CLASS tutorial: IV. Interfacing GILDAS and line catalogs

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LINEDB and WEEDS

LINEDB GILDAS kernel language to query online or local spectroscopic databases (Developed by M. Lonjaret, S. Bardeau, S. Maret, & J. Pety). ⇒ see LINEDB demo.

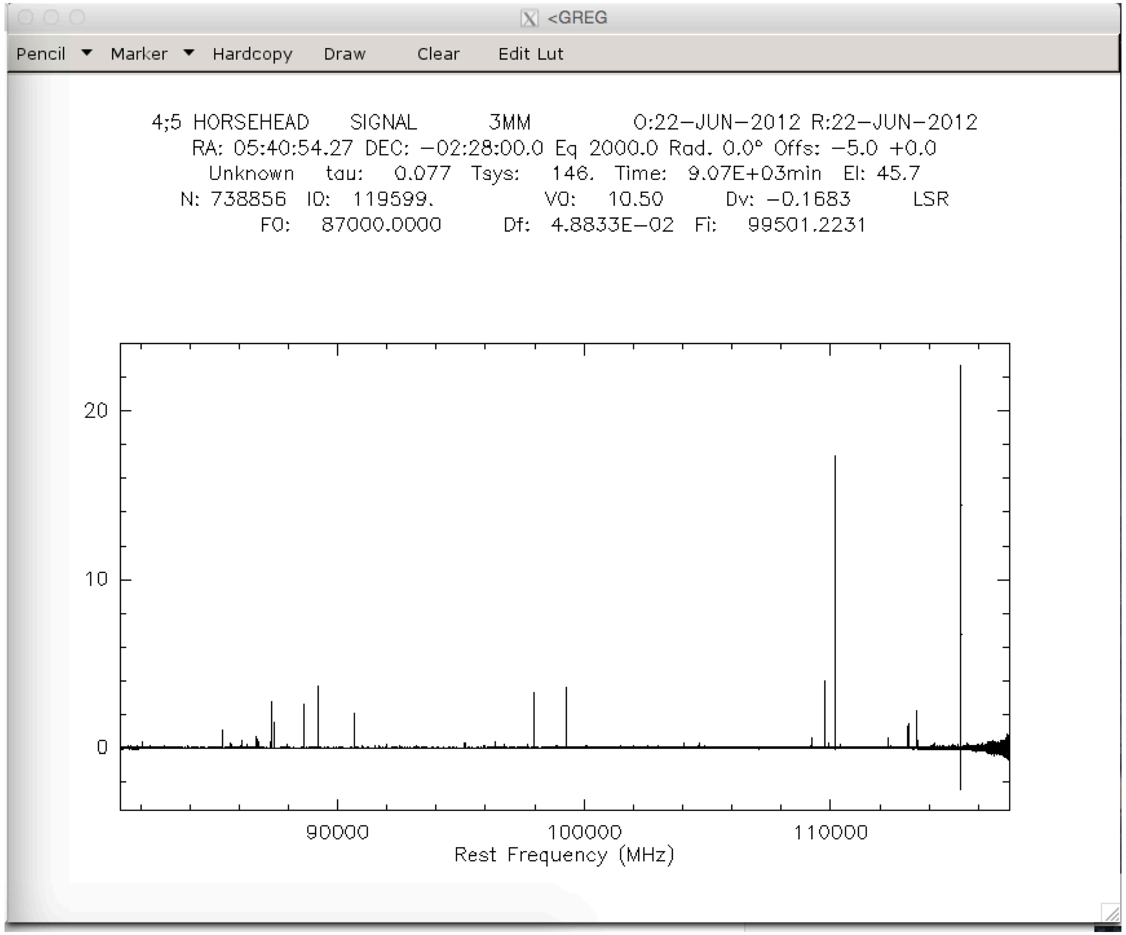
WEEDS Adaptation of LINEDB to the CLASS environment (see Maret et al. 2011, *A&A*, 256, 47). It offers

- Interactive use of line catalogs with CLASS spectra.
- LTE line modeling and production of synthetic spectra.

Compiled automatically if **python** (v$\geq$ 2.6) and **numpy** are installed (including the development packages).

Prerequisite: Plotting a spectrum in CLASS

```
LAS> file in mydata.30m
LAS> find
LAS> get first
LAS> plot
```



Connecting the input line catalog(s)

If you want to:

Select an online database (CDMS or JPL),

Duplicate a (subset of) an online database in an offline catalog,

Build a custom offline database,

Insert or remove lines in an offline catalog

⇒ see `LINEDB` demo.

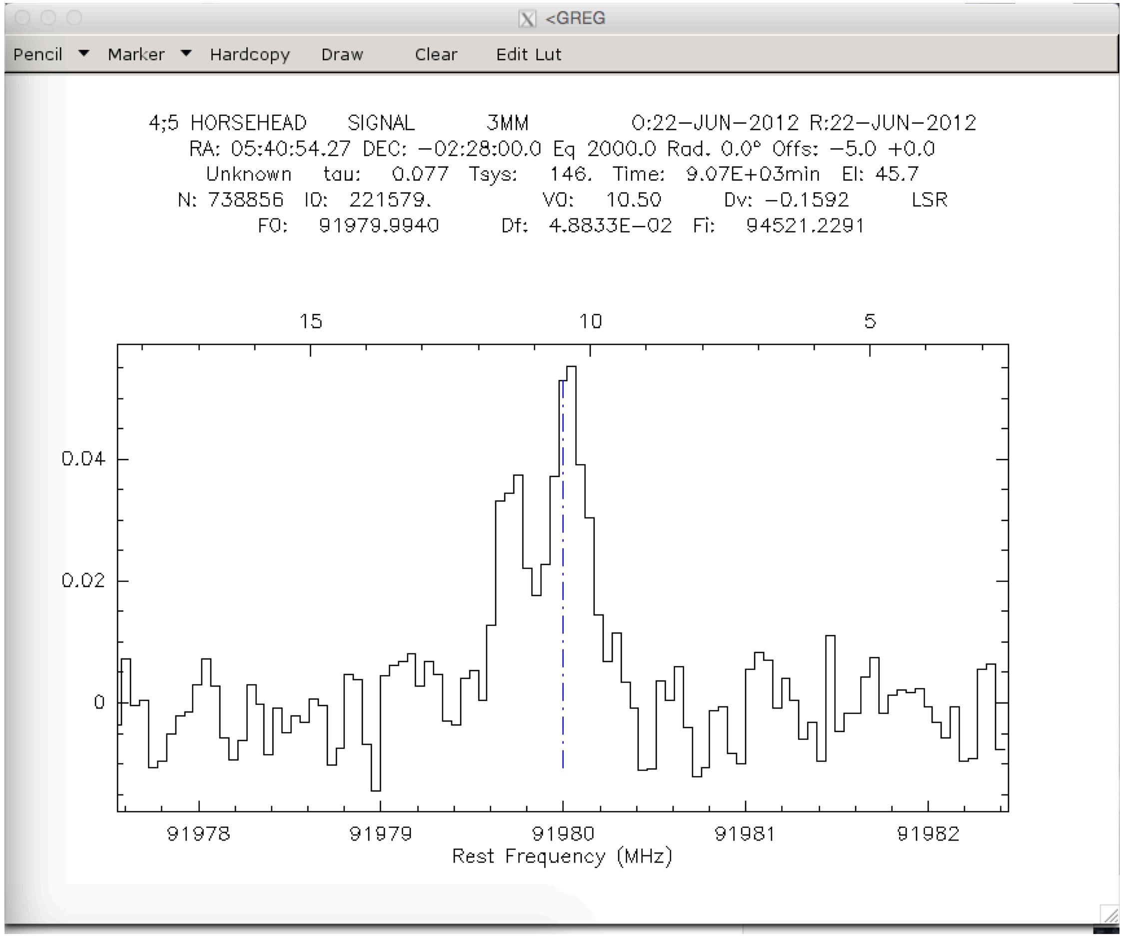
```
LAS> use in cdms       ! Online access to the CDMS database
I-USE,  cdms (online) selected
```

Find all the lines of a given species in the current connected line catalogs

```
LAS> lfind CH3CN    ! Create an index of all the lines associated of CH3CN
I-LFIND,  11 lines found in the frequency range 81159.6729337 to 117240.165713 MHz
LAS> llist         ! List them with their spectroscopic properties
  # Species          Freq[MHz] Err[MHz] Eup[K]  Gup  Aij[s-1]    Upper level -- Lower level    Origin
  1 CH3CN            91958.726   0.000   127.5   22  2.28e-05            5 4 -- 4 4               jpl
  2 CH3CN            91971.130   0.000    77.5   44  4.05e-05            5 3 -- 4 3               jpl
  3 CH3CN            91979.994   0.000    41.8   22  5.32e-05            5 2 -- 4 2               jpl
  4 CH3CN            91985.314   0.000    20.4   22  6.08e-05            5 1 -- 4 1               jpl
  5 CH3CN            91987.088   0.000    13.2   22  6.33e-05            5 0 -- 4 0               jpl
  6 CH3CN           110330.345   0.000   197.1   26  3.39e-05            6 5 -- 5 5               jpl
  7 CH3CN           110349.470   0.000   132.8   26  6.17e-05            6 4 -- 5 4               jpl
  8 CH3CN           110364.354   0.000    82.8   52  8.33e-05            6 3 -- 5 3               jpl
  9 CH3CN           110374.989   0.000    47.1   26  9.87e-05            6 2 -- 5 2               jpl
 10 CH3CN           110381.372   0.000    25.7   26  1.08e-04            6 1 -- 5 1               jpl
 11 CH3CN           110383.500   0.000    18.5   26  1.11e-04            6 0 -- 5 0               jpl
```

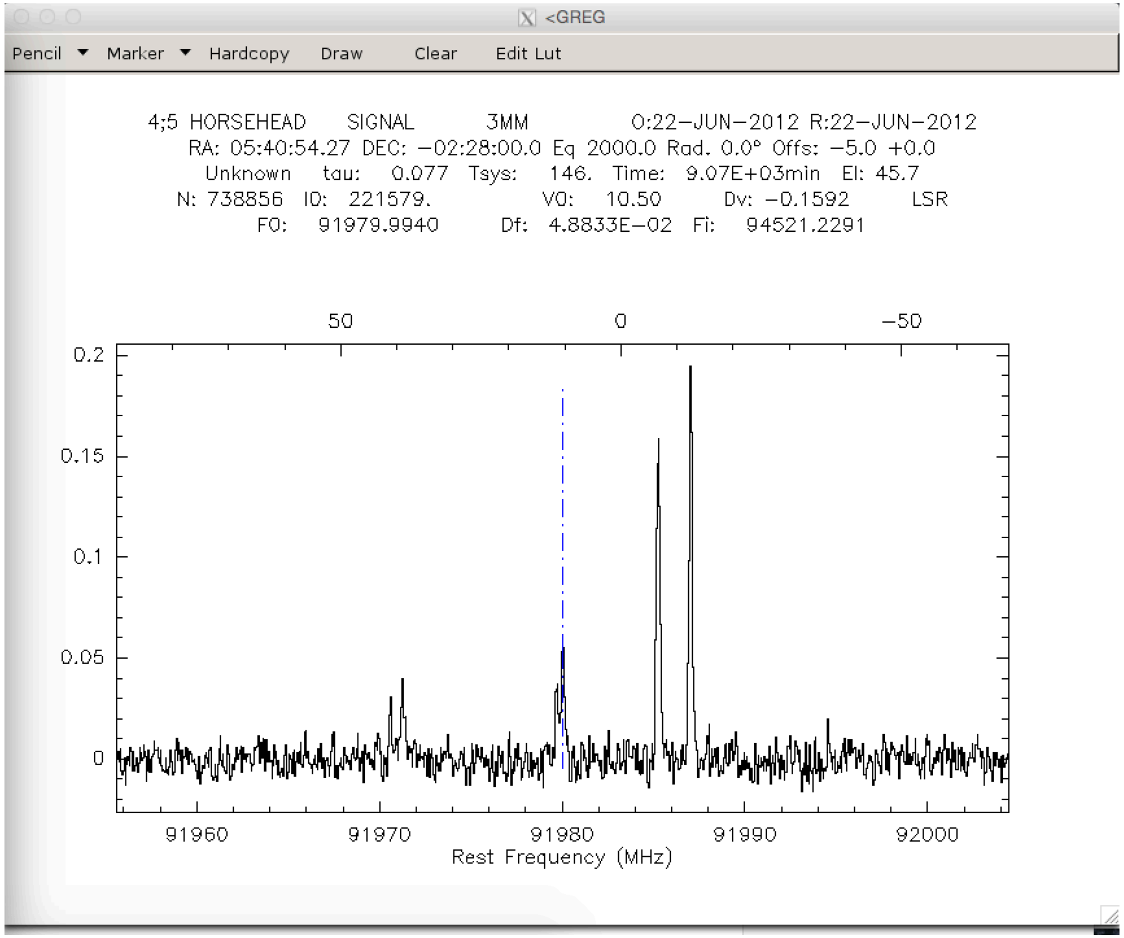
Plotting the frequency range associated to a single line of the current line index

```
LAS> lget 3    ! Get frequency range around line #3 of current index
I-LGET,  Found line frequency in the current scan
# Species Freq[MHz] Err[MHz] Eup[K]  Gup  Aij[s-1] Upper level -- Lower level Origin
1 CH3CN   91979.994   0.000    41.8   22  5.32e-05         5 2 -- 4 2           jpl
LAS> lplot     ! Plot the corresponding frequency range
```



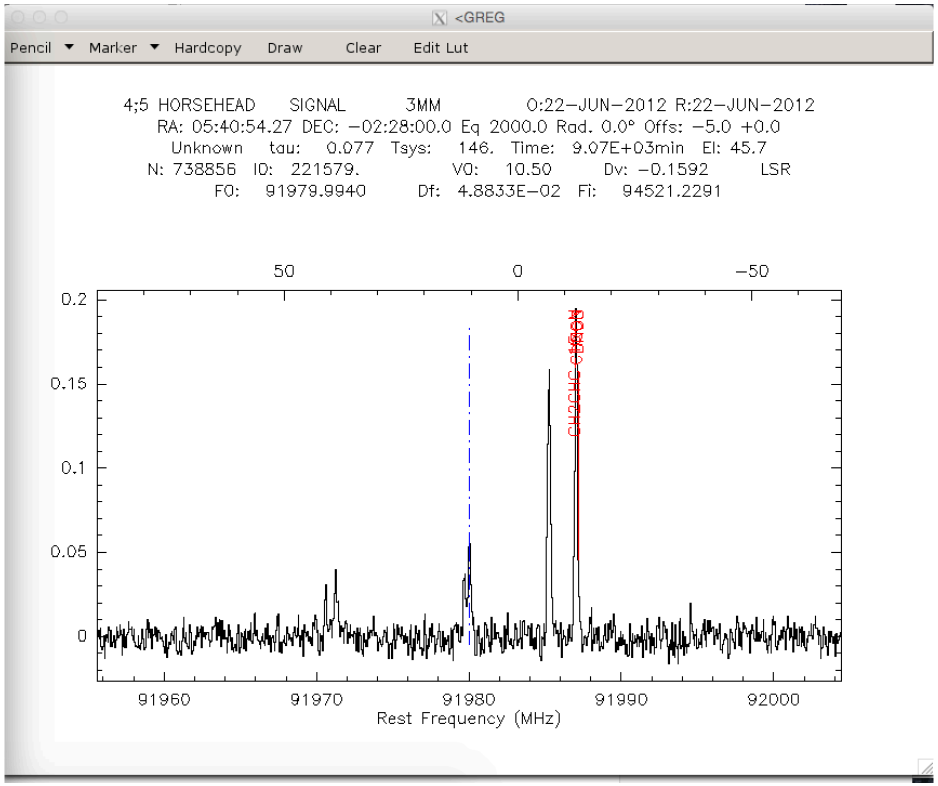
Enlarge the plotted frequency range

```
LAS> lplot 1000    ! Plot 1000 channels instead of the default 100 channels
```



Identifying a line on an already plotted spectrum

```
LAS> lid      ! Call the interactive cursor and list the lines in the current
              ! index that are nearby the selected frequency
I-LID,  9 lines found in the frequency range 91986.7037371 to 91987.1920663 MHz
  # Species               Freq[MHz] Err[MHz] Eup[K]  Gup  Aij[s-1] Upper level -- Lower level Origin
  1 H2CCHCN-15            91986.955   0.001    32.9   21  6.03e-05     10 2 9 -- 9 2 8          cdms
  2 CH2CHC-15-N           91986.955   0.001    32.9   21  5.85e-05     10 2 9 -- 9 2 8           jpl
  3 ag-diethyl ether      91987.000   0.006    52.7   39  7.06e-07     19 416 -- 18 415         cdms
  4 CH3CN, v=0            91987.088   0.000    13.2   22  6.33e-05        5 0 -- 4 0            cdms
  5 CH3CN                 91987.088   0.000    13.2   22  6.33e-05        5 0 -- 4 0             jpl
  6 Phenol                91987.100   0.002    64.9  175  1.58e-06   1714 3 0 -- 1713 4 1       cdms
  7 Phenol                91987.100   0.002    64.9  175  1.58e-06   1714 4 0 -- 1713 5 1       cdms
  8 CH3C-13-H2CN, v=0     91987.124   0.003    53.5   31  2.05e-06     15 114 -- 14 213         cdms
  9 DNO3                  91987.192   0.035   511.2   61  9.29e-08     3022 8 -- 3021 9          jpl
```

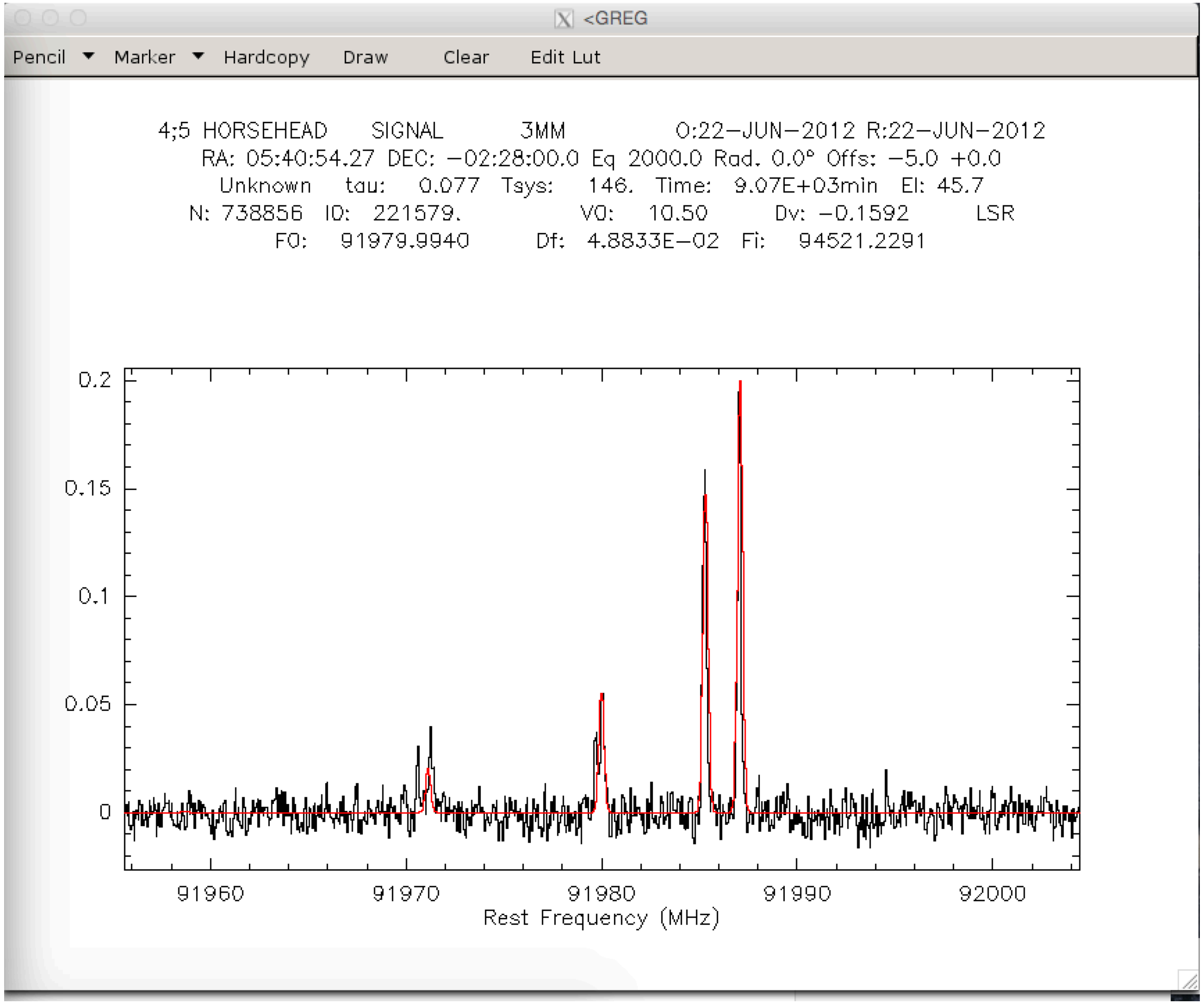


Creating a synthetic LTE spectrum

```
LAS> type ch3cn.mod                    ! Display the content of the ch3cn.mod file
! species  dcol    Tex   size    Voff    DV
!          (cm-2)  (K)   (")     (km/s)  (km/s)
  CH3CN    1e13    25    10      0       1
LAS> modsource ch3cn.mod 30 /verbose   ! Create the synthetic spectrum
I-MODSOURCE,  5 lines found in the frequency range 91955.5781255 to 92004.414063 MHz
I-MODSOURCE,   5 CH3CN lines found in the frequency range
I-MODSOURCE,  log10 of the partition function at 25.0 K from jpl is 2.3969
  # Species Freq[MHz] Err[MHz] Eup[K]  Gup  Aij[s-1]    Upper level -- Lower level Origin Tau
  1 CH3CN   91958.726   0.000   127.5   22  2.28e-05            5 4 -- 4 4         jpl 3.05e-04
  2 CH3CN   91971.130   0.000    77.5   44  4.05e-05            5 3 -- 4 3         jpl 8.03e-03
  3 CH3CN   91979.994   0.000    41.8   22  5.32e-05            5 2 -- 4 2         jpl 2.20e-02
  4 CH3CN   91985.314   0.000    20.4   22  6.08e-05            5 1 -- 4 1         jpl 5.90e-02
  5 CH3CN   91987.088   0.000    13.2   22  6.33e-05            5 0 -- 4 0         jpl 8.20e-02
I-MODEL,   Blanking value:   -1000.00000
I-RESAMPLE,  Frequency resolution: .04883 MHz (observatory), .04883 MHz (rest frame)
I-MODSOURCE,  Model has been stored in memory
```

Overplotting a synthetic LTE spectrum

```
LAS> modshow                      ! Overplot the synthetic spectrum
```



WEEDS was used to detect the first branched alkyl (isopropylcyanide) in the ISM with ALMA data (Belloche et al. 2014, Science, 345)