

EXOCOMET S

A STUDY OF THE GASEOUS ENVIRONMENT OF A-TYPE MAIN-SEQUENCE STARS

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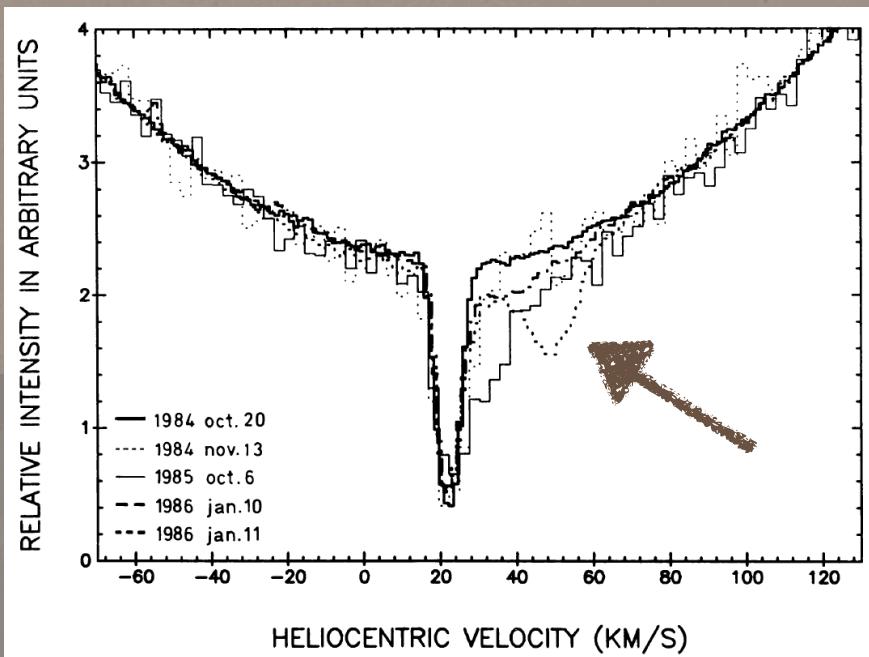
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While exoplanets are now routinely detected, the detection of small bodies in extrasolar systems remains challenging. Since the discovery of sporadic events, which are interpreted to be exocomets (falling evaporating bodies) around β Pic in the early 1980s, only ~20 stars have been reported to host exocomet-like events.

We aim to expand the sample of known exocomet-host stars, as well as to monitor the hot-gas environment around stars with previously known exocometary activity.

We have obtained high-resolution optical spectra of a heterogeneous sample of 117 main-sequence stars in the spectral type range from B8 to G8. The data were collected in 14 observing campaigns over the course of two years from both hemispheres. We analysed the Ca II K&H and Na I D lines in order to search for non-photospheric absorptions that originated in the circumstellar environment and for variable events that could be caused by the outgassing of exocomet-like bodies.

We detected non-photospheric absorptions towards 50% of the sample, and attributing a circumstellar origin to half of the detections (~26% of the sample). Hot circumstellar gas was detected in the metallic lines inspected via narrow stable absorptions and/or variable blue- and red-shifted absorption events. Such variable events were found in 18 stars in the Ca II and/or Na I lines; six of them are reported in the context of this work for the first time. In some cases, the variations we report in the Ca II K line are similar to those observed in β Pic. While we do not find a significant trend in the age or location of the stars, we do find that the probability of finding CS gas in stars with larger $v \sin i$ is higher. We also find a weak trend with the presence of near-infrared excess and with anomalous (λ Boo-like) abundances, but this would require confirmation by expanding the sample.

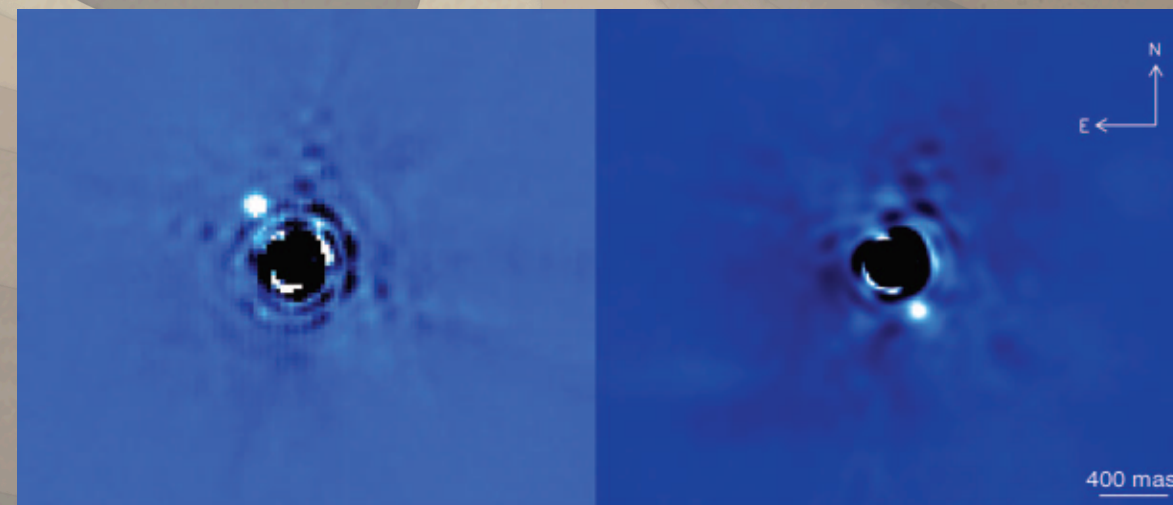


CaIIK (3933.66 Å)

Ferlet+87

In the case of the debris disc star β -Pic, the detected exocomets were consistent with the presence of a planet that was later discovered. That planet, β -Pic b, could be acting as a perturber, throwing material from the outer regions of the disc, towards the center.

Detection of variable gas in spectroscopic (mainly in Ca II lines) data of main sequence stars, points towards the presence of evaporating bodies (FEBs) in the close-in regions of the disc, that could be key in the planet formation processes:
Exocomets

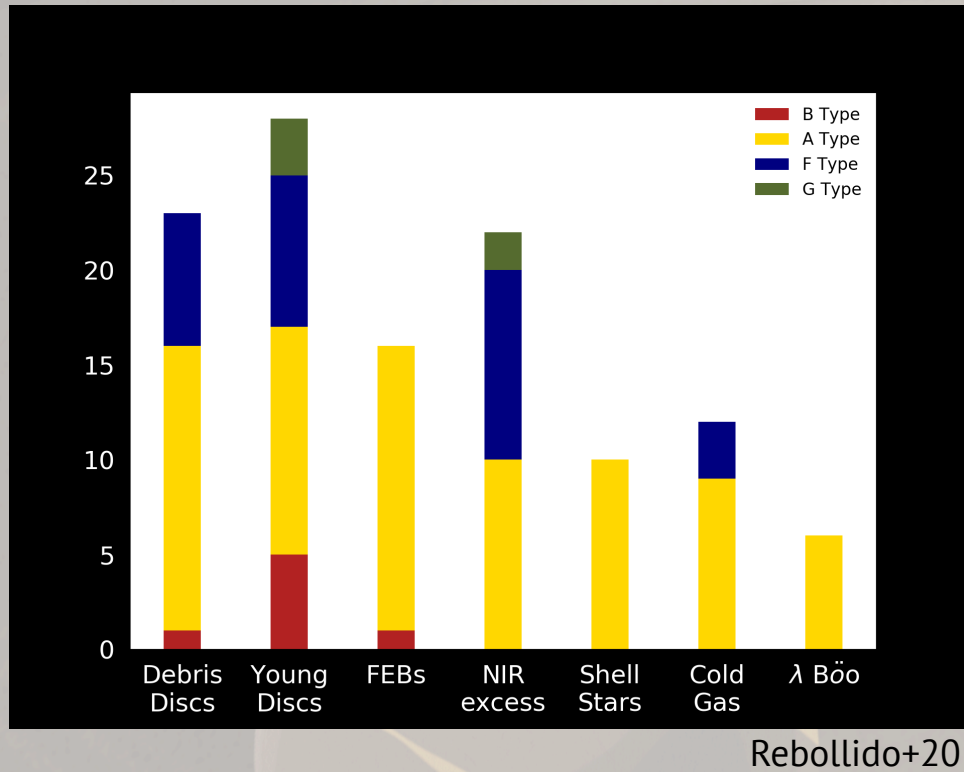


VLT/NACO imaging

Lagrange+08

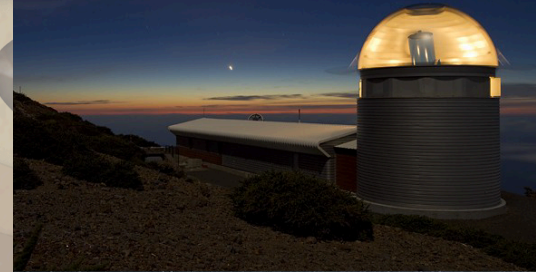
Before this work, only ~20 stars were known to have exocomet-like features

A heterogeneous **study sample** was constructed, with 117 stars, following at least one of the following criteria, that could improve the prevalence of circumstellar (CS) material:



14 observing campaigns and remote observations over 2 years (2015-2017) resulted in over 2000 spectra that were inspected for the presence of gaseous stable and variable features

Mercator / HERMES (La Palma, Spain)



NOT / FIES (La Palma, Spain)

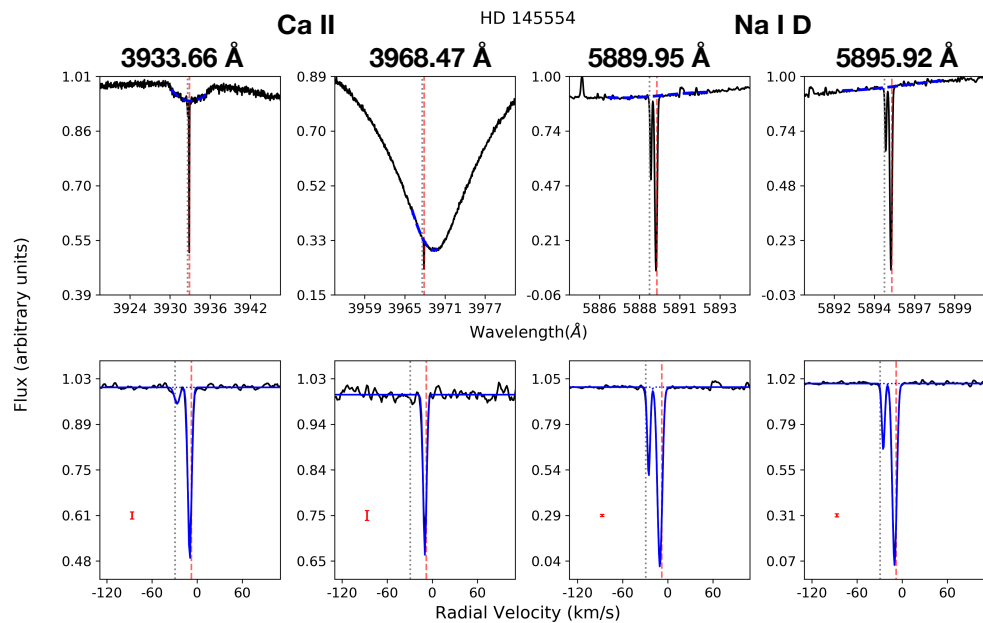


2.2 MPG / FEROS (La Silla, Chile)



TIGRE / HEROS (La Luz, México)

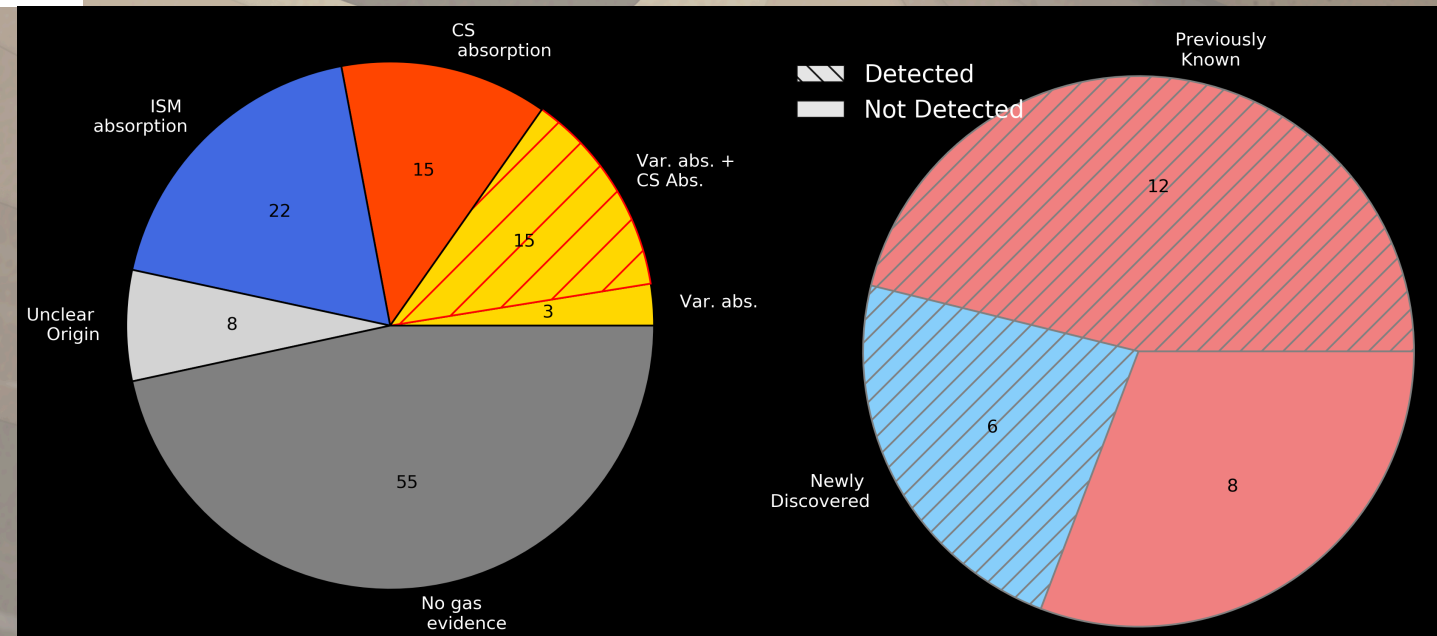


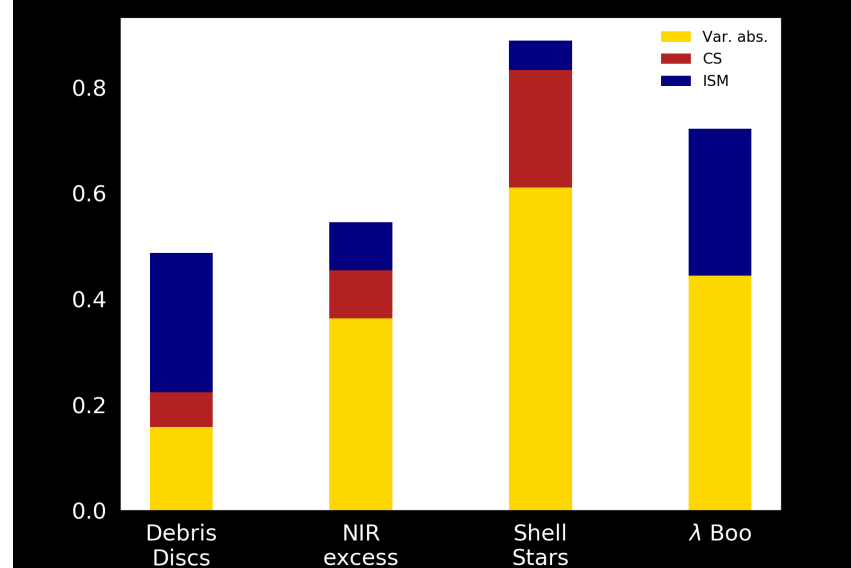
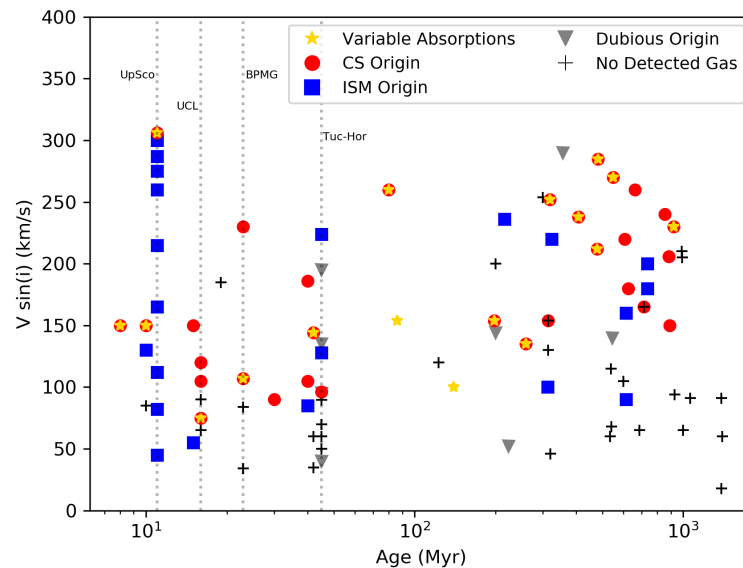
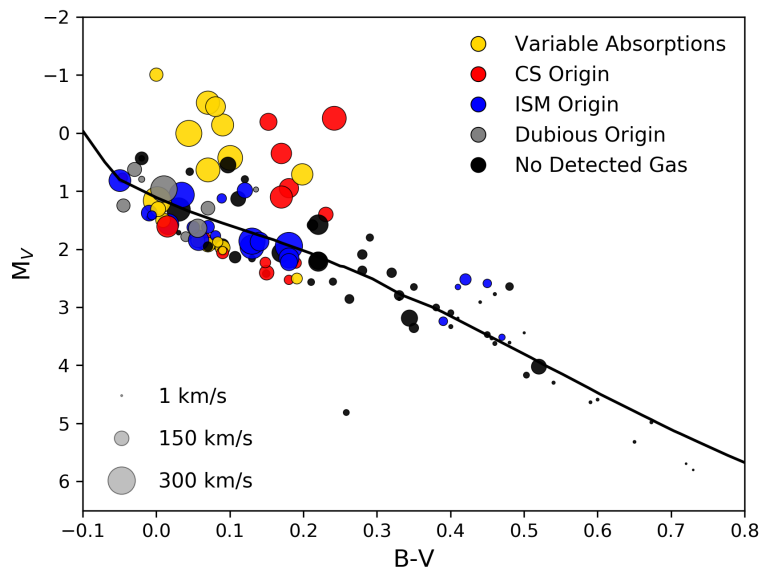


We inspected the **Ca II** and the **Na I D** lines in order to look for both variable and stable gas. We also investigated if the origin of the stable gas was CS or interstellar (ISM)

We detected **variable features in 18 stars**, where 6 of them were not reported before. Also, features compatible with the presence of circumstellar gas were found in 30 stars.

Rebollido+20





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- The color-magnitude diagram shows that most variable and stable CS gas appear in high-rotating A-type stars, whereas stable features originated in the ISM are found for all ranges of rotational velocities and spectral types.
- There is no apparent relation of the presence of variable features or CS gas with age, but there are few detections for rotational velocities below 100 km/s.
- Most detections of variable absorptions were in shell stars (with a strong CS component), λ Boo stars (with anomalous abundances), stars with near-IR excesses, and to a lesser extent in stars with debris discs.

Summary

- 6 new objects found with variability
- Dependence of the presence of gas with
 - Spectral type
 - $v_{\text{sin}i}$
 - λ Boo
 - NIR excess
- No apparent dependence on age

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Future work

- Spectroscopic follow-up to:
 - Discard false positives
 - Confirm correlation with NIR excesses and λ Boo stars
- Search for cold sub-mm gas in stars with optical gas detection (ALMA)
- Photometric studies of stars with exocometary signatures in their spectra (CHEOPS)
- Why are exocomets found only around A-type stars? (in spectroscopy)