

Ion-neutral decoupling deduced from prominence spectral observations

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Aims:

- (1) **Multi-fluid effects** in partially ionized prominence plasma are predicted by MHD models
- (2) Multi-fluid effects can manifest as **ion-neutral decoupling**
- (3) Ion-neutral decoupling can be observed as **Doppler velocity discrepancy (drift)** between ions and neutrals

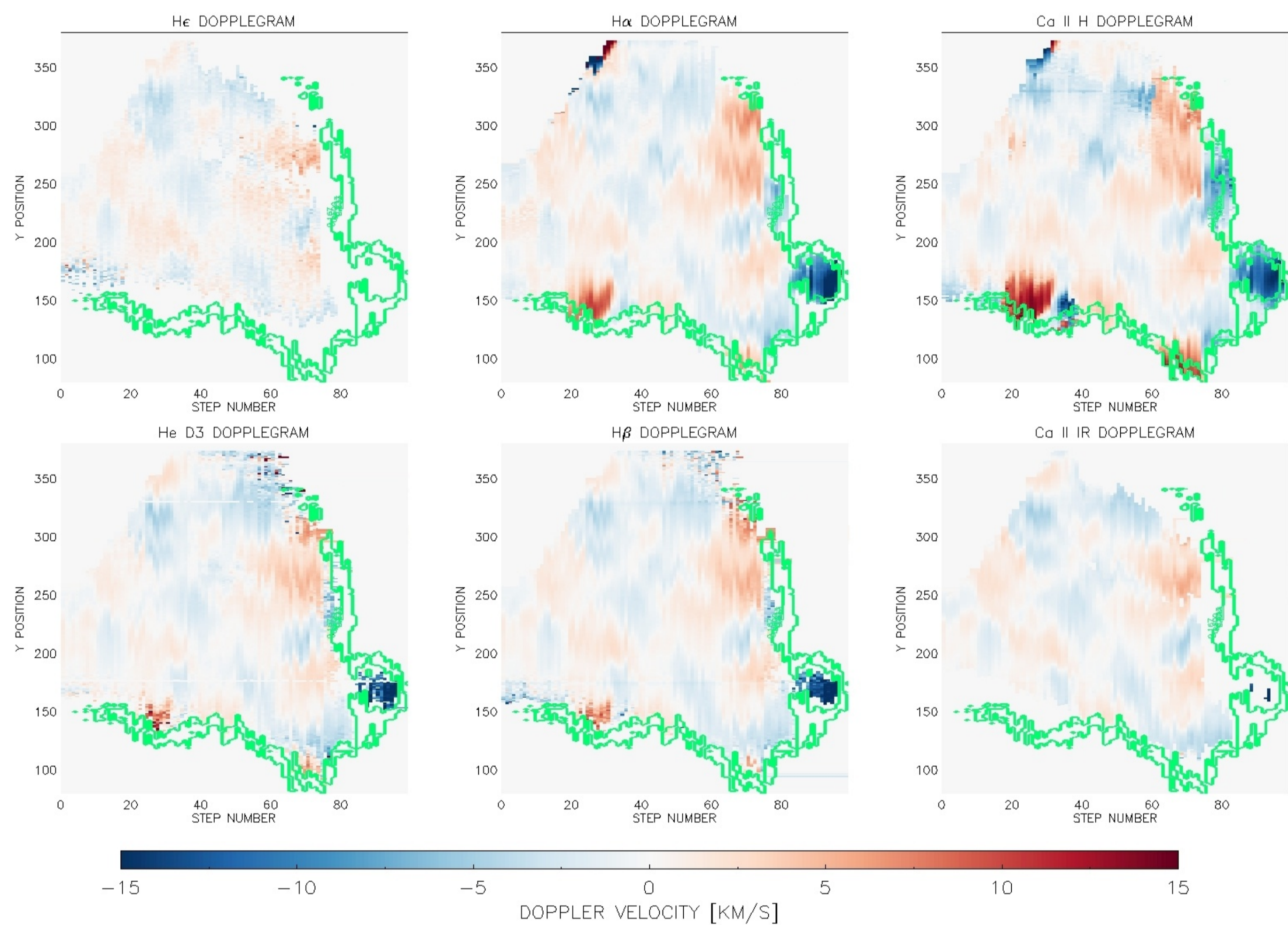
Conclusions:

- (1) **Drift of 1.7 km/s** detected between Ca II H ion line and H α , H β , and He D3 neutral lines is interpreted as **ion-neutral decoupling**
- (2) Detected **drift** is of **local** nature, present in prominence edges as predicted by multi-fluid MHD models
- (3) Our result is the another contribution to **controversial** problem of the detection of **multi-fluid effects** in solar prominences

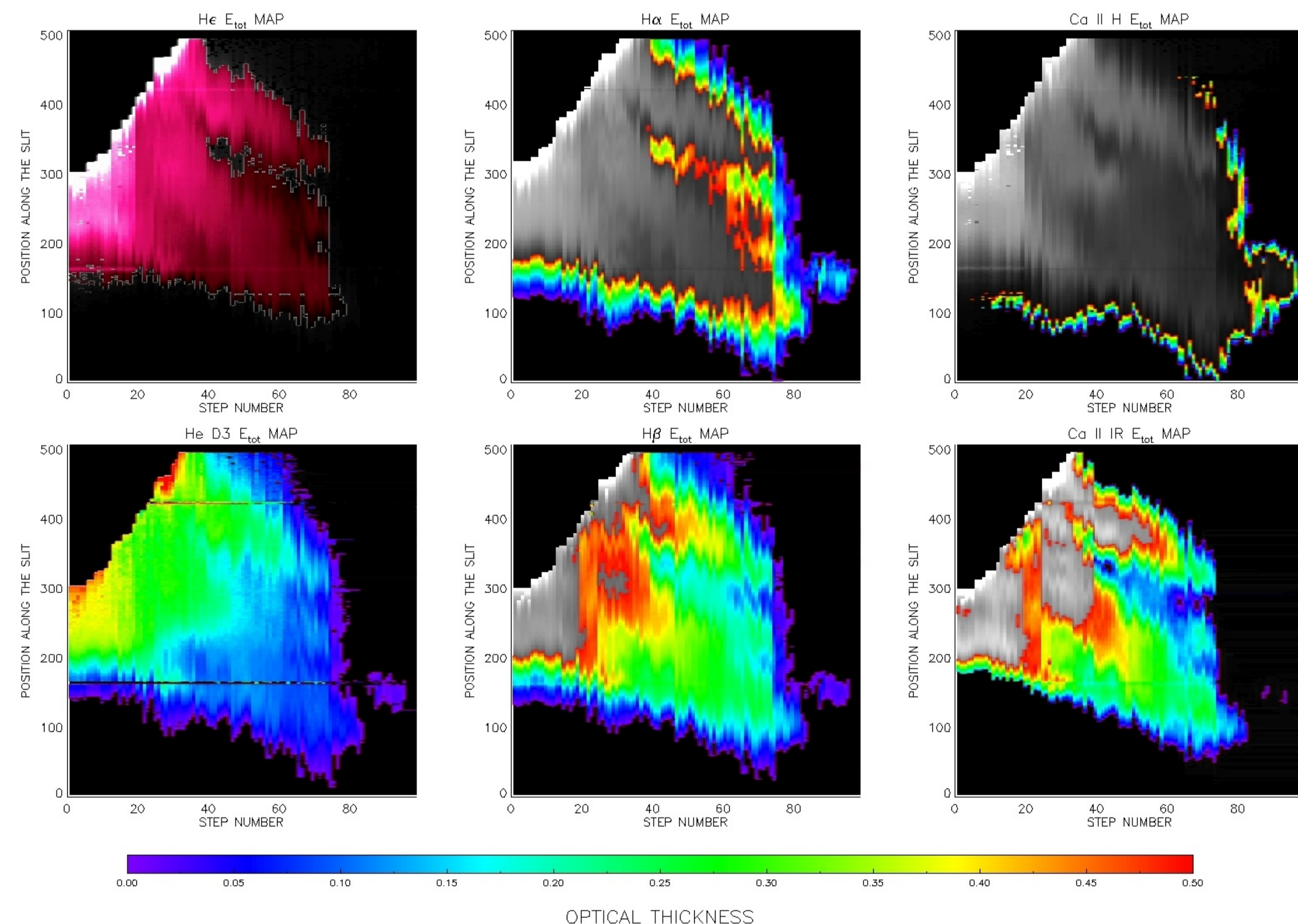
References: Zapiór, Heinzel, and Khomenko *Doppler-velocity Drifts Detected in a Solar Prominence* ApJ 934, 16 (2022)



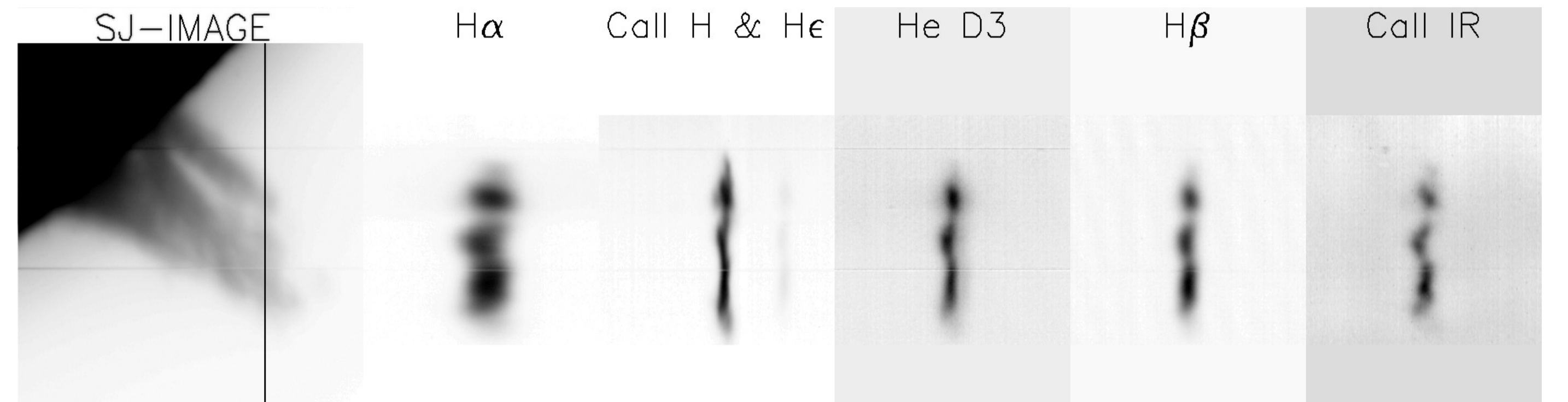
HSFA-2 solar spectrograph fed by 50-cm coelostat in Ondřejov Observatory.



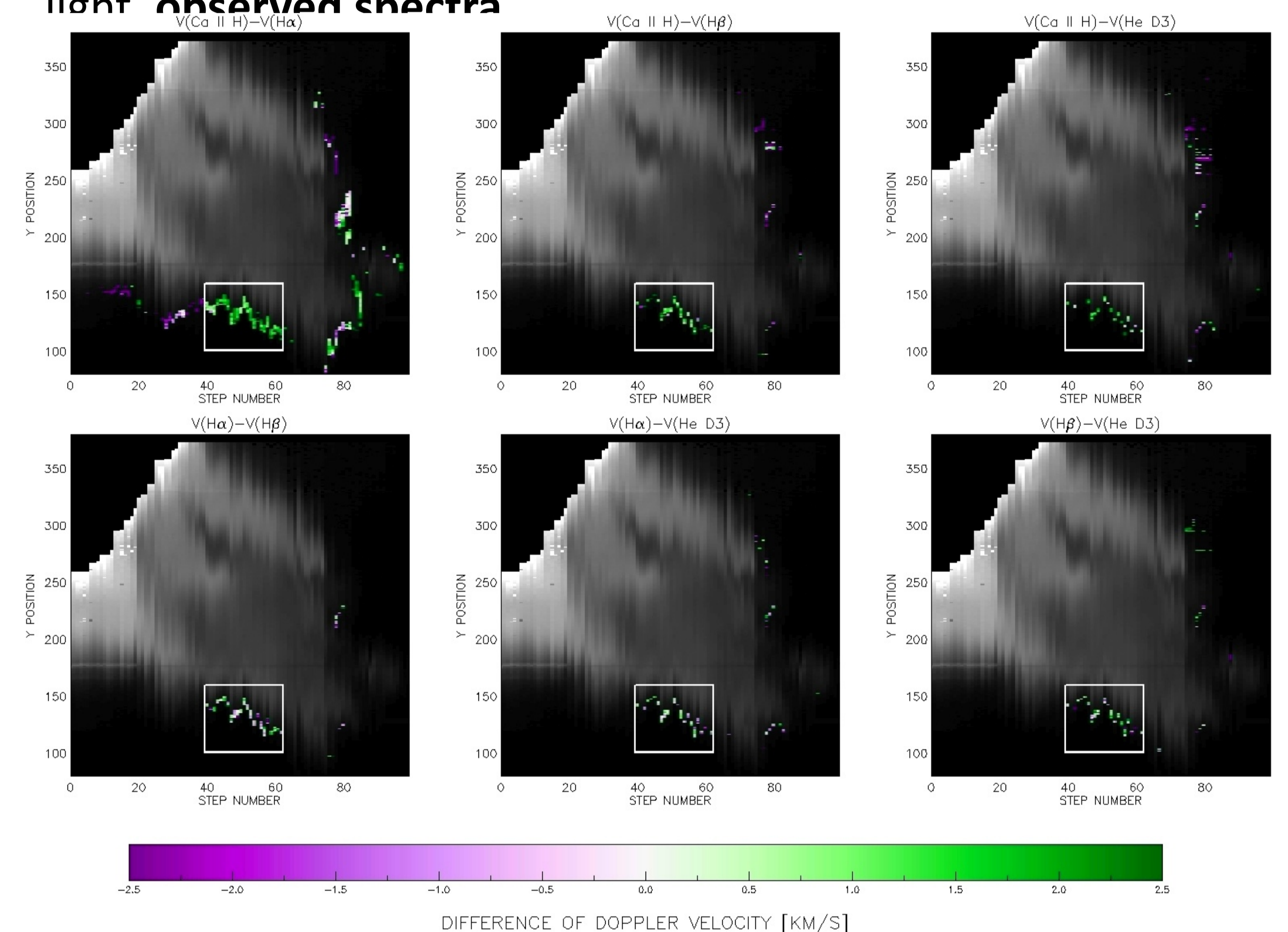
Dopplergrams calculated for data points in the observed prominence of August 26, 2011 in all the observed spectral lines. Color bar gives the value of the Doppler velocity. Green contours limit optically thin regime area, where $\tau(\text{Ca II H}) < 0.5$.



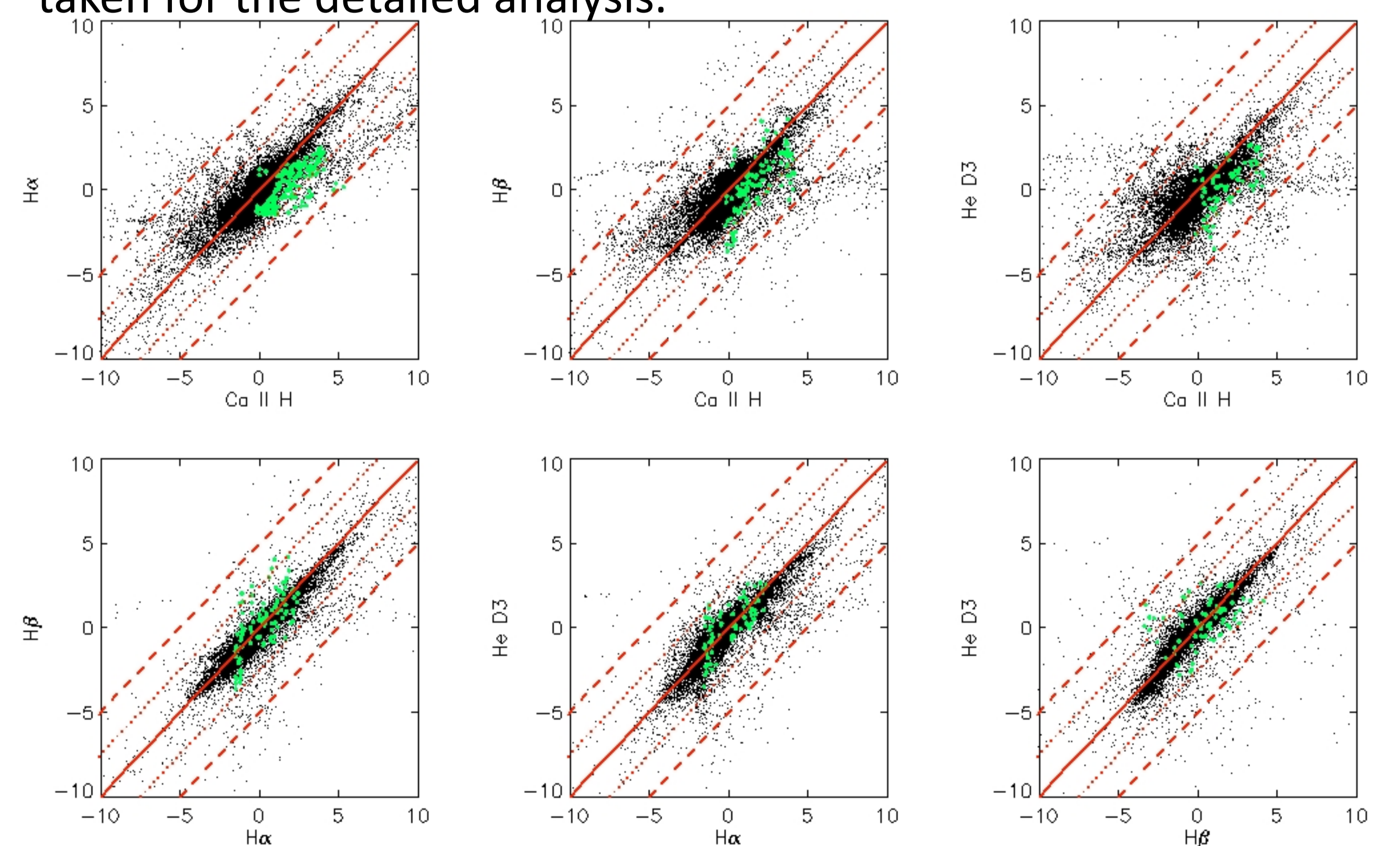
Integrated intensity maps derived from individual spectra for all positions along the slit and for all scans. Color scale gives the value of optical thickness (τ). Areas presented with gray scale have $\tau > 0.5$. For H ϵ line we have no data of τ , so the map is shown in purple color scale.



An example of the H α **slit-jaw image** of the observed prominence along with co-aligned, reduced, free from scattered light **observed spectra**



Maps of the **drift velocity** for the selected pixels. Colors represent the difference of the Doppler velocities measured in the considered lines. The color bar gives the velocity scale. Green rectangle shows the data points in optically thin regime taken for the detailed analysis.



Scatter plots of the **Doppler velocities**. Black points represent all data points in the whole prominence body. Green points show the Doppler data from the analyzed area. Labels show the considered lines. Axes are scaled in km/s. Solid red lines represent no drift, dotted lines net drift equal 2.5 km/s and dashed lines 5 km/s.