GILDAS and CLASS

Jérôme PETY
(IRAM/Obs. de Paris)
on behalf of the IRAM Science Software developers

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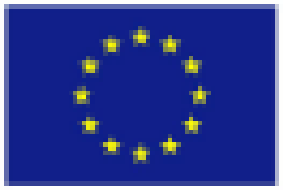


People (as of 2018 March)

- People participating in one way or another

  IRAM/Grenoble R. Zylka, J.M. Winters, E. Reynier, V. Pietu, J. Pety, E. Chapillon, A. Castro-Carrizo, M. Bremer, J. Boissier, S. Bardeau.

  IRAM/Granada H. Ungerechts, A. Sievers, P. Mellado.

  IPAG/Grenoble S. Maret.

  LAB/Bordeaux S. Guilloteau.

- Large code contributors: $\sim$ 5.0 FTE/yr

  R. Zylka `MOPSIC`.
  H. Ungerechts `PAKO`.
  A. Sievers `MIRA` + `MRTCAL`.
  E. Reynier kernel + `OMS`.
  V. Pietu `CLIC` + `RDI`.
  J. Pety kernel + `MRTCAL` + `CLASS` + `MAPPING`.
  P. Mellado `TAPAS`.
  A. Castro-Carrizo `CLIC` pipeline + `OBS`.
  J. Boissier `ASTRO`.
  S. Bardeau kernel (including the python binding) + `CLASS` + `MRTCAL`.
  S. Maret `CLASS/WEEDS`.
  S. Guilloteau Kernel + `MAPPING`.

Scope: I. Science Software at IRAM

Many different kinds of software at IRAM

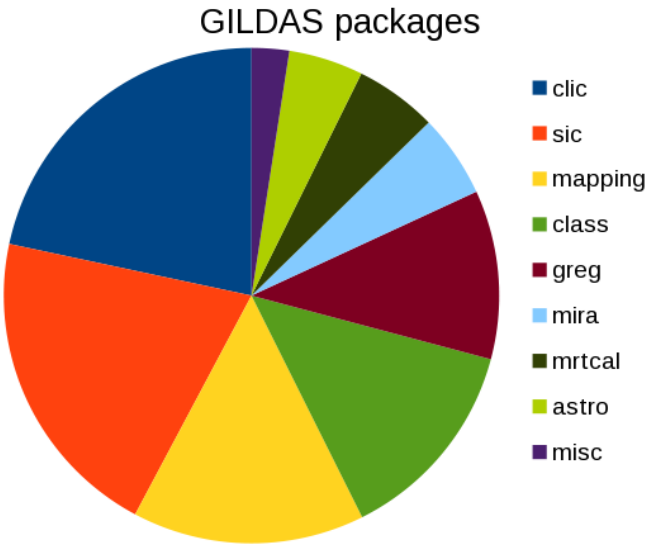
1. Proposal (submission, TAC, statistics, ...)
2. Preparation of observations, *e.g.* setups.
3. Scheduling and monitoring of observed projects (dynamic scheduling, pool observing).
4. Data acquisition:
   - 4.1 Low level, *e.g.* hardware control (antennas, receivers, correlators, etc...)
   - 4.2 High level, *e.g.* operator and observer interface.
5. Data archiving.
6. Data reduction and analysis (single dish + interferometry).
7. Generic plot package.

Science software deals only with a subset Points: 1, 2, 3, 4.2, 6, and 7.

`GILDAS` **deals with an even smaller subset** Points: 2, 4.2, 6 and 7.

Scope: III. GILDAS at IRAM
450 000 executable lines

- Common facilities
  - Command line interpreter: SIC;
  - Graphical possibilities: GREG
    (1D: curves, 2D: images, 3D: spectra cubes).
  - Preparation of observations: ASTRO.
- 30m
  - Spectroscopy: TELCAL + MRTCAL + CLASS.
- NOEMA
  - Calibration: CLIC;
  - Imaging + Deconvolution: MAPPING.



GILDAS Strengths

Large range of supported systems Linux, Mac/OSX, (Windows).

Light weight Data reduction and analysis possible on laptops.

35 **years of history** $\Rightarrow$ Accumulated expertise.

GILDAS users

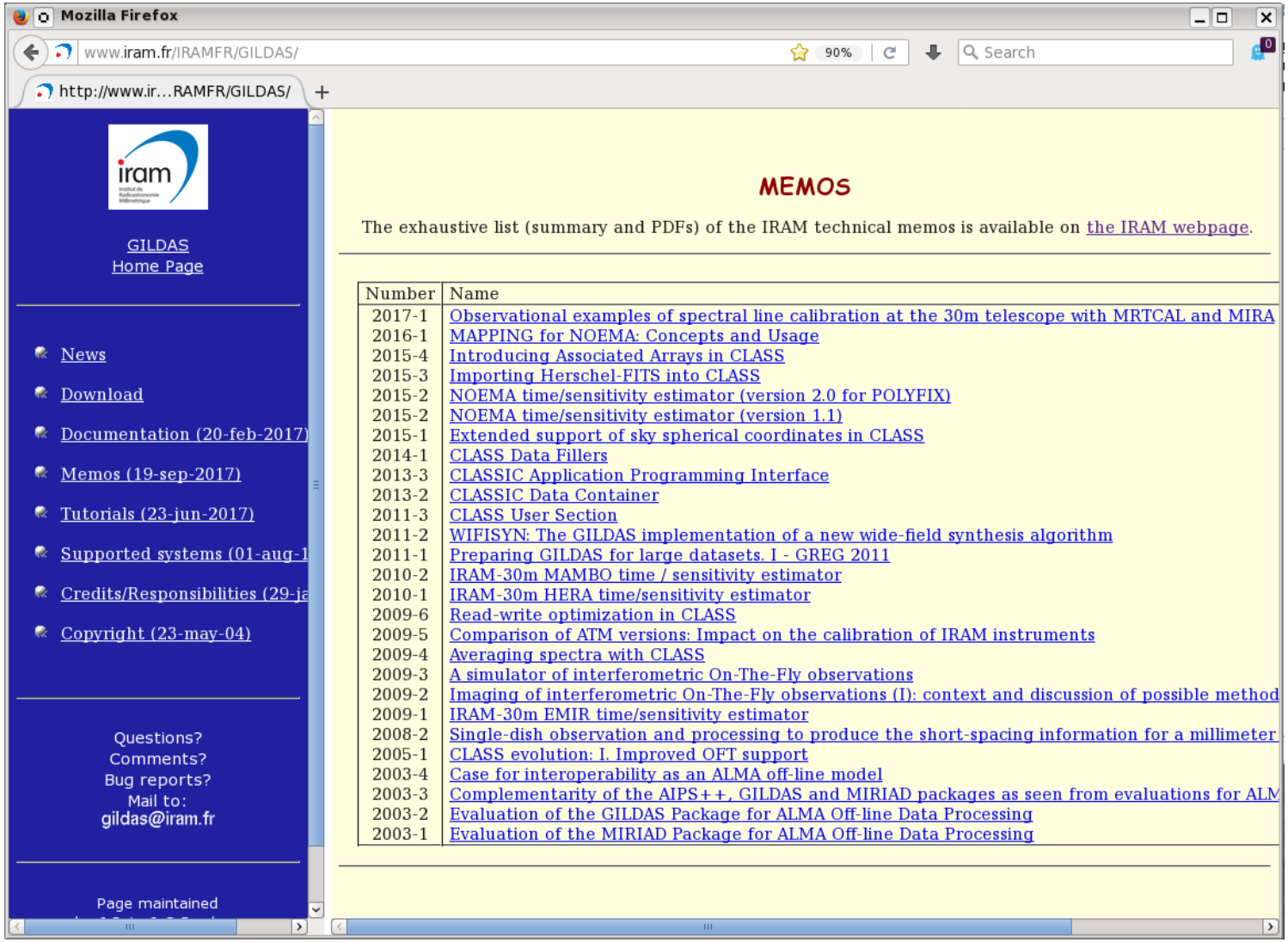
- IRAM AODs: Instrument monitoring, data pipelining.
- IRAM users: Data reduction.
- Other facilities users
  - CLASS is used in many facilities (*e.g.*, Herschel/HIFI, SOFIA/UpGREAT, APEX, NANTEN2, 40m, GBT, Effelsberg, PMO/Kosma, ...).
  - Science analysis, and publication quality figures.
- All kind of public from beginners to data specialists.
  - Easyness of use for new users.
  - Flexibility for data specialists.

⇒ GILDAS evolutions must be thought with all users in mind.

User support:
I. Documentation

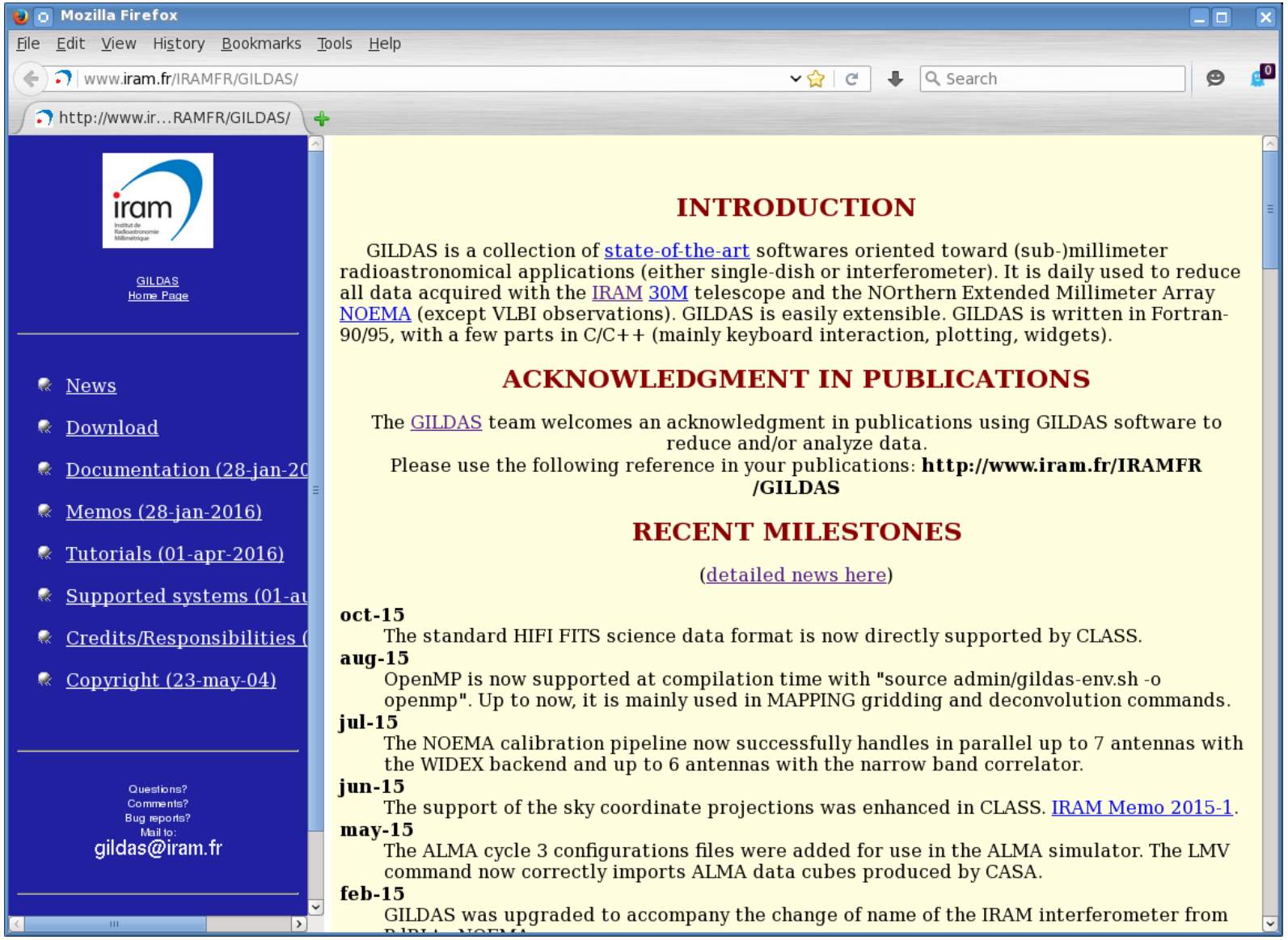
Web page http://www.iram.fr/IRAMFR/GILDAS.

Mail to gildas@iram.fr.

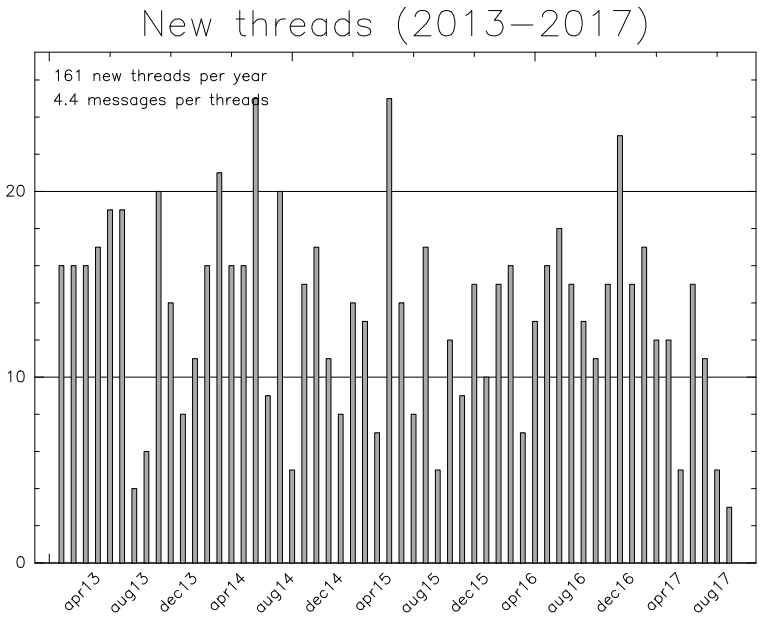


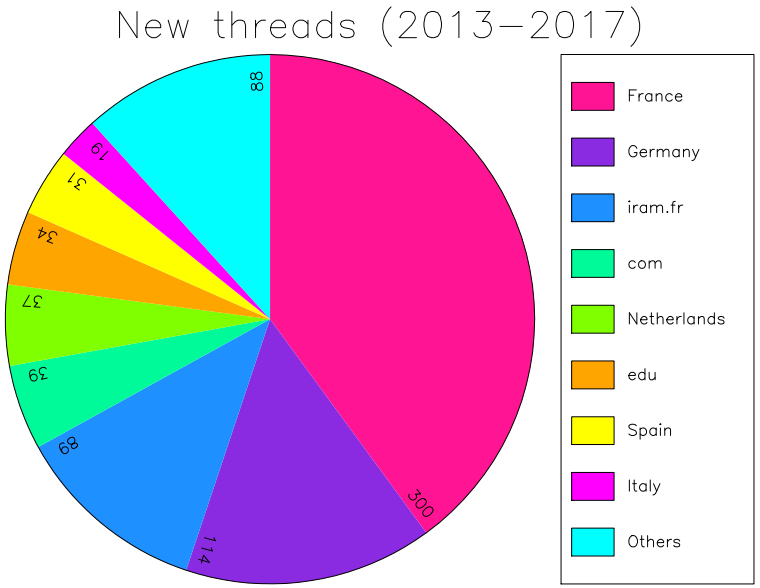
User support:

II. Web page http://www.iram.fr/IRAMFR/GILDAS



User support:
III. answers to gildas@iram.fr





- Total number of threads: 161/year.
- Number of emails per threads: 4.4.
- Median time to
  - First answer: 6h;
  - Final answer: 25h.

Bug report: I. Wrong way

Hi,

I have just stumbled on an obnoxious bug which prevents me from making the discovery of the century. I will defend my PhD thesis tomorrow. Fix this bug in the coming minutes.

Toto.

Bug report: II. Right way

Dear Gildas team,

Your software is great. For the first time in my life, I encountered a segmentation fault using it. I succeeded to reproduce the bug with a simple list of commands. I attach the following information: version of gildas I am currently using, list of commands and the data set to reproduce the bug. I hope this will help you solve the bug in the coming months. Continue the great work.

Best regards, Toto.

****

gildas version: `mar18b (x86_64-redhat6.4-ifort) source tree`

List of commands:
`LAS90>` file in test
`LAS90>` find
Blablablabla...
Segmentation fault

Data set attached: test.30m

****

No software is the answer to all these:

- Best (*i.e.* most recent) computing technology.
- Best portability.
- Best speed.
- Best ease of use (CLI and GUI).
- Best (*i.e.* shortest) learning curve.
- Best functionalities.
  - Best data calibration methods.
  - Best data mapping methods.
  - Best (*i.e.* most complete) analysis methods.
  - Best graphical possibilities.
- Best cost.

IRAM Science Software Strategy

Maintain high-quality software for IRAM instruments while staying open to outside world

- Focused but generic developments;
- In/out fillers;
- Python binding.

"Short", "focused" development cycles

- No one-fit-all-use-cases-in-astronomy software.
- Ruptures are possible but exceptional (e.g., data formats) and foresee large timescale for users to adapt.

A good balance between software astronomers and software engineers

- In-house astronomers make the link between the community and the engineers.
- Keeping a science activity is the best way to understand the community needs on a daily basis.
- Prototypes are useful first steps for more professional developments (e.g., IPP $\Rightarrow$ PMS, Weeds $\Rightarrow$ linedb).

Continuous aggregation of functionality without creating black boxes

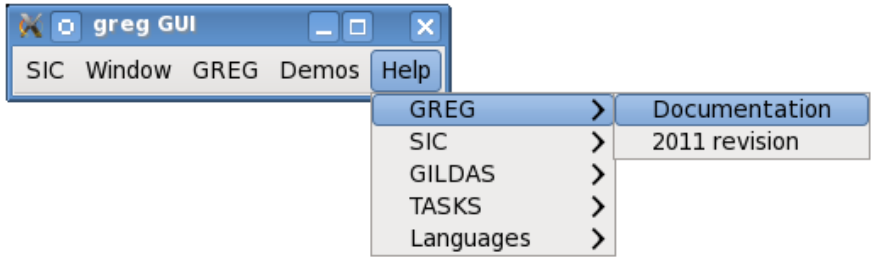
- Integration of functionality enable to simplify the interaction with ever increasing data complexity.
- Viewing the intermediate processing steps enable to keep control of the data reduction.

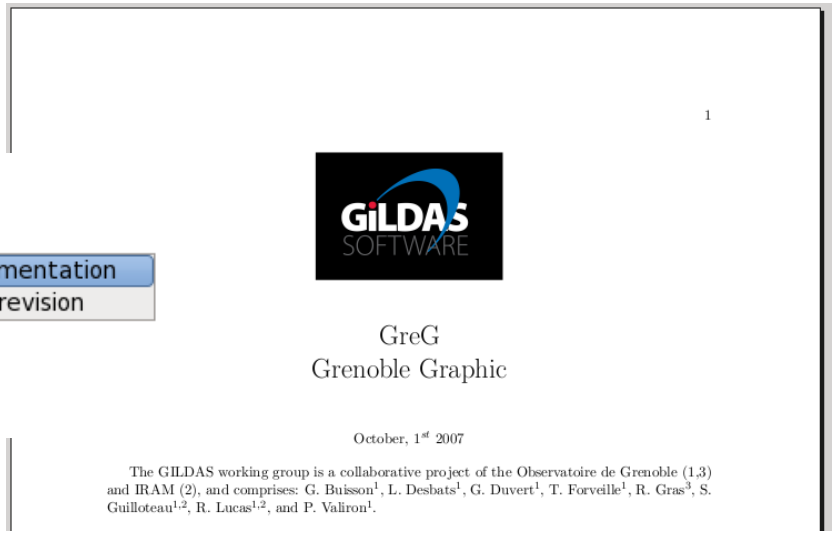
Professionalization

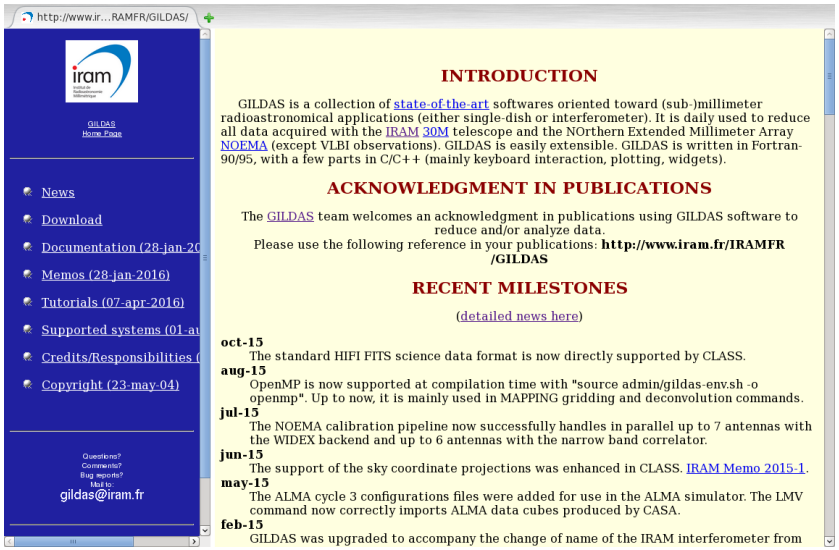
- Prototypes are rewritten to get a better design and an easier medium to long term maintenance.
- Yearly versions for the online acquisition.
- Major developments made in branches (`GREG2011`) or plug-ins (`WEEDS`) to avoid disruption.
- Much testing done before releasing new developments (`GREG2011`, `CLIC` pipeline, `MRTCAL`, ...).

Need generic help? I. Browsing the widgets

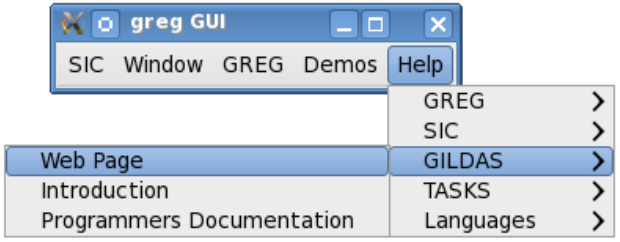
PDF document opened in your PDF viewer





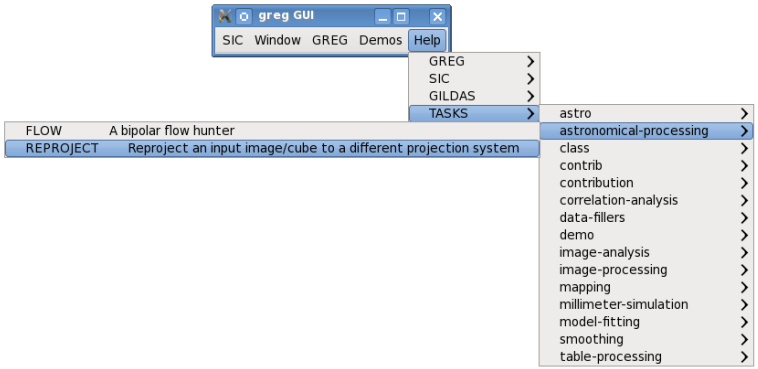


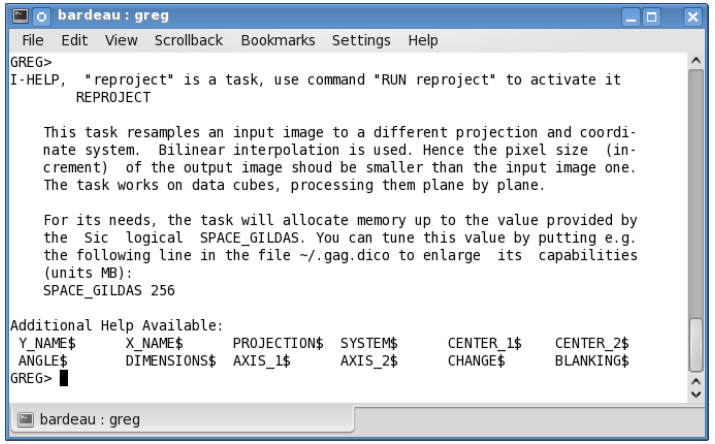
Web pages opened in your web browser

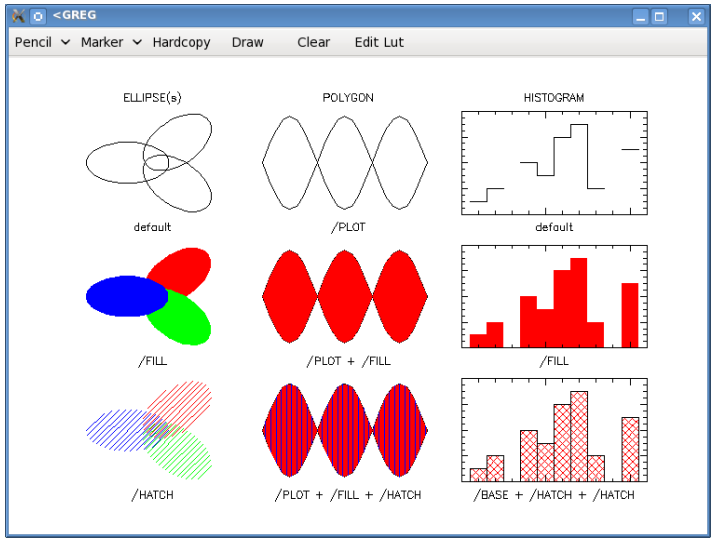


Need generic help? II. Demonstration procedures

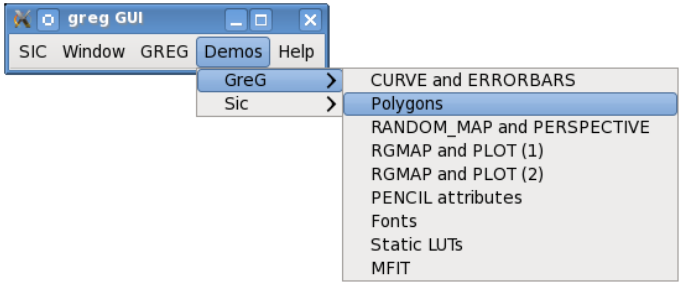
Online HELP displayed in the terminal window







Demonstration executed in the terminal and/or the plotting window



Need CLASS help?

GILDAS web page http://www.iram.fr/IRAMFR/GILDAS/

CLASS documentations and cookbooks Widget>Help>Class>...

Online help

```
LAS> HELP  ! Summary of all commands, gathered by language
...
LAS\
  ACCUMULATE   ASSOCIATE    AVERAGE      BASE         BOX          CATALOG
  CONSISTENCY  COPY         DROP         DUMP         EXTRACT      FILE
...
LAS> HELP LAS\ ! (with backslash) Language help with short command description
      LAS\ Command Language Summary
ACCUMULATE          Add R and T observation.
ASSOCIATE           Add an Associated Array to the R observation
AVERAGE             Average all the observations of the current index.
...
LAS> help average  ! Command help
    LAS\AVERAGE  [/RESAMPLE  [NX  Xref  Xval   Xinc   Unit]]   [/NOCHECK
[SOURCE|POSITION|LINE|SPECTROSCOPY|CALIBRATION]]

Average all the spectra of the current index using the current weighting
function (see SET WEIGHT).
...
LAS> help average /resample ! Command  subtopic help
...
```

Helpdesk (Questions? Comments? Bug reports?): gildas@iram.fr

Data exploration: I. What does the file contain?

```
LAS> file in demo
LAS> find
LAS> list
Current index contains:
 N;V   Source       Line          Telescope      Lambda     Beta Sys  Sca Sub
...
8600;4  B0355+508   12CO(1-0)     30M-V02-B100    +65.2    +60.0 Eq  9682.  2
8601;4  B0355+508   12CO(1-0)     30M-V02-B100    +68.2    +60.0 Eq  9682.  2
8602;4  B0355+508   12CO(1-0)     30M-V02-B100    +71.3    +60.0 Eq  9682.  2
8603;4  B0355+508   12CO(1-0)     30M-V02-B100    +74.4    +60.0 Eq  9682.  2
8604;4  B0355+508   12CO(1-0)     30M-V02-B100    +77.4    +60.0 Eq  9682.  2
8605;4  B0355+508   12CO(1-0)     30M-V02-B100    +80.5    +60.0 Eq  9682.  2
8606;4  B0355+508   12CO(1-0)     30M-V02-B100    +83.5    +60.0 Eq  9682.  2
8607;4  B0355+508   12CO(1-0)     30M-V02-B100    +86.6    +60.0 Eq  9682.  2
8608;4  B0355+508   12CO(1-0)     30M-V02-B100    +89.7    +60.0 Eq  9682.  2
8609;4  B0355+508   12CO(1-0)     30M-V02-B100    +92.7    +60.0 Eq  9682.  2
8610;4  B0355+508   12CO(1-0)     30M-V02-B100    +95.8    +60.0 Eq  9682.  2
8611;4  B0355+508   12CO(1-0)     30M-V02-B100    +98.8    +60.0 Eq  9682.  2
8612;4  B0355+508   12CO(1-0)     30M-V02-B100   +101.9    +60.0 Eq  9682.  2
8613;4  B0355+508   12CO(1-0)     30M-V02-B100   +104.9    +60.0 Eq  9682.  2
8614;4  B0355+508   12CO(1-0)     30M-V02-B100   +108.0    +60.0 Eq  9682.  2
LAS>
```

$\Rightarrow$ Too many information.

Data exploration: I. What does the file contain?

```
LAS> list /scan
...
 B0355+508    12CO(1-0)    30M-V02-B100    -108.5:   +108.8          +70.0       Eq  9626   73
 B0355+508    12CO(1-0)    30M-V01-A100    -108.5:   +108.8          +80.0       Eq  9627   73
 B0355+508    12CO(1-0)    30M-V02-B100    -108.5:   +108.8          +80.0       Eq  9627   73
 B0355+508    12CO(1-0)    30M-V01-A100    -109.4:   +107.9          +90.0       Eq  9628   73
 B0355+508    12CO(1-0)    30M-V02-B100    -109.4:   +107.9          +90.0       Eq  9628   73
 B0355+508    12CO(1-0)    30M-V01-A100    -109.6:   +107.7         +100.0       Eq  9629   73
 B0355+508    12CO(1-0)    30M-V02-B100    -109.6:   +107.7         +100.0       Eq  9629   73
 B0355+508    12CO(1-0)    30M-V01-A100        -100.0           -109.3:   +108.0 Eq  9634   73
 B0355+508    12CO(1-0)    30M-V02-B100        -100.0           -109.3:   +108.0 Eq  9634   73
 B0355+508    12CO(1-0)    30M-V01-A100         -90.0           -109.4:   +107.9 Eq  9635   73
 B0355+508    12CO(1-0)    30M-V02-B100         -90.0           -109.4:   +107.9 Eq  9635   73
 B0355+508    12CO(1-0)    30M-V01-A100         -80.0           -109.5:   +107.8 Eq  9636   73
 B0355+508    12CO(1-0)    30M-V02-B100         -80.0           -109.5:   +107.8 Eq  9636   73
 B0355+508    12CO(1-0)    30M-V01-A100         -70.0           -109.2:   +108.1 Eq  9637   73
...
LAS>
```

$\Rightarrow$ One line per scan and front-end/back-end combination

Data exploration: I. What does the file contain?

```
LAS> list /scan /brief
Current index contains:
 9608: 146   9609: 146   9610: 146   9611: 146   9612: 146   9613: 146
 9614: 146   9615: 146   9616: 146   9617: 146   9619: 146   9620: 146
 9621: 146   9622: 146   9623: 146   9624: 146   9625: 146   9626: 146
 9627: 146   9628: 146   9629: 146   9634: 146   9635: 146   9636: 146
 9637: 146   9638: 146   9639: 146   9640: 146   9641: 146   9642: 146
 9643: 146   9645: 146   9646: 146   9647: 146   9648: 146   9649: 146
 9650: 146   9651: 146   9652: 146   9653: 146   9654: 146   9655: 146
 9665: 146   9666: 146   9667: 146   9668: 146   9669: 146   9670: 146
 9671: 146   9672: 146   9673: 146   9674: 146   9676: 146   9677: 146
 9678: 146   9679: 146   9680: 146   9681: 146   9682: 146
LAS>
```

$\Rightarrow$ Just the list of scans and the number of dumps per scan.

Data exploration: I. What does the file contain?

```
LAS> list /toc

equivalent to

LAS> list /toc source line telescope
Current index contains:
Number of sources......   1
    B0355+508          8614 (100.0%)
Number of lines........   1
    12CO(1-0)          8614 (100.0%)
Number of backends.....   2
    30M-V01-A100       4307 ( 50.0%)
    30M-V02-B100       4307 ( 50.0%)
Number of setups.......   2
    B0355+508    12CO(1-0)    30M-V01-A100       4307 ( 50.0%)
    B0355+508    12CO(1-0)    30M-V02-B100       4307 ( 50.0%)
LAS>
```

$\Rightarrow$ Default table of contents.

Data exploration: I. What does the file contain?

```
LAS> list /toc observed scan
Number of observation dates   1
    12-SEP-2005        8614 (100.0%)
Number of scans.......  59
            9608        146 (  1.7%)
            9609        146 (  1.7%)
            9610        146 (  1.7%)
            9611        146 (  1.7%)
            9612        146 (  1.7%)
            9613        146 (  1.7%)
            9614        146 (  1.7%)
            ...
Number of setups.......  59
    12-SEP-2005          9608        146 (  1.7%)
    12-SEP-2005          9609        146 (  1.7%)
    12-SEP-2005          9610        146 (  1.7%)
    12-SEP-2005          9611        146 (  1.7%)
    12-SEP-2005          9612        146 (  1.7%)
    12-SEP-2005          9613        146 (  1.7%)
    12-SEP-2005          9614        146 (  1.7%)
    ...
LAS>
```

$\Rightarrow$ Customized table of content.