CASSIS, a software package to analyze high spectral resolution observations

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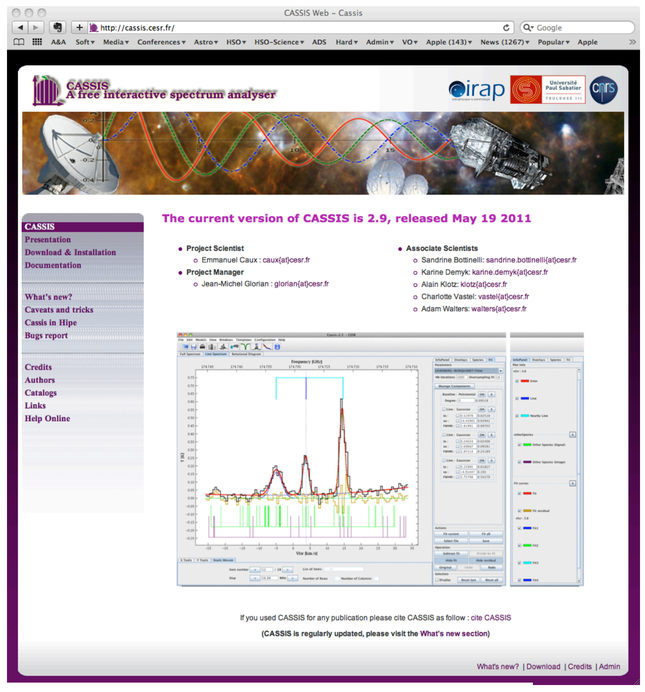
ABSTRACT

CASSIS[1] (Centre d'Analyse Scientifique de Spectres Infrarouges et Submillimétriques) is a software package aimed to speed-up the scientific analysis of high spectral resolution observations, particularly suited for broad-band spectral surveys. CASSIS is written in Java and can be run on any platform. It has been extensively tested on Mac OSX, Linux and Windows operating systems. CASSIS is regularly enhanced, and can be easily installed and updated on any modern laptop. It uses a fast Sql-lite access to a local spectroscopic database combining the JPL[2] and CDMS[3] molecular spectroscopic databases, and the atomic spectroscopic database NIST[4]. The tools available in the currently distributed version (2.9) include, among others, a LTE model and the RADEX[5] model connected to the LAMDA[6] molecular collisional database. A module allows to build a line list fitting the various transitions of a given species and to directly produce rotational diagrams from these lists. CASSIS is fully integrated into HIPE[7], the Herschel Interactive Processing Environment, as a plug-in, since version 5.1.



CASSIS website : http://cassis.cesr.fr

CASSIS software

- Full java (requires java 1.6 or above) (tested on MacOSX, Linux and Windows)
- GUI based, scripting in development
- Use of simple configuration files
- User-friendly automatic installer
- Standalone version
- HIPE plugin all-in-one
- Frequent updates reflecting bugs correction
- Automatic and tunable update
- Bugs reporting system

CASSIS database

- The database (< 1 Gb) is in Sqlite format (no need of any extra software)
- Combines JPL, CDMS and NIST databases
- Is resident on the laptop (no internet connection needed)
- Includes extra parameters used by CASSIS
- Ortho-Para separation for a few species (H_2O, D_2O, H_2S, D_2S, H_2CO, $H_2{}^{13}CO$, $H_2C^{18}O$, D_2CO, c-C_3H_2, H_2D^+, D_2H^+, NH_3)
- A-E separation for a few species (CH_3OH, CH_3CCH)
- Allows a quick access with various sorting (E_{up}, frequency, A_{ij})
- Can be populated separately by each user to create its own database (expert mode)

Astrophysical template (fixed parameters N, T_k, T_{ex}, N_{H2}, Δv, choice of the molecule…)

Observed spectra (laboratory or telescope)

CASSIS
- LTE model and Radex
- Parameters to vary: N, T_k, T_{ex}, n_{H2}, Δv, choice of the molecule and telescope, beam dilution…

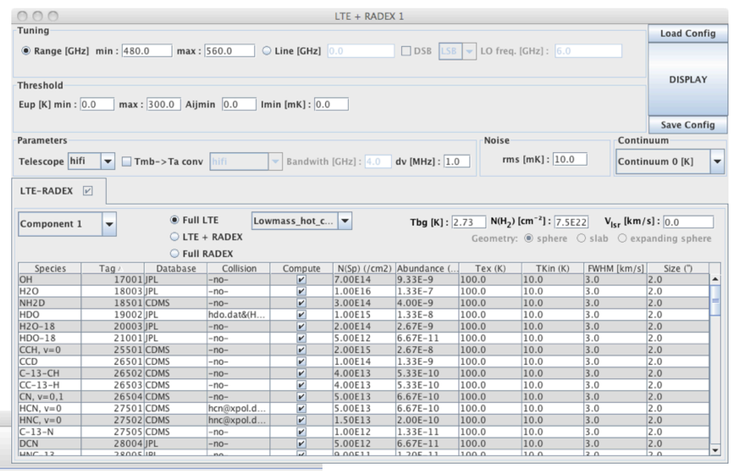
Spectroscopic and molecular databases (JPL, CDMS, HITRAN, Basecol, LAMDA)

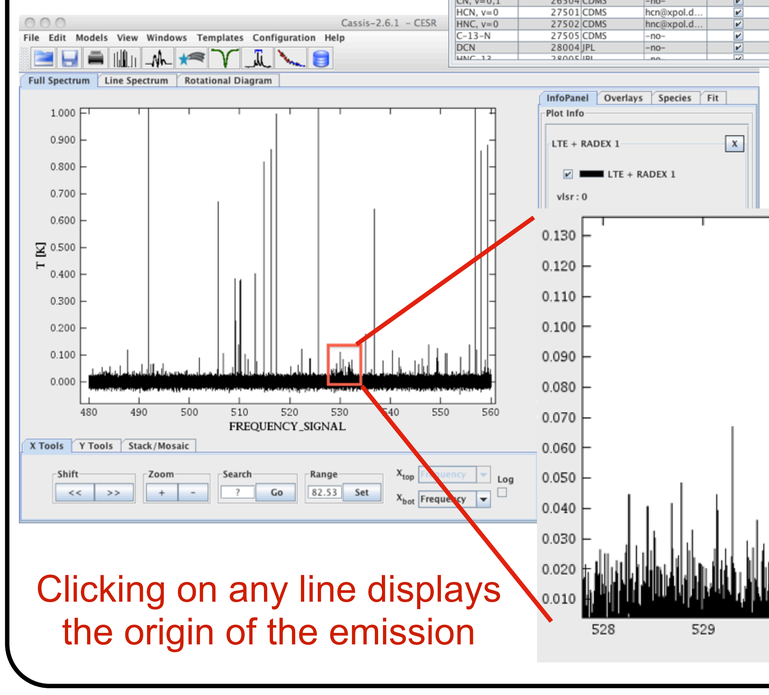
Synthetic spectra, Line identification, Adjustment of the source parameters

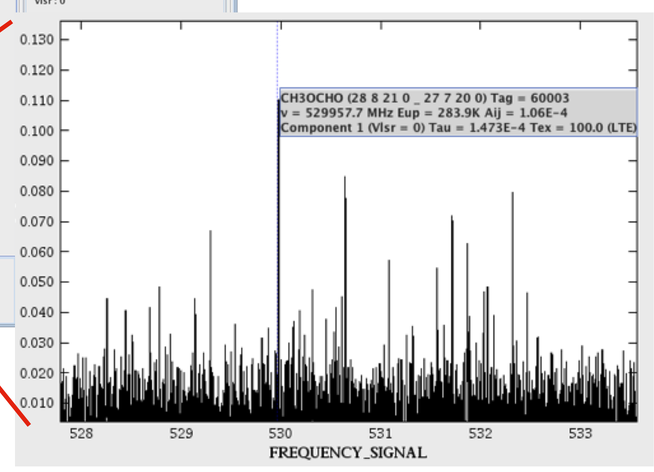
Easy installation to be ready to work with CASSIS within minutes

CASSIS links all the data needed to compute synthetic spectra and to compare them with observed spectra

- Entry panel allows different tunings, thresholds and choice of telescope
- LTE-Radex model available for multiple components
- Selection of any template present in the CASSIS database
- Quick and easy change of list of parameters or individual parameter
- If full Radex is selected only species with collision coefficient files will be computed
- Easy change of colliders and collider's density by clicking on the collision file
- Editable config files can be saved or loaded from previous computation



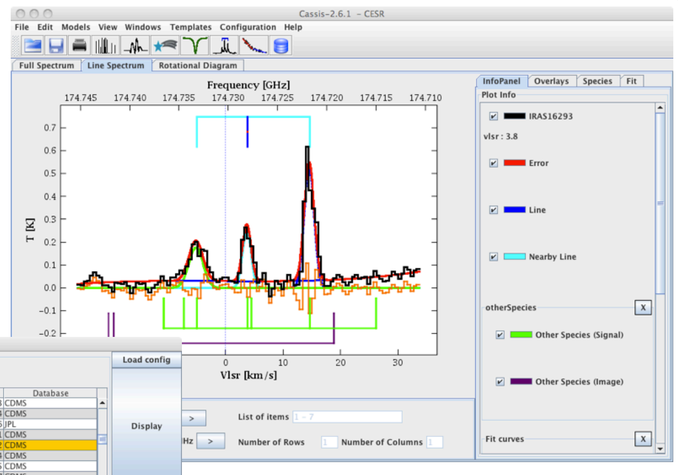


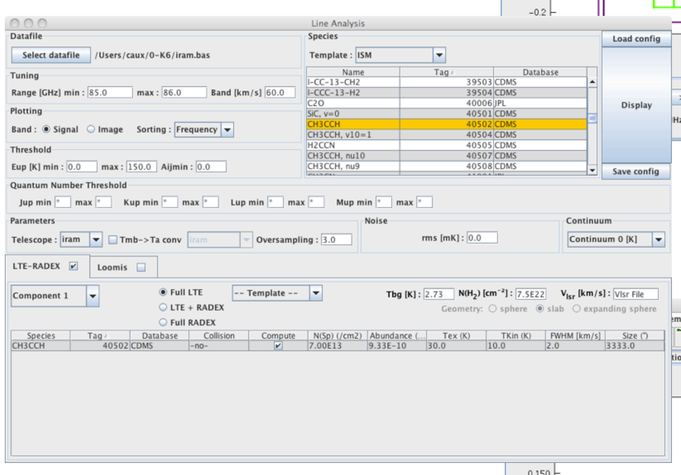


- Multi zooming
- Full description of the spectrum available at all scales

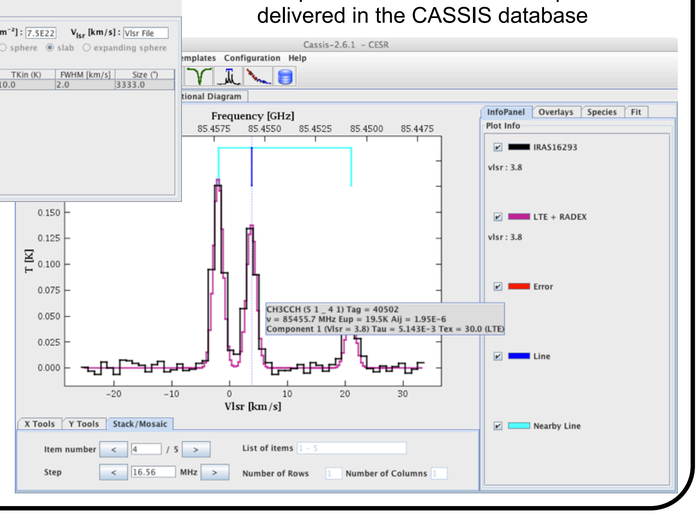
Clicking on any line displays the origin of the emission

- Quick stack display of spectra for all transitions of a species in a spectral survey
- Comprehensive fitting of baselines (polymomial, sinusoidal)
- Comprehensive fitting of lines (Gauss, Lorentz, Sinc and Voigt)
- Overlay of possible blending species from Signal and Image band (for DSB spectra)
- Overlay of synthetic spectra or other observed spectra





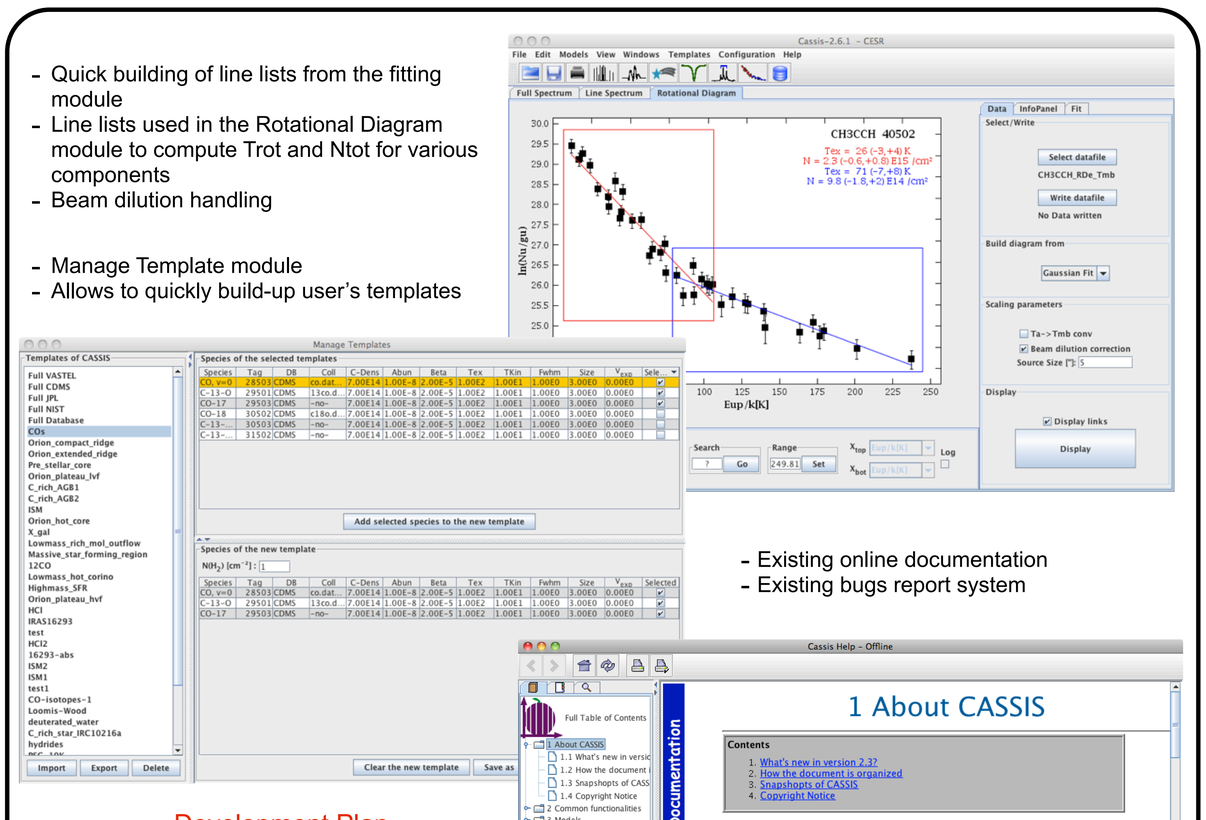
- Entry panel allows different tunings, thresholds and choice of telescope
- Overlay models with one or multiple components and choice of templates delivered in the CASSIS database



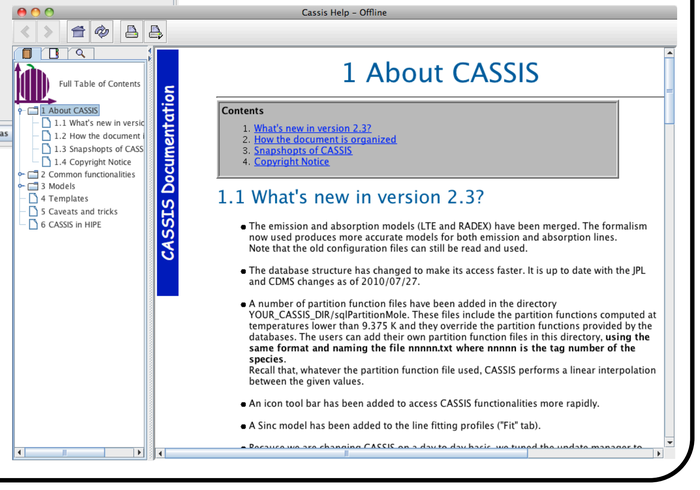
Clicking on any line displays the information present in the database (frequency, Aij, Eup...)

- Quick building of line lists from the fitting module
- Line lists used in the Rotational Diagram module to compute Trot and Ntot for various components
- Beam dilution handling

- Manage Template module
- Allows to quickly build-up user's templates



- Existing online documentation
- Existing bugs report system



Development Plan

- CASSIS WEB tools
- Use of instrumental profiles (PACS, SPIRE, ISO, SPITZER...)
- Datacubes handling
- Automatic multi-line fitting (all lines of the same species, same line of ≠ isotopes, HFS fit…)
- Scripting
- Creation of grid models -> VO

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[3]http://www.astro.uni-koeln.de/cdms/catalog

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[3]Müller, H.S.P., Schlöder, F., Stutzki, J. and Winnewisser, G., 2005, J. Mol. Struct. 742, 215

[4]Ralchenko, Yu., Kramida, A.E., Reader, J. and NIST ASD Team (2010). NIST Atomic Spectra Database (version 4.0), [Online]. Available: http://physics.nist.gov/asd

[5]van der Tak, F.F.S., Black, J.H., Schöier, F.L., Jansen, D.J., van Dishoeck, E.F. 2007, A&A 468, 627

[6]Schöier, F.L., van der Tak, F.F.S., van Dishoeck E.F., Black, J.H. 2005, A&A 432, 369

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