IGRINS-2 SV Observation Evaluation Form 1 form per science case

Title: Structure and kinematics of gaseous disks around massive stars in transition phases

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Description of the primary goals and the main findings

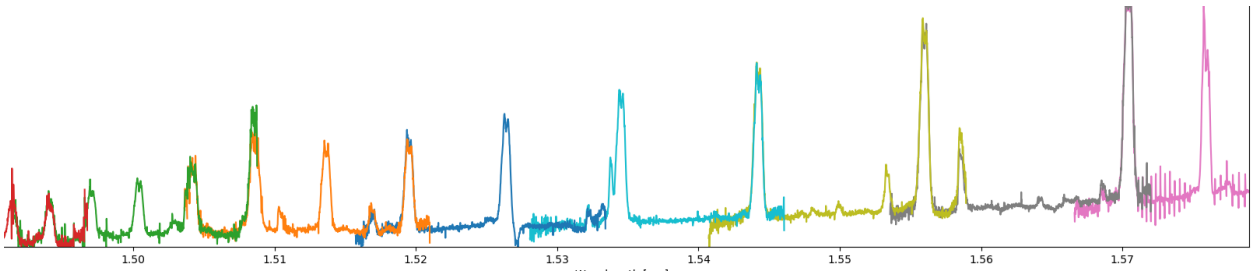
Describe the science case and the main results. Please include some figures.

I propose to observe three targets that are evolved massive stars in transition phases, that have suffered mass loss events and are surrounded by eyected material. The main goal is to characterize the structure and dynamics of the circumstellar material around these stars. This kind of objects show cool and dense gas disks with adecuate conditions for molecule formation, particularly CO bands. They also can show emission lines of low ionized metals and hydrogen originated in the disk. The high resolution provided by IGRINS-2 are required to reliably determine the kinematics in the CO emitting regions, as only with high resolution will it be possible to detect even small (projected to the line of sight) rotation speeds. Rotation, as in Keplerian disks, results in a characteristic band head shape, displaying a blue shoulder and a red peak, and the separation between these two corresponds to twice the rotational velocity projected to the line of sight.
As the CO emission typically emerges from the inner rim of the molecular disk, the shape of the ^{12}CO band heads delivers detailed information on the disk kinematics, while the relative strength of individual CO band heads constrains temperature and density. Also in the H and K band lay many low lines that trace the hot inner disk.

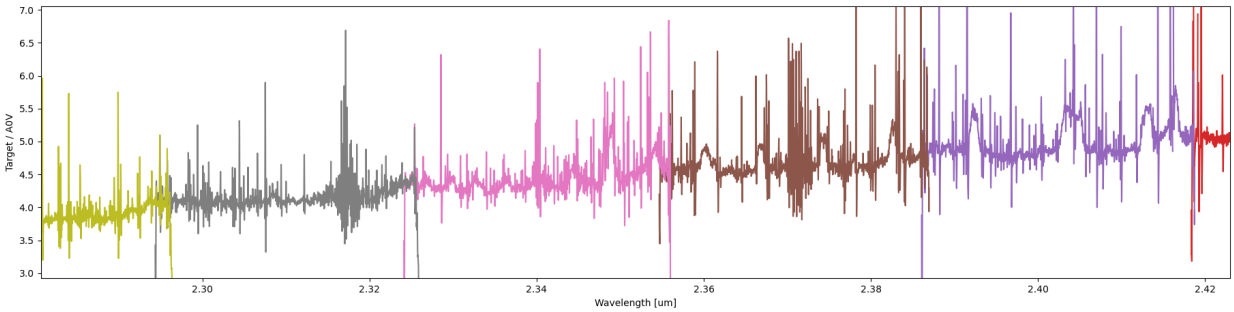
The proposal includes 3 targets, from which the 2 brightest ones were observed: MWC 349 and [FMR2006] 15. The required conditions were: CC 50%, IQ 70%, SB 80%, WV 80%. The data were reduced using the IGRINS-2 pipeline: "igrins2-dev" version.
The quality of the spectra are good, with enough S/N and resolving power for the science purpose.

In the following figures are shown two plots of the H and K bands pipeline output for MWC349. The two peaks of the emission profiles are clearly resolved in lines of Br and Pfund hydrogen series, Fe II, [Fe II], Na I, Mg II from the gaesous disk. A weak CO molecular emission in the 2.3 microns region is also present, although it is very polluted with telluric lines. CO emission seems to be weaker than in previous observations indicating that ejected material has been expanding and cooling.

H-band portion of MWC 349 spectrum

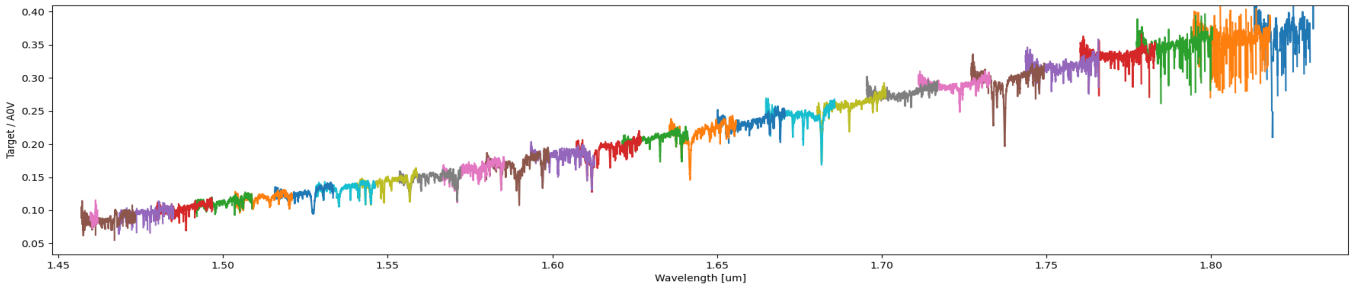


CO band emission for MWC 349 very polluted with telluric lines

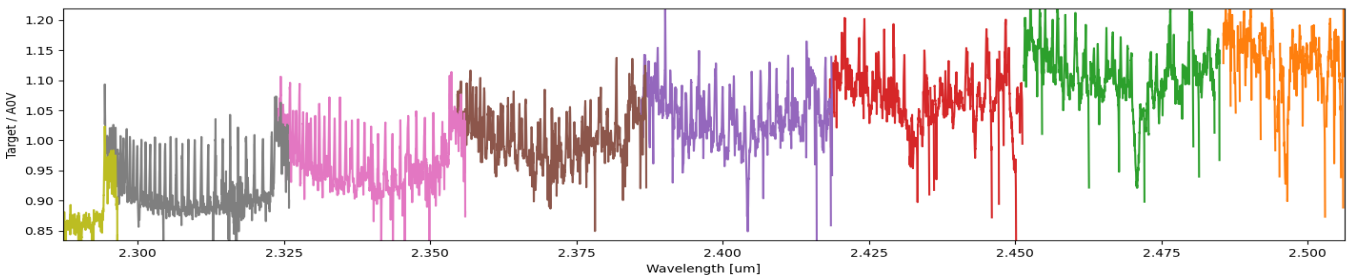


In the following figures we show portions of the H and K band spectra of [FMR2006]15. This star is a yellow hypergiant candidate and show a typical spectrum of a ~G0 type star, and presents a clearly resolved CO molecular emission and Na I emission lines, indicating the presence of dense circumstellar material. In this case the profiles are not two-peaked.

H-band spectrum for [FMR2006]15



CO molecular emission for [FMR2006]15



Suggestions for improvements:

Any comments on ITC, PIT, OT, data reduction pipeline, website, archive, etc…

The telluric corrected spectrum resulting from the pipeline is not good, so it is necessary to use another method to correct for telluric lines.
I tried to use the iraf task "telluric" to make the correction, and I could improve the H-band spectrum. However the K-band spectrum was still very difficult to correct. I still do not find the reason of this.

In the K-band some orders do not overlap well and have curved shape.

In some orders of the H-band the wavelength calibration is not precise.

It would be interesting that the pipeline be more interactive, as regards the extraction,and combination of orders, for example.

Any additional comments about IGRINS-2 SV