



# Modelling the Impact of Flares on Short-Period Brown Dwarfs

Aidan Gibbs and Michael Fitzgerald – University of California Los Angeles (UCLA)

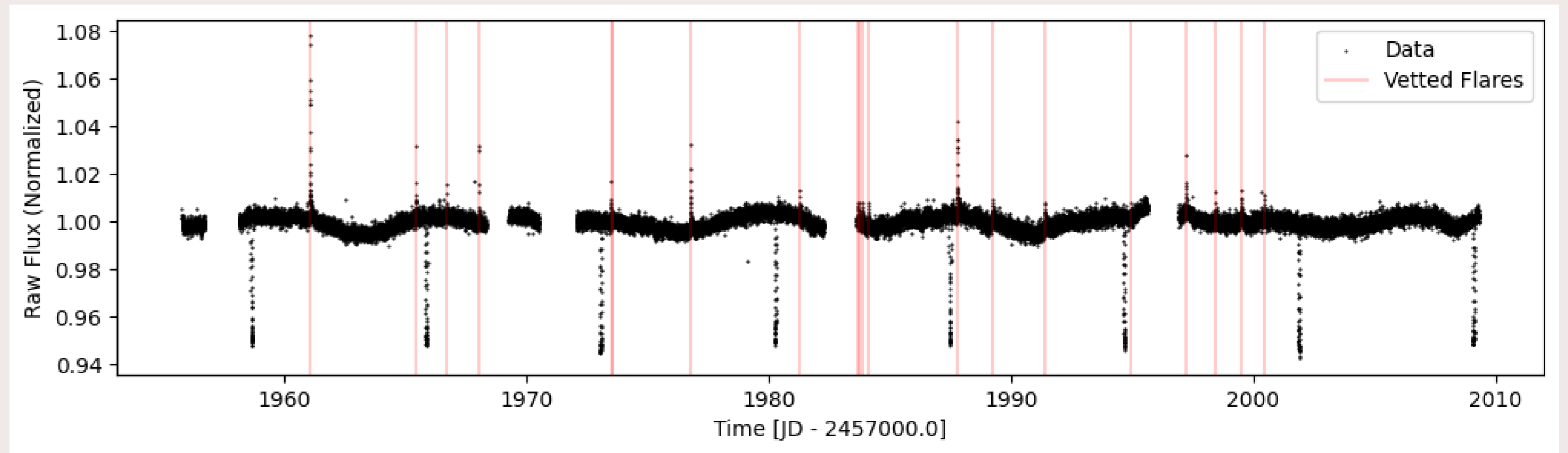
abgibbs@ucla.edu

## Question: What happens when superflares from M dwarfs impact close brown dwarf companions?

A number of brown dwarfs are now known on <10 day orbits around actively flaring M dwarfs

Their atmospheres are more readily observable by emission spectroscopy than those of more common smaller planets

Most known M dwarfs hosting Jovian planets have infrequent flares

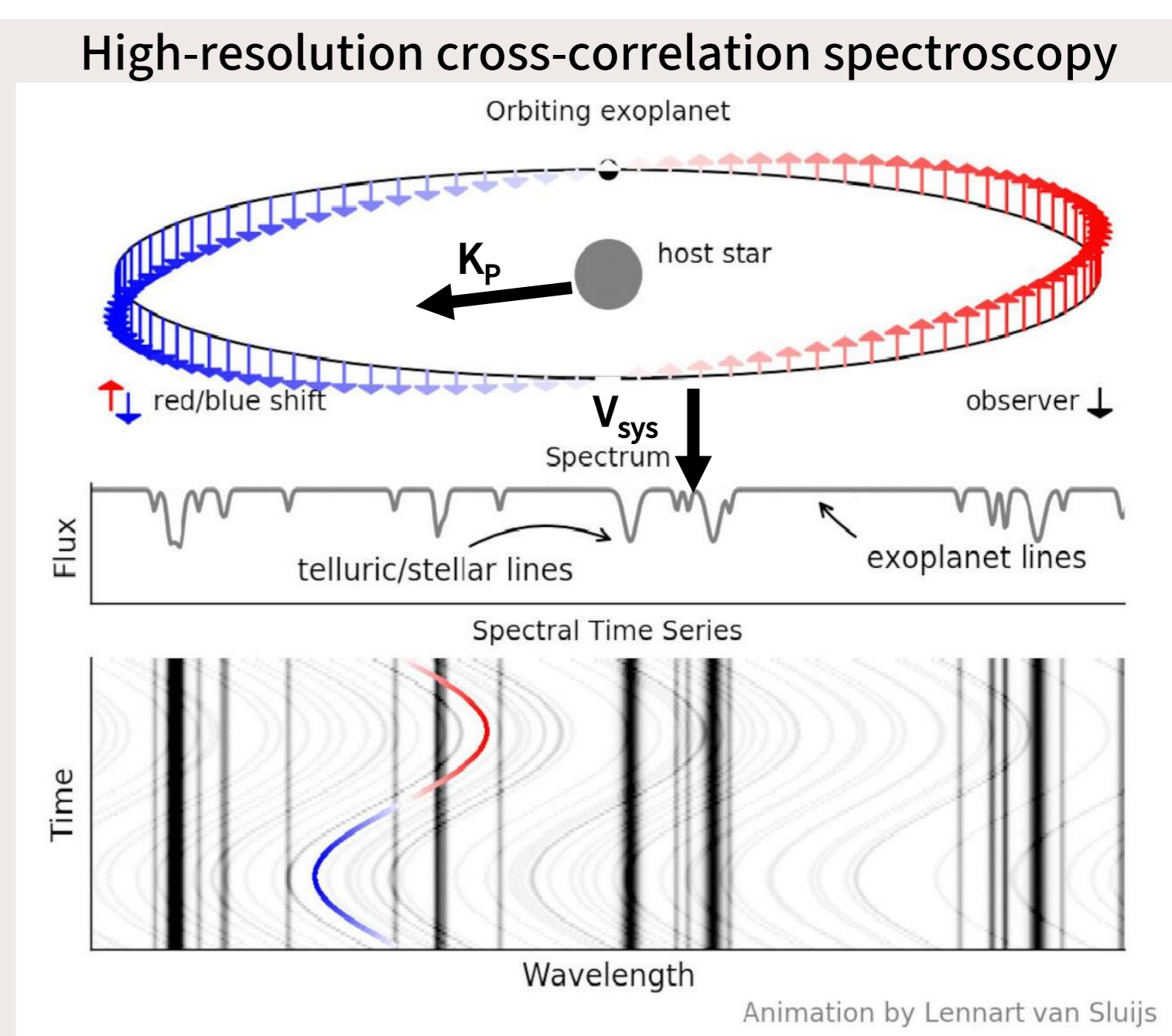
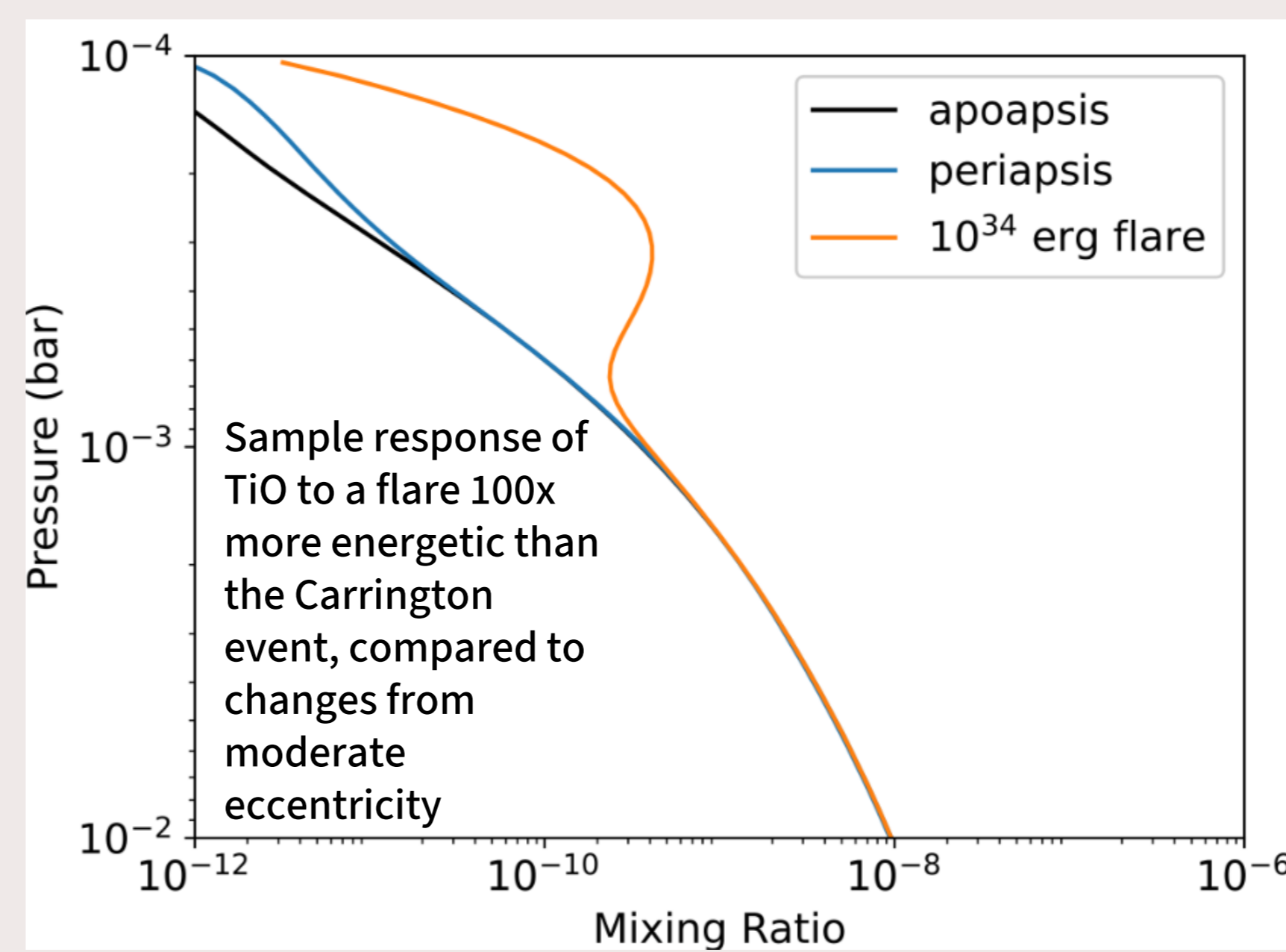


One example of a brown dwarf transiting an active M dwarf, as observed by TESS. Flares are marked by red vertical lines, all of which are >10<sup>32</sup> erg, more energetic than the most powerful flare ever recorded from the Sun.

## My work: Simulate the brown dwarf atmosphere's photochemical response to a flare and the observability of that response with high-resolution emission spectroscopy

Previous studies in giant planets have identified CH<sub>4</sub>, NH<sub>3</sub>, C<sub>2</sub>H<sub>2</sub>, and HCN as photoreactive species – I am extending this work for higher gravities and higher temperature species appropriate for brown dwarfs

Changes in mixing ratio might be observable in high-resolution (R>20,000) cross-correlation spectroscopy

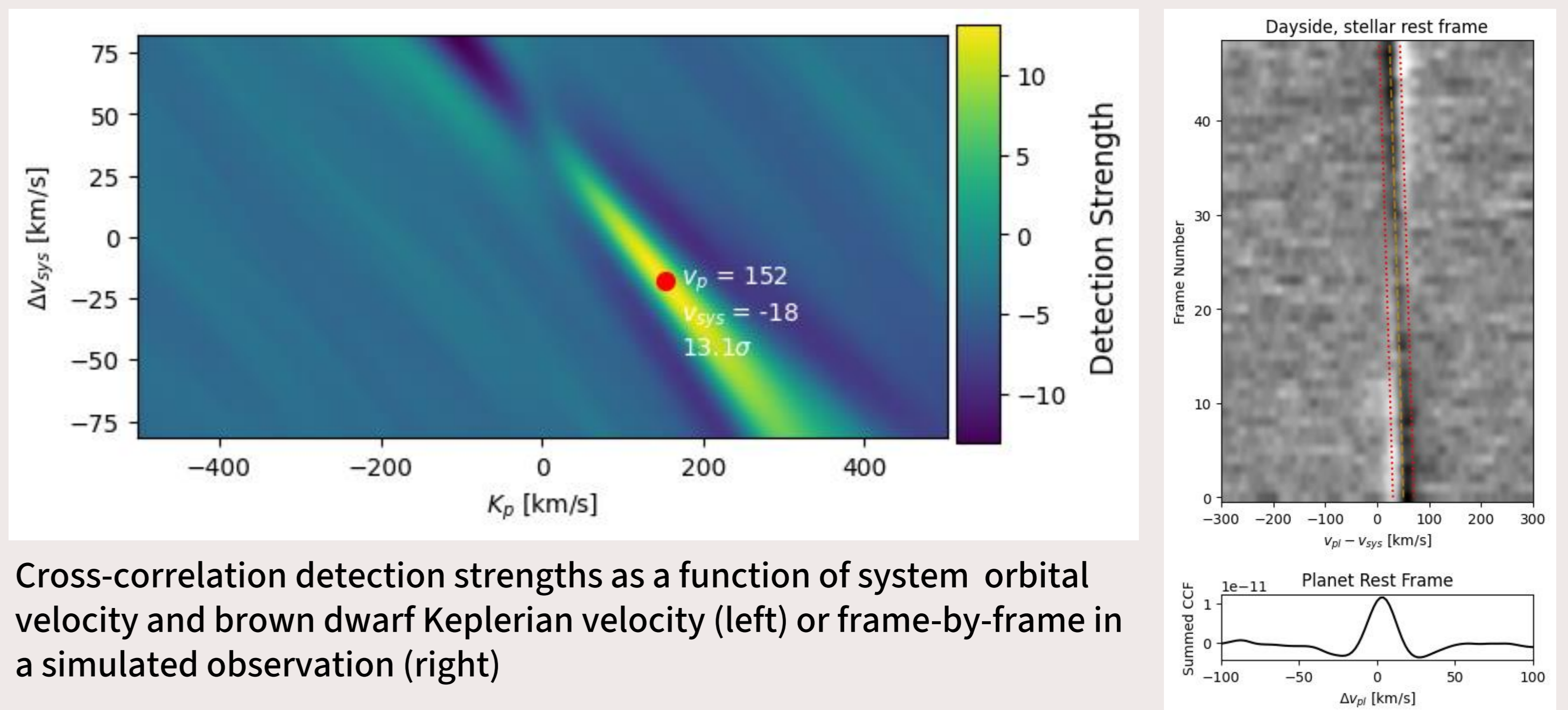


Change in mixing ratio causes change in observed spectrum  
Spectrum is extracted using orbital doppler shift

## Why it's important: Brown dwarf or giant planet atmospheres could provide a context for real-time observation of flare-driven photochemistry, with implications for smaller, habitable planets as well

A single night of observations with a high-precision NIR RV spectrograph can produce a strong atmosphere detection, meaning we can look for day-to-day spectral variability and potentially correlate changes to individual flares

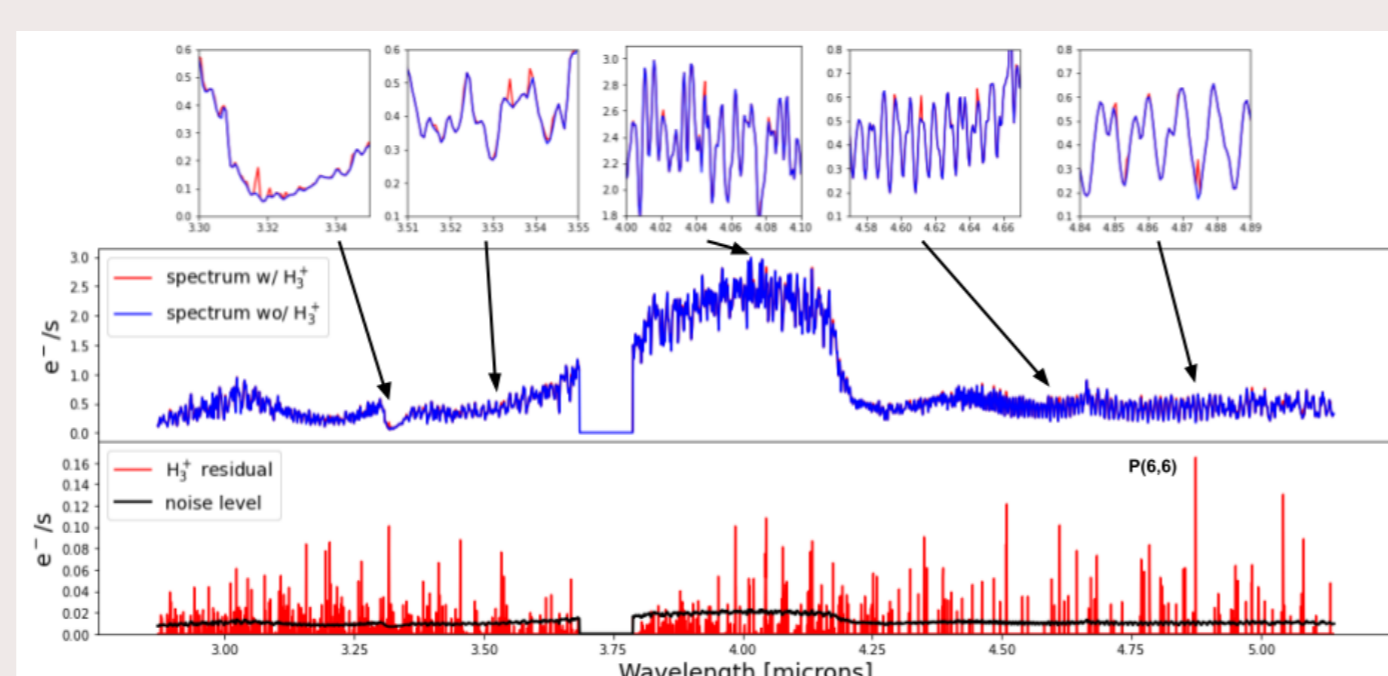
Success would provide valuable observational grounding for the study of flare-impacts in planetary atmospheres – it could also aid atmosphere simulations of terrestrial planets around flaring M dwarfs



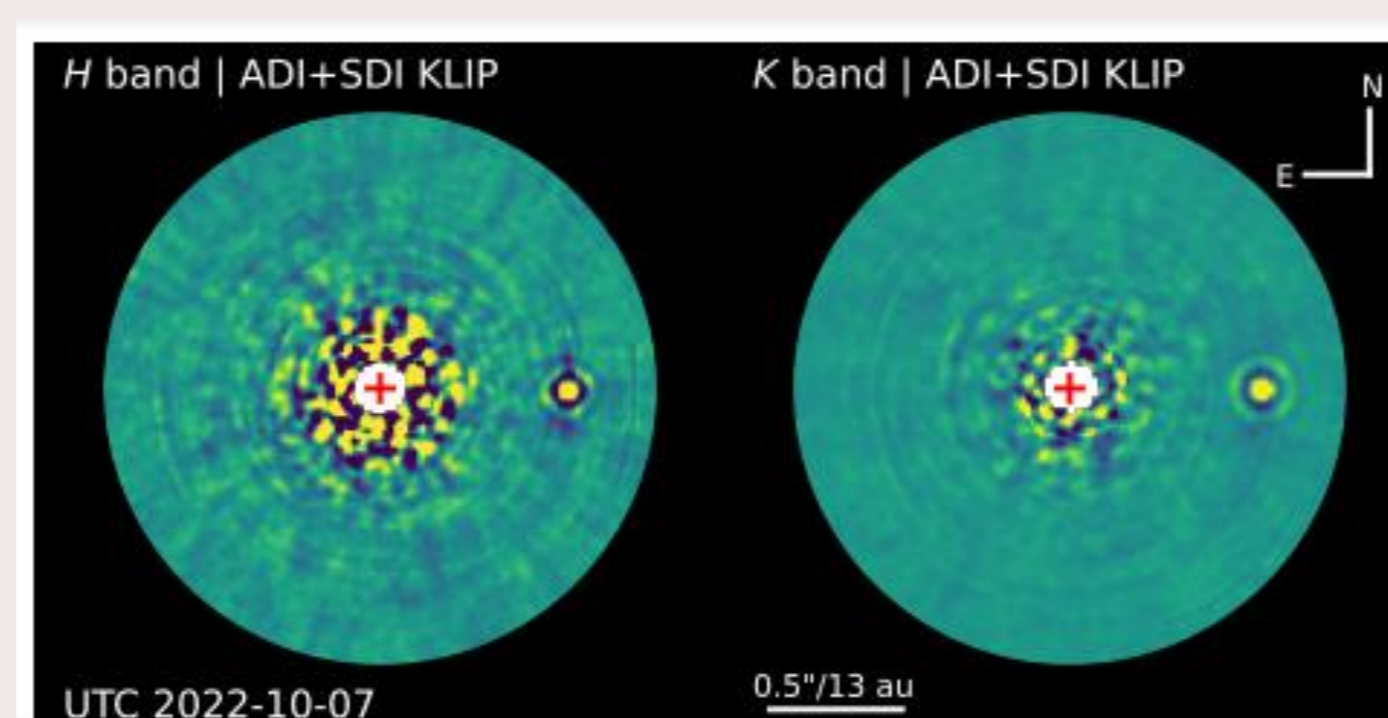
Cross-correlation detection strengths as a function of system orbital velocity and brown dwarf Keplerian velocity (left) or frame-by-frame in a simulated observation (right)

## What else do I do? I am entering the final year of my PhD and am looking for post-doctoral opportunities near the end of 2025

Spectral searches for infrared aurorae on brown dwarfs with radio emission



High-contrast imaging and spectroscopy of brown dwarfs and debris disks



Simulations of high-resolution fiber fed echelle spectrographs



Ground-based transit searches for planets around late M dwarfs

