# **V**ienna
# **A**tomic
# **L**ine
# **D**atabase

*VALD team*

# VALD content

**VALD** is a collection of about 1 million of classified spectral lines with the reliable atomic parameters for accurate abundance analysis of stellar atmospheres, more than 60 million lines for opacity calculations, and 11.5 million lines for 5 isotopes of TiO

**VALD** default contains large number of individual line lists for spectroscopy organized in 145 VALD lists in configuration file

# VALD access

A registration of the client is requied in **VALD**.

Access to **VALD** data is free from charge.

# VALD content

For each line **VALD** contains:

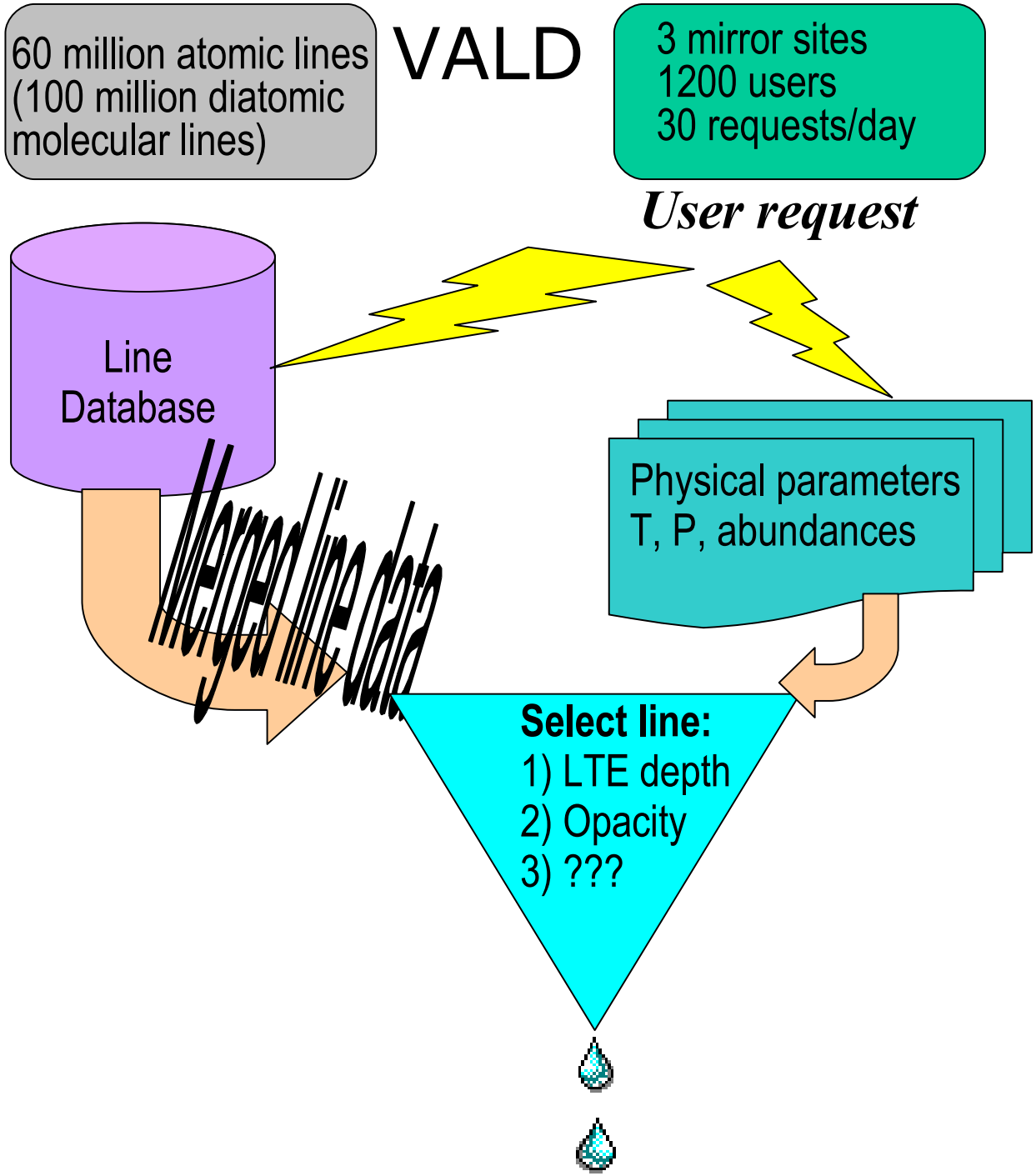
1. Wavelength, transition probability log(gf)
2. Energy, quantum number *J*, Lande factor of the lower and upper levels
3. Radiative, Stark and Van der Waals damping constants
4. Term designation, error in log(gf)
5. Reference for log(gf)

# VALD content

- Total storage requirement is 12 Gbytes
- The data is stored in a compressed format
- Compression ratio in average is 1:2.5 for *binary* files
- One can start decompression within 1000 records from any specified wavelength
- Original lists are compressed and stored separately (today $\approx$145 lists)
- For each list rank is assigned to each data item according to its quality
- Final selection is merged according to the ranks
- The default ranking is assigned by VALD group of experts
- VALD client can keep a separate personal configuration

# VALD extraction tools

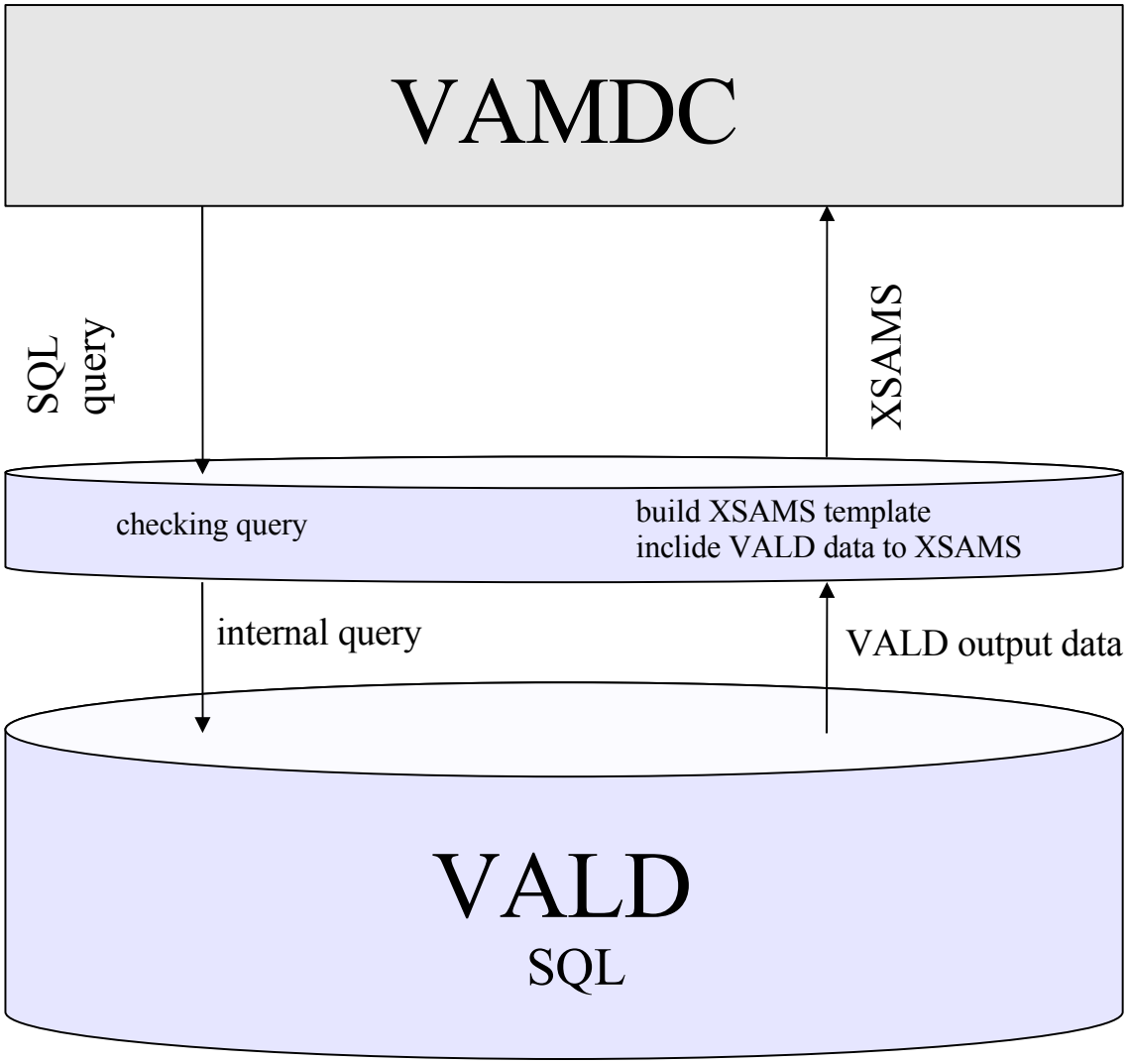
- Extraction is performed by a pipeline of programs – flexibility
- Two tools can initiate a pipeline: SHOWLINE and PRESELECT
- Next stage in the pipeline selects lines according to certain criteria (e.g. known damping constants)
- The most important tool is SELECT. It has two modes: *synthesis* and *opacity*. In the *synthesis mode* it solves the RT in the center of each spectral line and extracts only significant ones. In the *opacity mode* it selects the lines that produce significant opacity
- Performance: SELECT analyses 39500 lines in 130 sec on HP PA 8600 440 MHz workstation


60 million atomic lines
(100 million diatomic
molecular lines)
VALD
3 mirror sites
1200 users
30 requests/day
User request
Line
Database
Physical parameters
T, P, abundances
Merged line data
Select line:
1) LTE depth
2) Opacity
3) ???

# New elements in the revised version of VALD (VALD3)

- Extraction of the wavelengths is provided for vacuum, air, Ritz and wavenumbers
- Energy levels are in $cm^{-1}$.
- Extended description of electronic configuration and term name based on the connection schemes accepted in NIST
- Identification term designation in VALD → XSAMS

# Towards VAMDC ...



# Actions

- Recieving query to VALD
  - SQL format of query
  - VALD data in  open source database MySQL
  - Validation of query and sent to VALD
- Transform data from VALD to XML format using XSAMS schema
  - JAVA language, JAXB technology
  - Make XSAMS template as JAVA classes
  - Getting data from VALD SQL-table
  - Embed VALD data into JAVA classes
  - Build XML output  in XSAMS format
- Return XSAMS output

# Testing

(10.000 transition from VALD – 29 Mb in XSAMS output file)

*AMD Phenom II X4 3.0GHz with 8Gb DDR3 and local MySQL server:*

- For standalone JAVA program
  - About 2 second:
    - 0.5 sec for initialization of XSAMS template in JAVA classes
    - 1.5 sec for build XML result data
- For embedded JAVA classes in Tomcat server
  - About 1 second
    - 0.1 sec for initialization of XSAMS template in JAVA classes
    - 0.9 sec for build XML result data

# VALD mirrors

- 3 mirror sites. Automatic synchronization of line lists, list of clients, statistics, personal configuration

**VALD Mirror Sites**

1. **Institute for Astronomy, Vienna University**
   **http://vald.astro.univie.ac.at/~vald/php/vald.php**

2. **Uppsala Astronomical Observatory**
   **http://www.astro.uu.se/~vald/php/vald.php**

3. **Institute of Astronomy, Moscow, Russia**
   **http://vald.inasan.ru/~vald/php/vald.php**

4. ***NASA Goddard Space Flight Center***
   **(presently at STScI, internally)**

# VALD data retrieval

- VALD-EMS is run by cron once every 20 minutes:

  Parsemail → Process, jobXXX → parserequest →
  VALD extraction tools → email/ftp to the client

- Web interface: formulate/submit request, edit personal configuration file

# VALD collaboration

- R. Kurucz
- D.R.E.A.M. - Data Base on Rare-Earths at Mons University (Belgium)
- BELDATA – Data Base on Stark widths in Belgrade
- Institute of Spectroscopy, RAS
- University of Amsterdam (calculations for Fe-peak elements)
- University of Wisconsin, Madison (experimental transition probabilities)
- Imperial College (London)
- Lund Astronomical Observatory

# Types of VALD requests

1. **Showline –** returnes a full information collected in VALD about an individual spectral line and how data are merged for the final output to provide the best atomic parameters

2. **Extract all –** extracts best atomic parameters for all lines in a chosen spectral window

3. **Extract element –** extracts best atomic parameters for all spectral lines of the particular chemical element or ion in a chosen spectral window

4. **Extract stellar –** extracts all spectral lines (with their best parameters acoording to ranking) which produce significant absorption in a stellar atmosphere with given effective temperature and gravity

# VALD output files

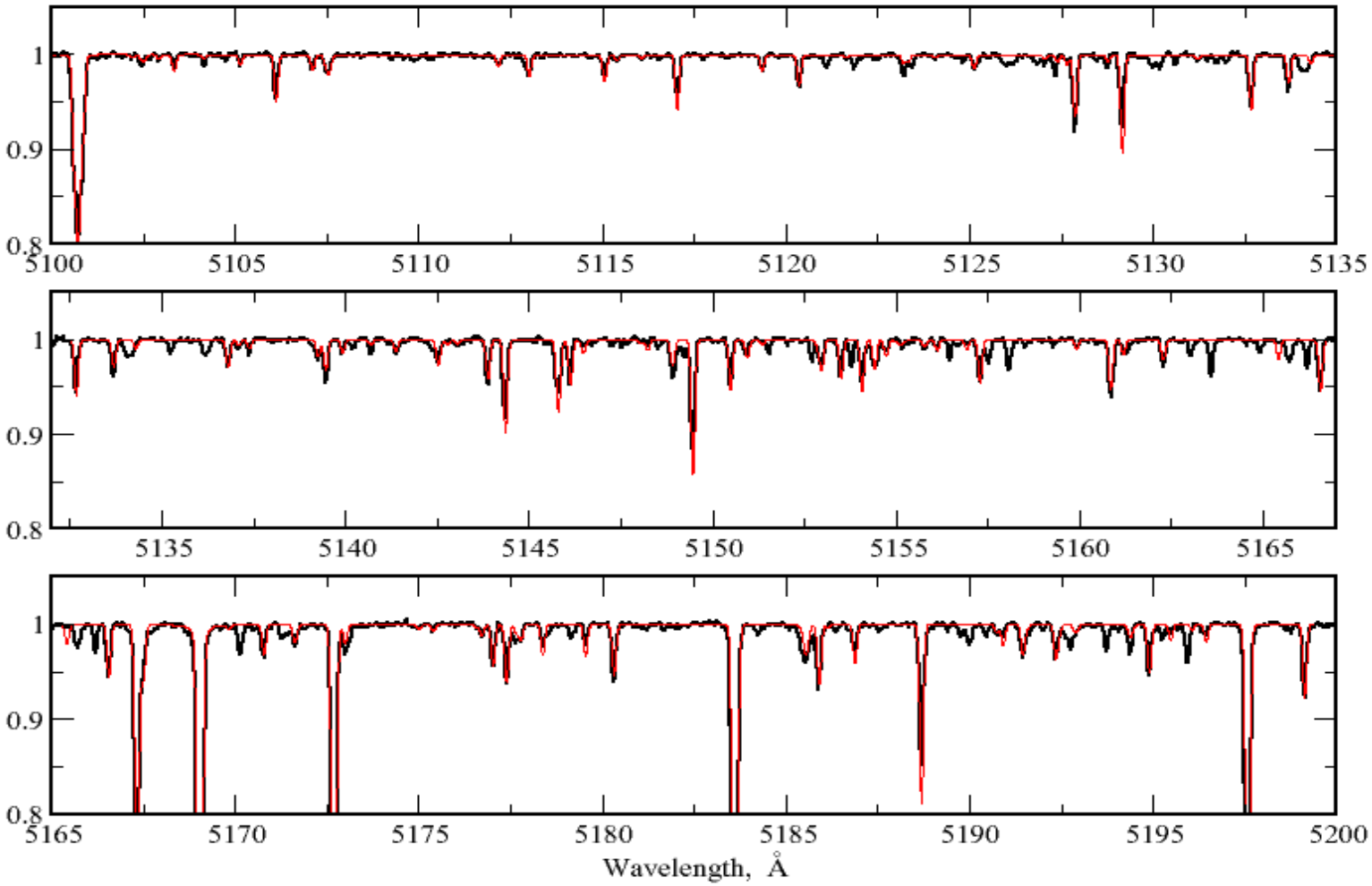
**VALD** returns data in the format directly used for synthetic spectrum calculations (simple and magnetic), model atmosphere calculations, abundance analysis, opacity tables for 3D MHD simulations.

**VALD** is the main source of atomic data for space projects CoRoT and Kepler.

Spectral synthesis

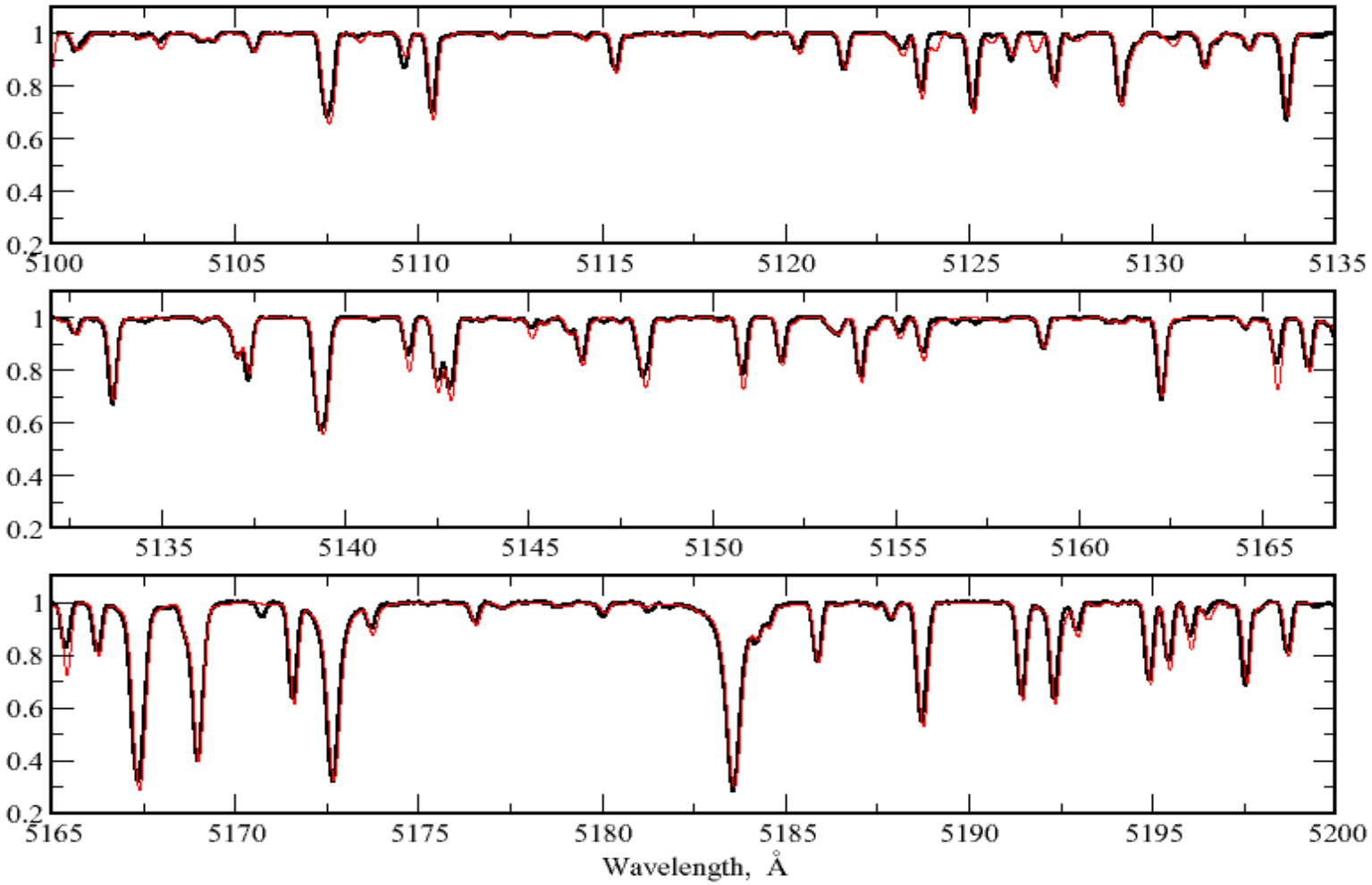
# 21 Peg

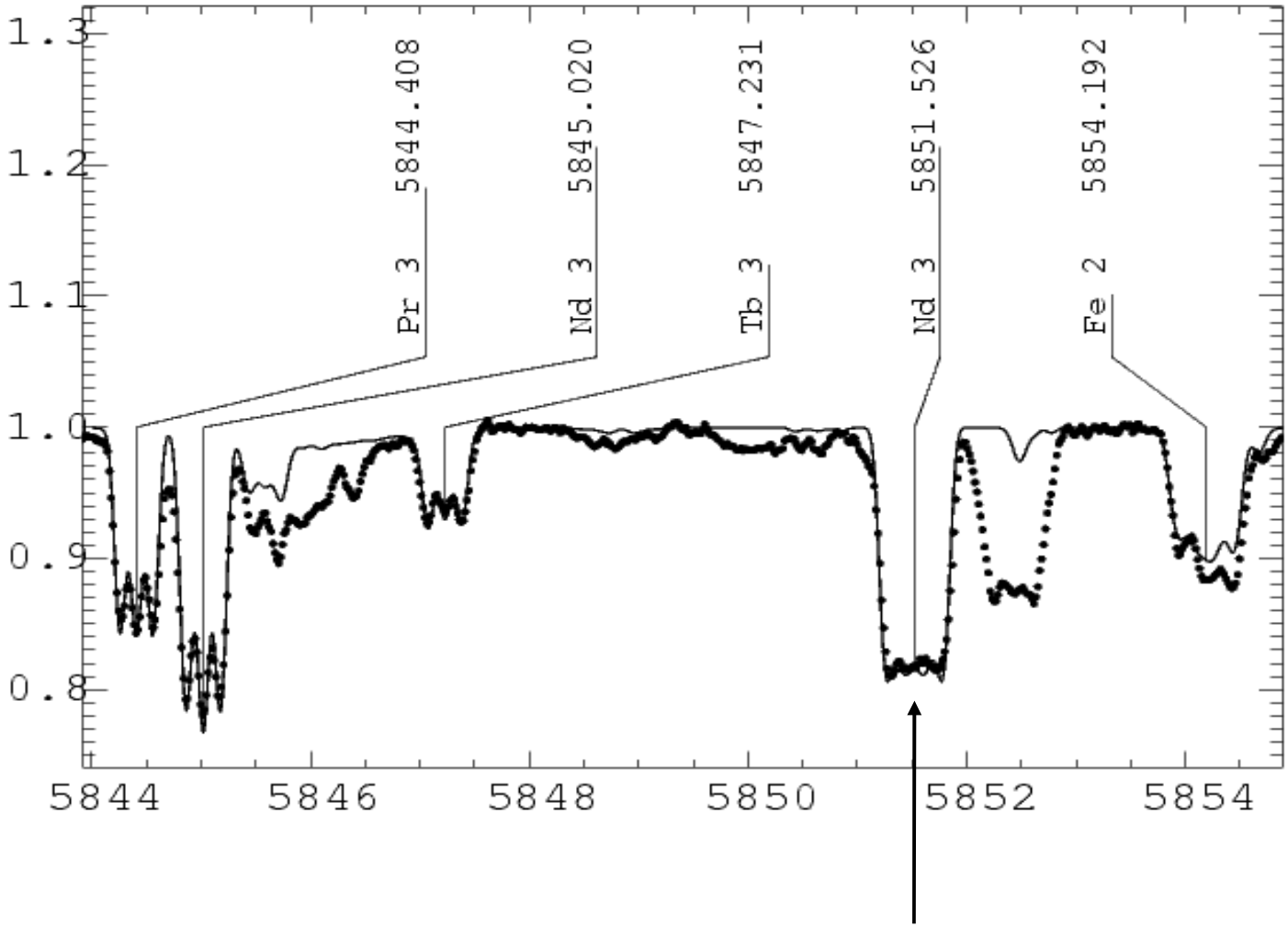
## $T_{eff}$=10400 K, logg=3.75



# HD 49933

## $T_{eff}$=6450 K, logg=3.90






New classified Nd III line