VSOP

Fixing the variable sky with one-shot typing of neglected variables

Present in Kyoto:


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The VSOP Vision

✲ VSOP will obtain the first spectroscopy of all unstudied variable stars in both hemispheres, using the worlds leading observatories.

✲ VSOP will process incoming data, determine or revise spectral and variability type, and make the data available to the public.

✲ VSOP will cause a continuous influx of serendipitous discoveries, and will provide the framework for easy collaboration among researchers across all fields of stellar astrophysics.

VSOP @ GEMINI

The Gemini branch of the VSOP project was launched in Semester 2007B. This was before the bad weather programs were instated. We explicitly requested to be assigned band 3 and that the observations be treated as fillers or bad weather options. The proposal was successful and over a hundred observations were obtained with GMOS North and South. Since, we have been granted time in band 3 and band 4 (which is now the bad weather band) in each semester. Without the inclusion of the on-going 2009A semester, more than 900 spectra have been obtained, over 500 of those collected during the highly prolific 2008A semester.

This remarkable success lies in the perfect alignment between the queue observing mode and our program. Here are three key factors:

1. Time needed for each target is short.

   For each target, we only need from 10 to 40 minutes of time, including slew and setup time.

2. We provide targets all over the sky.

   VSOP has targets at any time of the year, any time of the night.

3. We can observe through really poor weather.

   Because all our targets are point sources and relatively bright, we can observe in worse conditions than most programs. In fact, most of our targets were observed in "Poor Weather" conditions: a seeing of 1.2" or worse, and often several magnitudes of extinction from thick clouds.

When combined together what those 3 factors lead to is an increased efficiency of the queue. For example, VSOP can fill in a gap between two higher priority targets if second is not available for another 10 minutes. Another typical gap to fill is that time between the last observation of the night and twilight. Or maybe, it is a very cloudy night; it is likely that there is a VSOP target in that only hole in clouds. In this way, we have successfully acquired many of our observations.

Automated Data Reduction

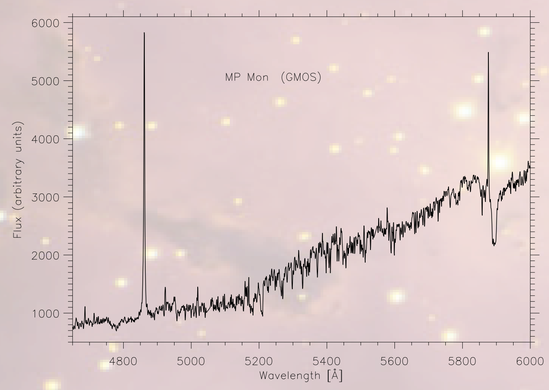
Because of the large influx of data, the data reduction must be automated. The uniform and standard nature of the observations facilitate this task. Gemini does not have a science pipeline, yet, therefore a custom tool had to be created.

The Gemini VSOP automated data reduction script is written in Python and makes use of the pyraf module maintained and distributed by STScI. With that module, a Python script can call IRAF tasks as subroutines. Thanks to that bridge, the Gemini VSOP mini-pipeline can use the standard GMOS IRAF data reduction tasks when needed, and use other powerful Python tools in the same program.

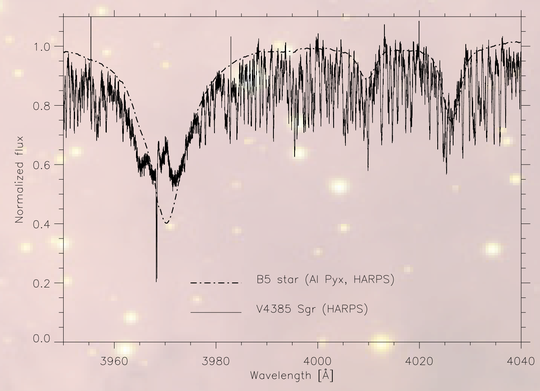
The data reduction script is launched from the UNIX shell and offers the user various options, in particular the ability to extract multiple sources, and the ability to activate the interactive mode for wavelength calibration, sky subtraction, and extraction when optimization is required.

If you are interested in learning more about using Python for data reduction, talk to Kathleen Labrie.

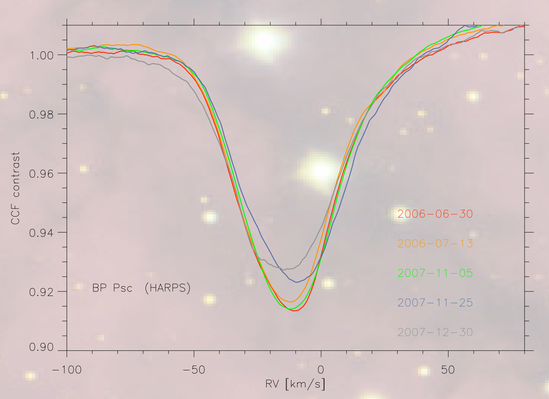
The spectrum of MP Mon illustrates the overall quality and spectral coverage of the VSOP GMOS (Gemini) observations. MP Mon (V = 16.63) is a known emission-line star in the NGC2264 region, but the only previous spectroscopy comes from old prism film plates as it was too faint for the survey by Rebull et al. (2002; AJ 123, 1528).

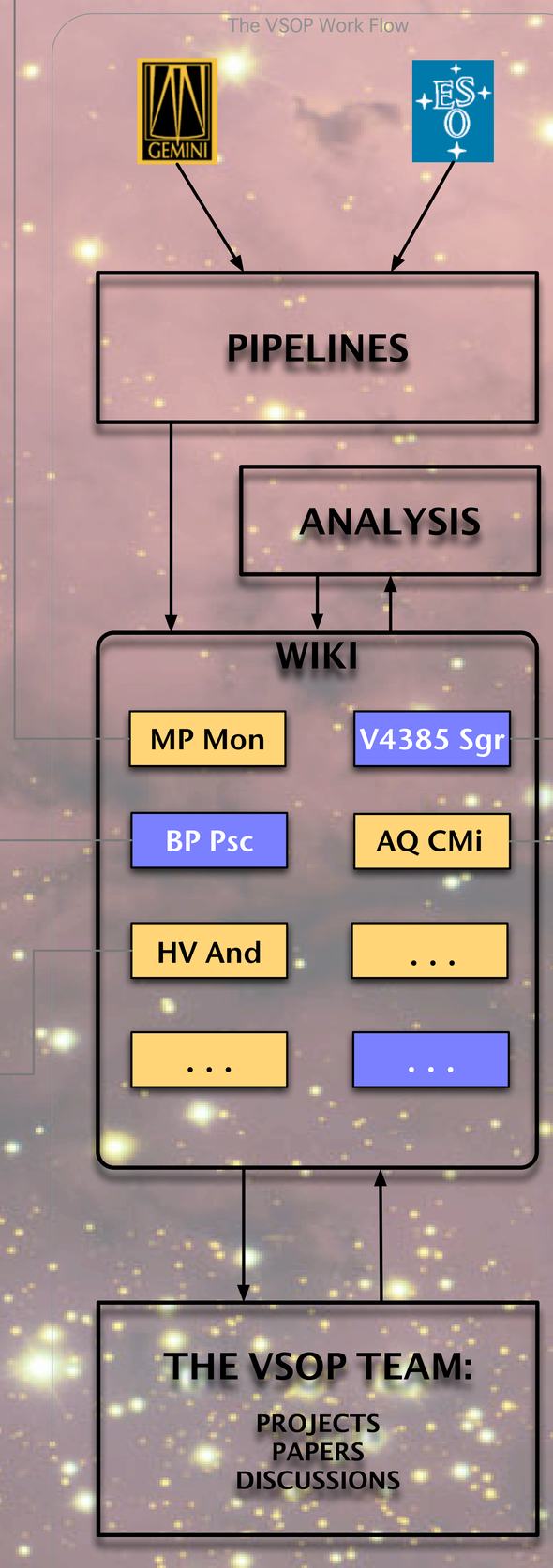


V4385 Sgr is a well-known composite spectrum (B+F) star. Our VSOP HARPS spectrum is the first high resolution spectrum of the source. The photometric period is 2.62 days, but the vsini of the F star is only 13 km/s, which together with the negligible difference in Radial Velocity between the components leads us to suggest that the system is viewed close to pole-on and that both stars are actually rapid rotators, which may be the cause of the peculiar structure of the Ca II region.

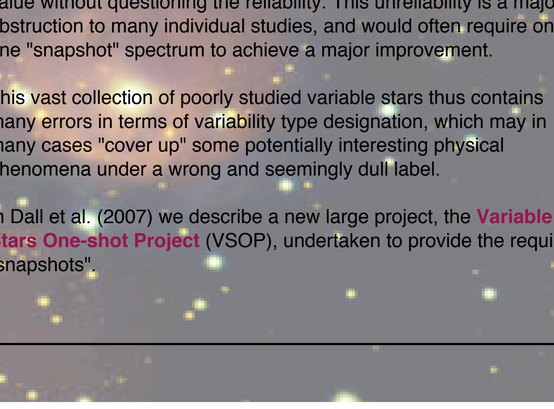


BP Psc appears to be a young T Tau star, but recently Zuckerman et al. (ApJ, in press) presented evidence for it being a post-MS star with a gas and dust disk originating from a disrupted companion. The first VSOP HARPS spectra showed changes in the Radial Velocity, which spurred a follow-up search for signatures of additional companions. This plot shows the evolution of the average spectral line in BP Psc. Results will soon be submitted to A&A.

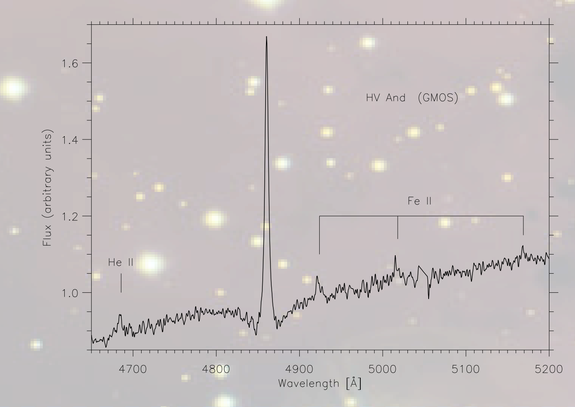




This is the first ever spectrum of AQ CMi, confirming it to be a Dwarf Novae. It was not included in the survey by Zwitter & Munari (1994; A&AS 107, 503) because of its faintness (B = 14.5). This GMOS spectrum has been rebinned slightly to enhance S/N around the Hβ line which shows a typical accretion profile. The He I 5876 line is barely detectable.



GMOS-N spectrum of the Hβ line region in HV And. This star has been classified as a Nova-Like CV because of the emission lines and the underlying blue continuum. However, we propose a Be star classification, given the quite narrow emission core and the underlying broad photospheric absorption line. The sequence of Fe II lines indicated are normal for Be stars as well.



References

✲ Dall, Foellmi, Pritchard et al. (2007), A&A 470, 1201 - Paper 1 from the VSOP team with rationale, overview and first data release.

✲ https://vsop.eso.org - The VSOP wiki web site. All the released data can be accessed from here.

About VSOP

About half of newly identified variables have unknown variability type and most of them have no published spectral type. Moreover, many (even "firm") variables have disagreeing designations between different authors and even between different catalogs, e.g. there are frequent disagreements between the SIMBAD database and GCVS. In addition, binarity is rarely detectable unquestionably by photometric data alone. Finally, many designations are taken at face value without questioning the reliability. This unreliability is a major obstruction to many individual studies, and would often require only one "snapshot" spectrum to achieve a major improvement.

This vast collection of poorly studied variable stars thus contains many errors in terms of variability type designation, which may in many cases "cover up" some potentially interesting physical phenomena under a wrong and seemingly dull label.

In Dall et al. (2007) we describe a new large project, the **Variable Stars One-shot Project** (VSOP), undertaken to provide the required "snapshots".