

# IRAF

## Budowa i Instalacja Pakietu

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CA UMK Torun

# IRAF basics

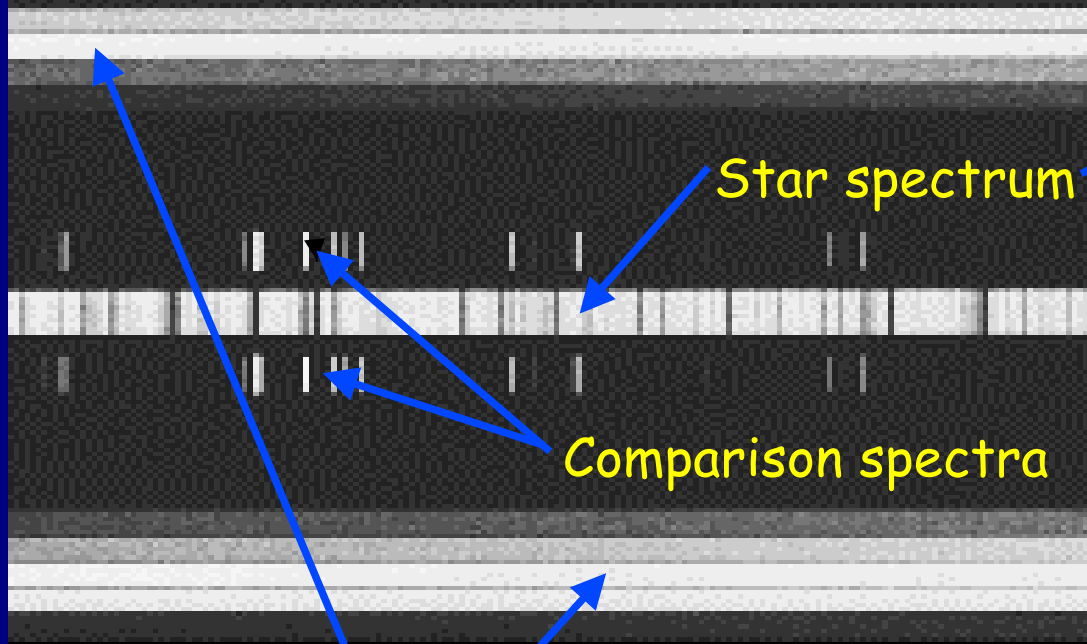
---

- Why IRAF and for what we can use it
- Installation
- Philosophy and practice of IRAF
- IRAF set-up
- Reading, writing and printing data

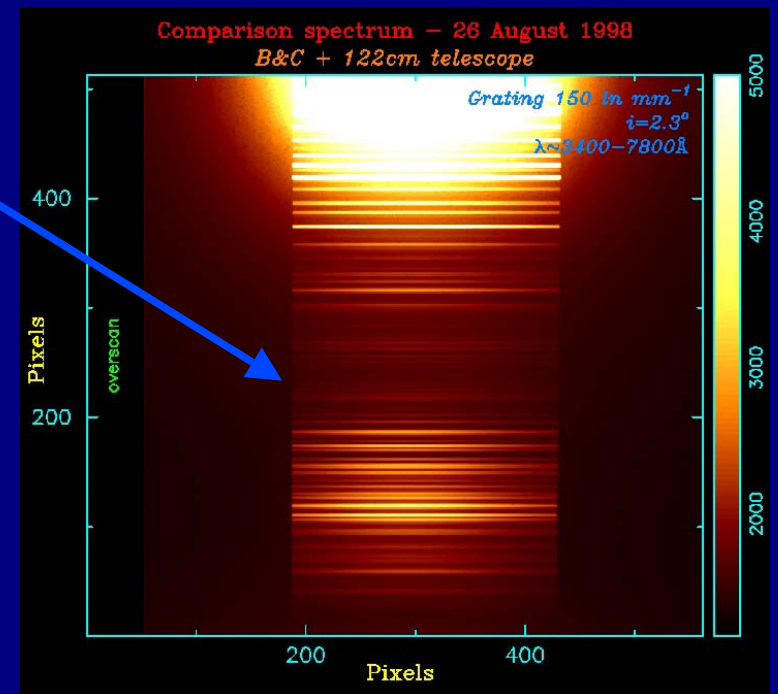
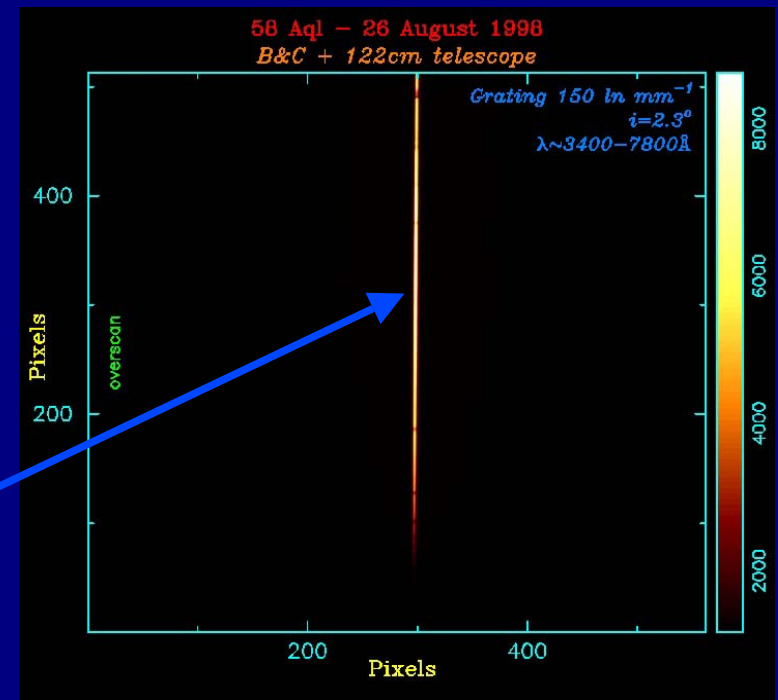
# Example spectra

Photographic  
spectrum

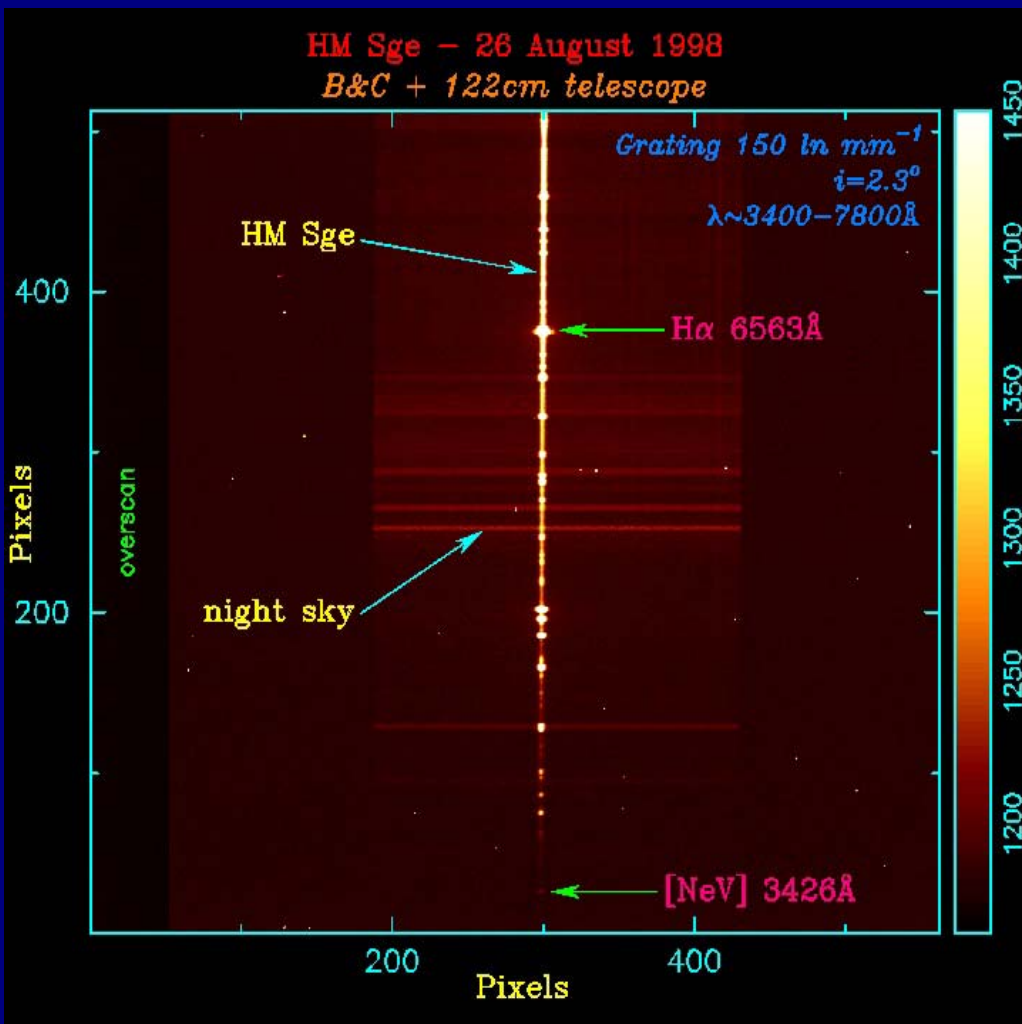
CCD  
spectrum



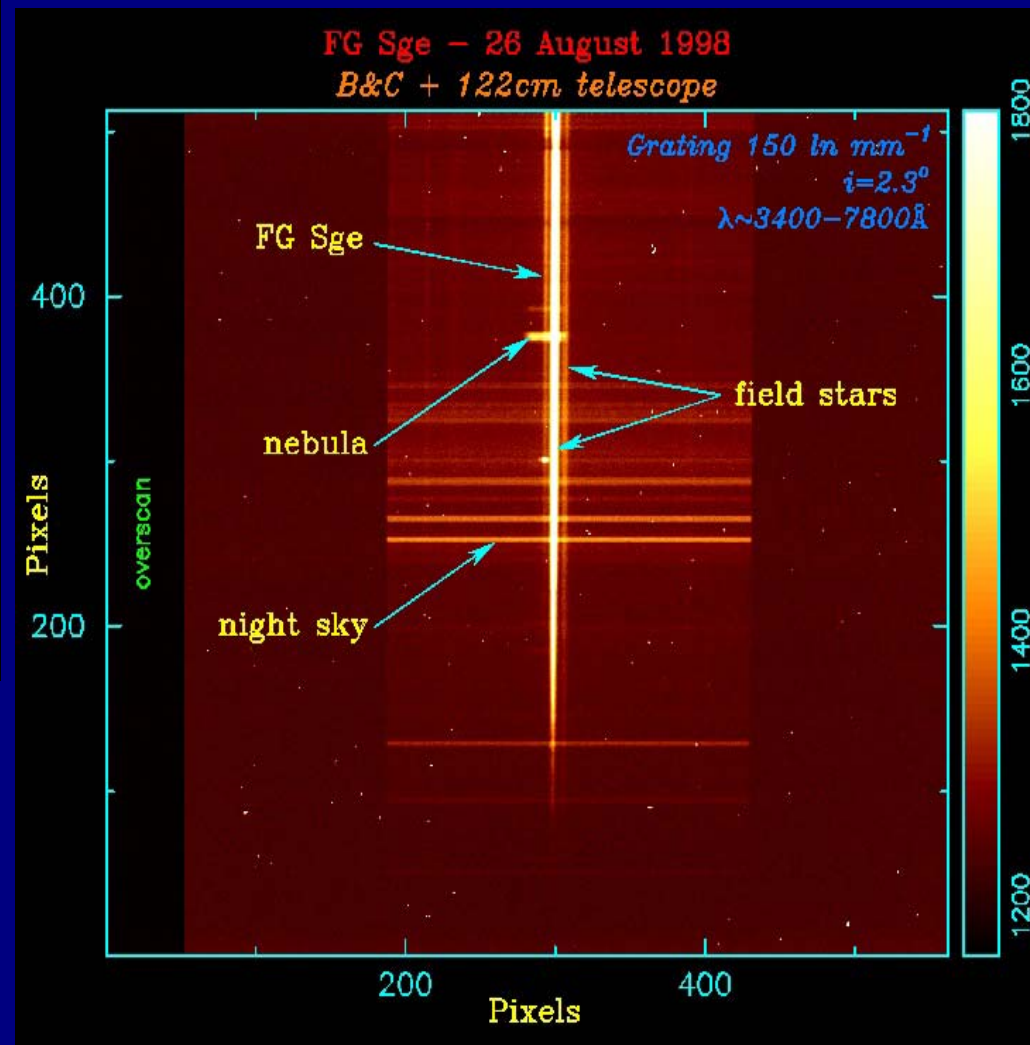
Spectrophotometric  
calibration



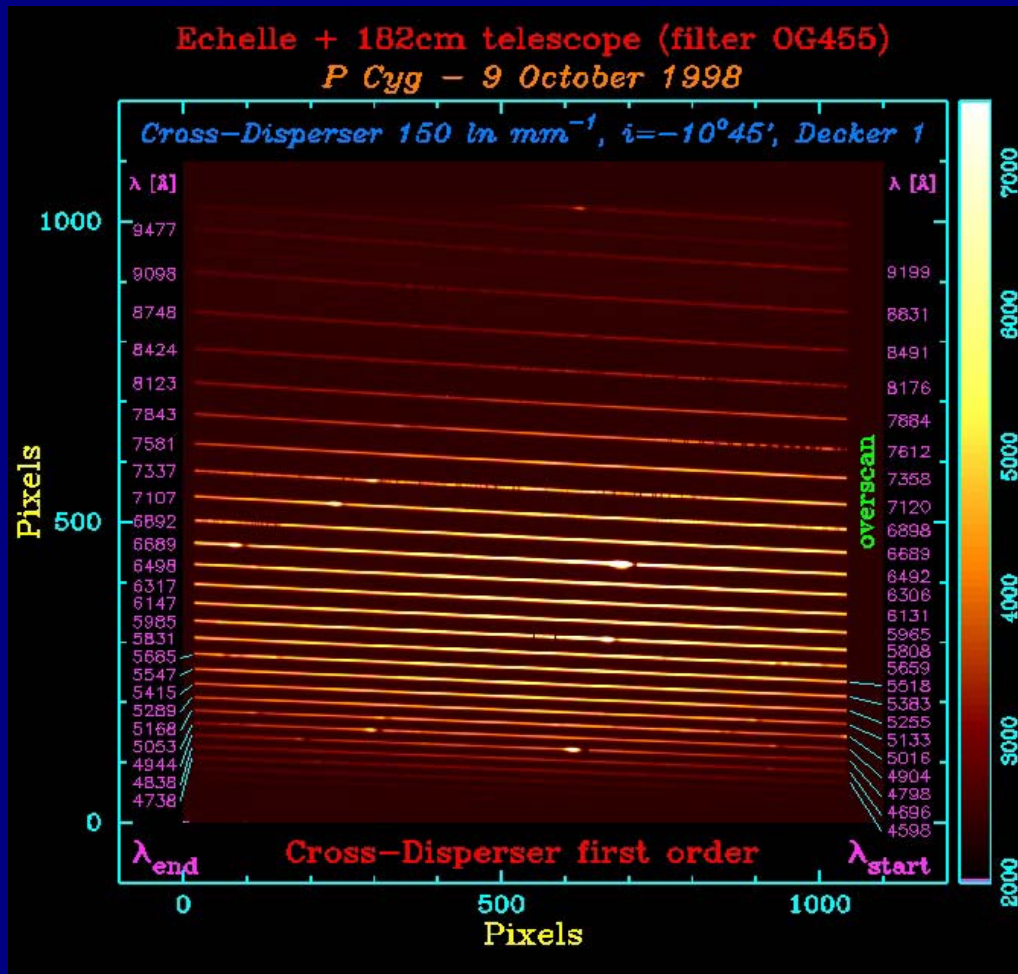
# More example spectra



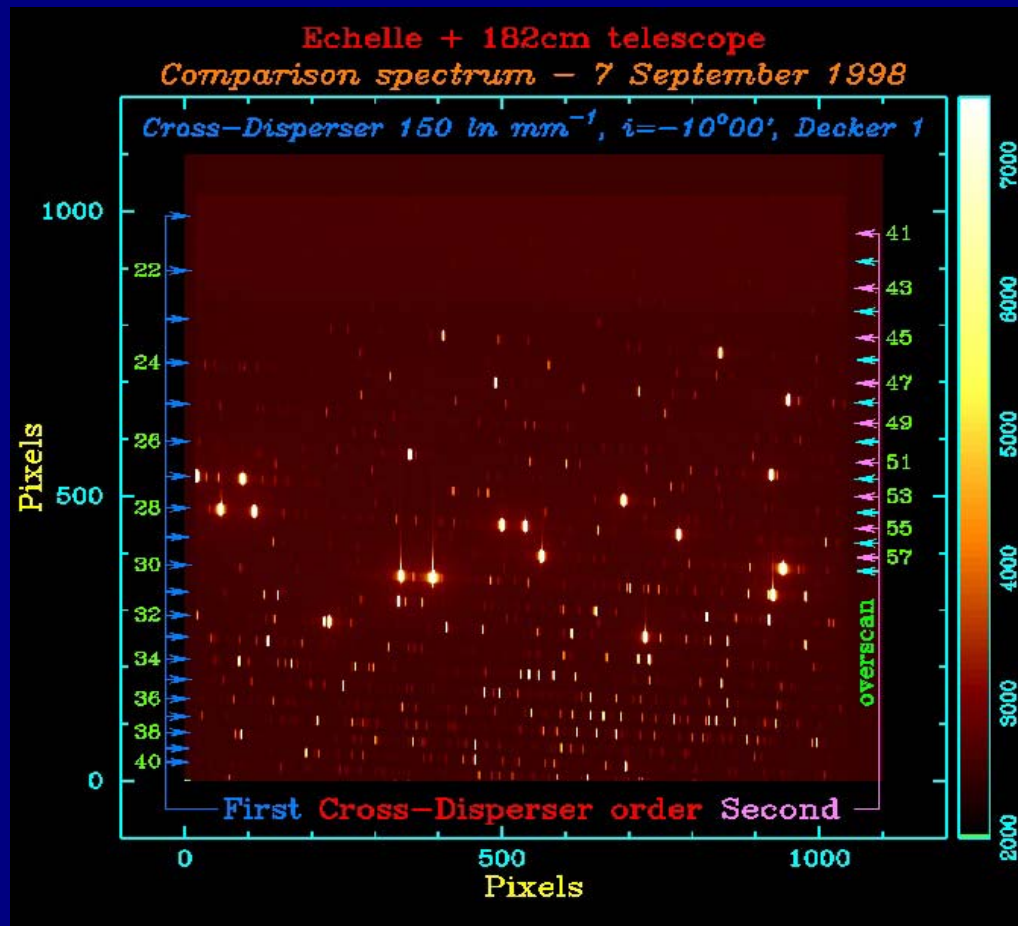
## B&C spectra



# More example spectra



## Echelle spectra



# From where to download IRAF

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## IRAF

Image Reduction and Analysis Facility

Welcome to the IRAF Homepage! *IRAF* is the Image Reduction and Analysis Facility, a general purpose software system for the reduction and analysis of astronomical data. IRAF is written and supported by the [IRAF programming group](#) at the [National Optical Astronomy Observatories \(NOAO\)](#) in Tucson, Arizona. NOAO is operated by the [Association of Universities for Research in Astronomy \(AURA\)](#), Inc. under cooperative agreement with the [National Science Foundation](#)

### IRAF V2.12.1 / X11IRAF V1.3.1 Patch and New Platform Releases

(16 July 2002) The **IRAF V2.12.1 EXPORT** and **X11IRAF V1.3.1** releases are now available for **ALL** platforms from the [IRAF ftp archive](#). This new release represents a Patch to the earlier V2.12/V1.3 release for Sun and PC-IRAF systems, and the first release for the remaining supported platforms: Digital Unix, Hewlett-Packard, and Silicon Graphics. Please see the [IRAF Release Notes](#) for a detailed list of changes in V2.12 as well as the **README** file for each system for platform-specific information. Details of what's been changed in the patch release can be found in the [Patch Release Announcement](#).

<b>Sun/IRAF V2.12.1</b> <a href="#">Distribution Files</a> <a href="#">README</a> <a href="#">Installation Guide</a> <a href="#">Site Manager's Guide</a> <a href="#">V2.12.1 Patch File</a>	<b>PC-IRAF V2.12.1</b> <a href="#">Distribution Files</a> <a href="#">README</a> <a href="#">Installation Guide</a> <a href="#">Site Manager's Guide</a> <a href="#">V2.12.1 Patch File</a>	<b>X11IRAF V1.3</b> <a href="#">Distribution Files</a> <a href="#">README</a> <a href="#">Release Notes</a>
<b>DUNX/IRAF V2.12.1</b> <a href="#">Distribution Files</a>	<b>HPUX/IRAF V2.12.1</b> <a href="#">Distribution Files</a>	<b>IRIX/IRAF V2.12.1</b> <a href="#">Distribution Files</a>

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IRAF Project H Toma Tomov

Sun Aug 17, 19:56

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Aside from the online help pages distributed with the system there is a large collection of user material available from our [FTP](#) archive or through this web page:

- [General Documentation and Beginner's Materials](#)
- [Recommended Documentation for every site](#)
- [Photometry](#)
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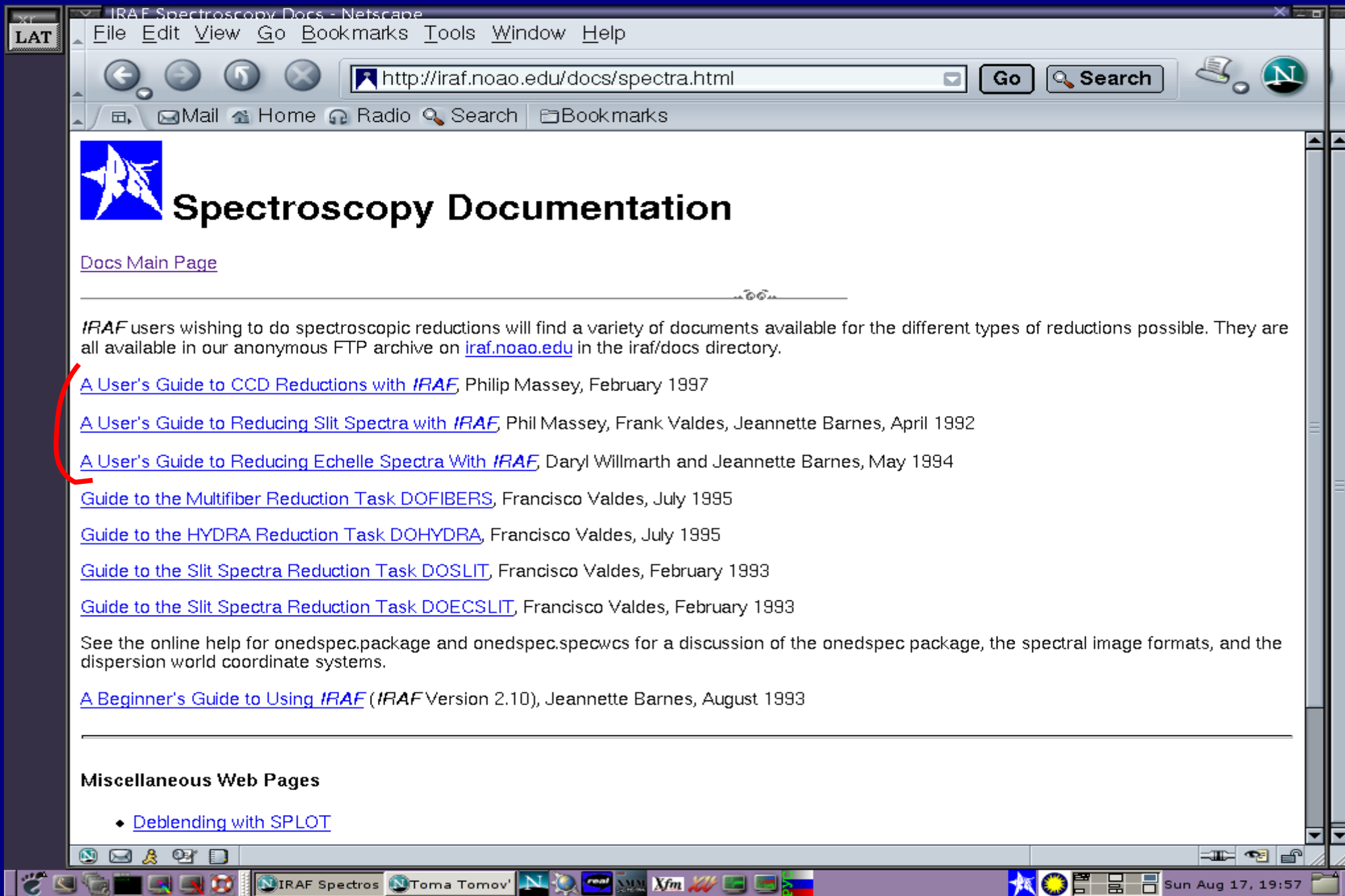
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IRAF Document Toma Tomov Sun Aug 17, 19:57

# IRAF spectroscopy documents




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## Spectroscopy Documentation

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*IRAF* users wishing to do spectroscopic reductions will find a variety of documents available for the different types of reductions possible. They are all available in our anonymous FTP archive on [iraf.noao.edu](http://iraf.noao.edu) in the iraf/docs directory.

- [A User's Guide to CCD Reductions with \*IRAF\*](#), Philip Massey, February 1997
- [A User's Guide to Reducing Slit Spectra with \*IRAF\*](#), Phil Massey, Frank Valdes, Jeannette Barnes, April 1992
- [A User's Guide to Reducing Echelle Spectra With \*IRAF\*](#), Daryl Willmarth and Jeannette Barnes, May 1994
- [Guide to the Multifiber Reduction Task DOFIBERS](#), Francisco Valdes, July 1995
- [Guide to the HYDRA Reduction Task DOHYDRA](#), Francisco Valdes, July 1995
- [Guide to the Slit Spectra Reduction Task DOSLIT](#), Francisco Valdes, February 1993
- [Guide to the Slit Spectra Reduction Task DOECSLIT](#), Francisco Valdes, February 1993

See the online help for onedspec.package and onedspec.specwcs for a discussion of the onedspec package, the spectral image formats, and the dispersion world coordinate systems.

[A Beginner's Guide to Using \*IRAF\*](#) (*IRAF* Version 2.10), Jeannette Barnes, August 1993

---

### Miscellaneous Web Pages

- ◆ [Deblending with SPLOT](#)

Taskbar: LAT, IRAF Spectros, Toma Tomov, Sun Aug 17, 19:57





# Philosophy and practice of IRAF

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IRAF may be big and difficult to learn in whole, but it has a very clear philosophy that is consistently implemented in all of its commands

IRAF is more than a software package just aimed to extract and calibrate astronomical CCD frames. Exploring in more detail, you will find that inside IRAF you have, for example, excellent plotting packages, a lot of tools for general astronomical computing, etc.

# Some example tools

---

Under the package `noao.astutil`  
you have the tasks listed here

```
noao.astutil:
```

- `airmass` - Compute the airmass at a given elevation above the horizon
- `astcalc` - Astronomical calculator
- `asthedit` - Astronomical header editor
- `astradius` - Find images within a circle on the sky
- `asttimes` - Compute UT, Julian day, epoch, and sidereal time
- `ccdtime` - Compute time, magnitude, and signal-to-noise for CCDs
- `galactic` - Convert ra, dec to galactic coordinates
- `gratings` - Compute and print grating parameters
- `keywpars` - Translate the image header keywords used in ASTUTIL package
- `pdm` - Find periods in light curves by Phase Dispersion Minimization
- `precess` - Precess a list of astronomical coordinates
- `rvcorrect` - Compute radial velocity corrections
- `setairmass` - Compute effective airmass and middle UT for an exposure
- `setjd` - Compute and set Julian dates in images

# Commands, packages and tasks

---

- IRAF contains a large number of commands
- They are grouped in chunks called packages. For example onedspec package
- The packages are connected together in a tree-like structure
- Only a limited number of commands are available when IRAF starts. Others can be enabled by typing the name of the package they belong to
- Each package contains so called tasks . When you start a task you actually enter a subprogram, or even a specific graphic environment

# Commands, packages and tasks (cont.)

While you are executing a task you may enter commands in two ways:

- Buy hitting single keyboard keys: for example `q` usually leaves the task and `?` shows a list of available commands (!!! do not press `ENTER` !!!);
- Buy entering double colon `:` followed by some more letters. For example:  
`: o r d e r 5` `ENTER` (!!! finish by `ENTER` !!!)

Do not press keys randomly !!!

IRAF recognizes abbreviations !!!

IRAF is an open software that allows you to write your own commands, tasks and packages. In your tasks you can include any IRAF command and task and even Fortran type code (check *An Introductory User's Guide to IRAF Scripts*)

# Starting and leaving IRAF

---

- IRAF should be started from an xgterm window by typing `cl`
- The magic word to leave IRAF is `logout`
- In case of troubles `Ctrl+C` or `Ctrl+Y` but after that surely `f1prc`
- To leave a package type `bye`
- To leave a task type `q`

!!! Within a command or task do not press keystrokes randomly, not even the `ENTER` key or mouse buttons !!!

!!! To edit a command line do not use `BACKSPACE`,  
use `DELETE` !!!

# Getting help

---

From within IRAF type:

❑ `help package-name` → for help on a package

❑ `help task-name` → for help on a task

❑ **variations:**

`help task-name > file name` → to save in a  
**text** **file**

`help task-name dev=ps | lprint` → to print in  
**a postscript file**

To scroll use `SPACE` and `d`

To change the number of scrolling lines type

`stty nlines=24`

To quit use `q`

# Getting help example

`help noao` shows a one-line description of each command in the package noao

```
cl> help noao
```

```
rootnoao.noao:
```

```
  artdata - Artificial data generation package [up]
  astrometry - Astrometry package
  astcat - Astronomical catalog and surveys access package [up]
  astutil - Astronomical utilities package [up]
  digiphot - Digital stellar photometry package [up]
  focas - Faint object classification and analysis package
  imred - Image reductions package [up]
  mtlocal - Magtape i/o for special NOAO format tapes [up]
  nobsolete - Obsolete tasks to be phased out in a future release [up]
  nproto - Prototype (temporary, contributed) tasks [up]
  observatory - Examine and define observatory parameters [up]
  obsutil - Observing utilities (planning or evaluation) [up]
  onedspec - One dimensional spectral red & analysis package [up]
  rv - Radial velocity analysis package [up]
  surfphot - Galaxy isophotal analysis package
  twodspec - Two dimensional spectral red & analysis package [up]
```



# Remembering, finding ...

---

- `?` → to see the task names in the current package
- `??` → to see the task names in all open packages
- `help task-name` → to see on top of the help screen  
in which package is the task
- If you have no idea of the name of task you are  
looking for:

- `help * | match display`

- `references display`

# Operating system commands

---

- Some linux system commands like `ls`, `pwd`, `cp`, `mv`, etc., you can execute within IRAF (check `login.cl`):

```
cp file1 file2
```

- To execute a command which IRAF do not "know" use `!` :

```
!lpr file-name
```

- To execute a command as a background process:

```
!ximtool& or better !ds9&
```

# Editing commands

---

- To access the last command type `e` `ENTER`, then you can use the up-arrow key. You may edit the invoked command before execution

Use `DELETE` not `BACKSPACE`

`ENTER` key executes the command

- The last command starting with `hel` is invoked by typing `e hel`
- The command history shows a list of last typed commands. Command number 15 is repeated by typing `^ 15`
- `history` lists all the commands in the buffer

# Task's parameters

---

Each IRAF task has its own set of required and hidden parameters that determine its execution. The values are stored in `uparm` directory. The required parameters should be supplied otherwise you will be asked for values.

You may change the values of parameters in two ways:

temporary change:

```
display image-name zrange=no zscale- z1=100 z2=300
```

permanent change:

```
epar task-name
```

To list the parameters type `lpar task-name`

To return back to defaults use `unlearn task-name`

# Task's parameters example

Executing `epar setjd` we can edit the parameters

```
IRAF
Image Reduction and Analysis Facility

PACKAGE = onedspec
TASK = setjd

images = █ Images
(observa=   )_.observatory) Observatory of observation
(date      =   date-obs) Date of observation keyword
(time     =   ut) Time of observation keyword
(exposur=   exptime) Exposure time keyword
(ra       =   ra) Right ascension (hours) keyword
(dec      =   dec) Declination (degrees) keyword
(epoch    =   epoch) Epoch (years) keyword

(jd       =   jd) Output Julian date keyword
(hjd      =   hjd) Output Helocentric Julian date keyword
(ljd      =   ljd) Output local Julian date keyword

(utdate   =   yes) Is observation date UT?
(uttime   =   yes) Is observation time UT?
(listonl=   no) List only without modifying images?
(mode     =   ql)
```

**ESC-?** for HELP

# Calculator

---

IRAF has its own calculator. Simply type

```
= 180/3.14159
```

to calculate how many degrees is one radian.

You can use parentheses, trigonometric functions and refer to variables. For example

```
= display.z2 - display.z1
```

gives the range of grey levels in displaying images with the display task.

# IRAF set-up

Choose your IRAF starting directory, go there and execute the command `mkiraf`

```
toma@nrex:> mkiraf
Initialize uparm? (y/n): n
Terminal types: xgterm,xterm,gterm,vt640,vt100,etc.
Enter terminal type: xgterm
A new LOGIN.CL file has been created in the current directory.
You may wish to review and edit this file to change the defaults.
toma@nrex:> █
```

Then you can edit the `login.cl` file

```
# LOGIN.CL -- User login file for the IRAF command language.

# Identify login.cl version (checked in images.cl).
if (defpar ("logver"))
    logver = "IRAF V2.12.1 July 2002"

set      home           = "/home/toma/data/work/"
set      imdir          = "/iraf/imdirs/toma/"
set      uparm          = "home$uparm/"
set      userid         = "toma"
```

# How to run IRAF

---

First, you must start a xgterm from a xterm by typing

```
xgterm&
```

Switch to xgterm and cd to you IRAF starting directory where the file login.cl is. To start IRAF simply type

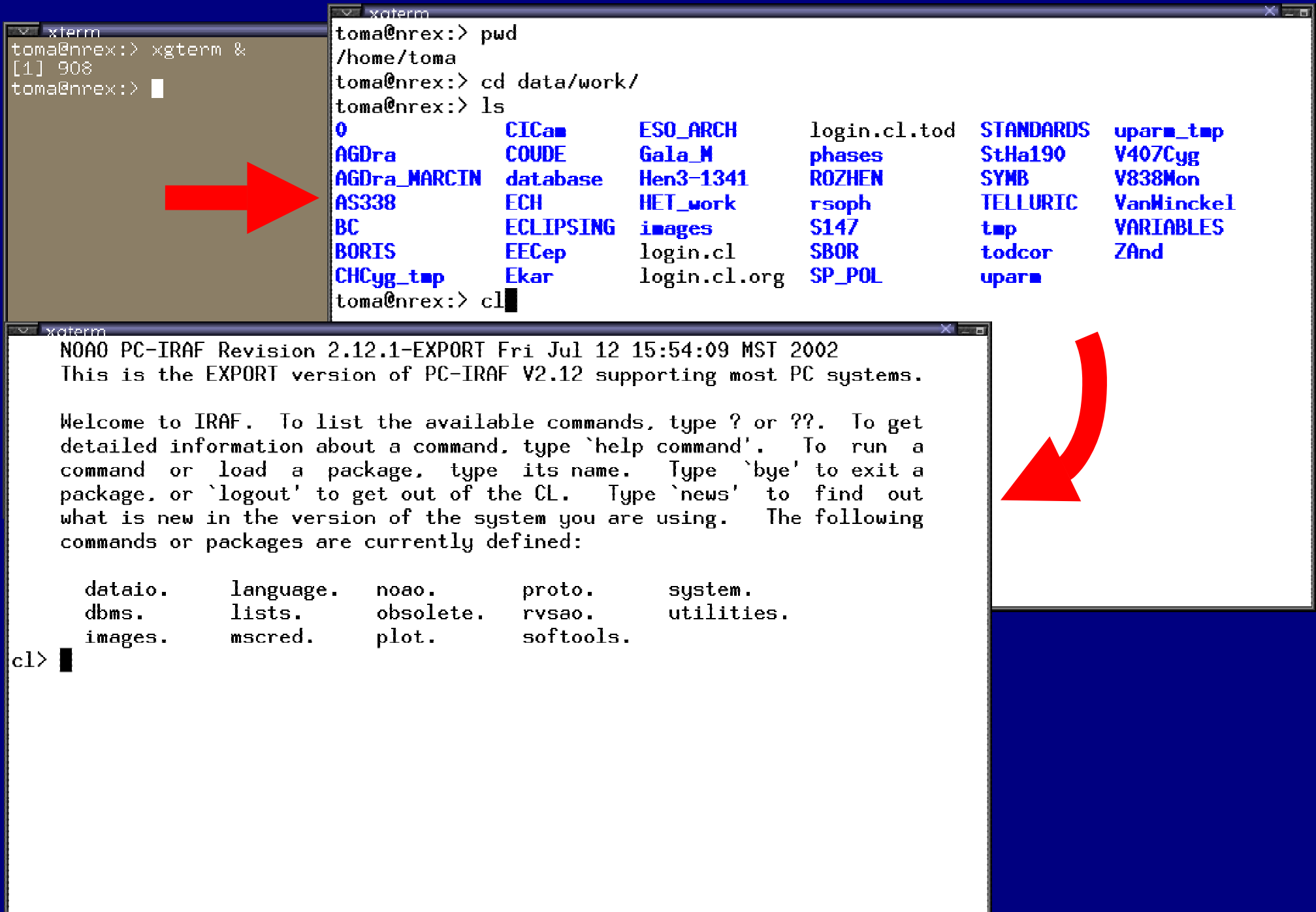
```
cl
```

Another possibility is to put in your /usr/local/bin an executable script like this

```
cd /home/toma/data/work/; xgterm -geometry +0+244 >  
-fn 10x20 -bg LightSteelBlue -fg black -dc -e cl &
```



# Starting IRAF screenshot



The screenshot shows three terminal windows. The top-left window shows the user running `xgterm &`. The top-right window shows the user running `pwd` (output: `/home/toma`), `cd data/work/`, and `ls`, which lists a directory of files and subdirectories. A red arrow points from this window to the bottom window. The bottom window shows the IRAF welcome screen, including the version information (NOAO PC-IRAF Revision 2.12.1-EXPORT) and a list of currently defined commands or packages. A red arrow points from the right side of the screen to this window.

```
toma@nrex:> pwd
/home/toma
toma@nrex:> cd data/work/
toma@nrex:> ls
0          CICa  ESO_ARCH  login.cl.tod  STANDARDS  uparn_tmp
AGDra     COUDE   Gala_M    phases        StHa190    V407Cyg
AGDra_MARCIN database Hen3-1341  ROZHEN      SYMB        V838Mon
AS338     ECH     HET_work  rsoph         TELLURIC   VanWinckel
BC        ECLIPSING images     S147         tmp         VARIABLES
BORIS     EECep   login.cl  SBOR          todcor     ZAnd
CHCyg_tmp Ekar    login.cl.org SP_POL       uparn

toma@nrex:> cl
```

```
NOAO PC-IRAF Revision 2.12.1-EXPORT Fri Jul 12 15:54:09 MST 2002
This is the EXPORT version of PC-IRAF V2.12 supporting most PC systems.

Welcome to IRAF. To list the available commands, type ? or ??. To get
detailed information about a command, type `help command'. To run a
command or load a package, type its name. Type `bye' to exit a
package, or `logout' to get out of the CL. Type `news' to find out
what is new in the version of the system you are using. The following
commands or packages are currently defined:

    dataio.    language.   noao.      proto.     system.
    dbms.      lists.     obsolete.  rvsao.    utilities.
    images.    mscred.    plot.      softools.

cl>
```

# IRAF image display set-up

---

XIMTOOL or DS9, this is the question ?

ximtool is the original IRAF image viewer but works with 256 color mode only (color depth 8). So, you must start X-windows with a command like this

```
startx -- -bpp 8
```

DS9 is the last generation of SAOimage and SAOtng viewers. Works in color depth 24 mode and interacts with IRAF in the same way as ximtool.

I suggest DS9

# XIMTOOL screenshot

**Ximtool Control**

**View**

Frame:  1  2

-- Frame 1 --  
X center: 256.0  
Y center: 256.0  
X scale: 1.00  
Y scale: 1.00  
X zoom: 1.0  
Y zoom: 1.0

Zoom: Toggle Zoom 5 Zoon In 3  
8 4 2 1 2 4 8  
Zoon Out 3 Center 5

Aspect Flip X Flip Y Flip XY Clear Frame Fit Frame

**Enhancement**

Grayscale  
Color  
Heat  
HSV  
ATPSN

-- Grayscale --  
Con 1.00 Brt 0.50

Invert Operate

**Blink**

Blink Frames: 1 2   Reset

Blink Rate:

Register Match LUTs Blink

**Options**

Panner  Coords Box  
 Autoscale  Antialias  
 Tile Frames  Warnings

Initialize Normalize Done

**ximtool**

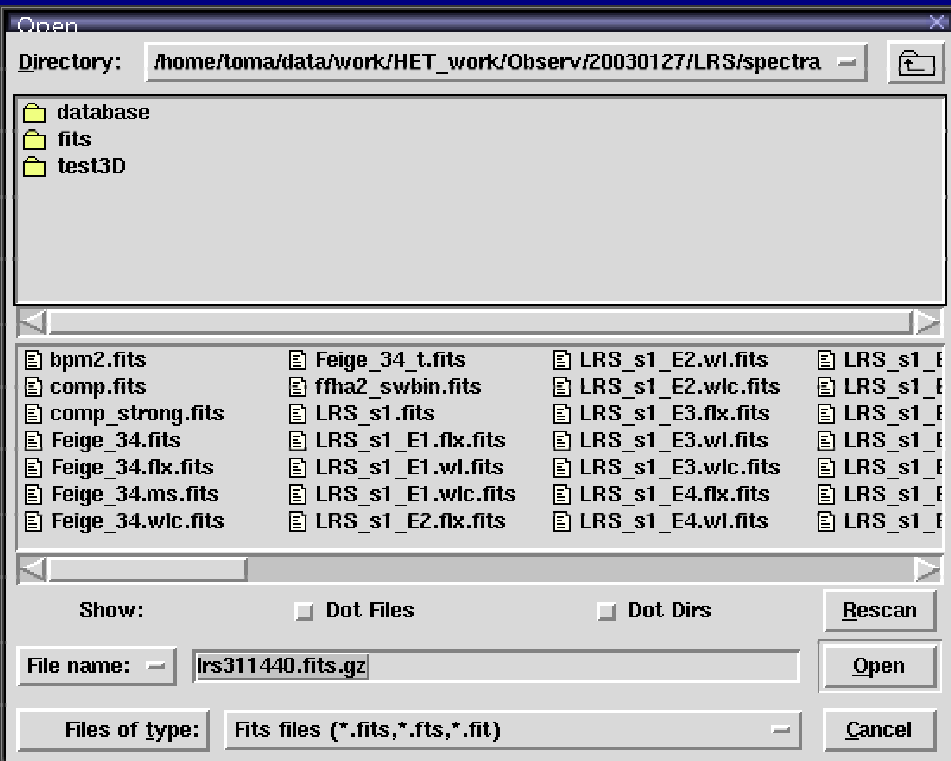
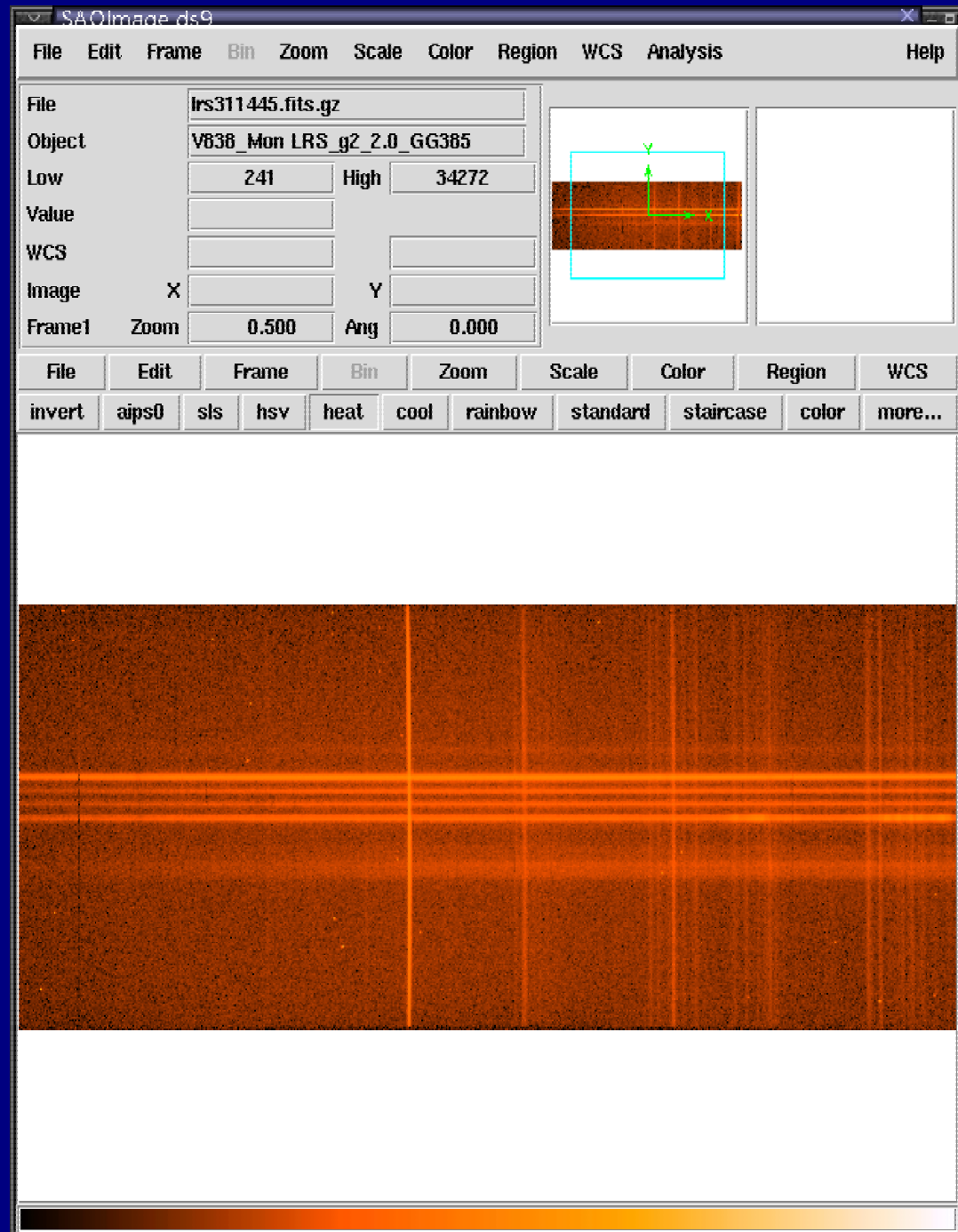
File View Options dev pix - m51 B 60s

58.00 461.39 74.5

# DS9 screenshot

Download site:

<http://hea-www.harvard.edu/RD/ds9/>



# IRAF in action screenshot

The screenshot displays a workstation environment with several windows:

- Terminal (xterm):** Shows the user navigating through the file system and running IRAF commands. The terminal output includes:

```
images spectra
toma@nrex:> cd images
toma@nrex:> ls
10dec_s1_pre.fits image.35
27jan_s1_pre.fits image.39
27jan_s2_pre.fits image.44
35.ctr image.B
39.ctr image.ctr
44.ctr image.V
B.ctr
B.fits
coords
FB.fits
fits
FR.fit
FV.fit
IFB.fi
IFR.fi
IFV.fi
toma@n
```

The IRAF interface is shown with the following parameters:

```
PACKAGE = dataio
TASK = rfits

fits_file= IMA0001.fits FITS
file_lis= 0 File
iraf_fil= 11 IRAF
(make_im= yes) Creat
(long_he= no) Print
(short_h= yes) Print
(datatyp= u) IRAF
(blank = 0.) Blank
(scale = yes) Scale
(olDIRaf= no) Use d
```
- SAOImage ds9:** A graphical interface for image reduction and analysis. The main window displays a large astronomical image of a galaxy or nebula. The interface includes a menu bar (File, Edit, Frame, Bin, Zoom, Scale, Color, Region, WCS, Analysis, Help) and a toolbar with various processing options (linear, log, squared, sqrt, hist equ, minmax, 99.5%, 99%, 98%, zscale, zmax). The main image shows a bright, diffuse structure with a central core and surrounding stars. A small inset window in the top right corner shows a zoomed-in view of the central region with coordinate axes (X, Y, E, N).

# Image display

---

Within IRAF start the image viewer you prefer with

`!ximtool &` or `!ds9 &`

To see different dimension images you can change the `stdimage` IRAF variable

- `reset stdimage=imt28` → to see a 976x3040 pix image
- `reset stdimage=imt4` → to see a 1600x1600 pix image

The command `gdevices` lists all the available values for `stdimage`

Very useful tasks are `imexamine` and `implot`

# IRAF format

---

IRAF has its own internal image format. Each FITS file is separated in two parts:

- header → ASCII, extension .imh, contains log-book infos
- pixel file → binary, extension .pix, stored in imdir

The last versions of IRAF can operate with FITS files.  
Sometimes it is very useful but not always

Check the package dataio typing `help dataio` to see the available commands for reading and writing files in IRAF.

# Using lists of files

---

Almost any IRAF command accepts 3 sorts of input:

- single filenames, e.g. `sp001.imh`
- comma-separated sequences of filenames, e.g. `sp001.imh,sp002.imh,sp003.imh`
- lists, e.g. `@list_a`. The @-character tells IRAF to open file `list_a`.

To create file lists use the `files` command.

For example: `files a* > list_a`

or `files cat*.%fts%imh% > log.txt`



# Reading FITS files to IRAF format

---

The IRAF command is `rfits`. You can use it as follows:

- `rfits in_name * out_name` → for single file
- `rfits @in_list * @out_list` → for in and out file lists
- `rfits @in_list * c` → output in files `c0001`, `c0002`, ...
- `rfits @in_list * 'old+` → restore the original file names
- `rfits @in_list make_im-` → only to check the content of a magnetic type or DAT

# Writing IRAF files in FITS format

---

The IRAF command is `wfits`. You can use it as follows:

- ❑ `wfits in_name out_name` → for single file
- ❑ `wfits @list1 @list2` → for file lists
- ❑ `wfits fy*.imh mttk1` → to write onto a DAT

How to change the filenames  
for a list of files ?

# Deleting and setting bits appropriately

You can remove normal files in two ways using

```
delete log*.lst or !rm log*.lst
```

Images you can remove using the command `imdelete` only!!! For example `imdelete a*.imh` will delete both the `a.imh` and `a.pix` files.

It may happen that your images look to be composed of pixels with negative counts. This is generally a reading/writing software problem.

For example, if in your image the counts range from -32768 to +32768 you can restore the original 0 to 65536 scale using

```
imarith @list_a + 32768 @list_b calctype=real pixtype=real
```

# Printing text, graphics or image

---

Text can be printed directly `lprint file-name` or with redirection `help astutil | lprint`

Line graphics can be copied to a printer by pressing the `=` key. The same screens can be also saved to a postscript file by typing `:.snap epsfl` `ENTER`

For halftone graphics use `ximtool` or `DS9`. See for help the corresponding File menu