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

IRAM Millimeter Interferometry Summer School  
Oct. 1 - 5 2018, Grenoble
Contributors: I. People (as of 2018 October)

Large code contributors $\sim 5.0$ FTE/yr

R. Zylka  PIIC.
A. Sievers  MRTCAL and PAKO.
E. Reynier  OMS + kernel.
V. Pietu  CLIC + RDI.
J. Pety  kernel + MRTCAL + CLASS + MAPPING.
V. de Souza Magalhaes  MAPPING.
A. Castro-Carrizo  CLIC pipeline + OBS.
J. Boissier  ASTRO.
S. Berta  PIIC.
S. Bardeau  kernel (including the python binding) + CLASS + MRTCAL.
S. Maret  CLASS/WEEDS.
S. Guilloteau  MAPPING + Kernel.

Many other IRAM staff slightly contributing, or advising, or testing.
Contributors: II. Recent collaborations

python-GILDAS binding IRAM/Bordeaux.

HIFI FITS support (CLASS) IRAM/LERMA/IRAP/ESAC.

DSB deconvolution (CLASS) IRAM/IPAG/Cologne.

Analysis of line surveys (WEEDS) IRAM/IPAG/Bonn.

Imaging and deconvolution (MAPPING) IRAM/Bordeaux
What my daughters think I do at IRAM

les pensées qui fleurissent

Dans la tête de Papa (quand il travaille)
Actual activity: Helping people to make sense of

Hexadecimal representation of the $^{12}$CO(1-0) LMV cube of the south-western edge of the Orion B molecular cloud...

4c7225bfa4b317bff31e063f21fab6bd7846db3e0e4d5abf2f20803ed28e
b53e23910dbfa730babe1bbee2a3f8c2a5be1e7f49bffcc4fe93e4bafbe83e
4694b83f916ebe6984ae3e9798a23ecfc39bb3f0d91e0be23f4b23d4213
b93e2c81e8b8b5caf18bff30531beccdfabee326e7bc46a2d53e2da3963d
40ea9bcb91a2d53d0607b1bc98894ebe96ce19b89f7c6f683f17bea624
4bbecc1bf9e3e0f9f923f0a1bbf0f3cf2d02cc0f4d189e7615fde37f3f4be
2418b6ccc7192e3fe0477f30fc38f93bfa4a2c8bafe4f765be4ae63b3e2cec
b23e7ef00c3f3409ef3e946d07bfe0ffcbdb4fee443e04f48bdafbf3bbe
1ad525bfcd5c6d6f95a883e4ac373f539ac9be6db95c3e806de2ef64d4
3b3e3cd4d33e053405f52a12ebed6f6397be2c71353f5f615a3f0357043f
29ca013e459010bf989f503ed1646f3e04a236bfe4d01bf04ad0a0abf2e5b
7abcbede96bf42af0abf7f6d54be3c37c9be6d1c06beceae9d0be13e72bd
34984af0d5c5cbd528c0fe4c32943e73723adebe96a0213eac883f6bfe537
0abfcfc050b3b56dfbeb315123f35b80b3dfbb7a7bda62325bf8356cbbc
df2834bf8b27a73f6105823f41881b3f75a003d3efde8a3f3ce354ab4f81bb
1f3f83d53200a3e15243sfa63a3fa0d37be3fscaab3e025e35f3a2c3f
91ff3e3a3bad13e3e3ef60bf4817073f11e714bc1cf28ebc5a885dbfd8dc5
8bf88a339bd3f4d93f8cbbc03f9374dc6e06a6e8683e0362873f19e0453e
9e8f8ec3d0d9394e5f0b05bf0d94efc39f980823fbff7bbf2af55de96a
973e2168b3eb3704bffa2a88f3d761c71bfe6cb80be8b75003fbd59f63e
8e5c0a3fe8b24bd2a7e6abaa72313f2906a83edcad1be0009dbd8625
fabda6f426be4a56e3ea91305b5f397233d5a3d783ee02e65f66c913f
071b99b3ee73bebe17cfdf83eb053783f962aae3efd2a93be8e66f3c3edf58
4f6e33d70e3f4f8fb93e65e5be3d4b98b3e78b7173ecb4c7d3e492b063e
18e5373ec55eeef3d924a5d3ec355853f9ce2f4bdca6e16bf5963cbe9598
223fda2a643e77bb8c3ed520193f1175a43e73e5b73ef992763dc68c53e
6fa5b63e7dfe15bf8832063e25ab06bec64f10b59c4d4abe8b6f83be451f
883d848e17be720c2c3f45d65e3fac91293f590dfde3eca0ca73e86acbc3e
294ed83eda03a3f3f07b23eb99a143fffc4483fcb724beb0318f6be69e8
283f4289b73e025d1a3d824c68bef42c423e53df0cbef420db3e62ada13e
Scope: I. Softwares developed at IRAM

Goals

1. Handling of proposals and scheduling (statistics, dynamic scheduling, pool observing).
2. Preparation of observations, *e.g.* setups.
3. Data acquisition:
   3.1 Low level, *e.g.* hardware control (antennas, receivers, correlators, etc...)
   3.2 High level, *e.g.* operator and observer interface.
4. Data archiving.
5. Data reduction and analysis (single dish + interferometry).

This talks deals with points 1, 2, 4, 5, and 6

**GILDAS** A collection of state-of-the-art software oriented toward (sub-)millimeter radioastronomy (points 2, 5, and 6).

**Observation Management System (OMS)** Set of independent tools to manage a project along its lifetime from submission to delivery of data (points 1, 2, and 4).
Scope: II. Observation Management System
40 000 executable lines
Scope: III. **GILDAS in a nutshell**

A collection of state-of-the-art software oriented toward (sub-)millimeter radioastronomy

**Common facilities**
- Command line interpreter: **SIC**.
- Graphical possibilities: **GREG** (1D: curves, 2D: images, 3D: spectra cubes).
- Preparation of observations: **ASTRO**.

**30m**
- Spectroscopy: **MRTCAL + CLASS**.
- Continuum camera: **PIIC**.

**NOEMA**
- Calibration: **CLIC**;
- Imaging + Deconvolution: **MAPPING**.

35 years of accumulated expertise
- 470 000 executable lines
- Crafted power tools
- Light weight
GILDAS users

IRAM AODs  Instrument monitoring, data pipelining.

IRAM users  Data reduction.

Other users

- GILDAS (e.g., CLASS) is used in many observatories.
- 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.

⇒ Evolutions must be thought with all users in mind.
User support:

I. Documentation

Online HELP displayed in the terminal window

Demonstration executed in the terminal and/or the plotting window
User support:
I. Documentation (Cont’d)
User support:

I. Documentation (Cont’d)

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

MEMOS

The exhaustive list (summary and PDFs) of the IRAM technical memos is available on the IRAM webpage.

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IRAM Memo 2013-2

CLASSIC Data Container

S. Bardeau\textsuperscript{1}, V. Piétu\textsuperscript{1}, J. Pety\textsuperscript{1,2}

1. IRAM (Grenoble)
2. LERMA, Observatoire de Paris

October, 3\textsuperscript{rd} 2013
Version 1.0

Abstract

The CLASS/CLIC Data Format are digital formats used to describe single-dish/interferometric radio-astronomy data. They can be described in two layers: 1) a CLASSIC Data Container, which is generic enough to store many kind of data, typically several observations which gather observational parameters with actual data, and 2) the CLASS/CLIC Data Format itself which make a particular use of the CLASSIC Data Container.

The size of the datasets produced by the IRAM instruments experience a tremendous increase (because of multi-beam receivers, wide bandwidth receivers, spectrometers with thousands of channels, and/or new observing mode like the interferometric on-the-fly). This implied that the CLASS/CLIC Data Format were reaching common limits in the size of data which could be stored. To solve these issues, the CLASSIC Data Container standard was revised, the document aims to describe the new standard. A companion document describes the GILDAS library which implements the standard and which is now used by CLASS and CLIC.

Related documents: The CLASSIC Library, IRAM memo 2013-3

IRAM Memo 2017-1

Observational examples of spectral line calibration at the 30m telescope with MRTCAL and MIRA

C. Marka\textsuperscript{1}, J. Pety\textsuperscript{2,3}, S. Bardeau\textsuperscript{2}, A. Siewers\textsuperscript{1}

1. IRAM (Granada)
2. IRAM (Grenoble)
3. Observatoire de Paris

Sep., 14\textsuperscript{th} 2017
Version 1.0

Abstract

Since February 2017, MRTCAL has replaced MIRA as the software for spectral line data calibration (except polarimetry and continuum) at the 30m Telescope. Slight changes in the calibrated spectra are expected, for example in form of an improved calibration accuracy at the edges of the atmospheric windows as result of the narrower calibration bandwidth used by MRTCAL (30 MHz by default, compared to up to about 1.35 GHz for MIRA). This report demonstrates the practical performances of MRTCAL by a systematic comparison of observations calibrated with both softwares.

Keywords: MRTCAL, MIRA, 30m calibration
Related documents: MRTCAL documentation, MIRA documentation, CLASS documentation.
User support:

II. On-line helpdesk (gildas@iram.fr)

- Total number of threads: 159/year.
- Number of emails per threads: 4.4.
- Median time to
  - First answer: 6h;
  - Final answer: 25h.
User support:

III. Face-to-face training

User Meetings 35 participants in Apr. 2016 + Another one in 2019.

Lectures and tutorials in IRAM schools

- Eight 30m-schools = 326 participants.
- Nine NOEMA-schools = 521 participants.

Participations to the European Radio Interferometry Schools (ERIS)

Other tutorials Bonn, Cologne, Garching (ESO).
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.
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: sep15b (x86_64-redhat6.4-ifort) source tree

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

Data set attached: test.30m

***************************************************************************
Coping with the NOEMA project: Challenges

Changes of technology

**Receiver** 2 polar, 4GHz, SSB ⇒ 2 polar, 8GHz, 2SB.

**Backend** XF ⇒ FX.

New operation modes *e.g.* double-array.

Increased complexity More antennas + More frontend/backend chunks.

Increased data rates by a factor 32 to 6000.

- **Number of baselines** PdBI-2010 × $N_{\text{ant}}(N_{\text{ant}} - 1)/30$, *i.e.* 1.9, 3, and 4.4 for 8, 10, and 12 antennas.
- **Channels** PdBI-2010 × 32.
- **Shorter integration times** PdBI-2010 × 1 − 45.
- **Typical data rates** at the end of phase 1, *i.e.* end of 2017
  - **Average (Single-field, 10 antennas)** 2.8 MB/s, *i.e.*, at most 77 GB for 8-hrs observation.
  - **Peak (Wide-field, 10 antennas)** 63.0 MB/s, *i.e.*, 1.7 TB for 8-hrs observation.

Bigger delivered data products Large 3D data cubes.

Increased scientific capabilities

- **Wide bandwidth.**
- **Higher sensitivity.**
- **Higher brightness dynamic.**
  ⇒ Discovery of subtle, previously undetected “artifacts”.

GILDAS J. Pety 2018
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 while staying open to outside world

Large projects divided into “Short”, “focused” development cycles

A good balance between software astronomers and software engineers

Continuous aggregation of functionality without creating black boxes

Yearly versions for the online acquisition

Monthly releases to the community