Planetology in VO:

Search for signatures of Exoplanets in data bases

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Outline

- A. Introduction
- B. Background
- C. Workflow: step by step
- D. Workflow: demo
- E. Conclusion

A. Introduction

- **Goal: Find exoplanet signatures in existing data sets**

  Red: To be implemented soon Blue: by hand

- **Tools: Elodie, Simbad (via Elodie), exoplanet encyclopaedia, BASECOL (atomic and molecular database), spectral analysis.**

  At this stage, preliminary in "home" format

  Initially as an exercise for students

- **Objectives:** TO MAKE IT IN VO FORMAT with VO-Paris Data Center

B. Background

- **Detection of exoplanets by radial velocity method (Doppler shift) on 100 000 spectral lines on spectra (Mayor & Queloz), spectral resolution: 6-7 m/s**
- **We propose to look on archived data with a fast global automatic search**
- More than 200 spectra from exoplanet search program on Elodie (Mayor and Queloz)

http://atlas.obs-hp.fr/elodie/E.cgi?

C. Workflow step by step

Colours

Black: Implemented

Red: To be implemented soon

Blue: Selected by hand

- 1. Selection of the star: 51 Peg
- 2. Asking for existing Elodie spectra (40)

Elodie: Spectral Data Base, high resolution

More than 17 000 spectra on line

The ELODIE archive

An on-line database
of high-resolution stellar spectra

Introduction | Help

NEW Access to cross-correlation results (2005/12)

Enter a designation or coordinates

51 Peg

Examples:
HIP117998, J04 14 57 15 32 10 , simbad:procyon, HD190007,HD190073, GJ%

a. For identifiers you can choose to query : only this object

b. For coordinate and around object queries, define a radius : [arcmin]

c. Choose a sample in the list: Whole archive

Submit Reset

Query a sample of objects in a region of the sky

a. Define a region of the sky (B1950 or J2000):

Right ascension from to

examples: 14 00 00 to 18 00 00 (B1950)
J14 00 00 to J18 00 00 (J2000)

Declination from to

example: -02 00 00 to 02 00 00

b. Choose a sample in the list: Whole archive

Submit Reset

Advanced search

a. Set multiple constraints: Select observations in a range of S/N, exposure time, date of observation...

b. List of objects: Upload a list of objects and find the corresponding observations.
The file must contain one designation per line (example)
Choisir le fichier aucun fichier sélectionné

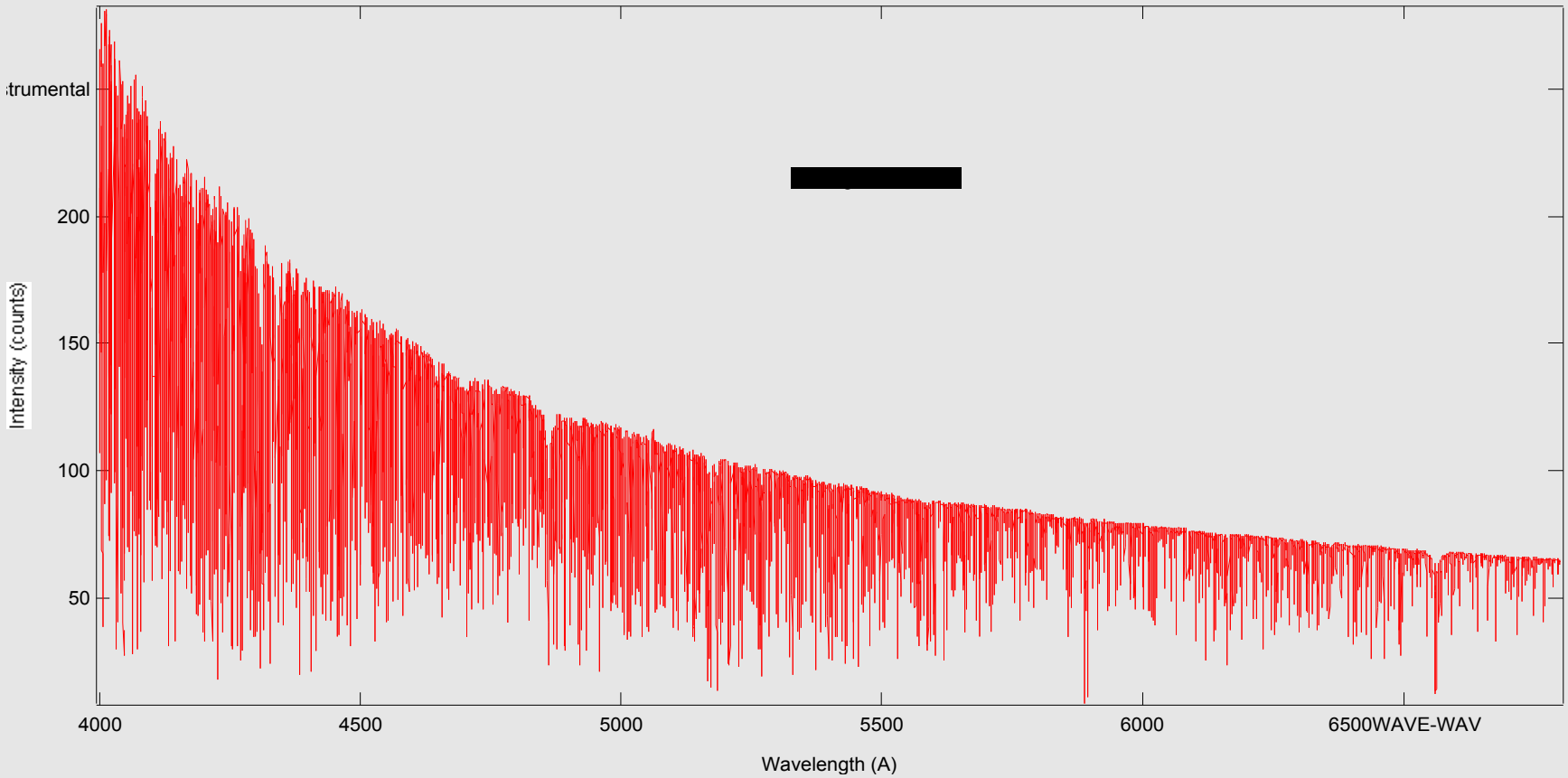
Load Reset

The ELODIE archive contains presently 33678 spectra, among which17460 are public

Bibliographic reference for the ELODIE Archive: Moultaka et al. (2004) PASP, 116, 693-698
External links: Pollux database project · Spectrophotometry in Hyperleda · UVES Paranal Observatory Project · ELODIE: The Stellar Library ·

Contact: Jihane Moultaka
Last revised:Mon May 01 2006 08:51:55

3. Download locally all existing Spectra of Elodie
Spectrum of 51 Peg, Elodie at OHP, 1 Nov 1995



- 4. Checking properties on Exoplanet encyclopaedia (period, stellar type, etc…) and with Simbad

Properties from Exoplanet Encyclopaedia
http://exoplanet.eu/
Available in VO- format

The Extrasolar Planets Encyclopaedia

Established since February 1995

Home | **Interactive Catalog** | Bibliography | Research | Meetings | Other Sites

Interactive Extra-solar Planets Catalog

Maintained by © 2006 ***Jean Schneider*** *(CNRS-LUTH, Paris Observatory)*
Technical support : ***Cyril Dedieu***

For the use of this catalog README first.

1.a. Candidates detected by radial velocity (update : **18 May 2006**)

[<< Back to the Index Catalog] [**Data Catalog**] [Histograms] [Correlation Diagrams] [Planet Table]

(sorted by **increasing period of the closest planet**) **Statistics :** 154 planetary systems / 180 planets / 19 multiple planet systems

Planet Data (PDF VERSION - ALL FORMATS) MORE DATA >>

PLANET	Mt.sin*I* (M_{JUP}) - stats	PERIOD (days) - stats	SEM-MAJ AXIS (AU) - stats	ECC.	INCL. (deg) - stats	STATUS	DISCOV. (year)	UPDATE
OGLE-TR-56 b	1.45	1.2119189	0.0225	0	81	R	2002	22/08/05
OGLE-TR-113 b	1.35	1.4324758	0.0228	0	88.2	R	2004	14/04/06
OGLE-TR-132 b	1.19	1.689857	0.0306	0	85	R	2004	13/04/05
Gliese 876 d	0.023	1.93776	0.0208067	0	-	R	2005	22/08/05
Gliese 876 c	0.56	30.1	0.13	0.27	? 84	R	2000	19/12/05
Gliese 876 b	1.935	60.94	0.20783	0.0249	84	R	2000	19/12/05
HD 86081 b	1.5	2.1375	0.039	0.008	-	R	2006	18/04/06

Star : 51 Peg

From the Extrasolar Planets Encyclopaedia : http://www.obspm.fr/planets

THE STAR

- **Basic data** :

Name	51 Peg
Distance	14.7 *pc*
Spectral Type	G2 IV
Apparent Magnitude	V = 5.49
Right Asc. Coord.	22 57 27
Decl. Coord.	+20 46 07

- **More data** :
  - Basic data (from Simbad)
  - Most recent ref (from ADS)

PLANET

- **Basic data** :

Name	51 Peg b
Mass	0.468 (± 0.007) M_J
Semi major axis	0.052 *AU*
Orbital period	4.23077 (± 5e-05) *days*
Eccentricity	0
Omega	0 *deg.*
$T_{max\ VR}$	2497 (± 0.022) *JD 2.450.000*

- **51 Peg Remarks** :
  - The orbital distance to the star (0.05 AU) was incompatible with theoretical predictions (A. Boss, *Science*, **287**, 360, 1995) and has triggered speculations on orbital migration (Lin *et al.* 1996, Rasio *et al.*, 1996)
  - **No** second companion found (Marcy 1996)
  - Further evidence for a planet (Hatzes *et al.*, 1996, 1997): nonradial oscillation modes ($l > 4$) excluded to explain RV amplitude
  - Further evidence for a planet (Pravdo *et al.*, 1996) from X-ray non detection
  - Planet or M2 star? This question was implicitely raised by a paper by the PTI team claiming that the 51 Peg system may be resolved. See the comment by G. Marcy
  - Circumstellar disk searched for at UKIRT and KECK but not found (Trilling *et al.* 1999 and 2000)

- **51 Peg Other web pages** :
  - Geneva Observatory data
  - Velocity curve and data (Butler and Marcy)
  - Precise radial velocity with AFOE (Advanced Fiber Optic Echelle Spectrometer; Sylvain G. Korzennik *et al.*, Harvard)
  - photometric monitoring of 51 Peg at Mount Wilson (Henry *et al.*) versus orbital phase and Julian Date
  - 51 Peg Web page at U. of Oregon.
  - Sky chart (Seti League)
  - Vanishing World (Scientific American)

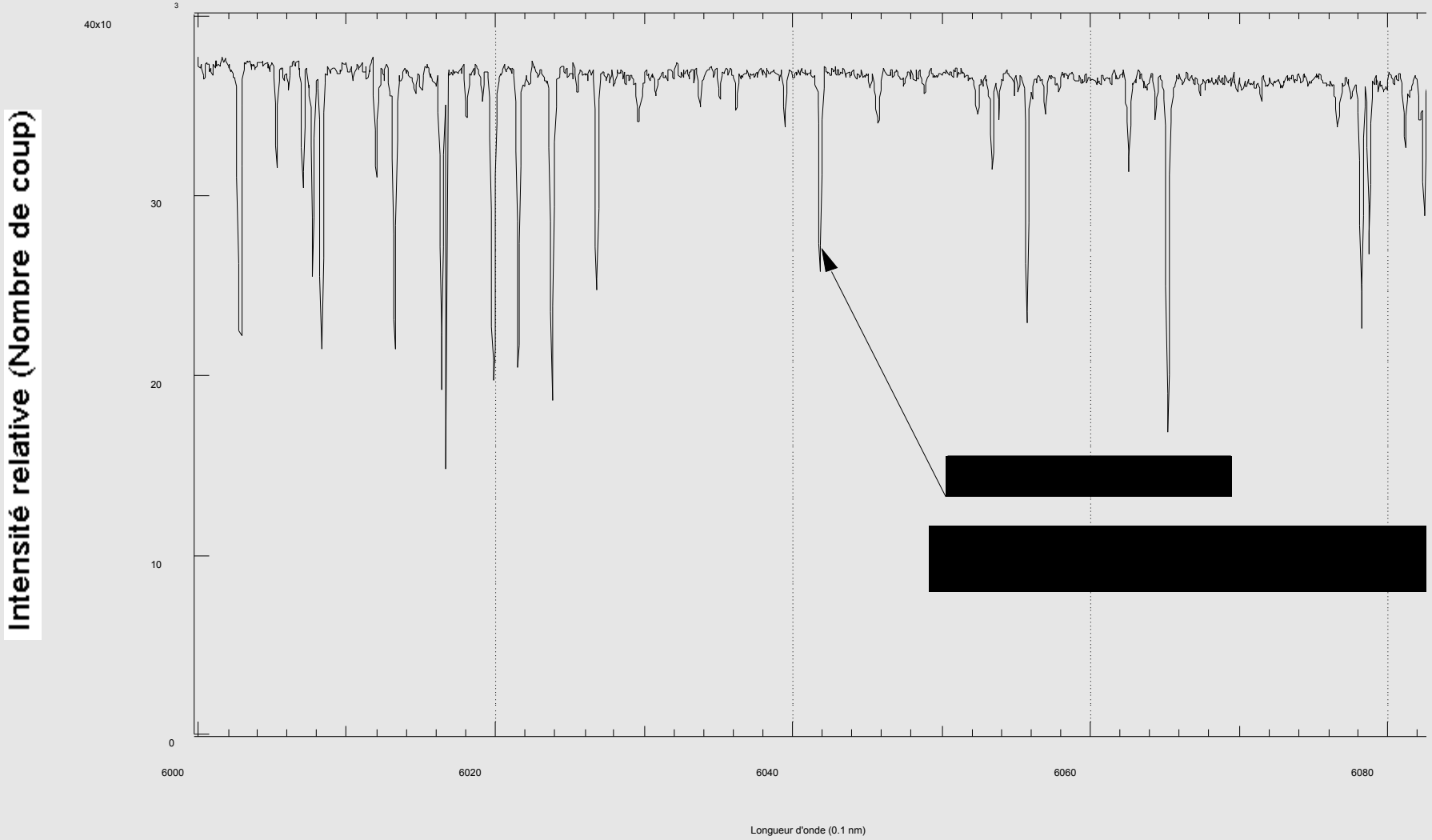
5. Checking reference of spectral lines at http://amdpo.obspm.fr/

BASECOL

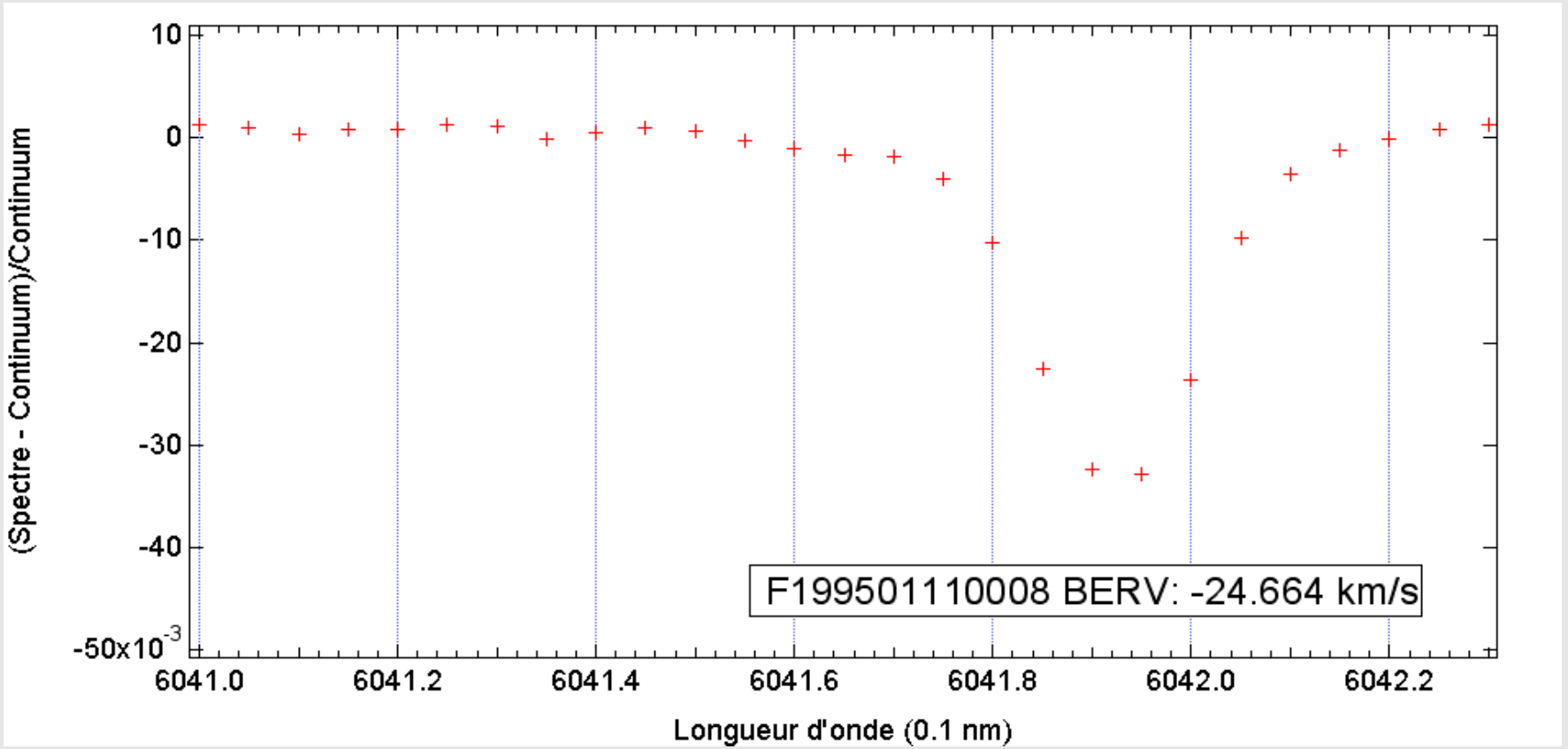
RO-VIBRATIONAL COLLISIONAL EXCITATION

Database and Utilities

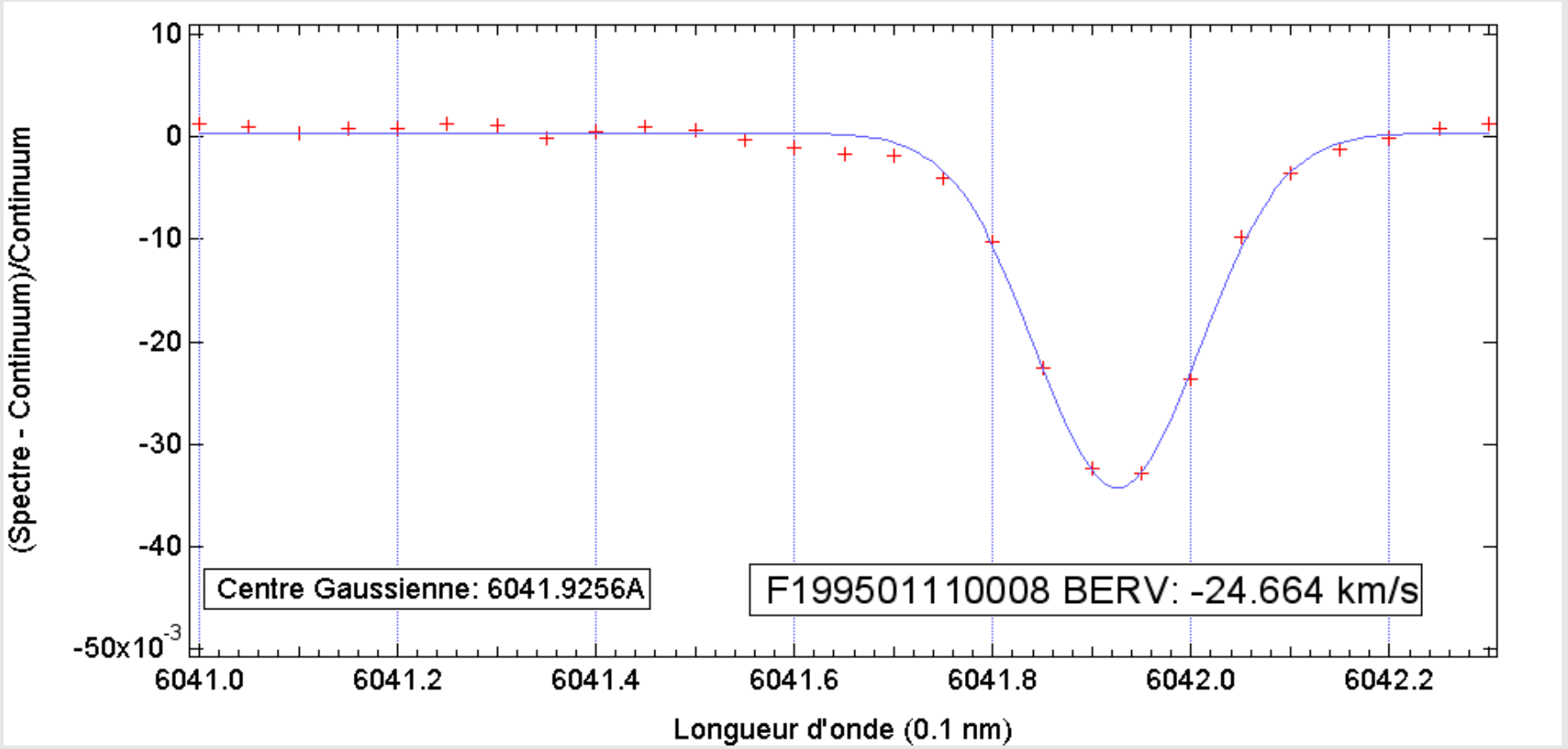
Selected spectral line



6. Spectral analysis for all spectra at 6042 A



7. Fit of 6042 A by a simple Gaussian: => Spectral shift

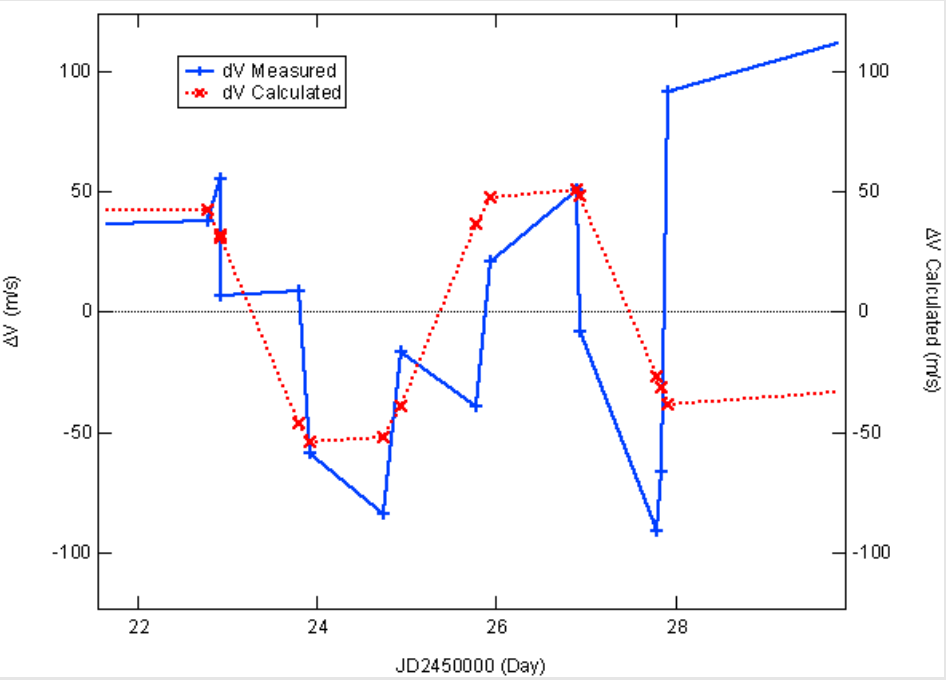


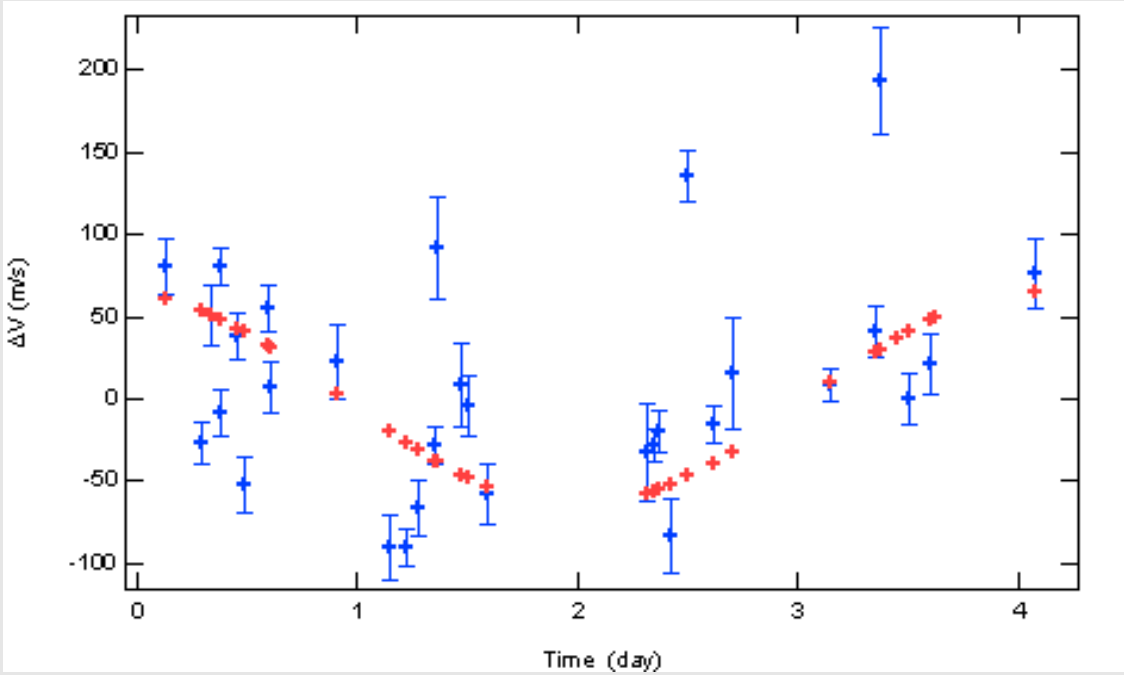
For all downloaded spectra

7. Periodicity check or search

- If known exoplanet: period, intensity of ΔV vs time.
- If not: ΔV versus time and search for periodicity

Results for 51 Peg





One Period

One Year, modulo the period

D. DEMO

Conclusion

- Results in VO Format
- To be extended to other data bases
- To be extended to other applications

  Asteroid search in DFBS

  H2O in spectra

  Temperature of exoplanets

Etc…