SYNSPEC

SYNSPEC

- calculation of synthetic spectra of stellar atmospheres and disks
- input model atmospheres TLUSTY or ATLAS

Hubeny, I., Štefl, S., Harmanec, P., 1985, Bull. Astron. Inst. Czechosl. 36, 214

http://www.physics.muni.cz/~krticka/synspec49.tgz

Equation to solve

- radiative transfer equation

$$\mu \frac{\partial}{\partial z} I(z,\mu,\nu) = \eta(z,\nu) - \chi(z,\nu) I(z,\mu,\nu)$$

- fixed structure of atmosphere

Files with the source code

http://nova.astro.umd.edu/Synspec49/synspec.html

- synspec45.f code
- PARAMS.FOR some basic settings
- LINDAT.FOR, MODELP.FOR
- rotin3.f code for the rotational convolution

compilation:
ifort [-O3] synspec45.f

Input files

http://nova.astro.umd.edu/

- file 1: the same as in TLUSTY
- file 5: the same as in TLUSTY
- files of the model ions (as in TLUSTY)
- nonstandard settings (as in TLUSTY)
- file 55: basic parameters of the calculation
- file 56: change of the chemical composition
- file 19: line list
- file 8: input model atosphere

File 55 (fort.55)

```
0 30 1          !IMODE, IDSTD, IPRIN
0 0 0 0         !INPUT MODEL, INTRPL, ICHANGE, ICHEM
0               !IOPHLI
0 0 0 0 1       !IFREQ, INLTE, ICONTL, INORIG, IFHE2
0 0 0 0 0 0 0 !ILYCS,IBVCS,IHE1,IHE4471,IHE2UV,I
4000 7000 10 10 1d-6 0.001 ! ALAM0,ALAST,CUTOF0,
                             CUTOFFS,RELOP,SPACE
2.0               ! turbulent velocity (in km/s)
```

Input parameters

`IMODE`: mode of calculation
`IDSTD`: index of the standard depth (unity optical depth)
`IPRIN`: amount of output
`INPUT MODEL`: (0=ATLAS, 1=TLUSTY)
`IOPHLI`: treatment of hydrogen lines
`INLTE`: treatment of NLTE
`ALAM0,ALAST`: wavelength limits
`RELOP`: minimum relative contribution of lines
`VTB`: turbulent velocity in km/s

Example tun

/home/krticka/prakaf/synspec/synspec

file syn:

```
DOMA=/home/krticka
JOBID=$1
MODEL=$2
LINES=$3
ln -s $MODEL.7 fort.8
ln -s $JOBID.55 fort.55
ln -s $DOMA/GF/$LINES fort.19
$DOMA/prakaf/synspec/synspec45 <$MODEL.5
     >! $JOBID.6
cp fort.7  $JOBID.7
cp fort.17 $JOBID.17
cp fort.12 $JOBID.12
cp fort.18 $JOBID.18
cp fort.13 $JOBID.13
cp fort.10 $JOBID.10
rm fort.*
```

Example run

`/home/krticka/prakaf/synspec/synspec`

file `syn`:

run `syn slun.s slun gf99.dat`

input files `slun.5, slun.7, slun.s.55, gf99.dat`

output files `slun.s.6, slun.s.7, slun.s.17 ...`

Output files

- file 6: basic model description
- file 7: emergent flux in lines
- file 17: emergent flux in continuum
- file 12: line identification (except H and He II)

CGS!

File 6 (fort.6)

- general model output
- tables with input data
- error messages

File 7 (fort.7)

- wavelength-dependent emergent flux
  (λ – Å, H_λ – erg cm^{-2} s^{-1} Å^{-1})

File 17 (fort.17)

- wavelength-dependent emergent flux in continuum
  (λ – Å, H_λ – erg cm^{-2} s^{-1} Å^{-1})

File 12 (fort.12)

- line identification table, *estimate* of the equivalent width, line strength ($*$)

Rotational convolution

- code `rotin3.f`
- input files
  - file 5: parameters of the calculation
  - file 7, file 17 (SYNSPEC output)
- output file
  - file 11: convolved spectrum (rotation+instrumental)

Input file 5

```
'fort.7' 'fort.17' 'fort.11'  ! filenames for the
70.0 0.00   0.001             ! vrot, chard, step
0.03001 0.001                 ! fwhm (instrumenta
4100 6900   1                 ! lam0, lam1, irel
```

- names of input and output files
- $v_{\rm rot} \sin i$ in km/s, 0., step
- FWHM of instrumental profile
- wavelength interval, absolute/relative spectrum

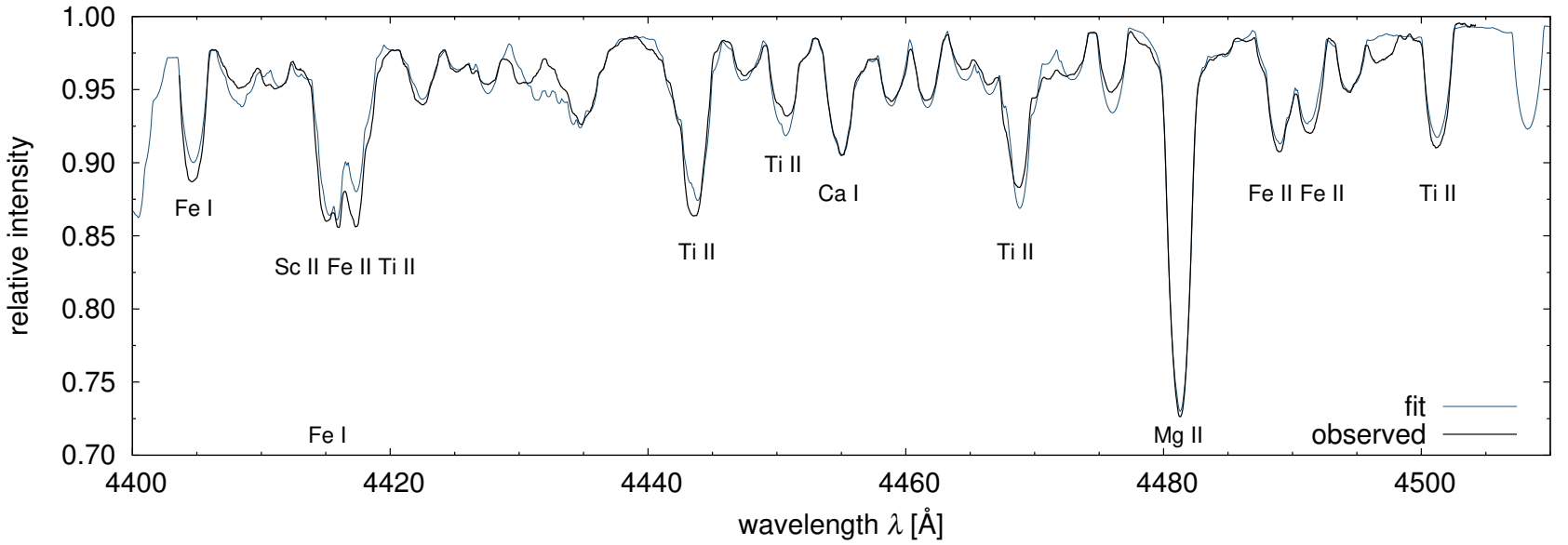
Example run

file rot:

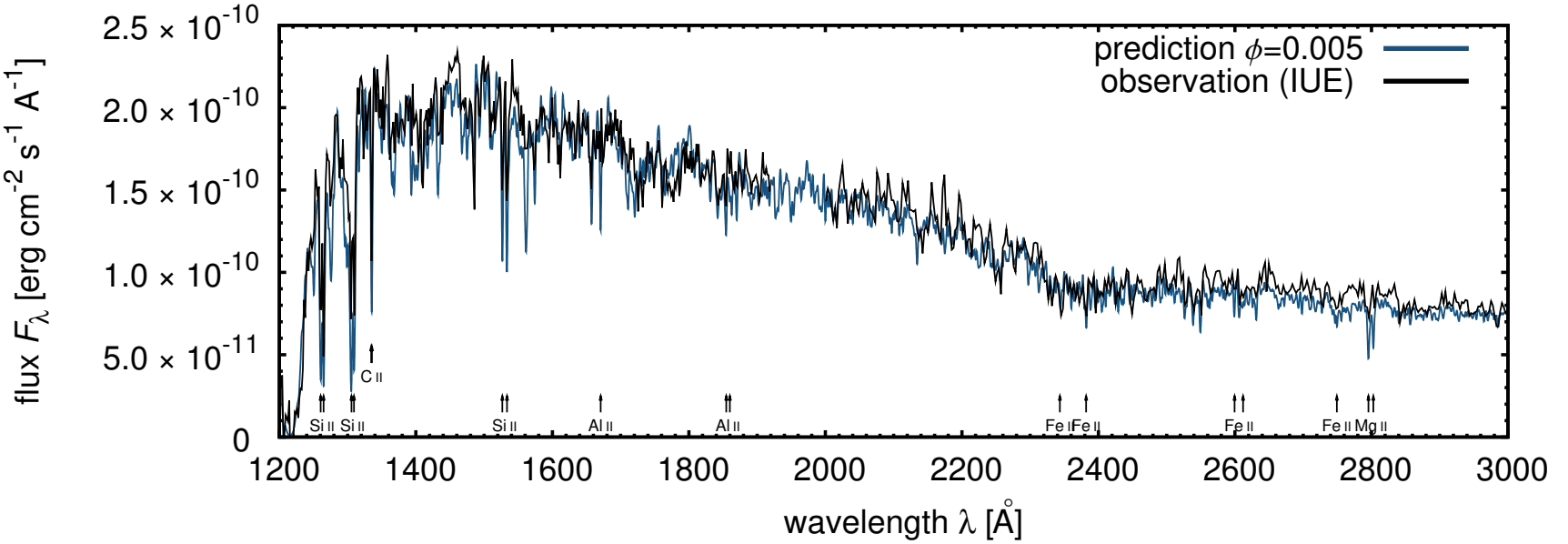
```
JOBID=$1
SPEK=$2
ln -s $SPEK.7 fort.7
ln -s $SPEK.17 fort.17
rotin3 <$JOBID.5
rm fort.7 fort.17
mv fort.11 $SPEK.11
```

execute: `rot rvs b.s`

Example of visual spectrum



Example of UV spectrum



Abundance analysis

minimalization

$$\chi^2 = \sum_{\lambda_i} \frac{\left(I_i^{\mathrm{obs}} - I_i^{\mathrm{syn}}\right)^2}{\sigma_i^2}$$