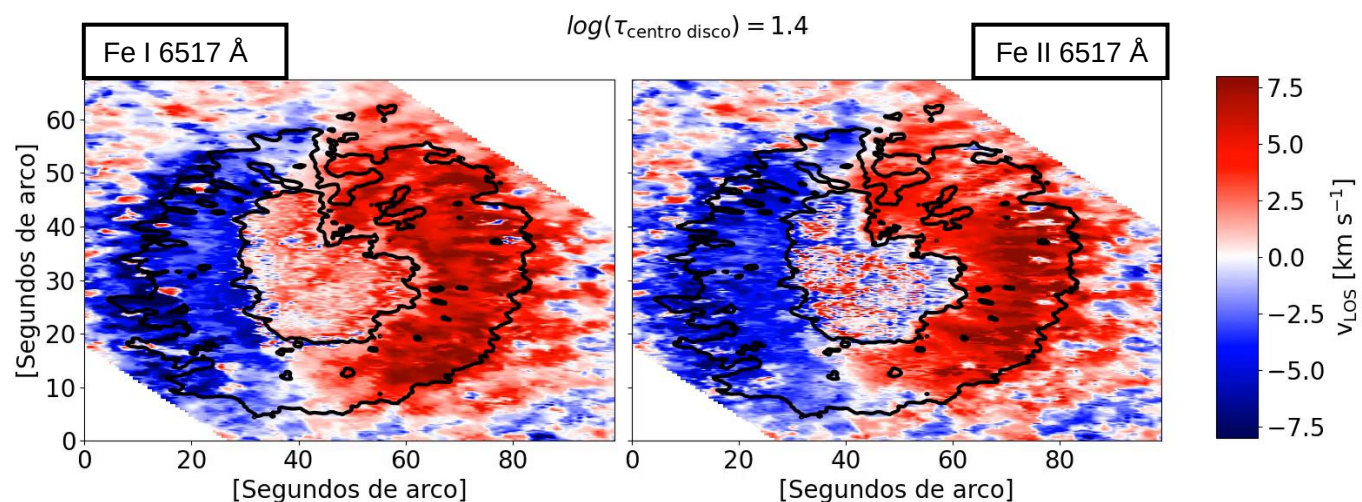
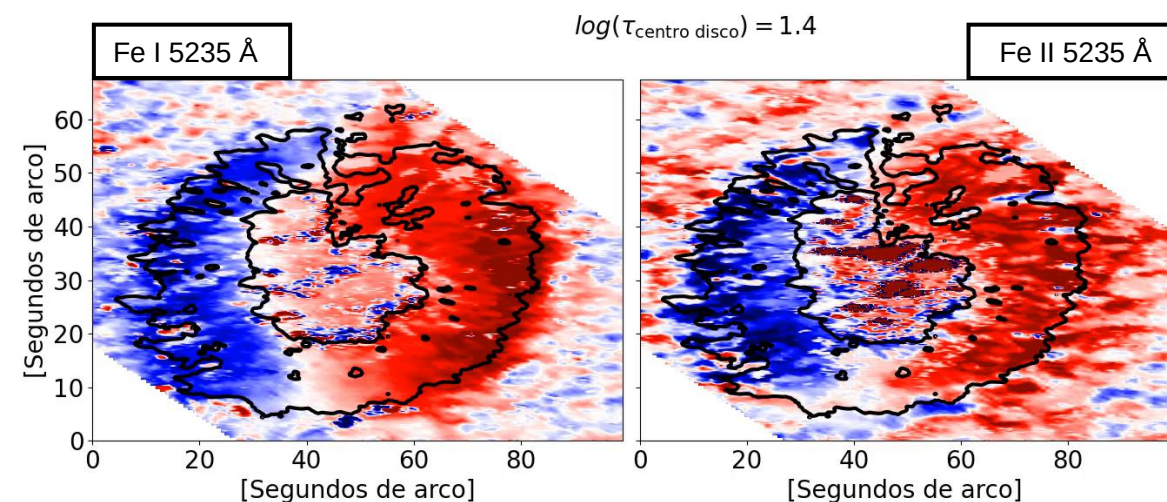
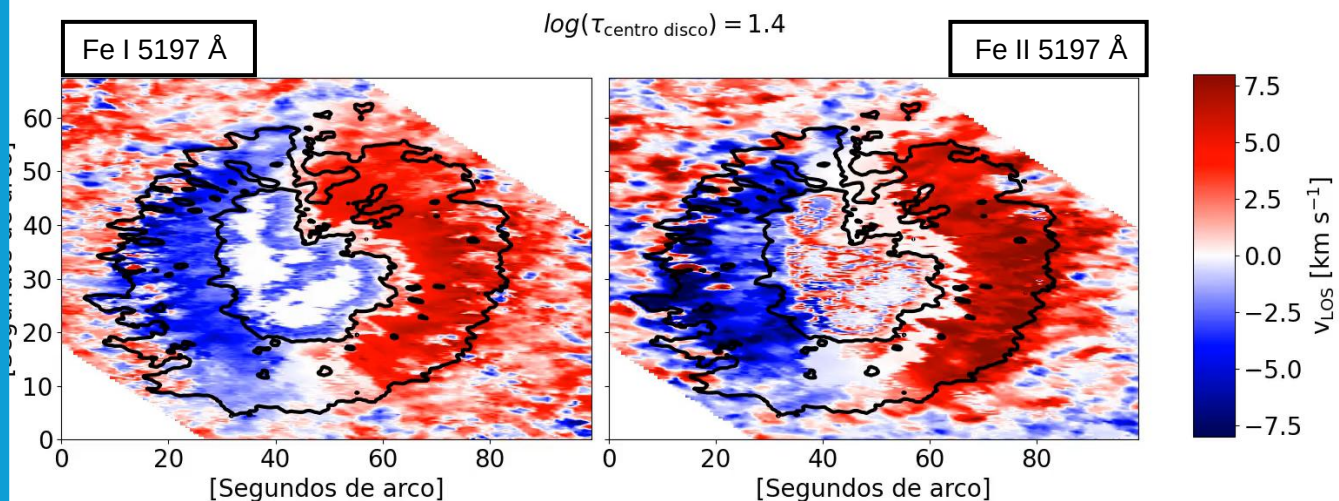
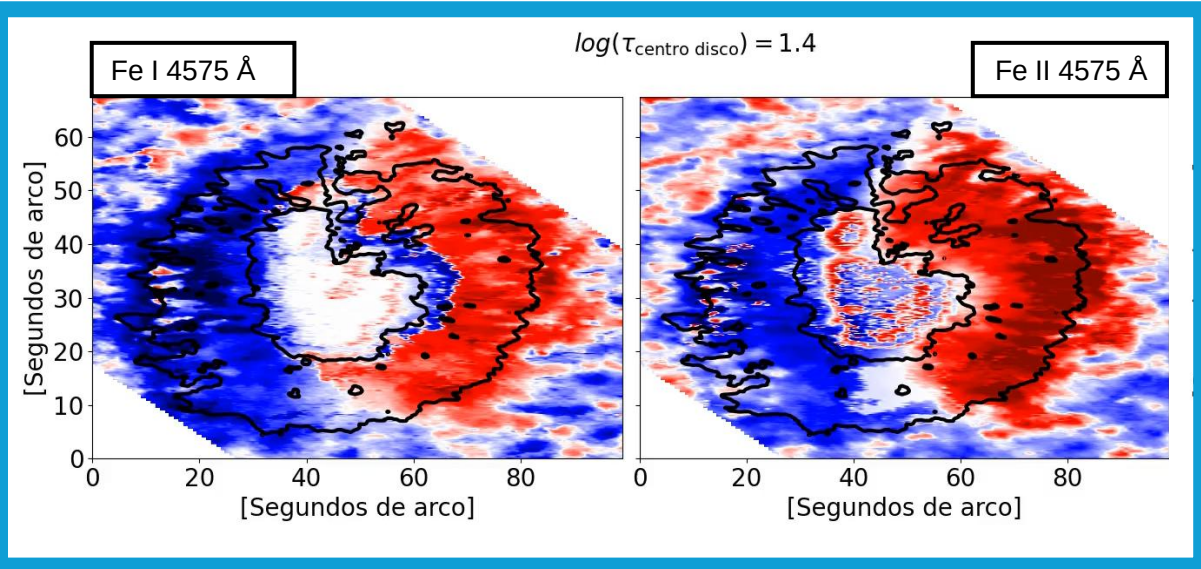


$$\log(\tau_{\text{centro disco}}) = 1.4$$



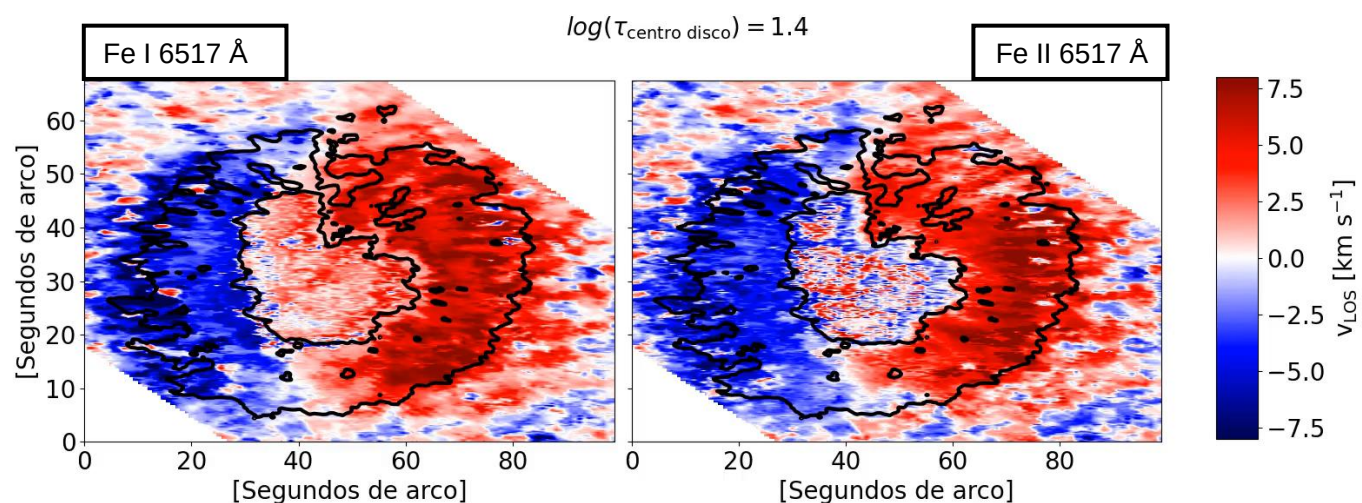
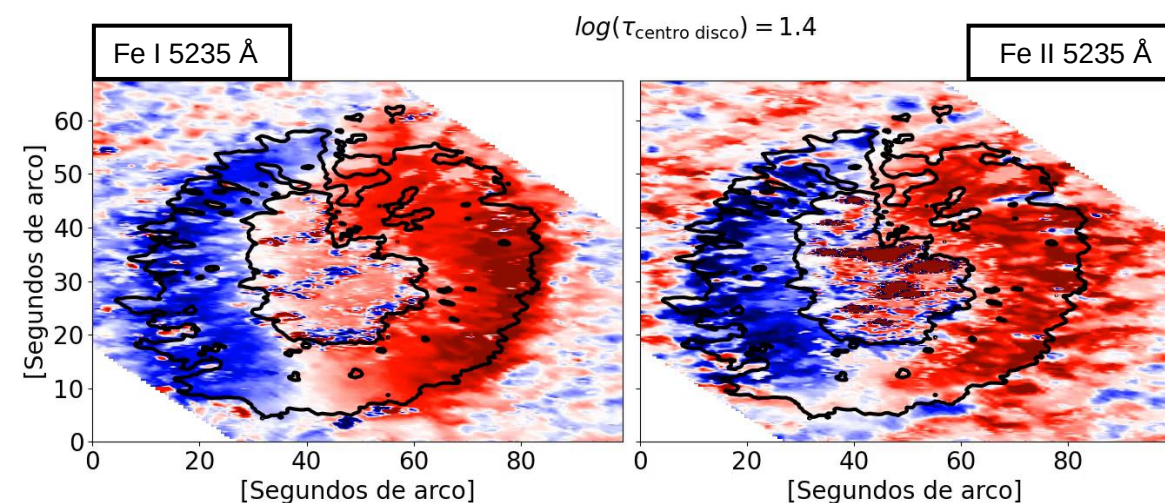
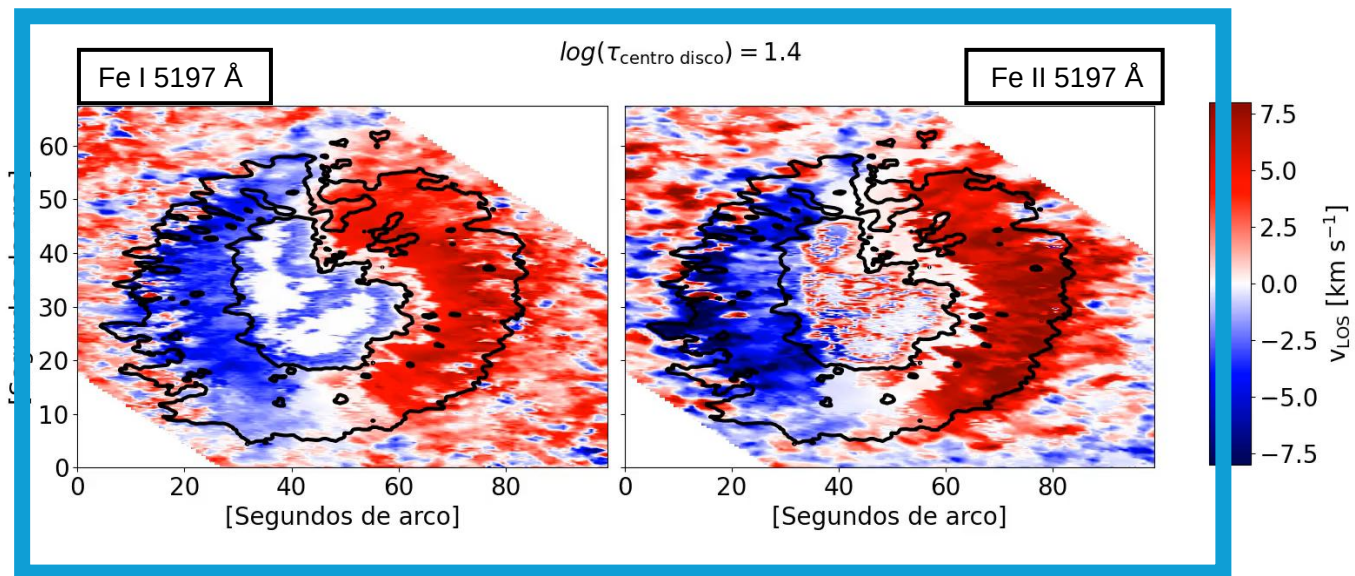
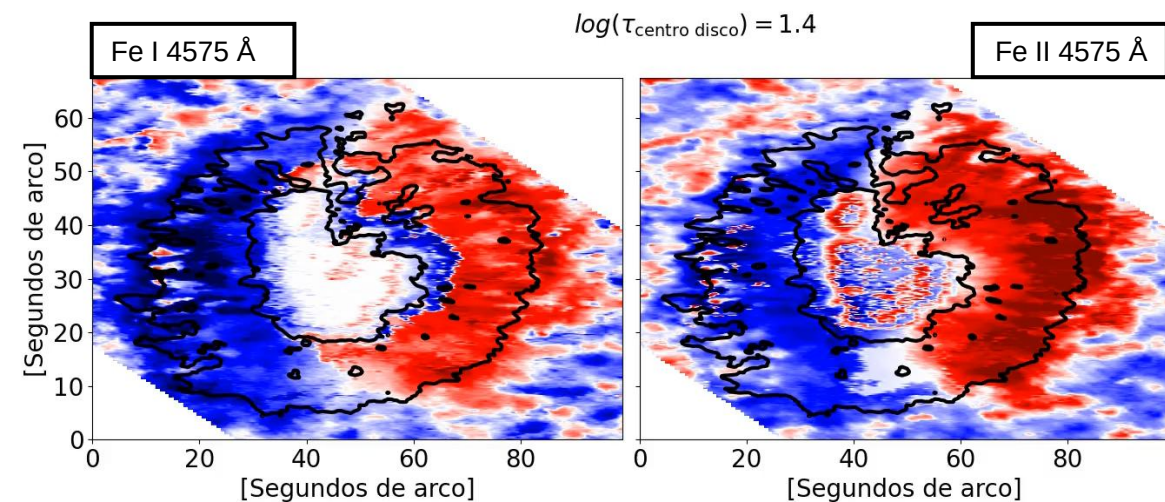
Resultados: penumbra

4575



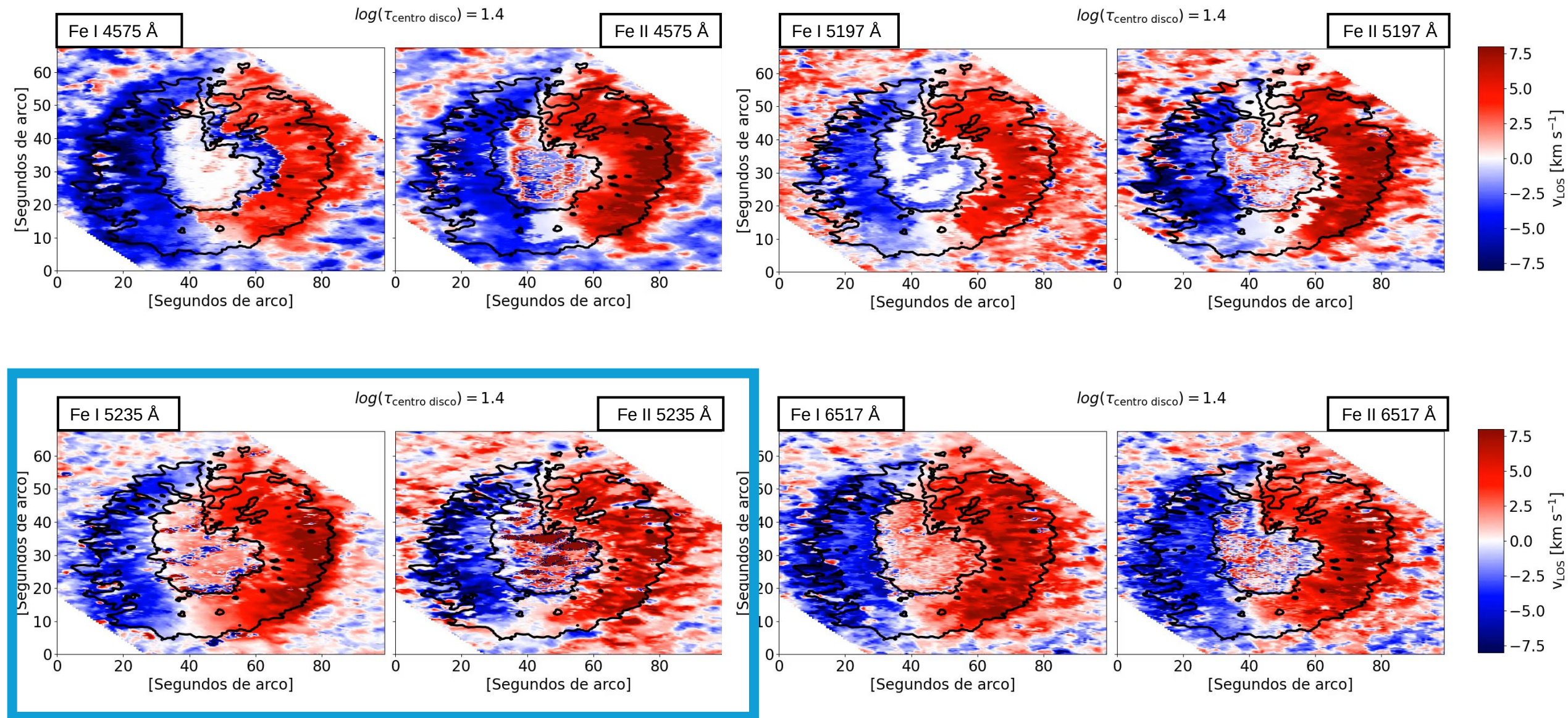
Resultados: penumbra

5197



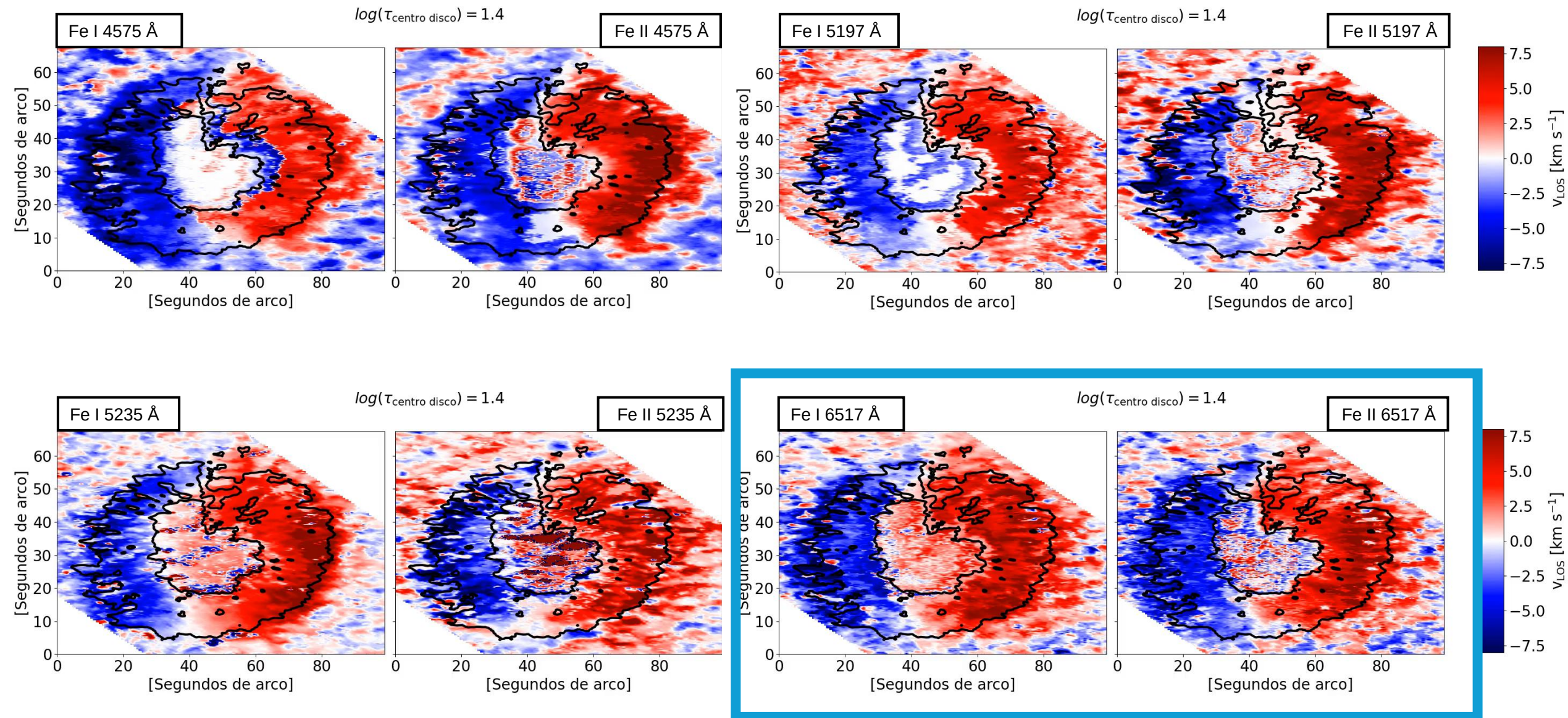
Resultados: penumbra

5235

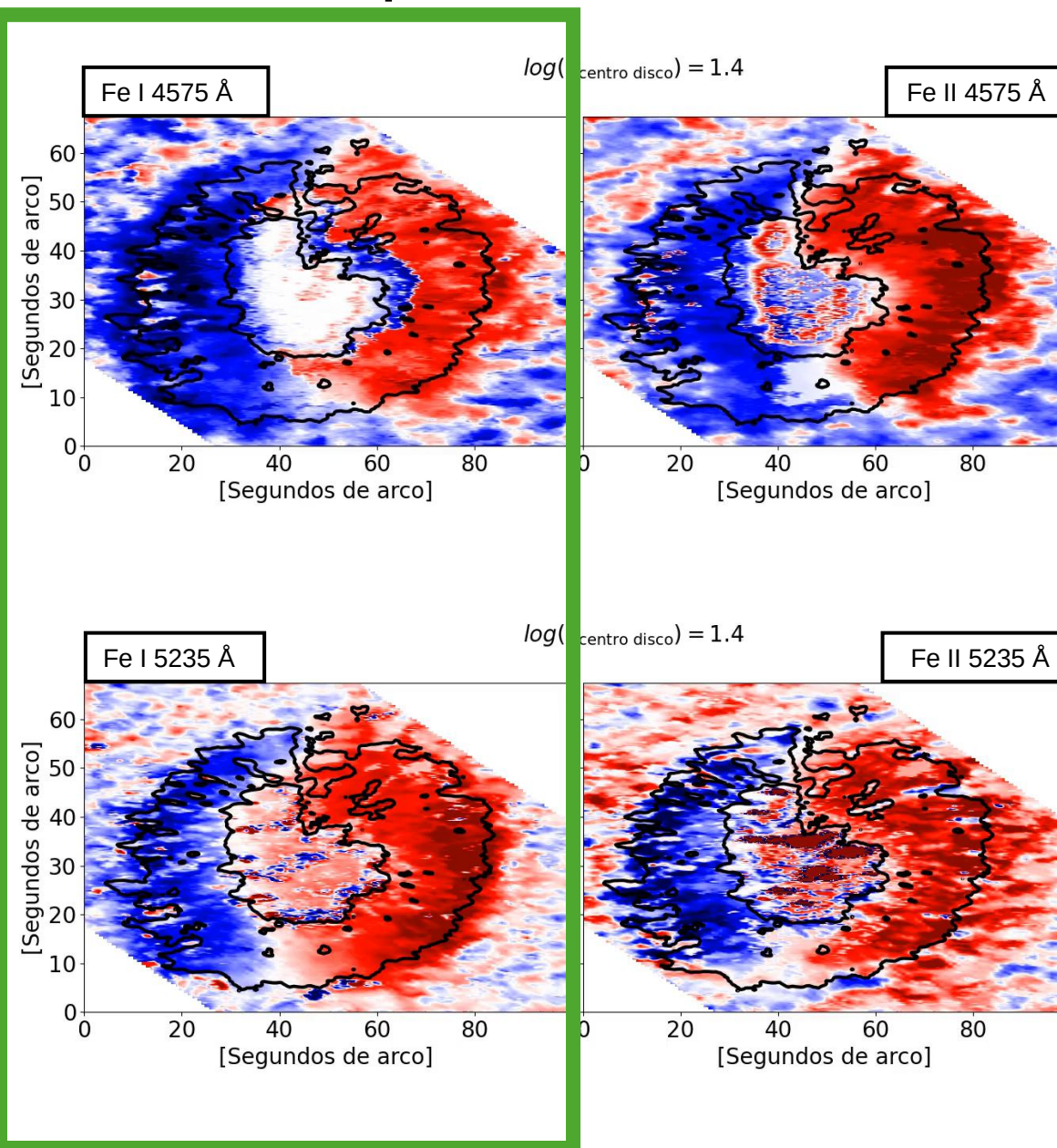


Resultados: penumbra

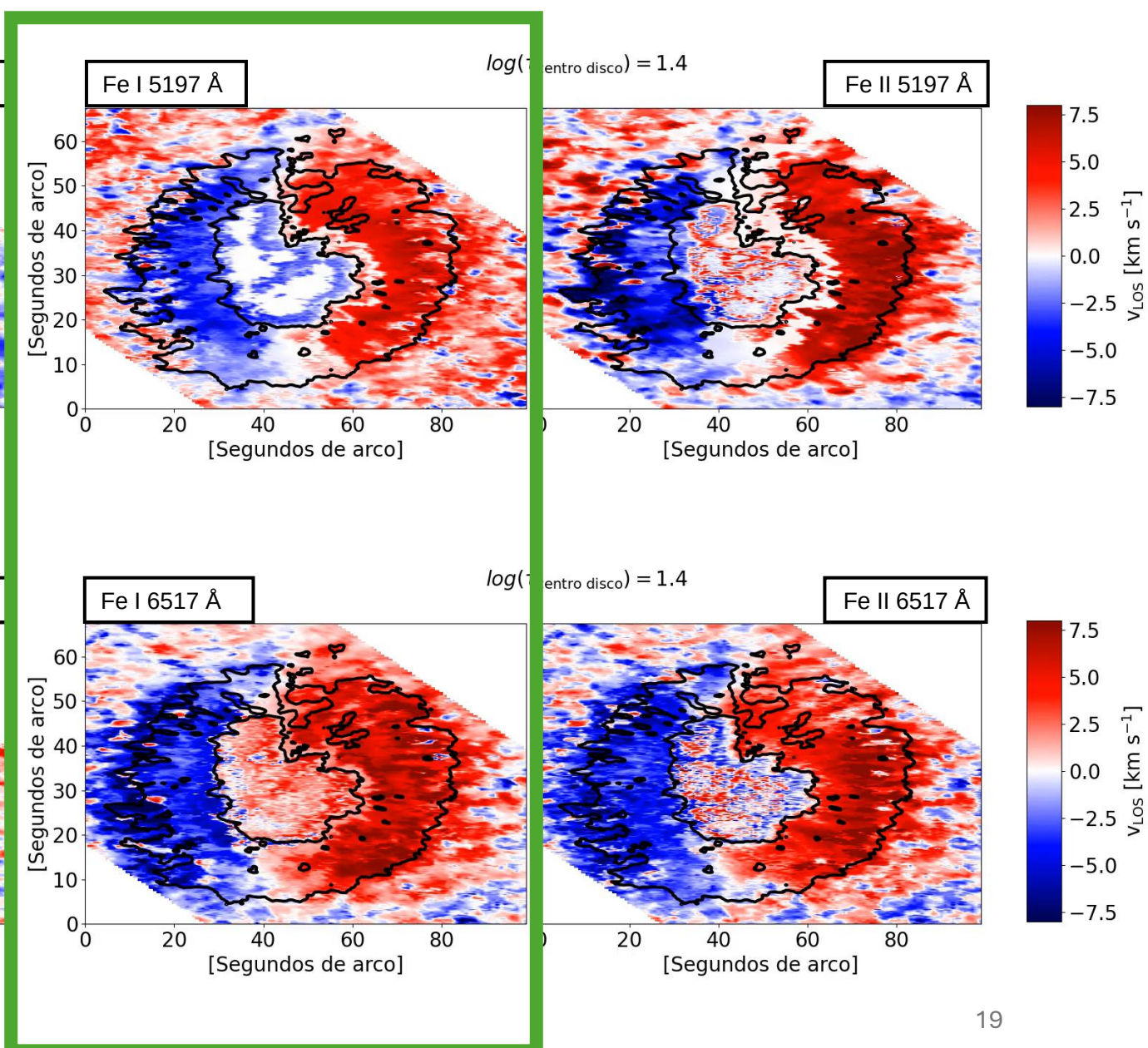
6517



Resultados: penumbra

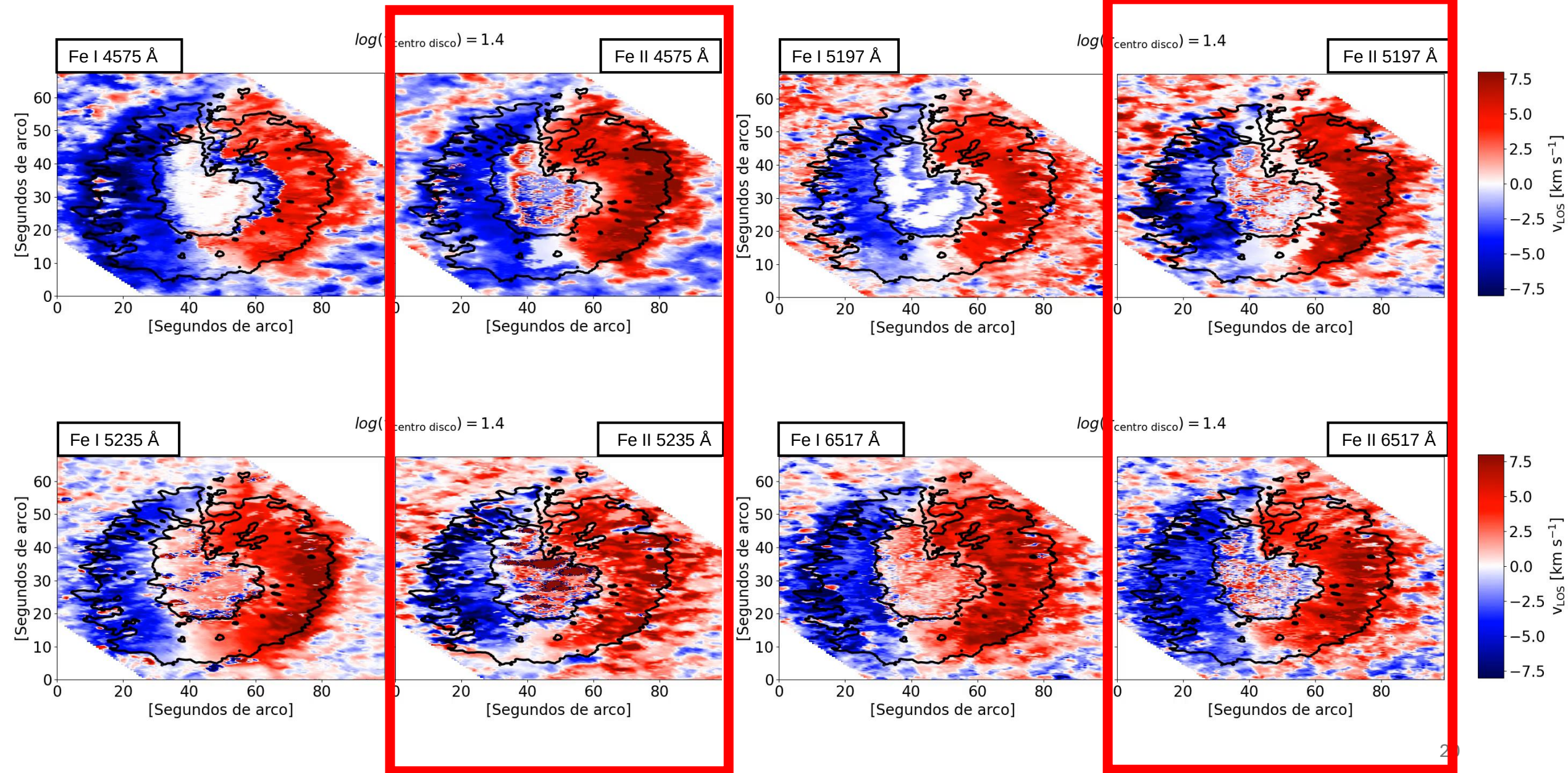


Neutros

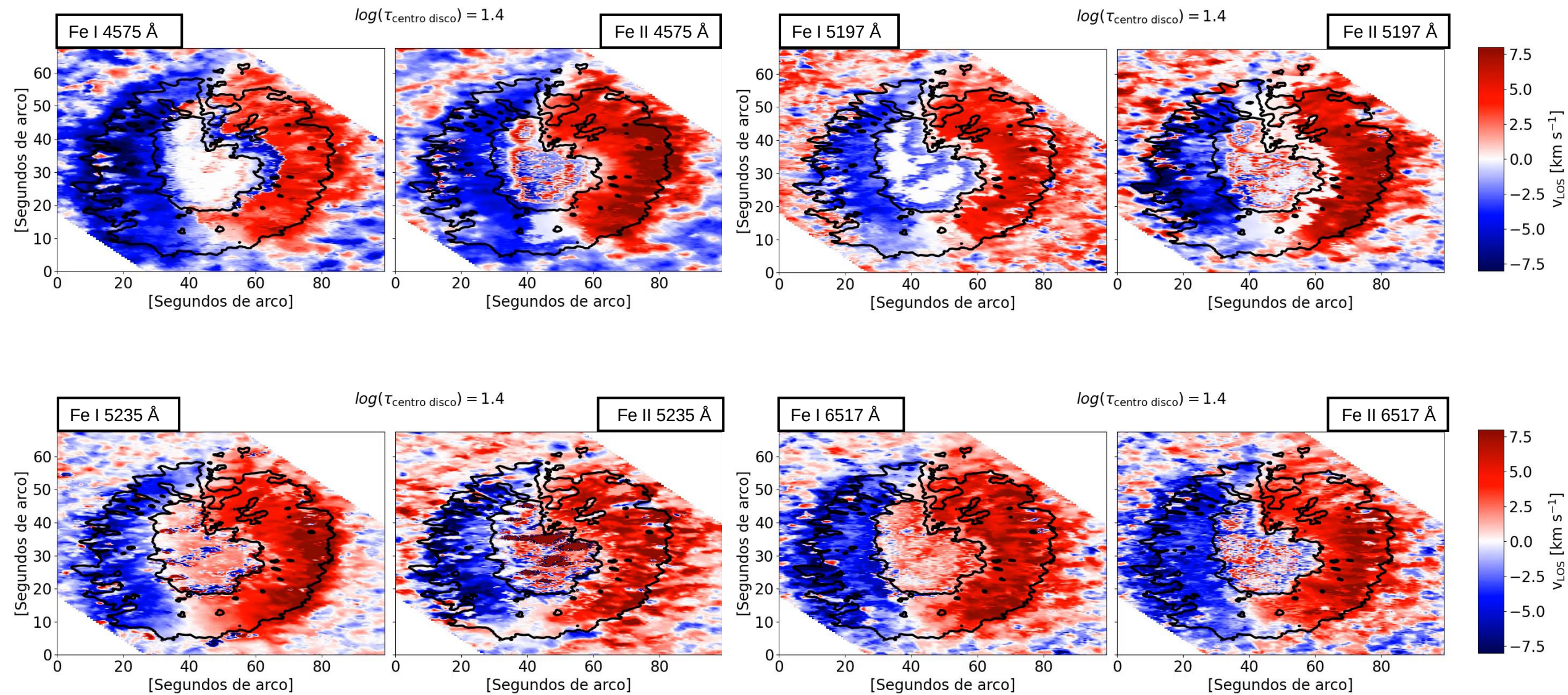


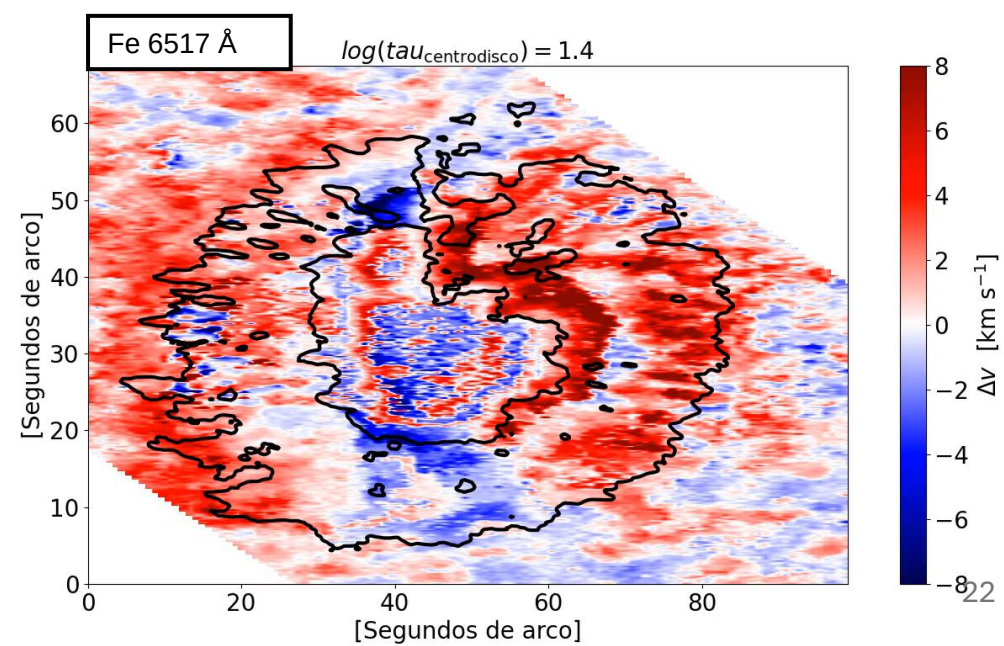
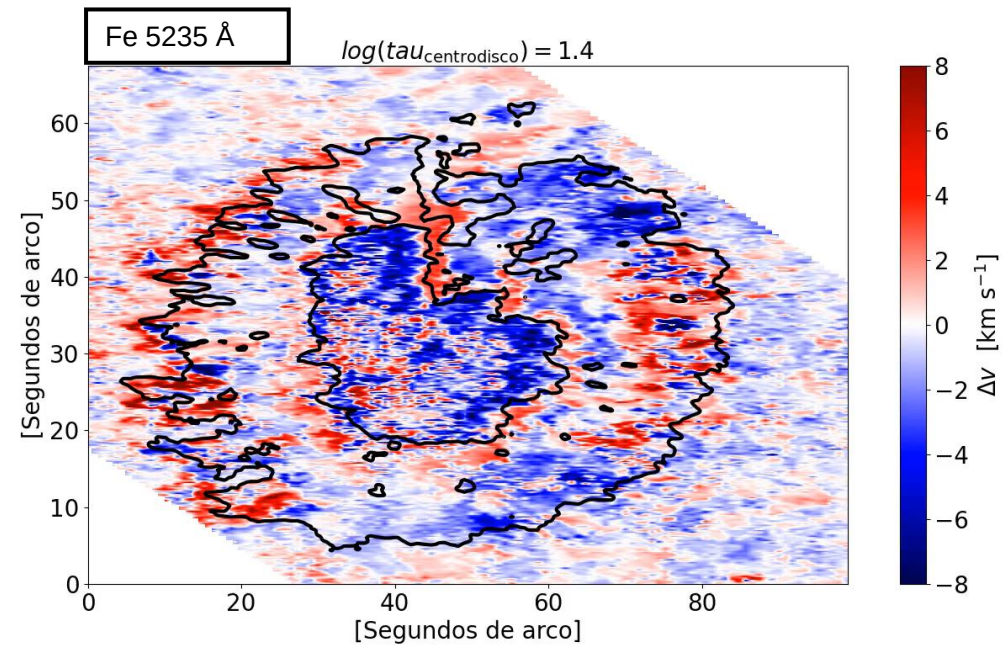
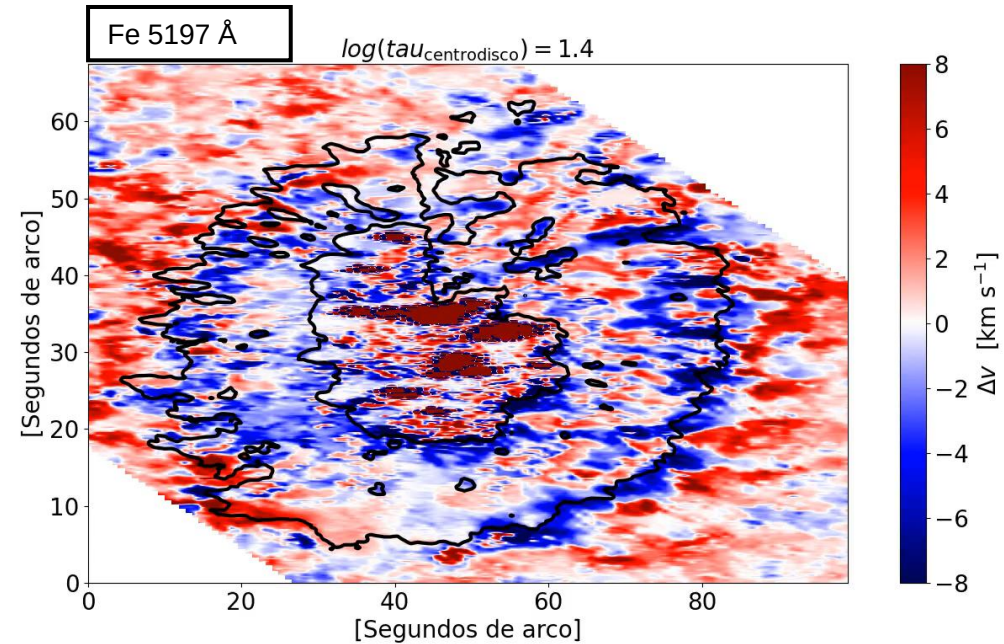
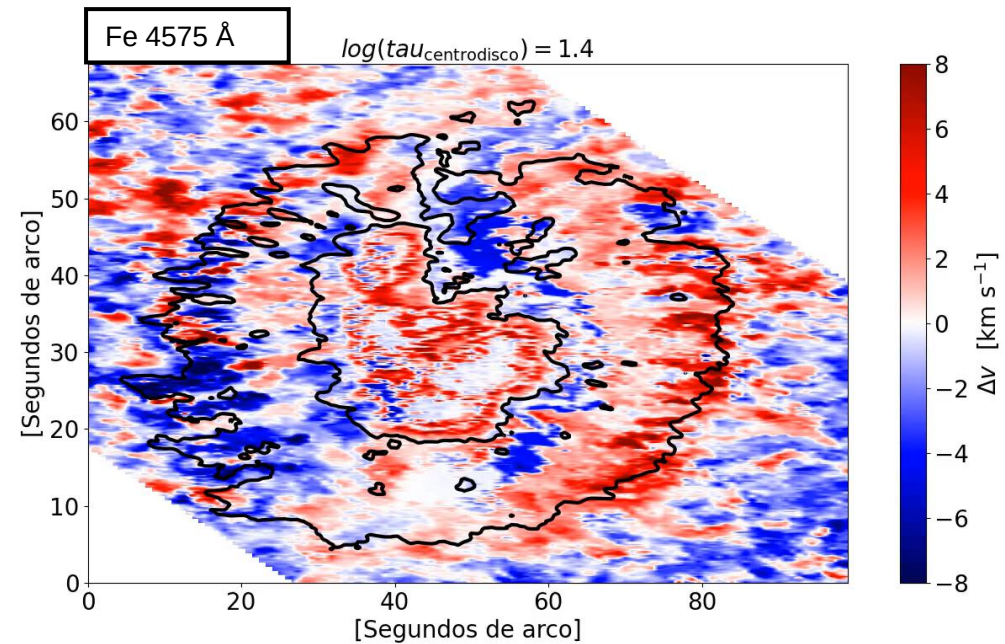
Resultados: penumbra

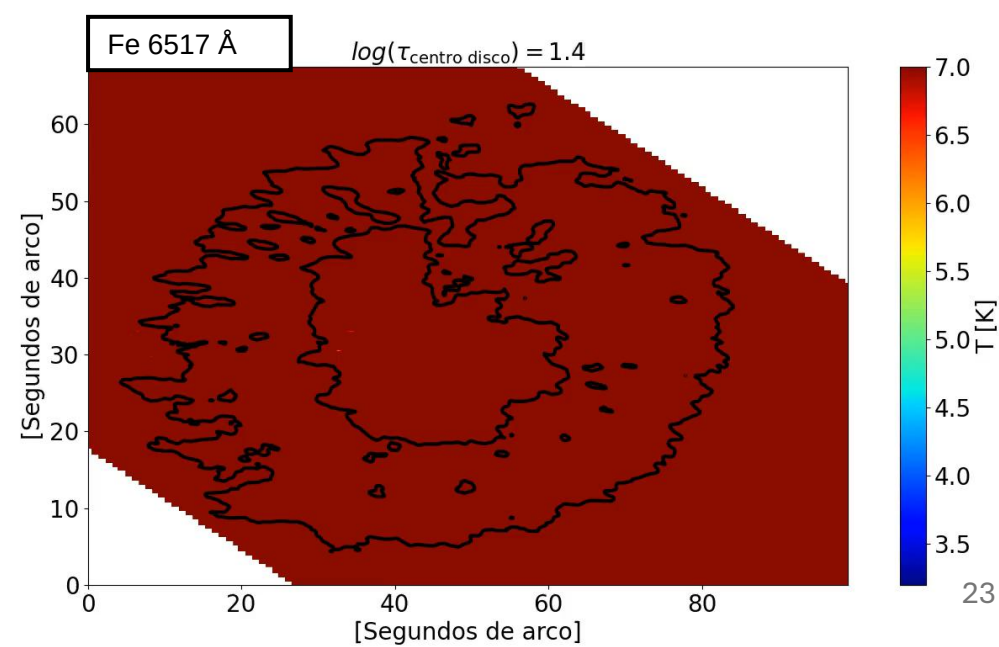
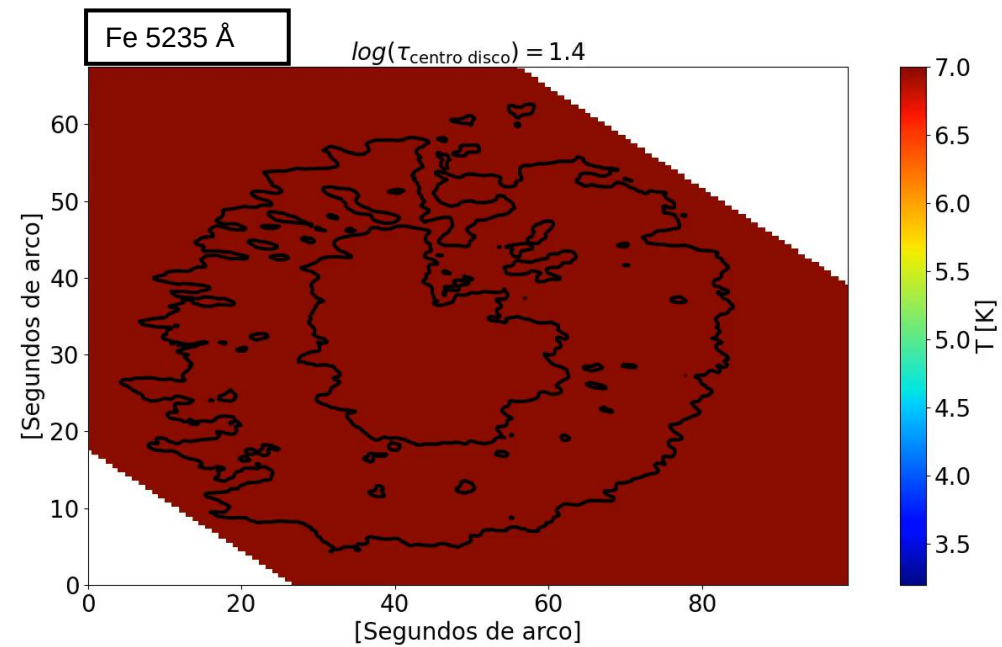
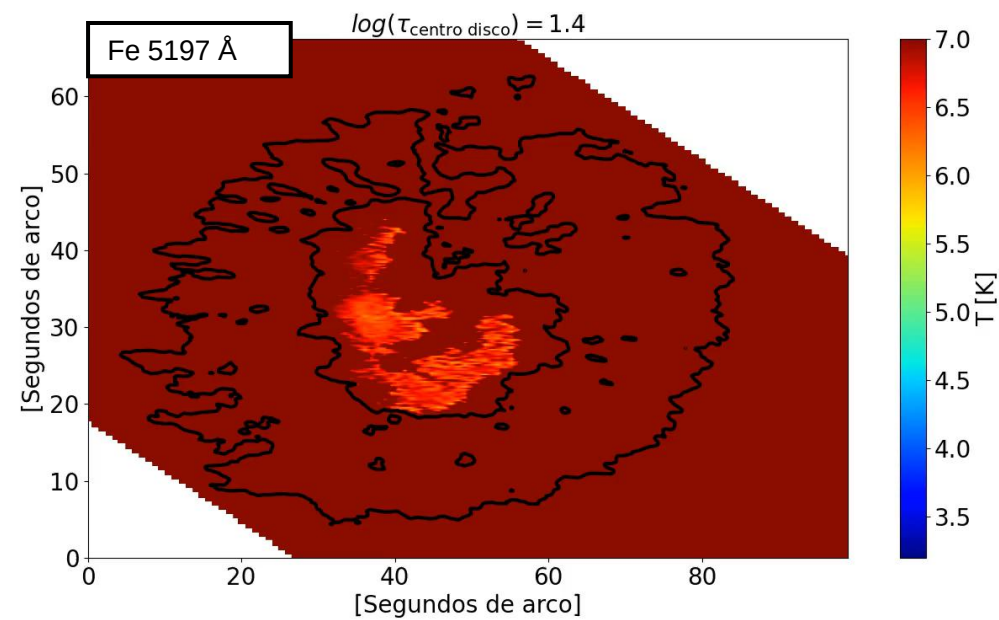
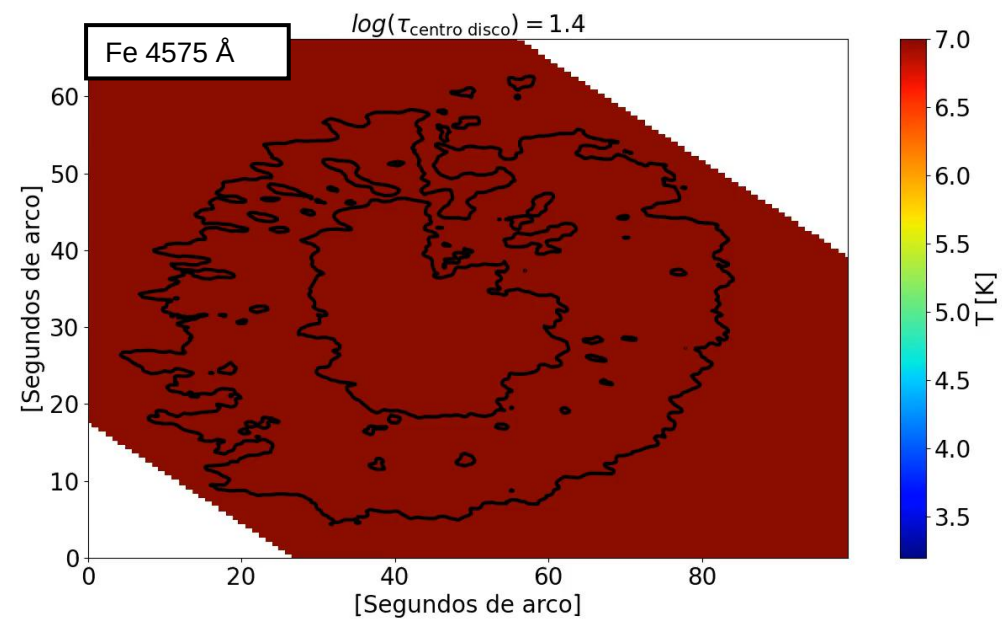
Iones



Resultados: penumbra







Bibliografía

Anan, T., Ichimoto, K., & Hillier, A. (2017). Differences between Doppler velocities of ions and neutral atoms in a solar prominence. *Å*, 601, A103. doi:10.1051/0004-6361/201629979

González Manrique, S. J., Khomenko, E., Collados, M., Kuckein, C., Felipe, T., & Gömöry, P. (2024). Two fluid dynamics in solar prominences. *Å*, 681, A114. doi:10.1051/0004-6361/202348119

Khomenko, E., Collados, M., Shchukina, N., Diaz, A. 2015, *A&A*, 584, A66

Khomenko, E., Collados, M., & Díaz, A. J. (2016). Observational Detection of Drift Velocity between Ionized and Neutral Species in Solar Prominences. *ApJ*, 823(2), 132. doi:10.3847/0004-637X/823/2/132

Wiehr, E., Stellmacher, G., & Bianda, M. (2019). Evidence for the Two-fluid Scenario in Solar Prominences. *ApJ*, 125. doi:10.3847/1538-4357/ab04a4

Wiehr, E., Stellmacher, G., Balthasar, H., & Bianda, M. (2021). Velocity Difference of Ions and Neutrals in Solar Prominences. *ApJ*, 47. doi:10.3847/1538-4357/ac1791

Bibliografía (2)

Videezy.com

<https://www.freepik.es>

Vídeo de "https://pixabay.com/es/users/javier_rtg-16842455/ de Javier Roca de Togores Ginestar

GIF de <https://pixabay.com/es/users/editiox-6398285> de David Montero

Créditos de la imagen de la imagen de la portada: NSO/AURA/NSF

Imagen sol en calma diapositiva3: <https://www.britannica.com/science/sunspot/additional-info>

Imagen protuberancia diapostiva 3: (<https://sdo.gsfc.nasa.gov/gallery/main>)

Conclusiones

- 1) No hay diferencia de velocidad en el sol en calma
- 2) Los neutros tienen más velocidad que los iones para las alturas fotosféricas en la penumbra
- 3) Como consecuencia, el flujo Evershed revierte en capas más altas para los neutros que para los iones
- 4) Se comprueba el resultado de Khomenko et al. 2015
- 5) La tendencia se repite para todas las regiones espectrales