

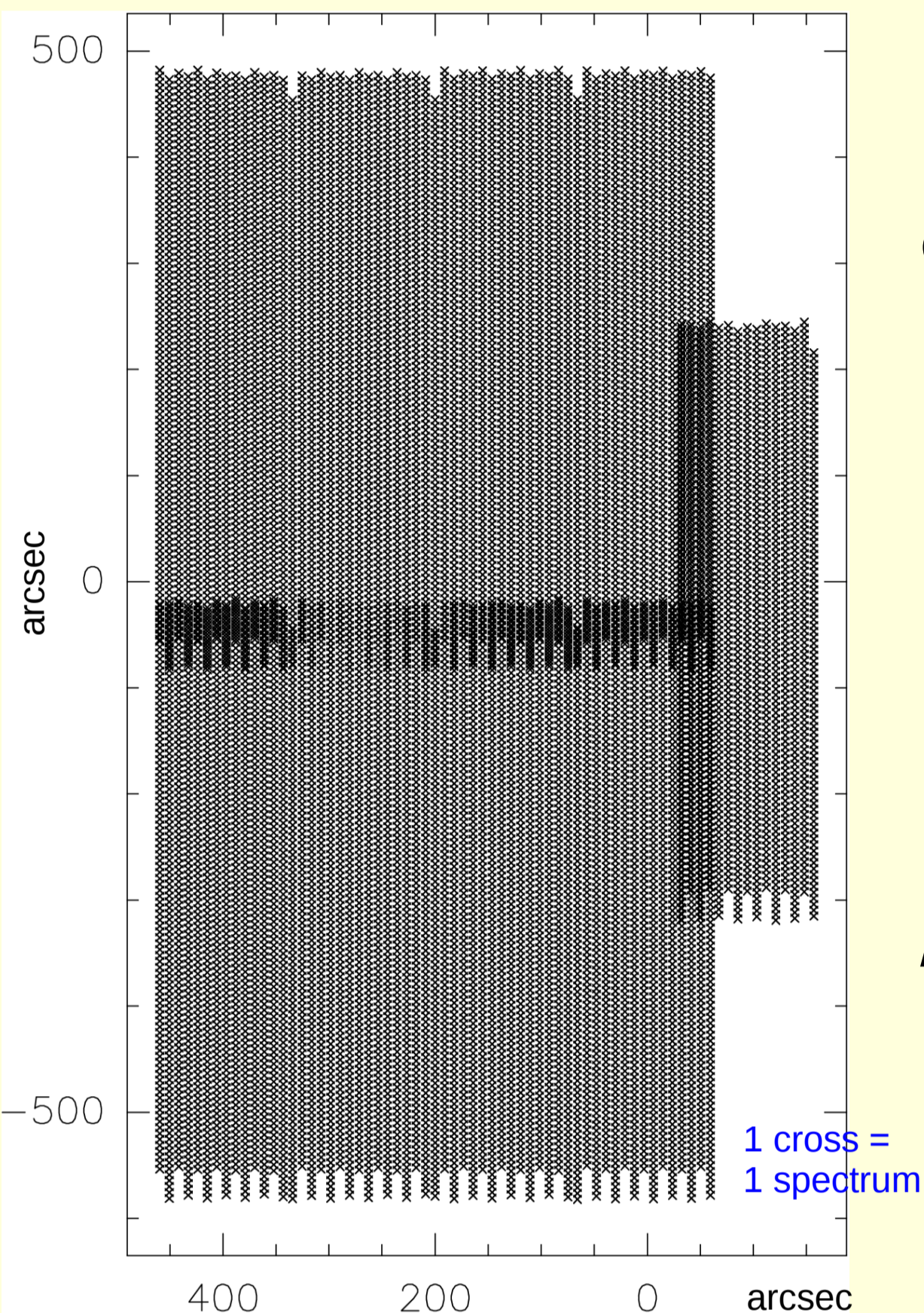


CLASS is a state-of-the-art software package for reducing spectroscopic data obtained on a (sub-)millimeter single-dish telescope. It can be used either for pointed observation (i.e. the telescope observes a single position) or on-the-fly (OTF) maps (i.e. the telescope continuously drifts over the targeted area).

CLASS is part of GILDAS, an extensible set of softwares which reduce and analyze radioastronomical data. CLASS is daily used at IRAM (at the 30m single-dish and Plateau de Bure Interferometer). It is also used in many other facilities (e.g. Herschel/HIFI, Apex, CSO, HHT, Effelsberg).

I/ Table-Of-Contents and Data browsing

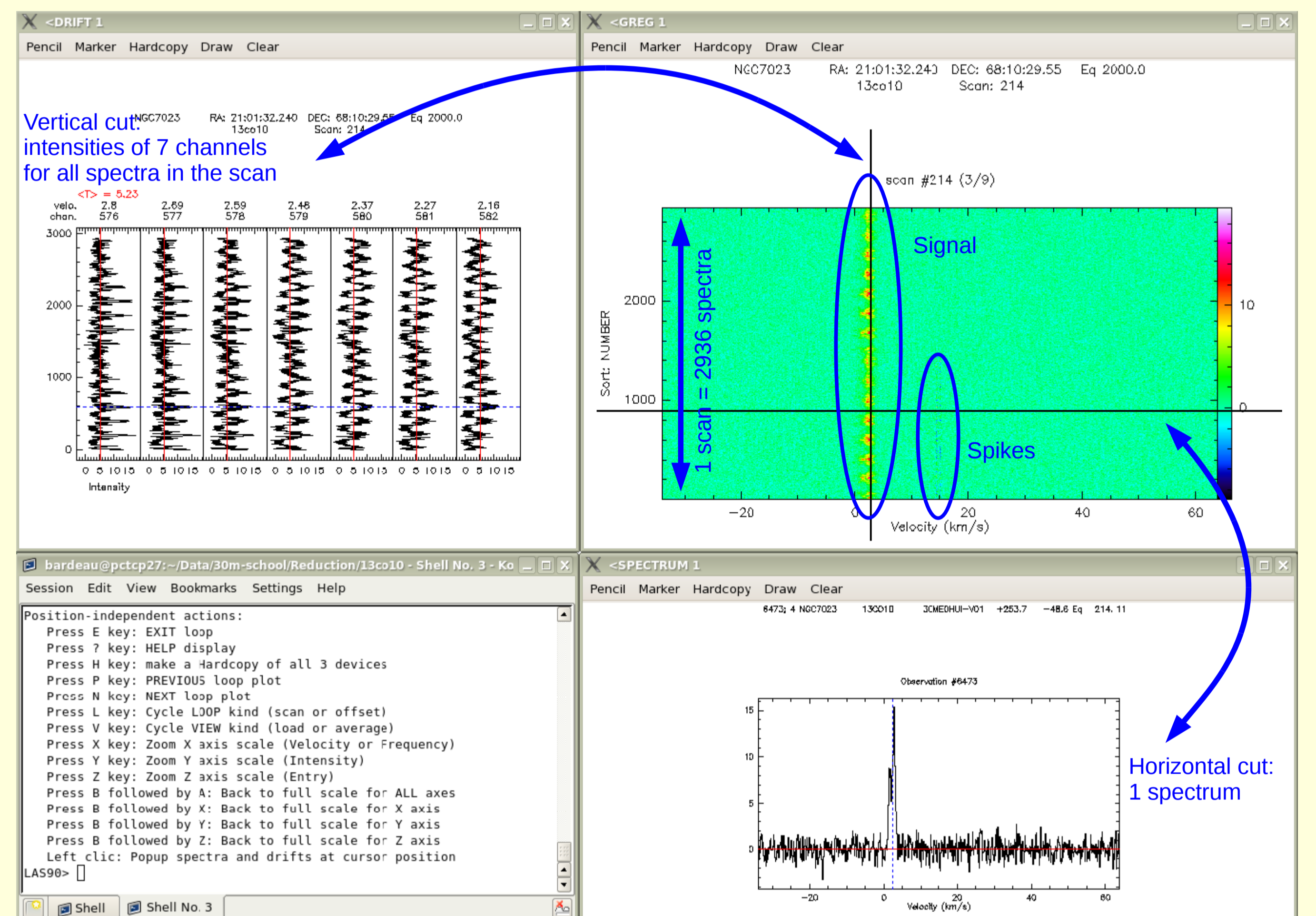
OTF observations produce a large amount of data (typically 10^{5-6} spectra). Here is an example of targeted area displayed by the **GO WHERE** tool:



CLASS data format can contain spectra coming from numerous observation setups (various sources, lines, or tunings of the telescope). Command line browsing with e.g. **commands FIND and LIST** is straightforward in order to ease data selection through scripts:

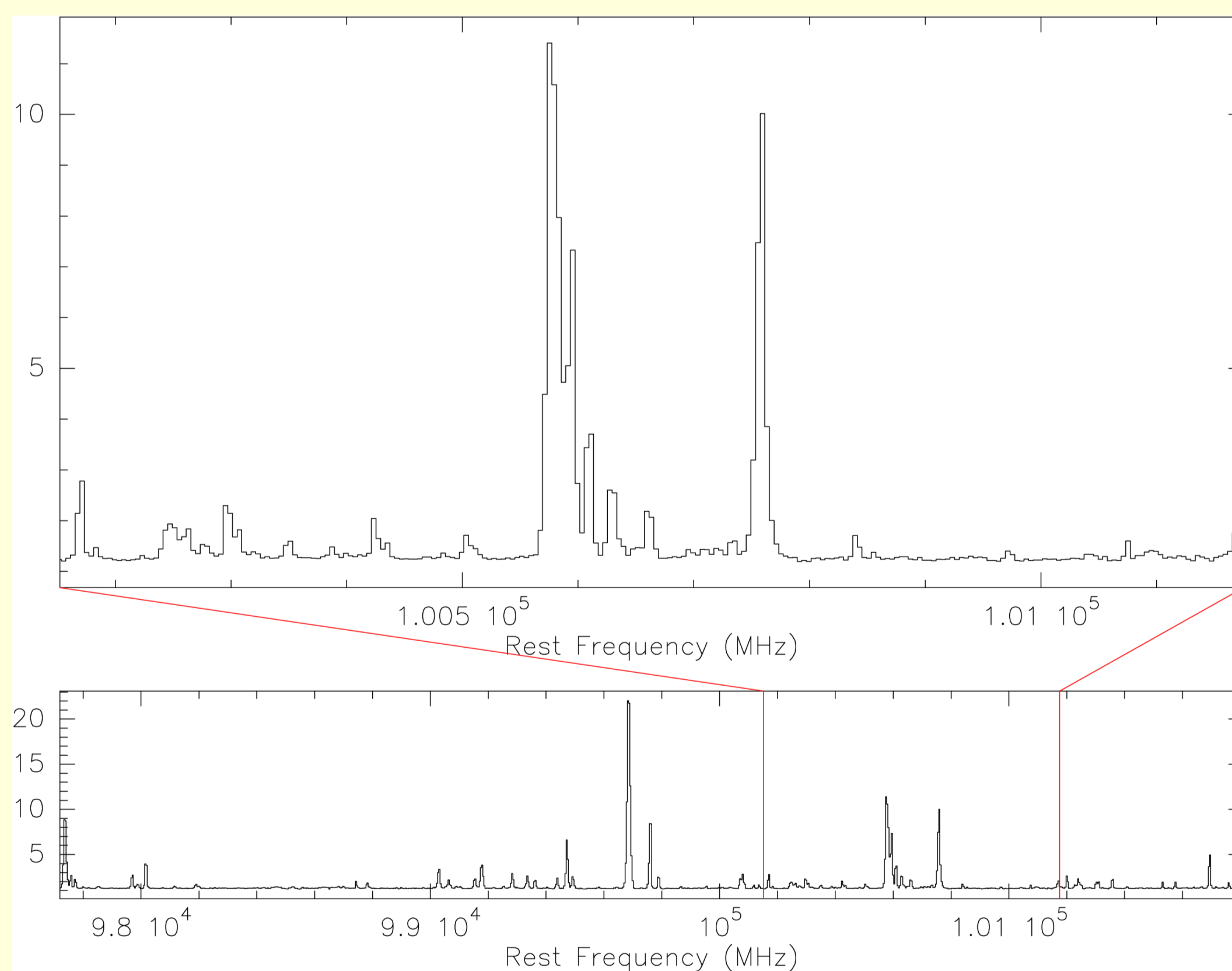
```
LAS90> find
I-FIND, 26090 observations found
LAS90> list /toc ! Table-Of-Contents
Current index contains:
Number of sources..... 1
  NGC7023 26090 (100.0%)
Number of lines..... 1
  13CO10 26090 (100.0%)
Number of backends..... 2
  30ME0HUI-V01 13045 (50.0%)
  30ME0VUI-V01 13045 (50.0%)
Number of setups..... 2
  NGC7023 13CO10 30ME0HUI-V01 13045 (50.0%)
  NGC7023 13CO10 30ME0VUI-V01 13045 (50.0%)
LAS90> find /line 13CO10 /telescope 30ME0HUI-V01 -
/ra -200 200 -300 300 ! Custom search
I-FIND, 4946 observations found
```

Visual check by human eye is important to detect unforeseen hardware problems. The **interactive GO EXPLORE** tool allows the user to easily browse up to 10^6 spectra:



II/ Identification of spectral lines

Modern heterodyne receivers (e.g. @ IRAM 30m telescope, or HIFI instrument on board of Herschel satellite) can cover an instantaneous bandwidth of several GHz. Fourier Transform Spectrometers process this bandwidth and deliver typically 20 000 channels, enabling many simultaneous detections.



Orion A spectrum covering 4 GHz around 100 GHz frequency:

An **interactive tool** is developed to ease spectrum browsing and zooming. This kind of tool is mandatory since the number of channels is larger than the number of screen pixels.

The **WEEDS** extension, written in Python, interfaces standard databases (CDMS or JPL) through VO protocol (SLAP) to help the user to easily identify lines:

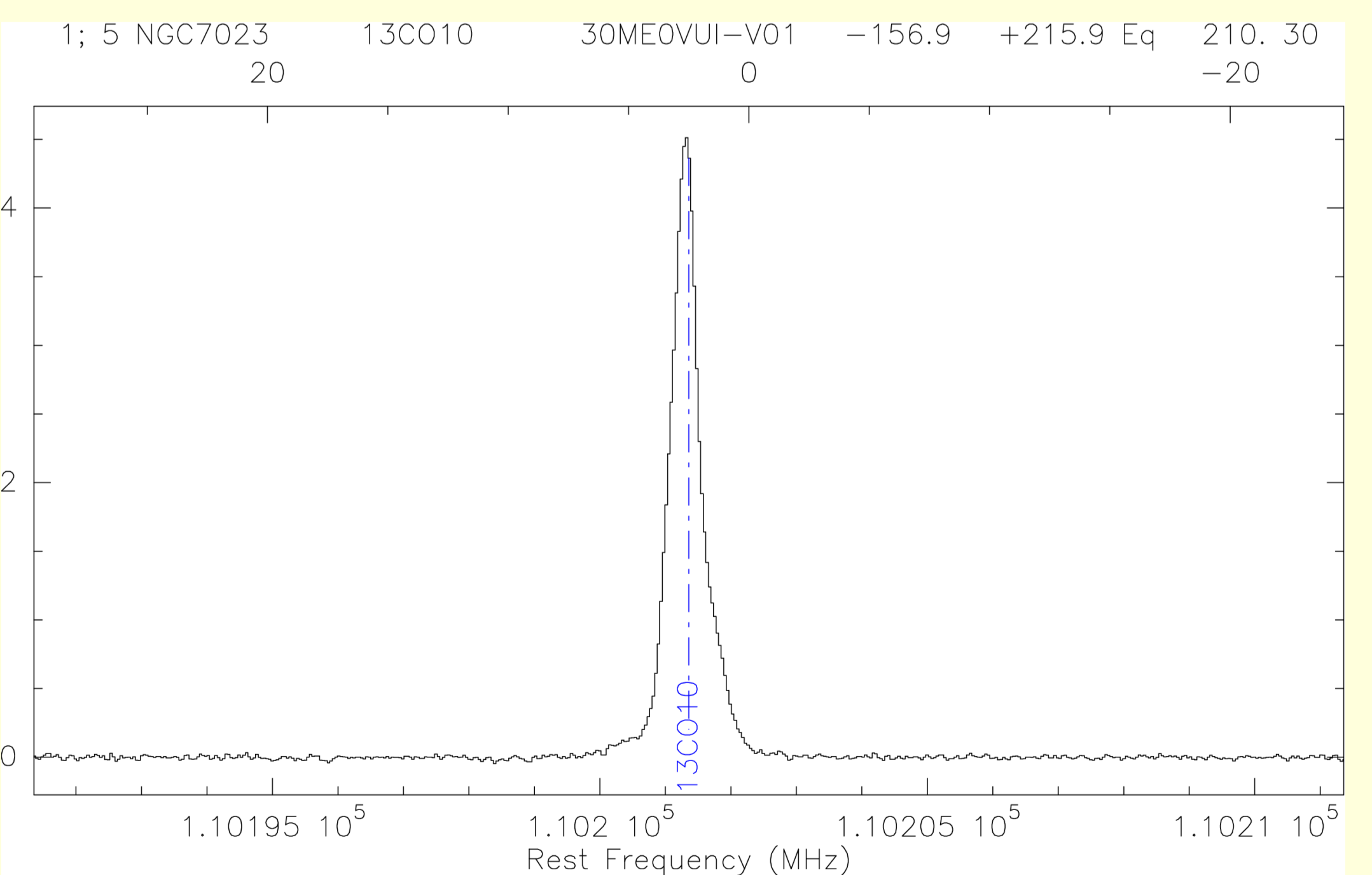
```
LAS90> dbselect cdms
I-DBSELECT, cdms database selected (online).
LAS90> lfind ! Search for known lines in the spectrum range
I-LFIND, 42 lines found.
LAS90> llist
```

Index	Species	Freq. (GHz)	Eup (K)	Upper level	Lower level
(truncated)					
13	1,2-Propanediol	110.194404	109.8	221111	-- 221012
14	1,2-Propanediol	110.195697	167.2	30 921	-- 291020
15	1,2-Propanediol	110.195801	109.8	221112	-- 221013
16	H2CCCHCN	110.196921	663.4	71 567	-- 70 664
17	ethyl formate	110.196956	610.2	491832 1	-- 481929 1
18	ethyl formate	110.196956	610.2	491831 1	-- 481930 1
19	aa-diethyl et...	110.197623	428.0	62 557	-- 61 656
20	NCHCO	110.197814	140.3	31 328	-- 31 229
21	C-13-O	110.201354	5.3	1	-- 0
22	n-C3H7CN	110.201728	188.9	20 020 1	-- 19 119 1
23	C3C-13-C2H	110.203856	129.4	40 1404040	-- 39-1393939
24	C3C-13-C2H	110.203907	129.4	40 1404041	-- 39-1393940
25	C3C-13-C2H	110.203963	129.4	40 1403939	-- 39-1393838
26	C3C-13-C2H	110.204014	129.4	40 1403940	-- 39-1393839
27	n-C3H7CN	110.204041	151.6	10 3 7 1	-- 9 1 8 1
(truncated)					

LAS90> lid ! Use the cursor to identify the lines

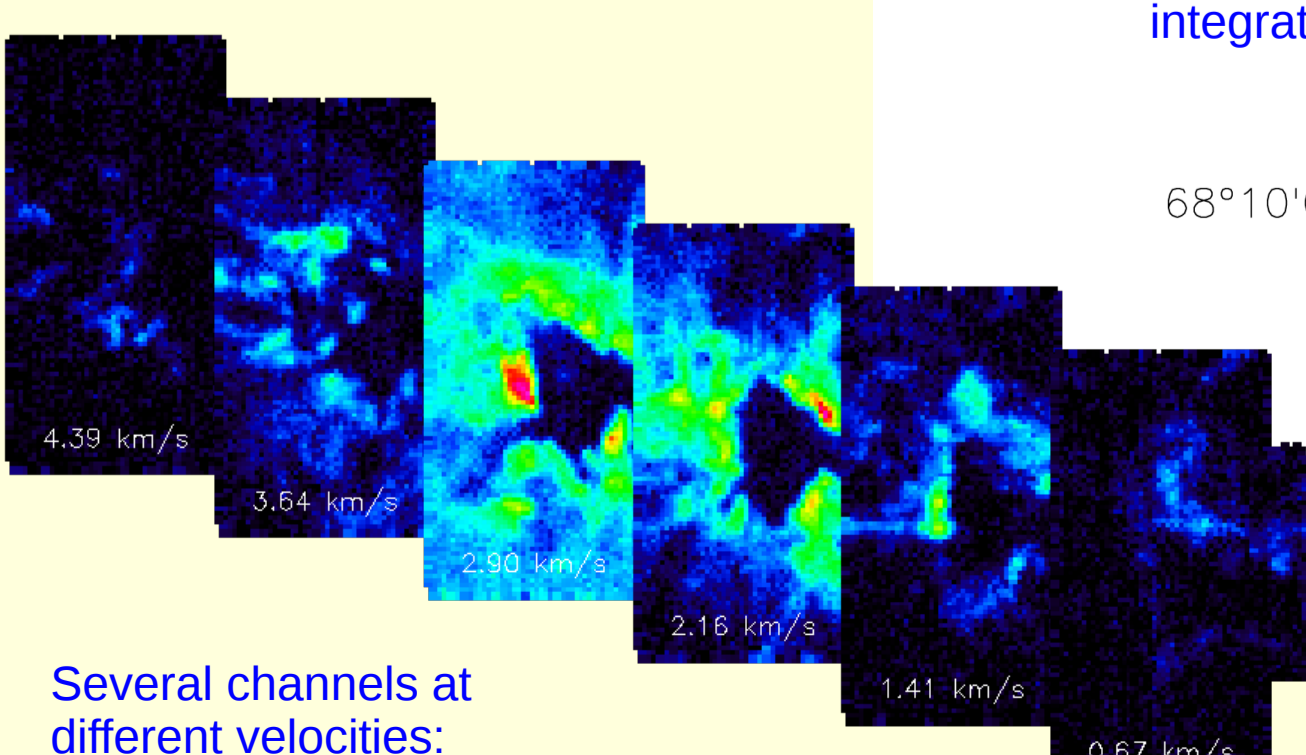
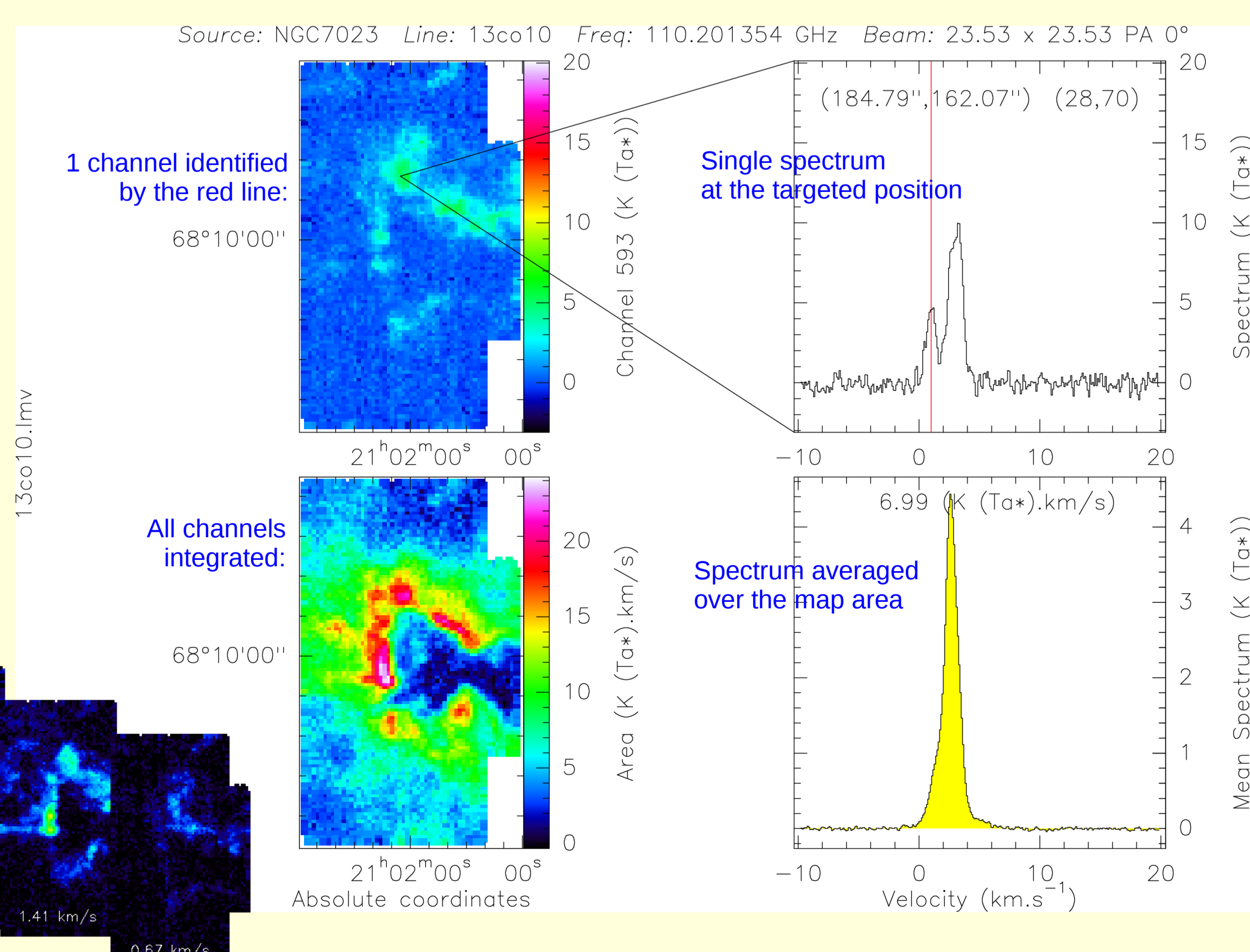
Species	Freq. (GHz)	Eup (K)	Aul (s-1)	Upper level	Lower level
(truncated)					
C-13-O	110.201354	5.3	6.33e-08	1	-- 0
n-C3H7CN	110.201728	188.9	3.14e-05	20 020 1	-- 19 119 1
(truncated)					

LAS90> lplot



III/ Exploration of cube of spectra

A set of spectra can be gridded to a position-position-velocity cube for spatial analysis of the signal. **Gildas tools** allow a detailed analysis of the cube.



References:

- *The CLASS documentation*
<http://www.iram.fr/IRAMFR/GILDAS/doc/pdf/class.pdf>
- *CLASS evolution: I. Improved OTF support* (P. Hily-Blant et al.)
<http://www.iram-institute.org/medias/uploads/class-evol1.pdf>
- *Averaging spectra with CLASS* (S. Bardeau et al.)
<http://www.iram-institute.org/medias/uploads/class-average.pdf>
- *The WEEDS extension documentation* (S. Maret et al.)
<http://www.iram.fr/IRAMFR/GILDAS/doc/pdf/weeds.pdf>