Science Analysis in VO Environment
A Case Study

(Integrating DAL and WGS for Spectra Disentangling)

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Spectra Disentangling

For blended spectra of binary (multiple) stars

Very powerful

Requires good orbital coverage, estimate of orbital parameters (SIMBAD)

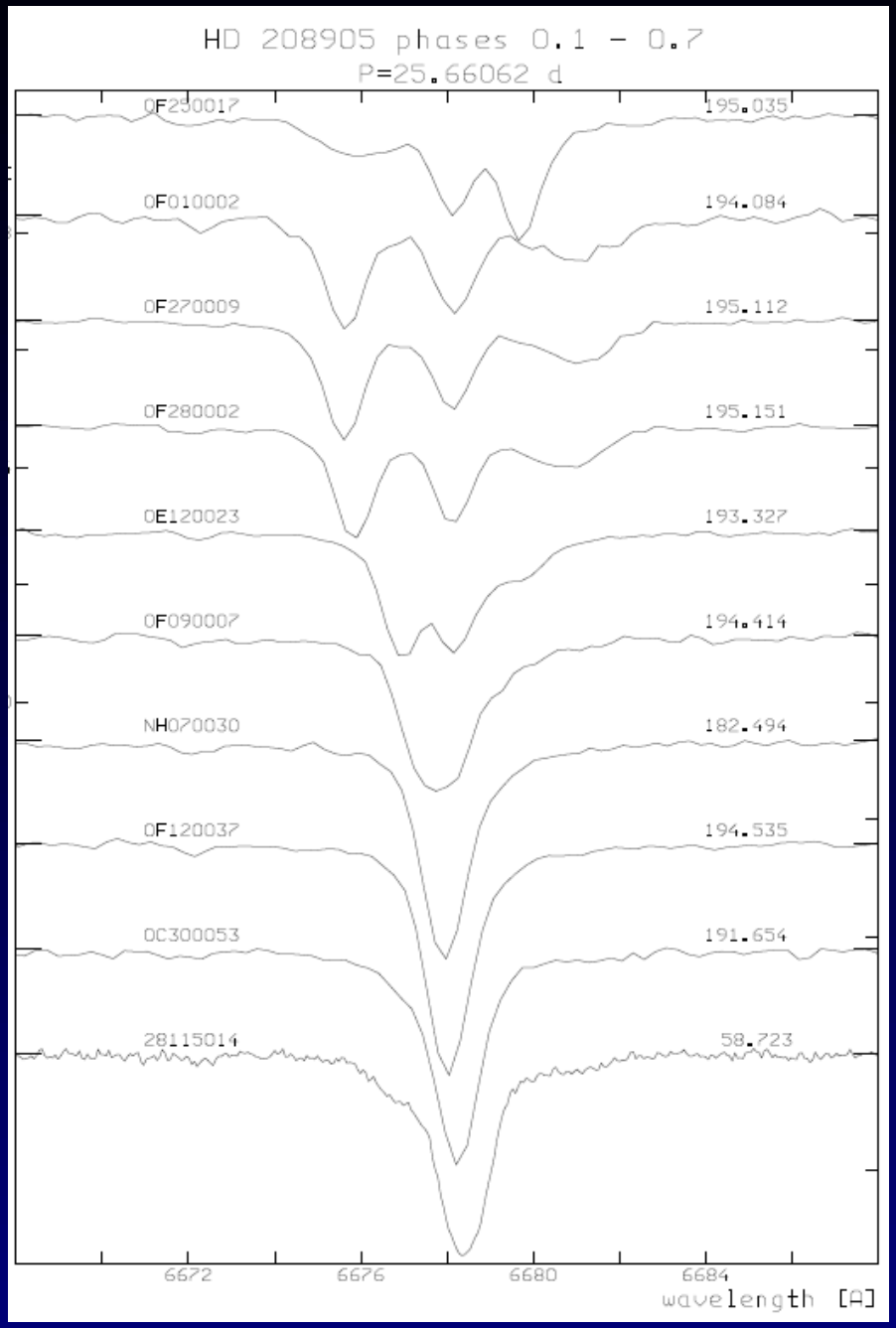
Wavelength space disentangling (Simon&Sturm)

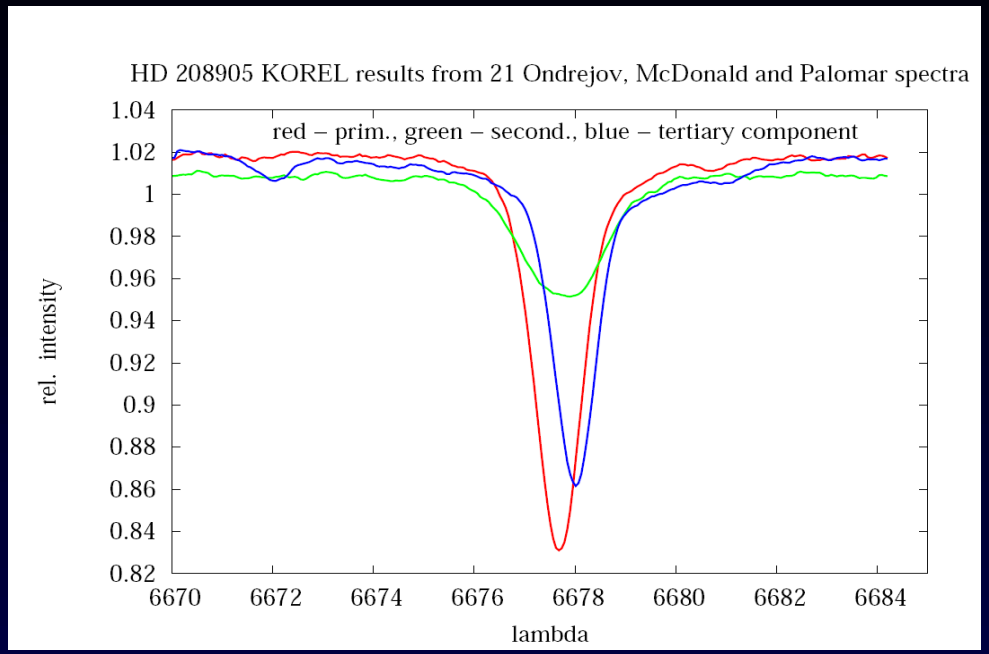
Fourier disentangling - (Hadrava 1995, 1997)

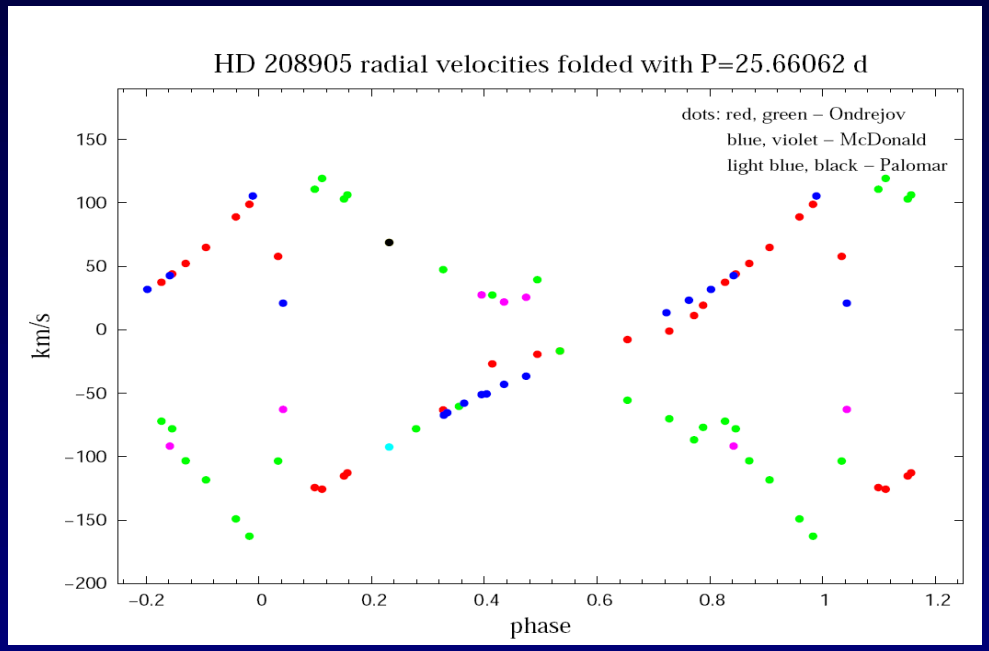
not only multiple stars - Pulsation, telluric lines, models of limb darkening, spots – still new theory

super resolution of spectra (subpixels)

Spectra Disentangling in Fourier Space - KOREL







HD208905: Koubsky et al. 2006

KOREL program (user view)

Product of ingenious scientist (punchcard culture)

Breaks all SW engineering standards, habits...

KOREL = F77 program of F66 scientist (IBM360)

Static arrays (dim Parameters, 2^n size FFT)

Author does not want to change (too much)

After bad experience not open source anymore

Not an fixed format - ad hoc changes (science)

Parameter file scarce, no comments (1 0 0 2 1..)

Different versions – 2^n, DOS/UNIX CR/LF ^Z

*** Cryptic for newcommer ***

KOREL program (SW developer view)

KOREL is nice backend engine

Works with files as filter (params + data (+templ))

Outputs iterations, output spectra, PS image...

Refeeding part of output to input (multi dim iterat)

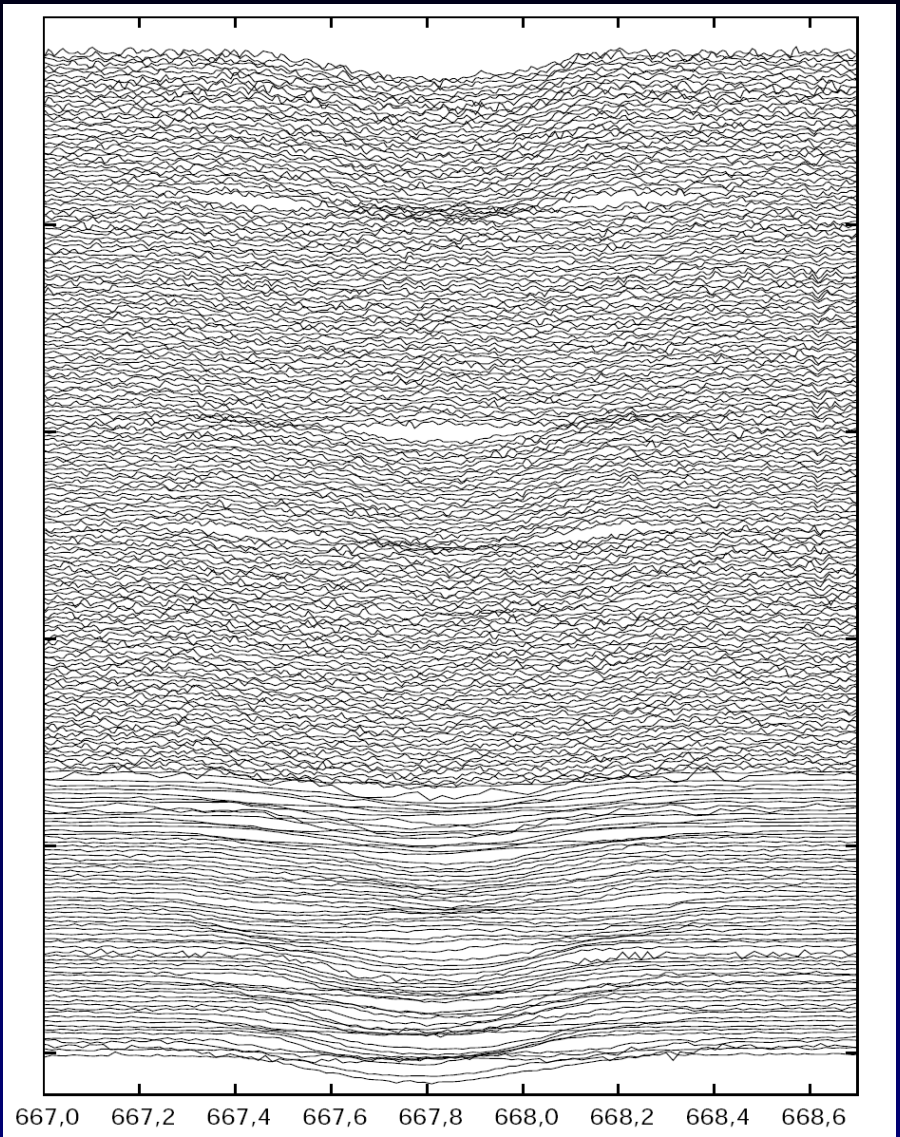
Programmable state automat driven by configuration file (different units on/off in pars)

Prepare data input (ASCII) - Interaction needed graphics = PREKOR (DOS, MS FORT)

Spectra visualization, cutout, rebin to ln wave

Access spectra by lists (remove bad SNR)

PREKOR tasks



V436 Per Janík 2003

Select multiple regions

Really 100-1000s spectra

Small regions (at sharp lines)

Stack or overplot

Check ranges before FFT

rebin to common grid in ln(lamda)

PREKOR role solved individually (Mathematica, MIDAS, Python)

output KOREL.DAT in ASCII

KOREL as VO service - idea

Run on GRID (dedicated or distributed, parallel)

Using VO for getting data, convert, display (user interaction)

Parameters in web form, upload config

User upload of data

Once run produces growing output

Redirected to graphic visualization

Or simple produce png – refresh

Send component spectra to postproc (classifier using synthetic grids, rotation...

KOREL Web Service (May 09)

The KOREL.DAT, KOREL.PAR left on user

User autentication and authorization (admin)

Upload parametric and data files (2-3)

check of upload

Run job (synchronous, asynch UWS in prep.)

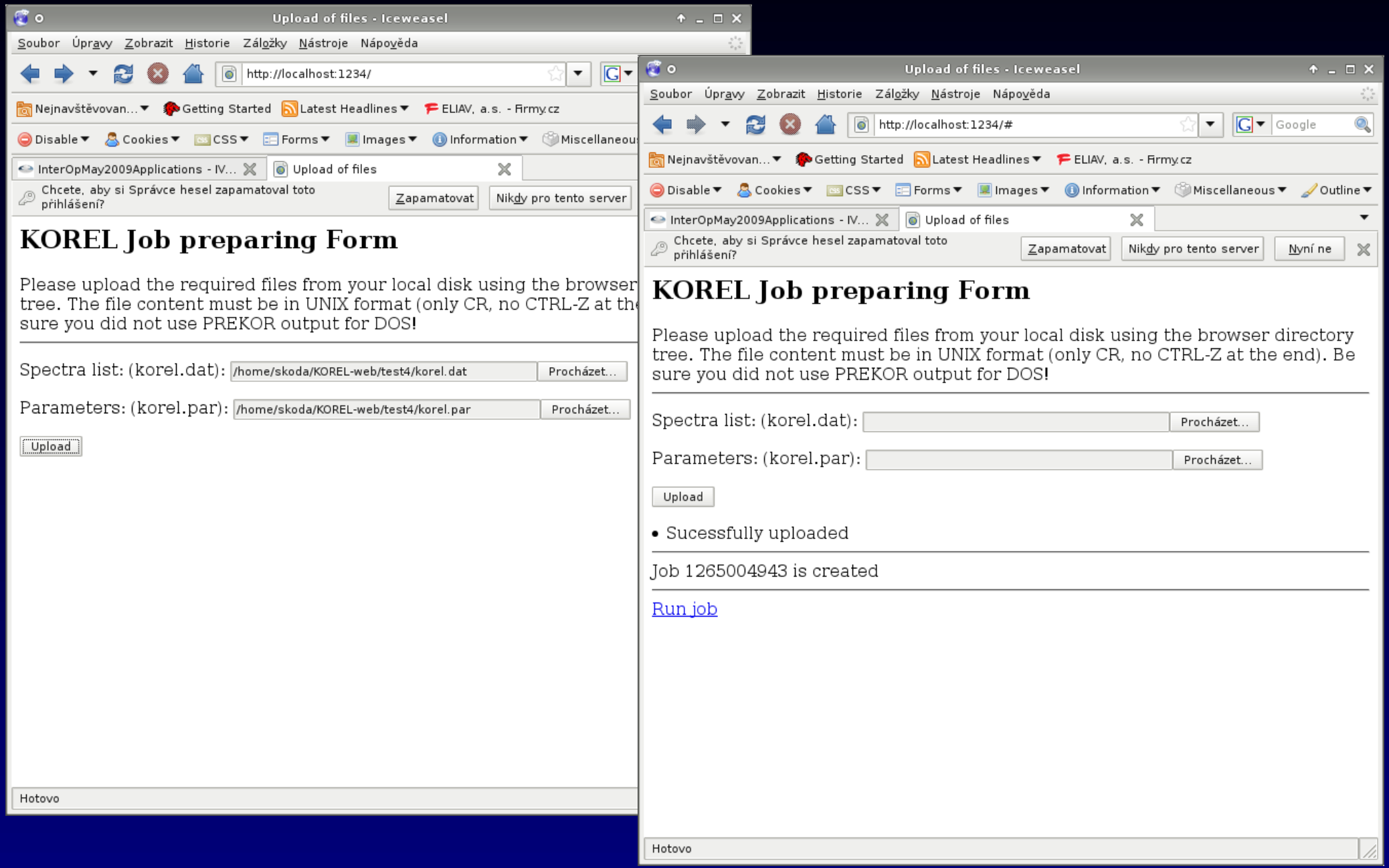
On-the fly output of png (ps), results on click

List jobs of user – storage for limited time

Re-editing parameters, resubmit

Job control (queue, max mem, time, users ?)

Upload of param and data file



Results and resubmitting

KOREL Job - Iceweasel

Soubor Úpravy Zobrazit Historie Záložky Nástroje Nápověda

http://localhost:1234/run.php?id=1098731063

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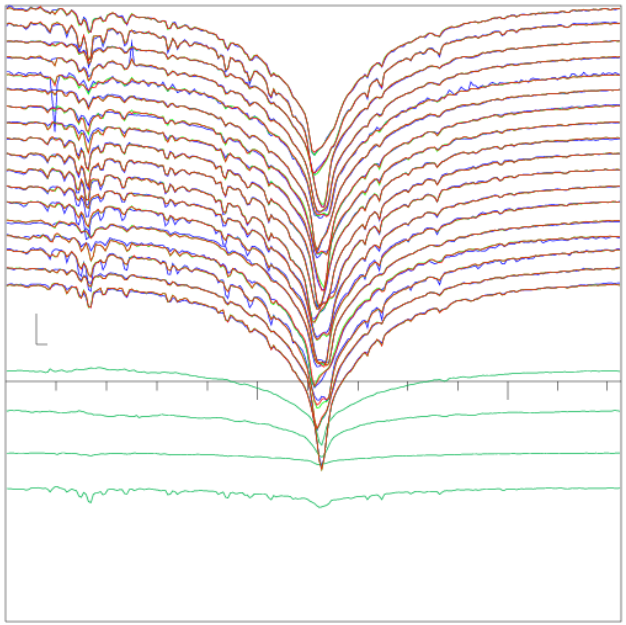
InterOpMay2009Applications - IV... KOREL Job

- Starting KOREL job 1098731063 ...
- Job complete

Results:

The disentangled spectra :



The result file korel.res

The whole job directory may be downloaded here

The parametric file, can be edited here.

Hotovo

KOREL Job - Iceweasel

Soubor Úpravy Zobrazit Historie Záložky Nástroje Nápověda

http://localhost:1234/run.php?id=1098731063

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InterOpMay2009Applications - IV... KOREL Job

The result file korel.res

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The parametric file, can be edited here.

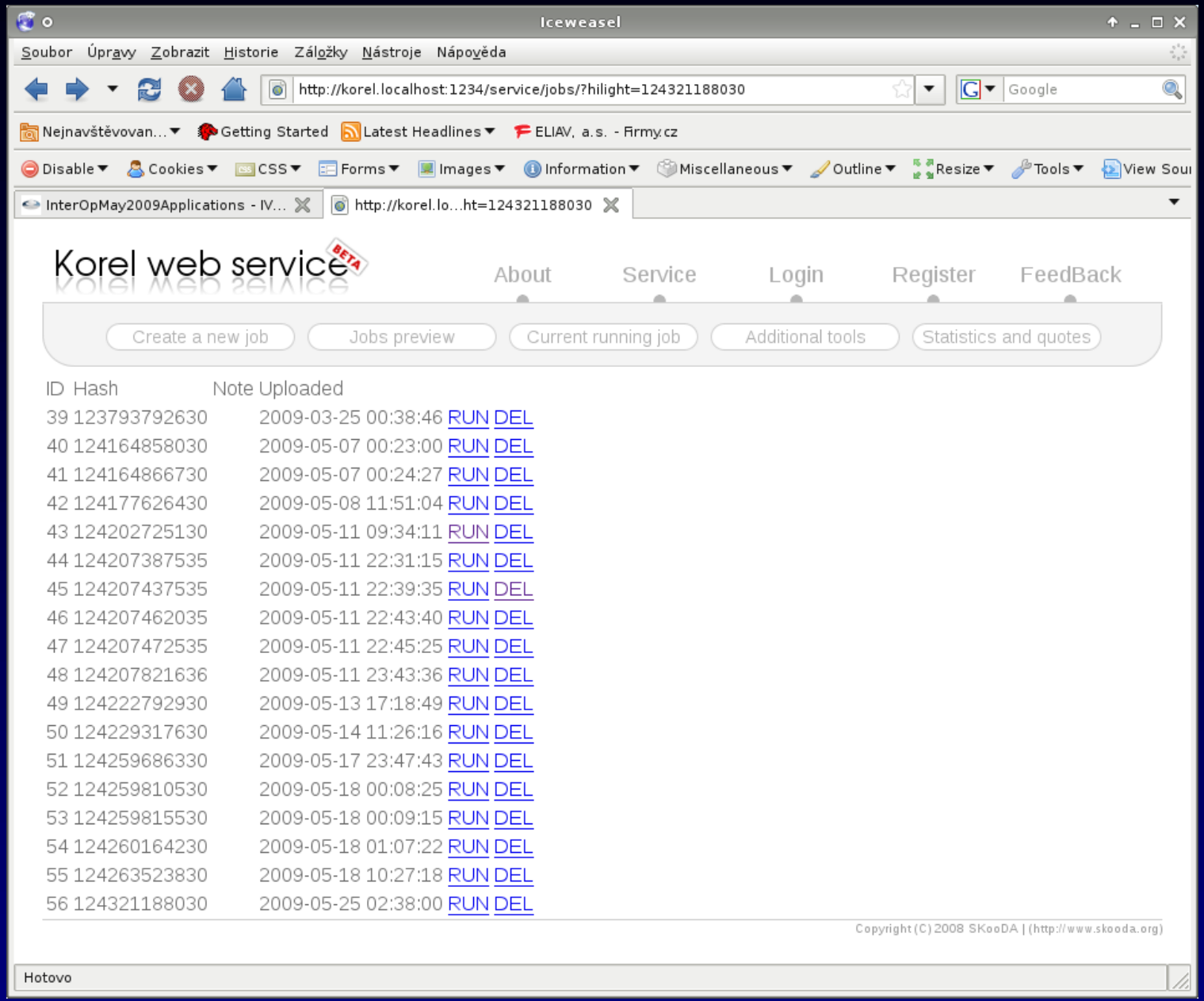
```
1 1 1 0 1 1 0 2 2 | key(1,...,5), k= Nr. of spectra>0, filter, plot
o 0 1 0 1 0      2.553798000  .0001 | 55 UMa sum= 8.504271844767466
o 0 2 0 1 1  49735.178839985  .002  |
o 0 3 0 1 1       .319733351  .01   |.357
o 0 4 0 1 1    122.951438877  1.1    |
o 0 5 0 1 1     76.095988350  .2     | 87...
o 0 6 0 1 1       .983388967  .01   |
o 2 1 0 1 0 1891.900000000   10.
o 2 2 0 1 1  52715.641149148   5.
o 2 3 0 1 1       .323942615   .03
o 2 4 0 1 1    243.685345134   5.
o 2 5 0 1 1     11.440382020   1.
o 2 6 0 1 1       .518137882   .1
o 3 1 0 1 1    365.256360000   .1          365.242200000   .1
o 3 2 0 1 1  51547.520600000   10.       49722.000000000   10
o 3 3 0 1 1       .016710220   0.001         .016730100   0.001
o 3 4 0 1 1    219.405411671   10.         220.909574736   2.
o 3 5 0 1 1       .001000000 .0001           .001578379   .001
o 3 6 0 1 1       .000039078 .000001         .000073525   .000001
o 3 7 0 1 1       .000009111 .00000001
s 1 01 0 1 0  -.19610  .1
s 1 02 0 1 0  -.07307  .1
s 1 03 0 1 0  -.10926  .1
s 1 04 0 1 0  -.11544  .1
s 1 05 0 1 0   .01207  .1
s 1 06 0 1 0  -.13162  .1
s 1 07 0 1 0   .07563  .1
s 1 08 0 1 0   .07801  .1
s 1 09 0 1 0  -.08540  .1
s 1 10 0 1 0   .00624  .1
s 1 11 0 1 0  -.03080  .1
```

save

Run new job

Hotovo

Beta version – jobs control (REST)



Spectra Postprocessing Service

- Normalization critical (continuum – long scale FT)
- Current funcionality
  - Different ServiceURL for cutout (BAND select/cut)
- Future development
  - Rebinning – how to specify in SSA ?
  - Orders at echelle ? ASSOCIATION
  - Transformation described by params (SSAv2???)
  - Instrument profile (de)convolution
  - Broadening functions (rotation, limb dark)
  - RV shift
- Not all in client – several servers (transform pipe)

NORMALIZED spectra in VO

Most optical spectra in two versions

Raw counts (unrectified, but wavelength calib)

Normalized (1.0) – most of final reports (even artistic continuum – novae , molecular bands)

How to present in VO ?

2 files, same metadata, FLUXCALIB=NORMALIZED → other directory?

How to refer continuum curve

Ratio, reference continuum ?

Conclusions ???

Is it feasible with current :

- standards (protocols, data formats
- clients
- Web services (REST)

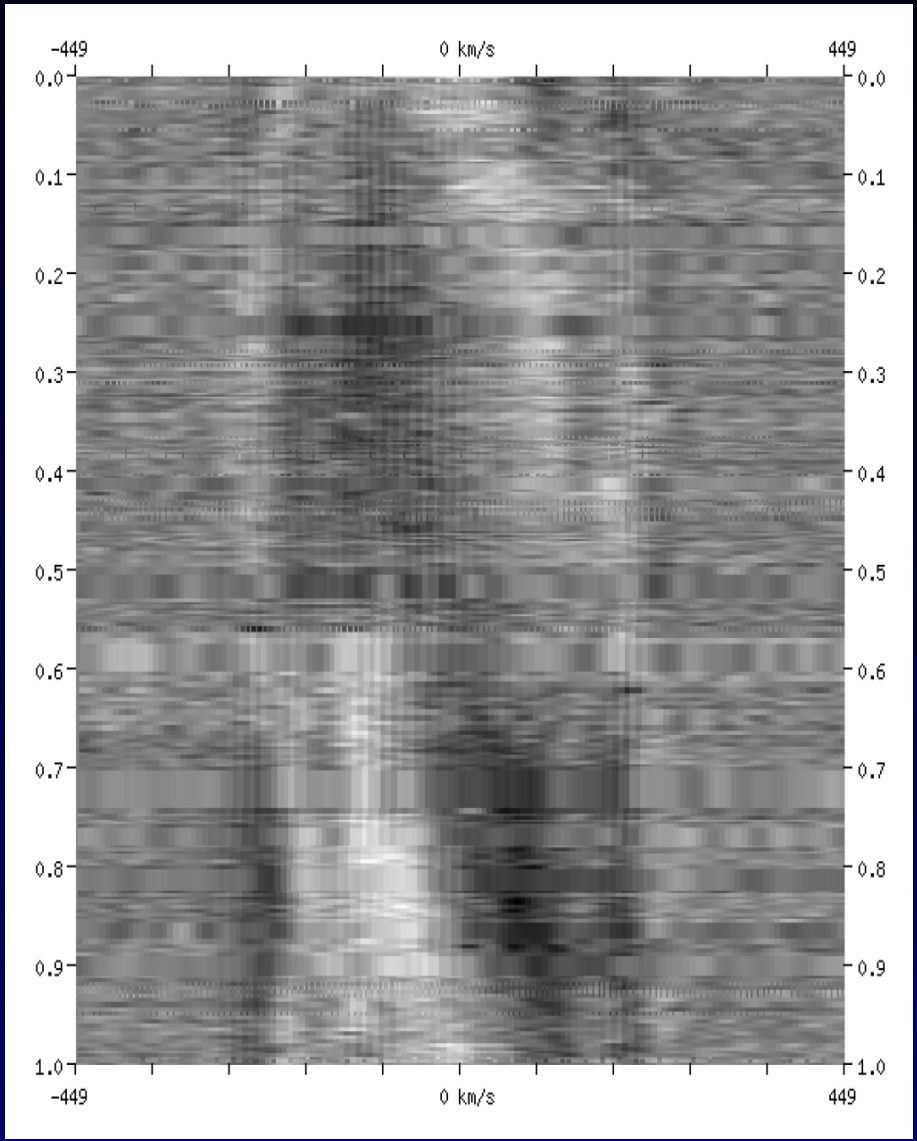
Is it efficient ?

- One server for all
- distributed postprocesing with remote accref:
- All in client (interraction crucial)

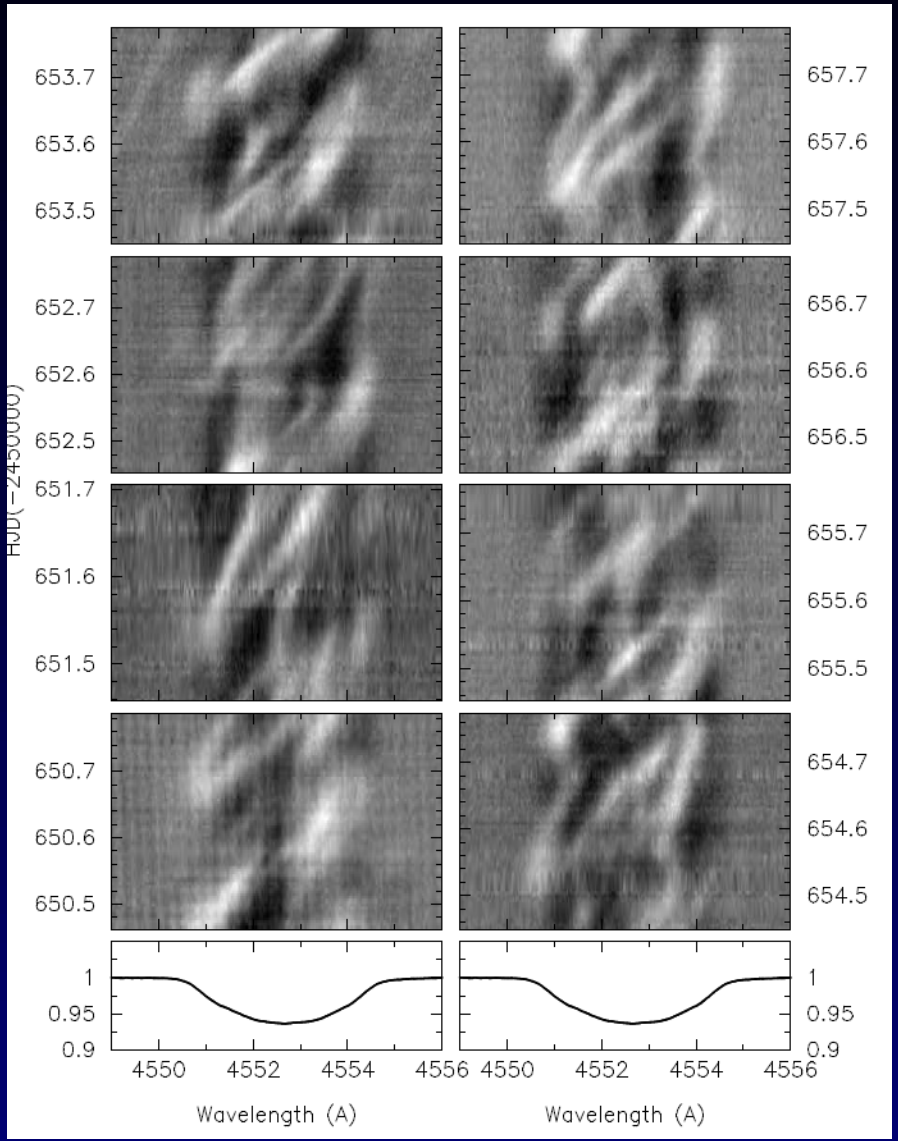
Is it worth to do it in VO way ?

- Potencial users = very conservative stellar astronomers (test BIN Brno June 2009)
- What does it bring NEW to current users ? (spectrum conversion, rebinning, selection, GUI)
- **Prototype for other services** (dynamical spectra, automatic RV, EW, model best fit) - see 2 examples:

Postprocessing - Dynamic Spectra

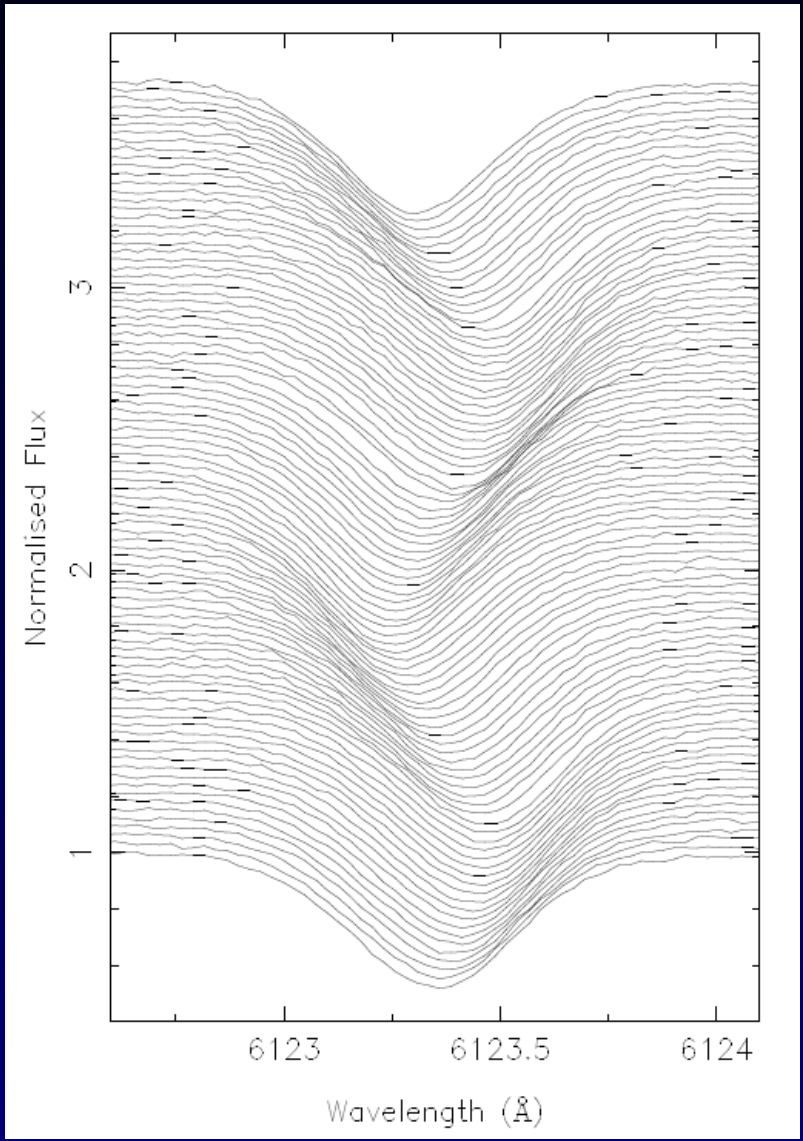


Netolický 2004

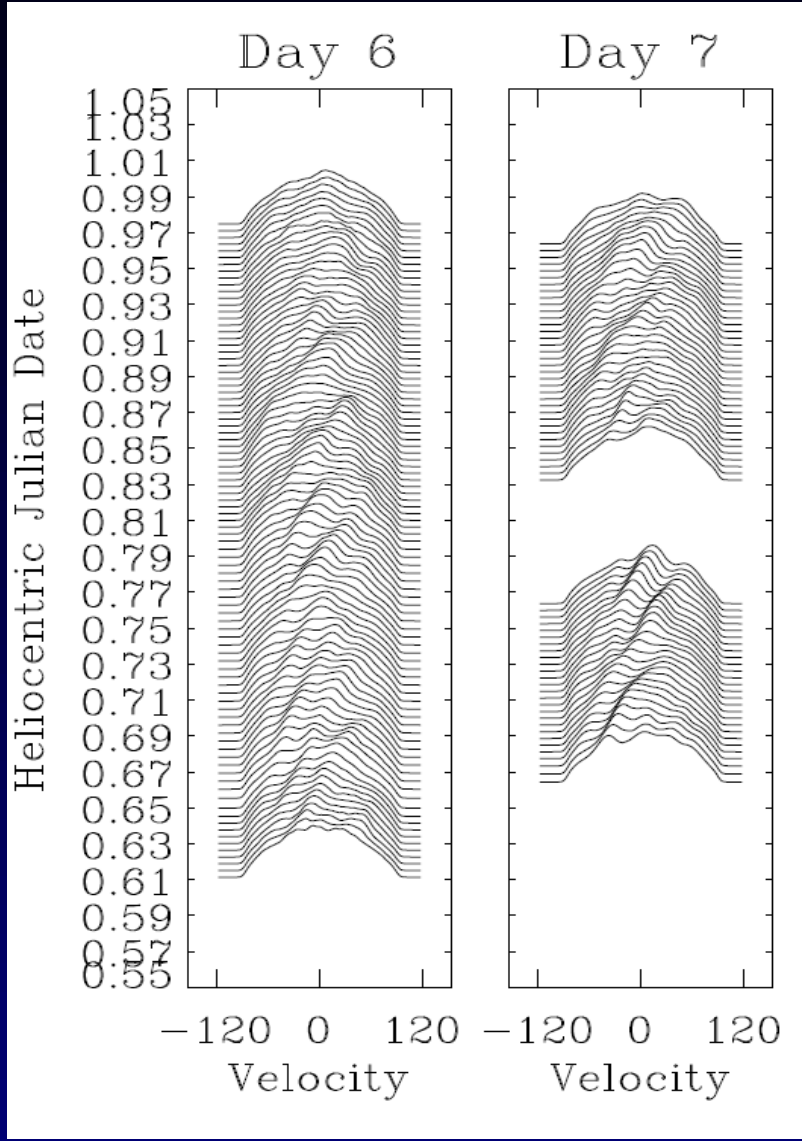


Lambda Sco: Uytterhoeven 2004

Disentangle modes - Pulsations



Rho Pup – del Sct type



Eps Cep - del Sct type