Rosseland Centre for Solar Physics

Diagnostic potential of Hε for small-scale energetic phenomena

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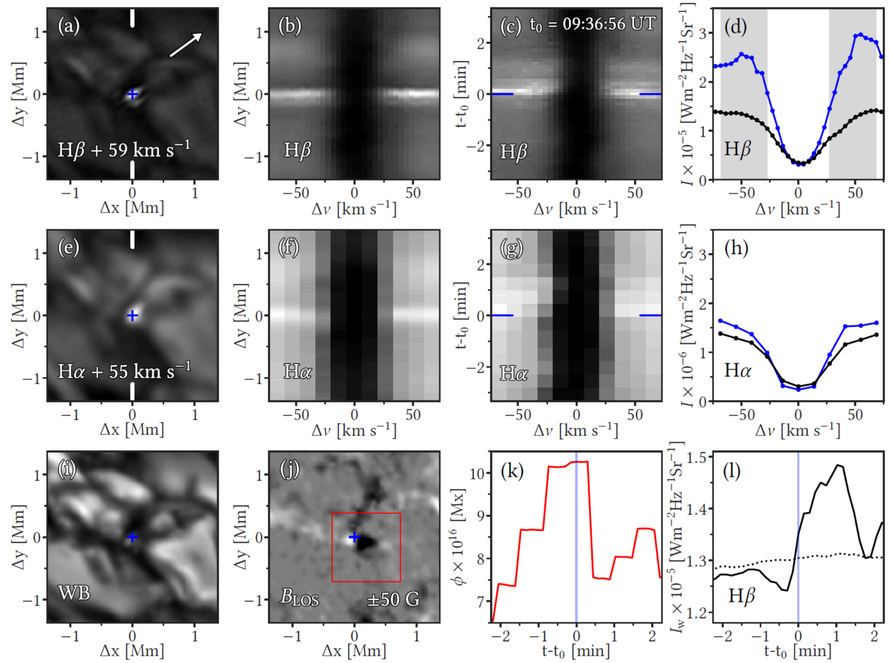
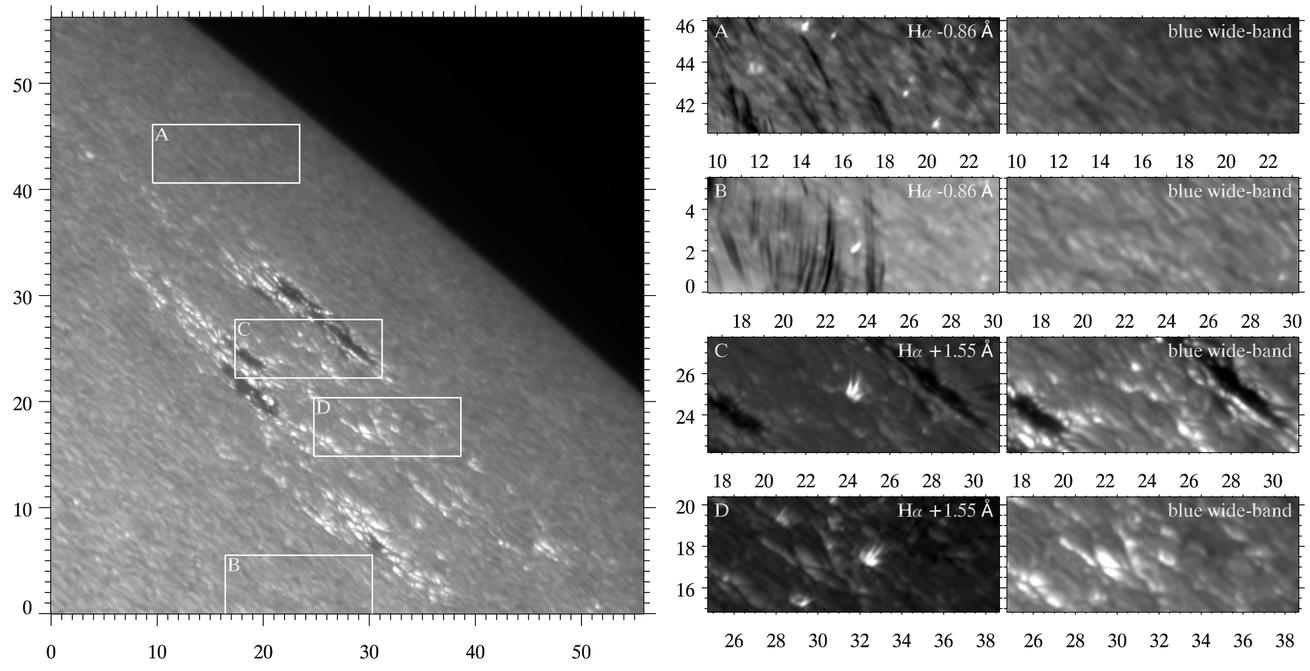
Motivation

- Diagnostic tool for small-scale reconnection in the deep solar atmosphere:
  - “Ellerman bombs” (EBs)
  - “Quiet Sun Ellerman-like brightenings” (QSEBs)



Joshi et al. 2020



Rouppe van der Voort et al. 2016

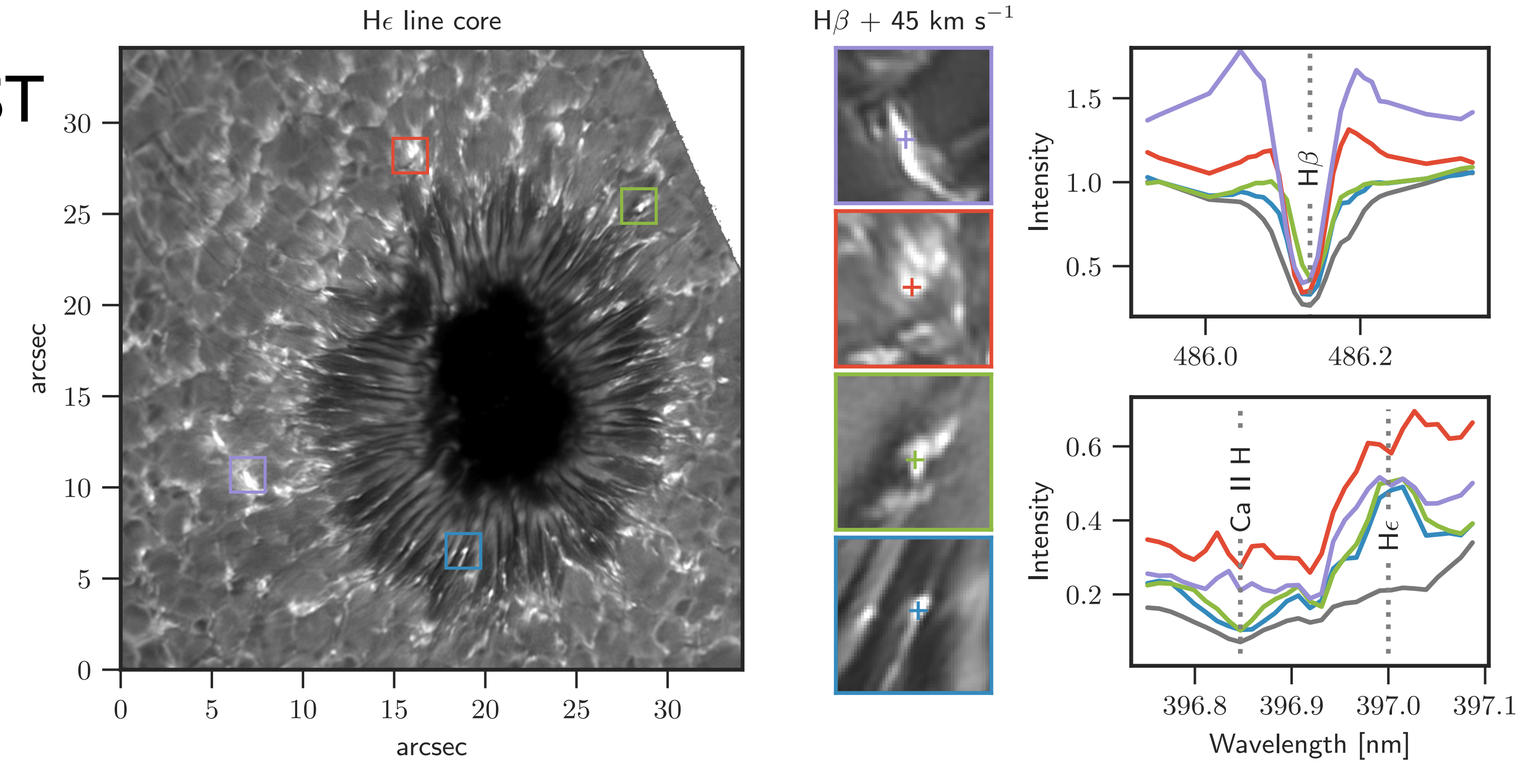
Why do we think that Hε line would be a good diagnostic tool ?

Why Hε ?

- Higher order lines of the Balmer series
  - Higher spatial resolution
  - Enhanced contrast
  - Possible to observe with SST

We are especially interested when Hε goes into emission!

- Hε is sensitive to the chromospheric temperature rise (Ayres et al. 1976)



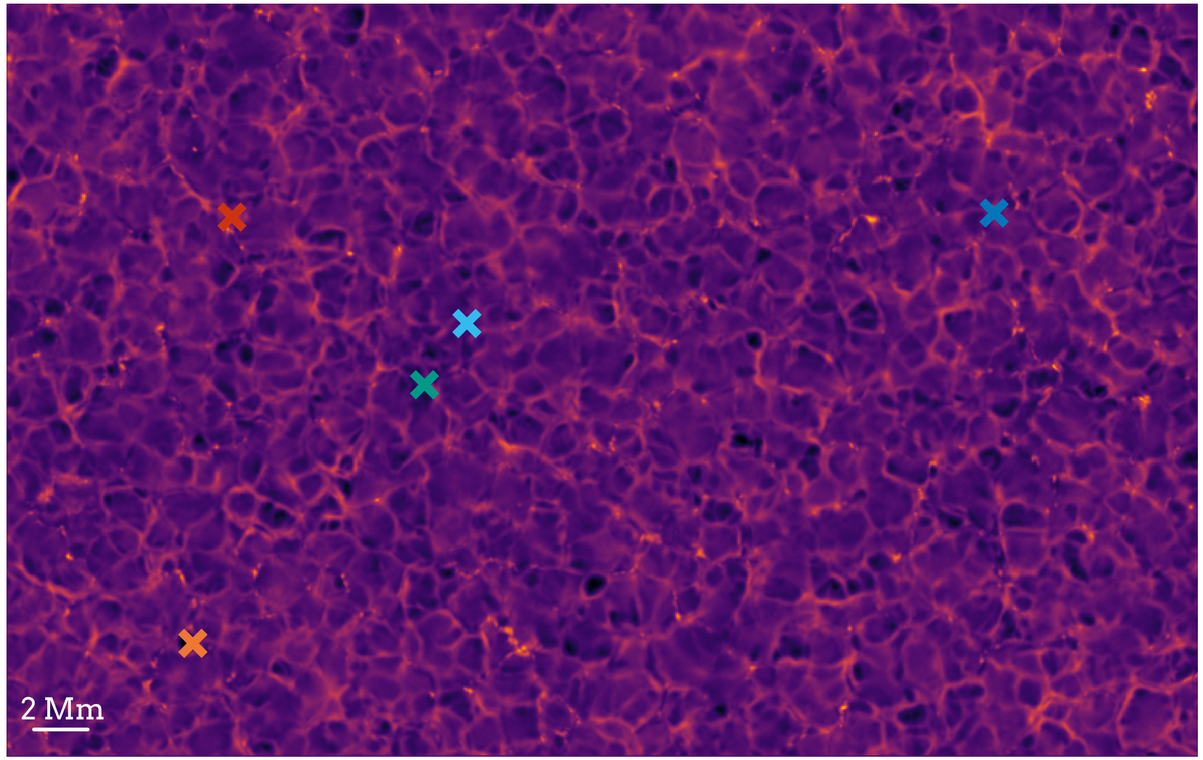
Credit: Joshi

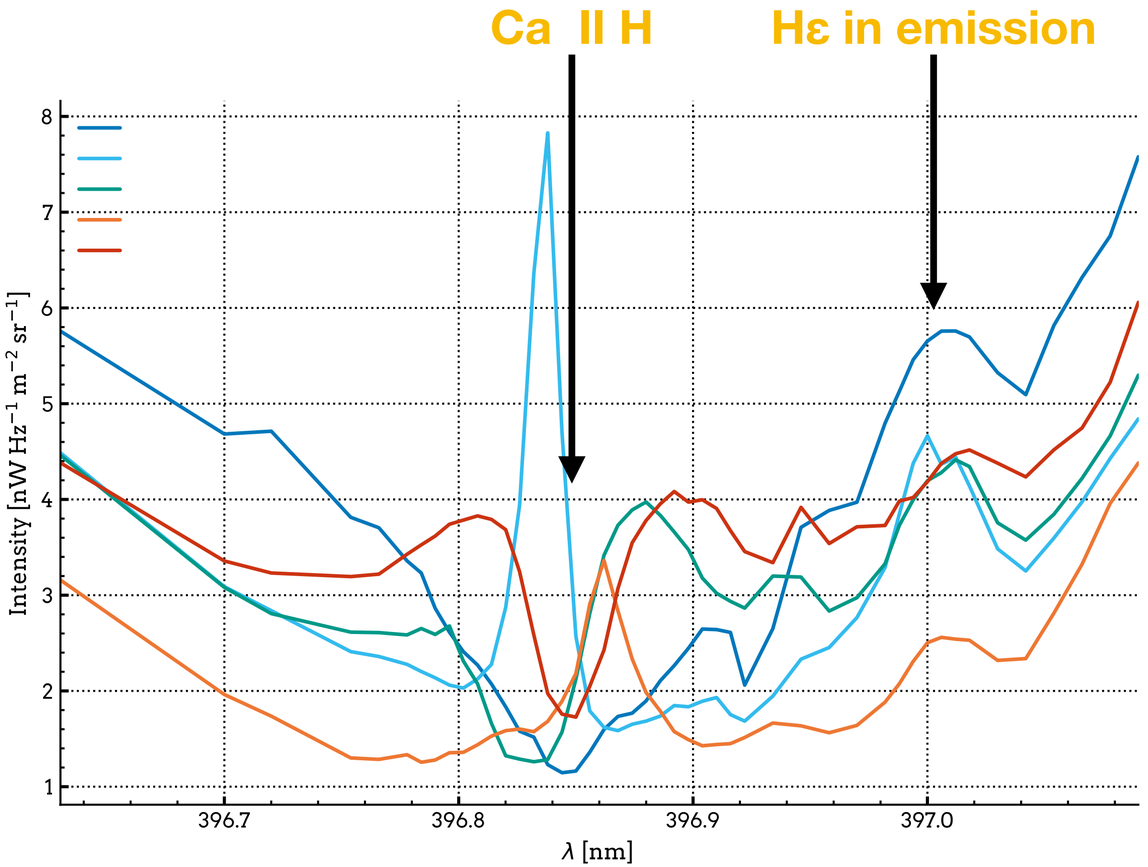
How ?

- Non-LTE spectral synthesis with RH 1.5D (Uitenbroek 2001, Pereira & Uitenbroek 2015)
  - Modelling Ca II H (PRD) with Hε as line blend
  - Balmer continuum and line blanketing
  - Effect of Non-Equilibrium Ionization
  - Solar enhanced network (EN) Bifrost simulation (Carlsson et al. 2016)

Quiet Sun Hε observation

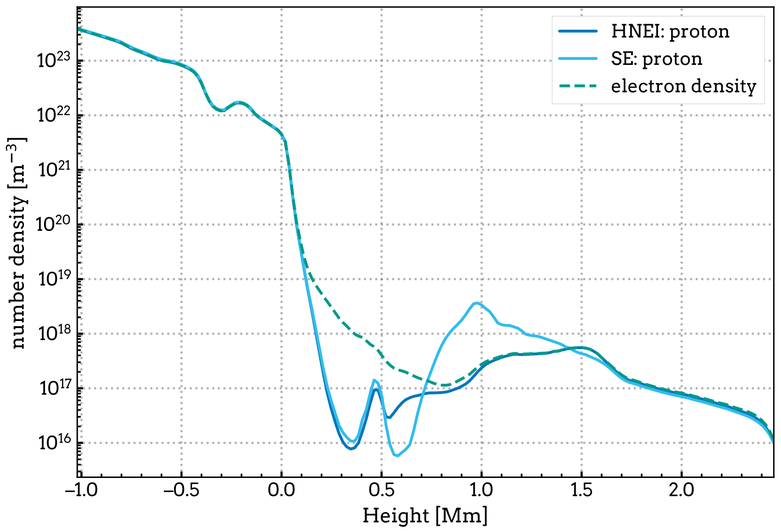
- Observation by CHROMIS at the Swedish 1-m Solar Telescope

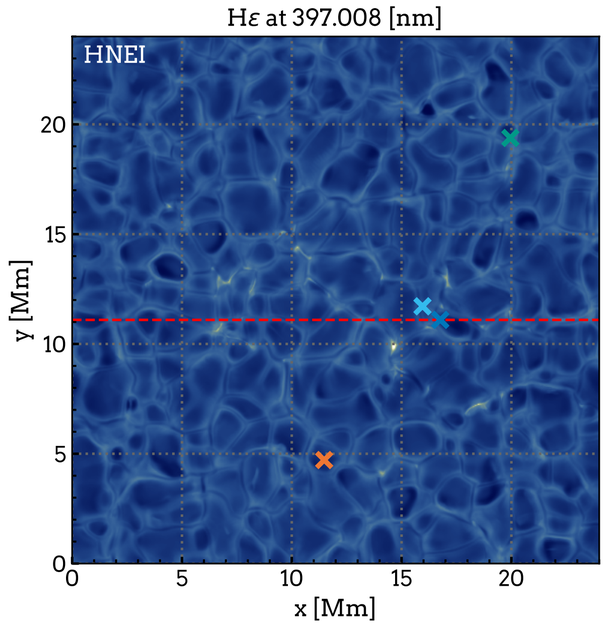


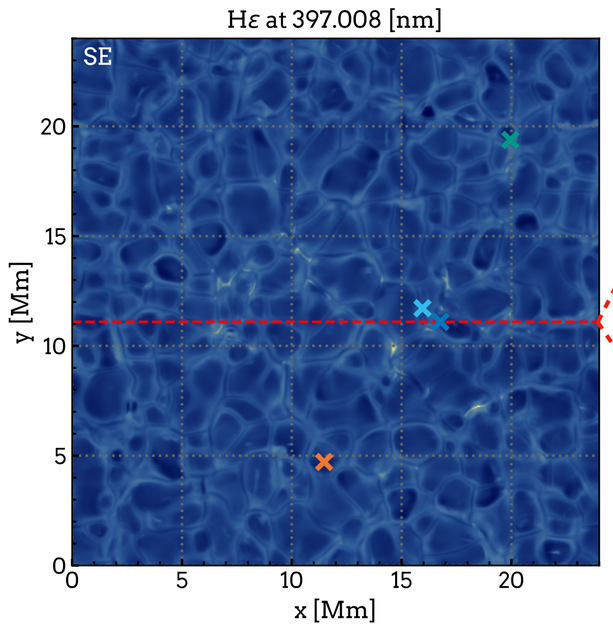


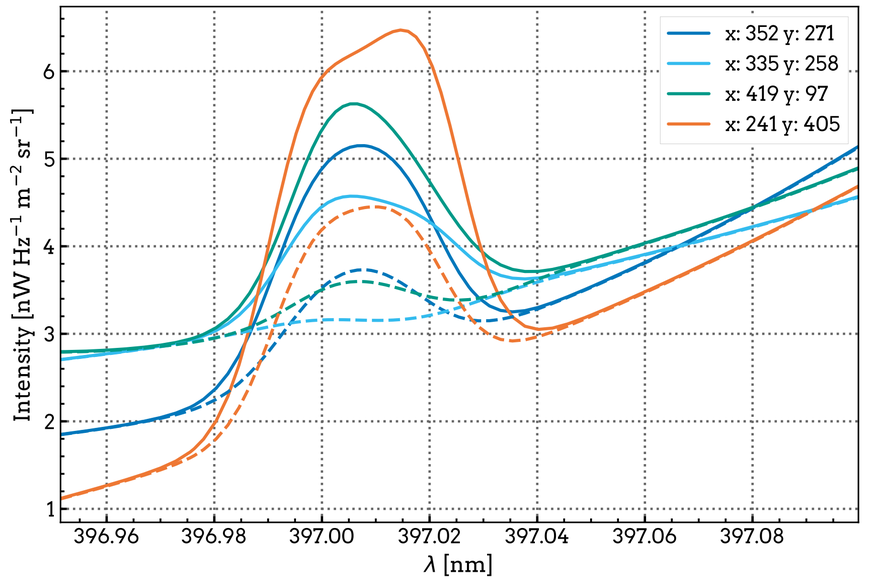
Synthetisized Hε Image from EN

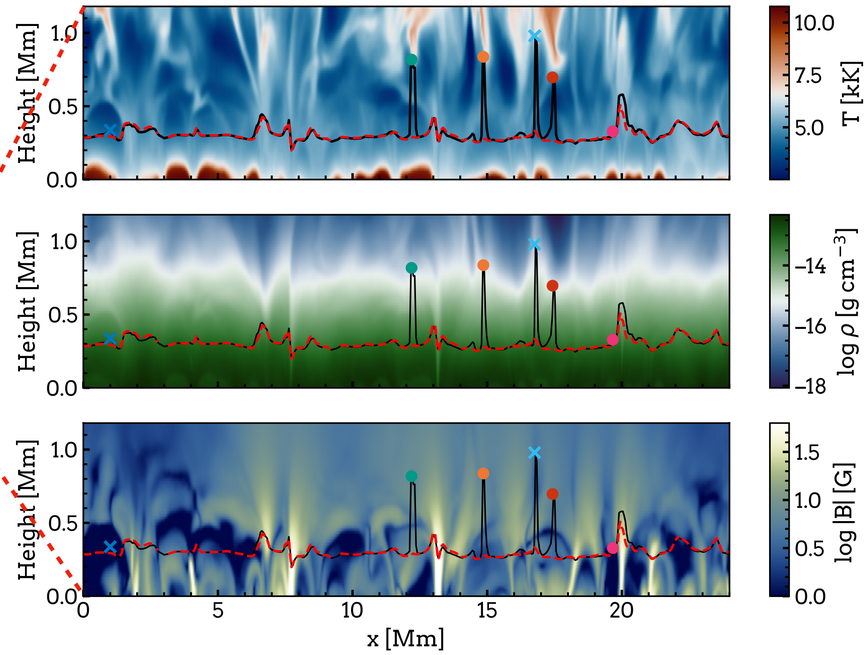
- Emission profiles found in:
  - Granules
  - Intergranular lanes
  - Bright features











Conclusion and Outlook

- EN simulation shows multiple regions with Hε in emission
- HNEI plays an important role
- Hε mark regions with steep temperature rise above the photosphere

Hε could be a valuable tracer for small-scale heating events with photospheric origin heating the lower chromosphere

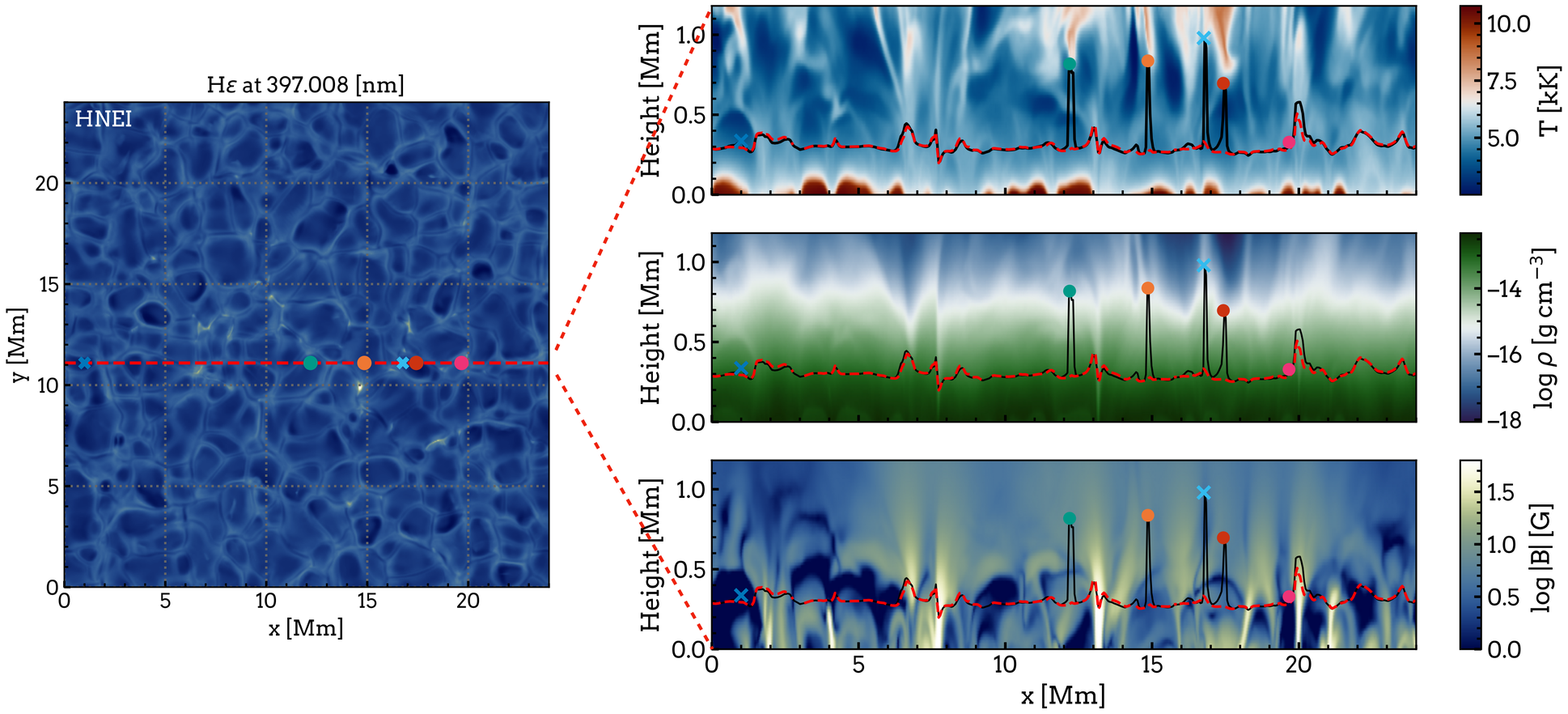
- Hε profiles from different RHMD simulations
- Hε evolution from RHMD time series

THE END

Thank you for your time!

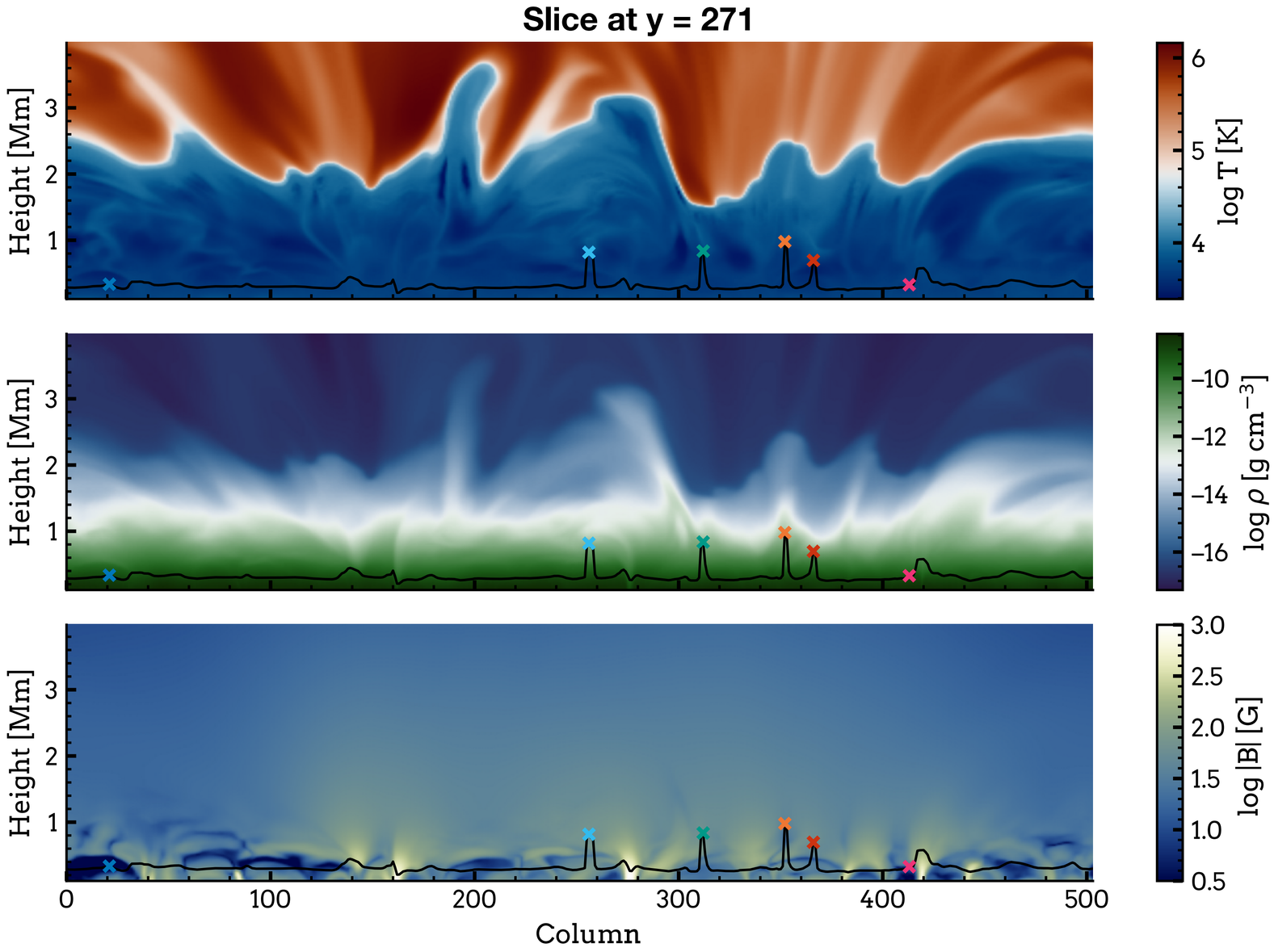
Slice through EN Atmosphere

- HNEI τ=1 height does not show peaks
- Hε mark regions with steep temperature rise



Slice through Atmosphere

CA II 8542 Å formed above ≈ 1 Mm



4 Panel Formation Diagrams

- Relative absorption or emission for Hε (Magain 1986)
- Former SE emission lines show now absorption contributions