DS9 ver 7.2 Demo
Extracting regions from two cubes

CARMA CO 1-0
Molecular Hydrogen

Herschel Far-IR IFU in space
ISM Cooling Lines and other
Atomic lines

SAOImage DS9

SAOImage DS9 is an astronomical imaging and data visualization application. DS9 supports FITS images and binary tables, multiple frame buffers, region manipulation, and many scale algorithms and colormaps. It provides for easy communication with external analysis tasks and is highly configurable and extensible via XPA and SAMP.

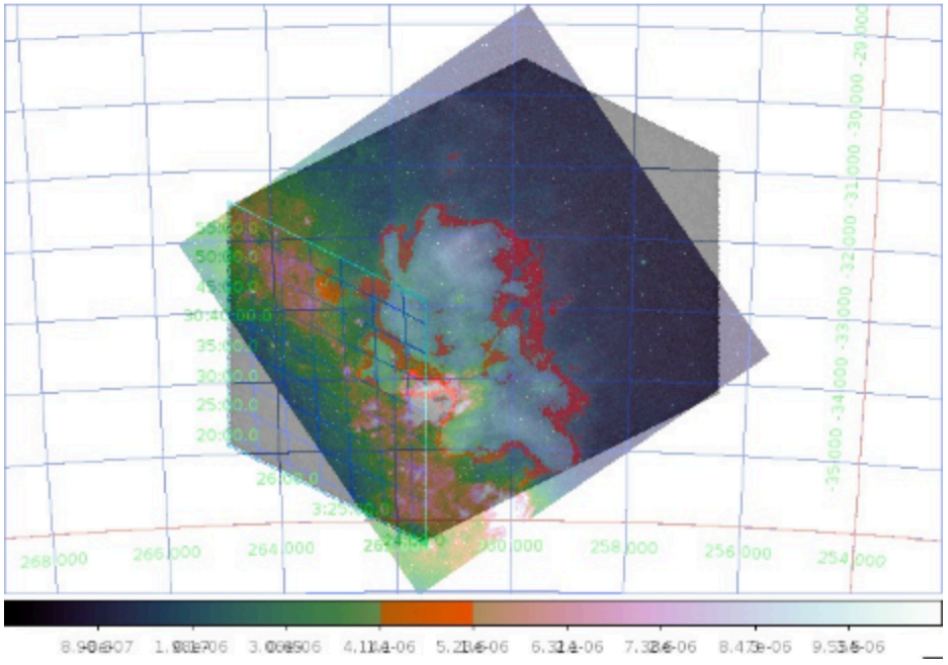
DS9 is a stand-alone application. It requires no installation or support files. All versions and platforms support a consistent set of GUI and functional capabilities.

DS9 supports advanced features such as 2-D, 3-D and RGB frame buffers, mosaic images, tiling, blinking, geometric markers, colormap manipulation, scaling, arbitrary zoom, cropping, rotation, pan, and a variety of coordinate systems.

The GUI for DS9 is user configurable. GUI elements such as the coordinate display, panner, magnifier, horizontal and vertical graphs, button bar, and color bar can be configured via menus or the command line.

SAOImage DS9 Version 7.2

DS9 version 7.2 is now available on the **Download** page. New to version 7.2 is support for loading and saving FITS images, data cubes, mosaics, and other formats such as arrays, NRRD, TIFF, JPEG, PNG. Please see the **What's New** page for more details.



IPAC Wireless

This computer is funded by the United States Government and operated by the California Institute of Technology in support of ongoing U.S.Government programs and activities. By continuing, you consent to your keystrokes and data content being monitored. Users of this system have no expectation of privacy. If you are not authorized to access this system, disconnect now.

Login: ipac-wl

Password: •••••••••

SAOImage DS9 development has been made possible by funding from the Chandra X-ray Science Center (CXC) and the High Energy Astrophysics Science Archive Center (HEASARC). Additional funding was provided by the JWST Mission office at Space Telescope Science Institute to improve capabilities for 3-D data visualization.

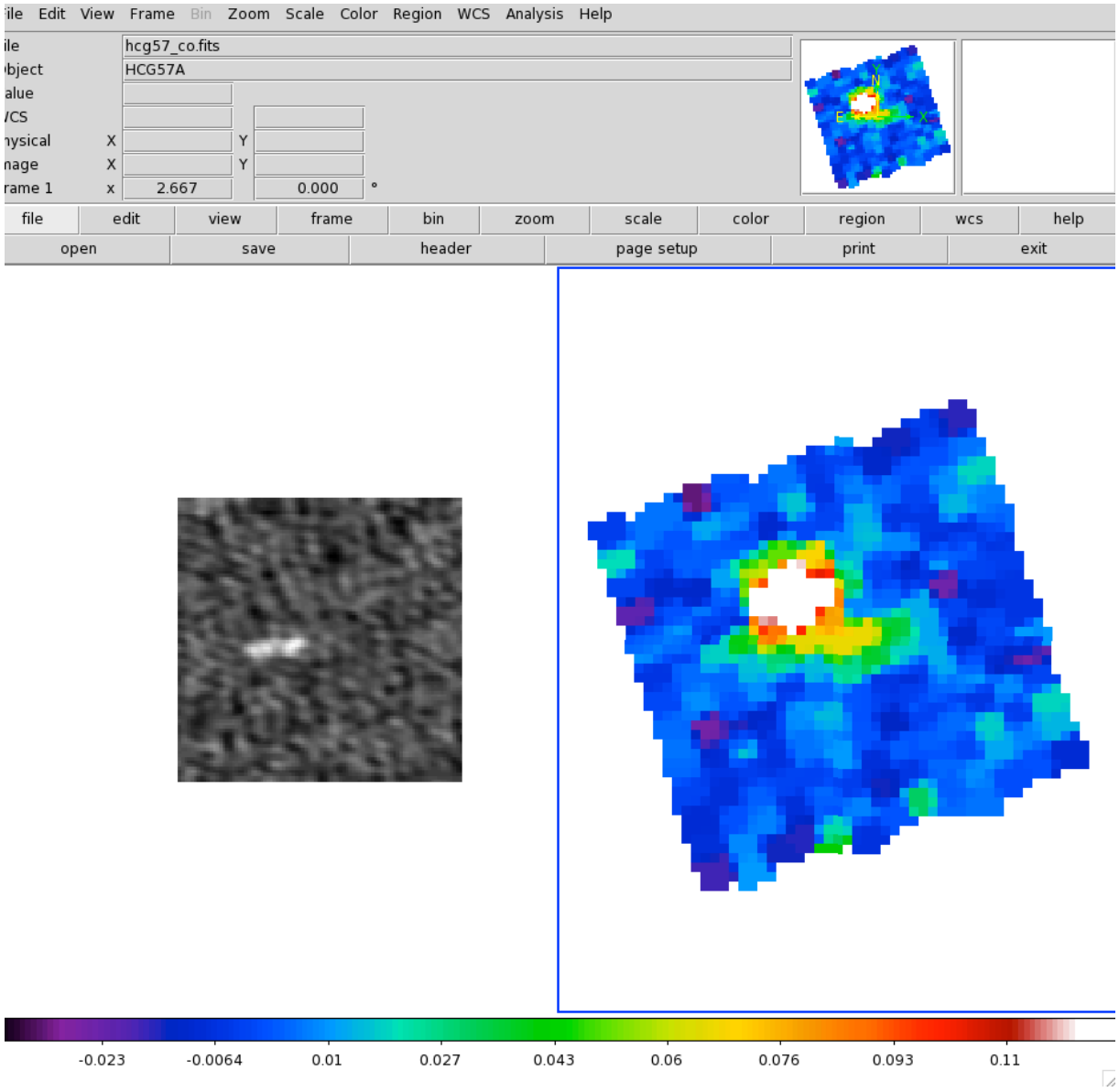
Demo

- ds9 version 7.2
- Demo DS9 with CO data cube from BIMA
- Save data
- Extract same region from PACS C+ IFU data cube
- Save data
- Run IDL script to convert DS spec into wavelength and velocity format by reading PACS FITS extension
- Discuss average and SUM options
- Run on HIFI spectral cube to show that in this case frequency is preserved and can be read (Not an IFU)

This demo is based on a dataset recently published in the APJ
Alatalo+Appleton et al. (2014) arXiv:1409.5482
"Strong far-IR Cooling Lines, Peculiar Kinematics and Possible Star Formation Suppression in Hickson Compact group 57"

It uses Herschel C+158micron and CARAM CO(1-0) data

Although we did not use DS9 for this analysis, it's a convenient publish dataset to demo the new capabilities of DS9.



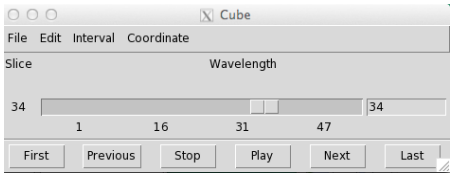
CARMA CO 1-0 Cube

C+ Cube

1) Load CARMA and Herschel

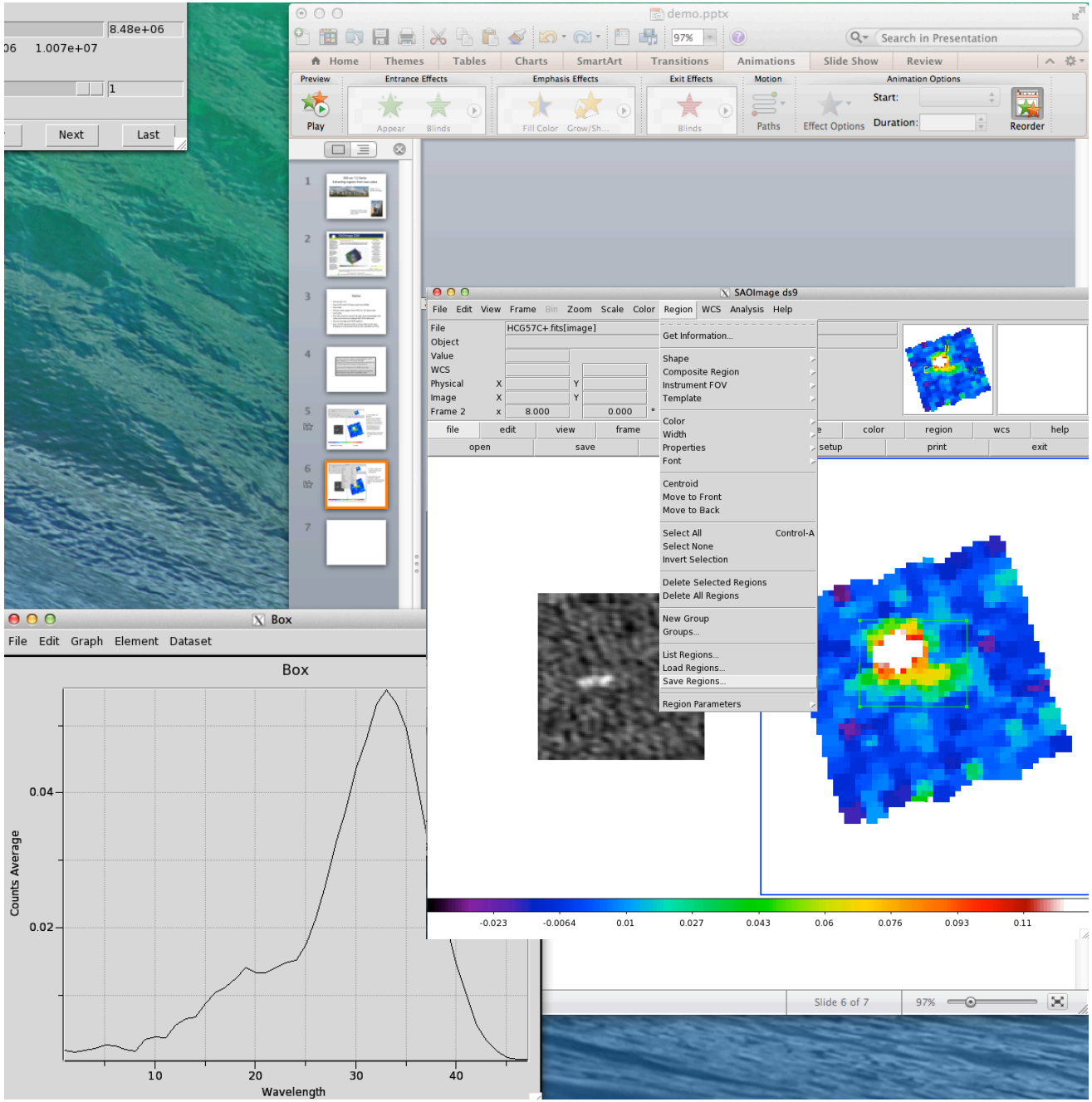
Cube into ds9 as different frame and turn on tiling

2) Make sure frame/cube is activated for Herschel data



3) frame/match_frame/wcs

To bring to frame to same scale



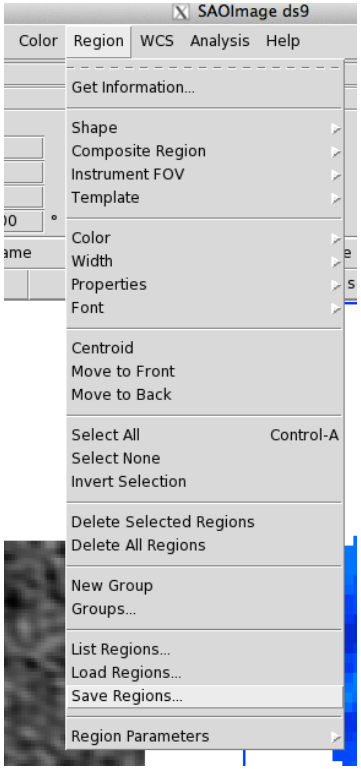
4) Chose a region and move to area you are interested in

5) Start with one cube (C+) and define a region
: Spectrum will immediately Pop-up, save spectrum to Disk

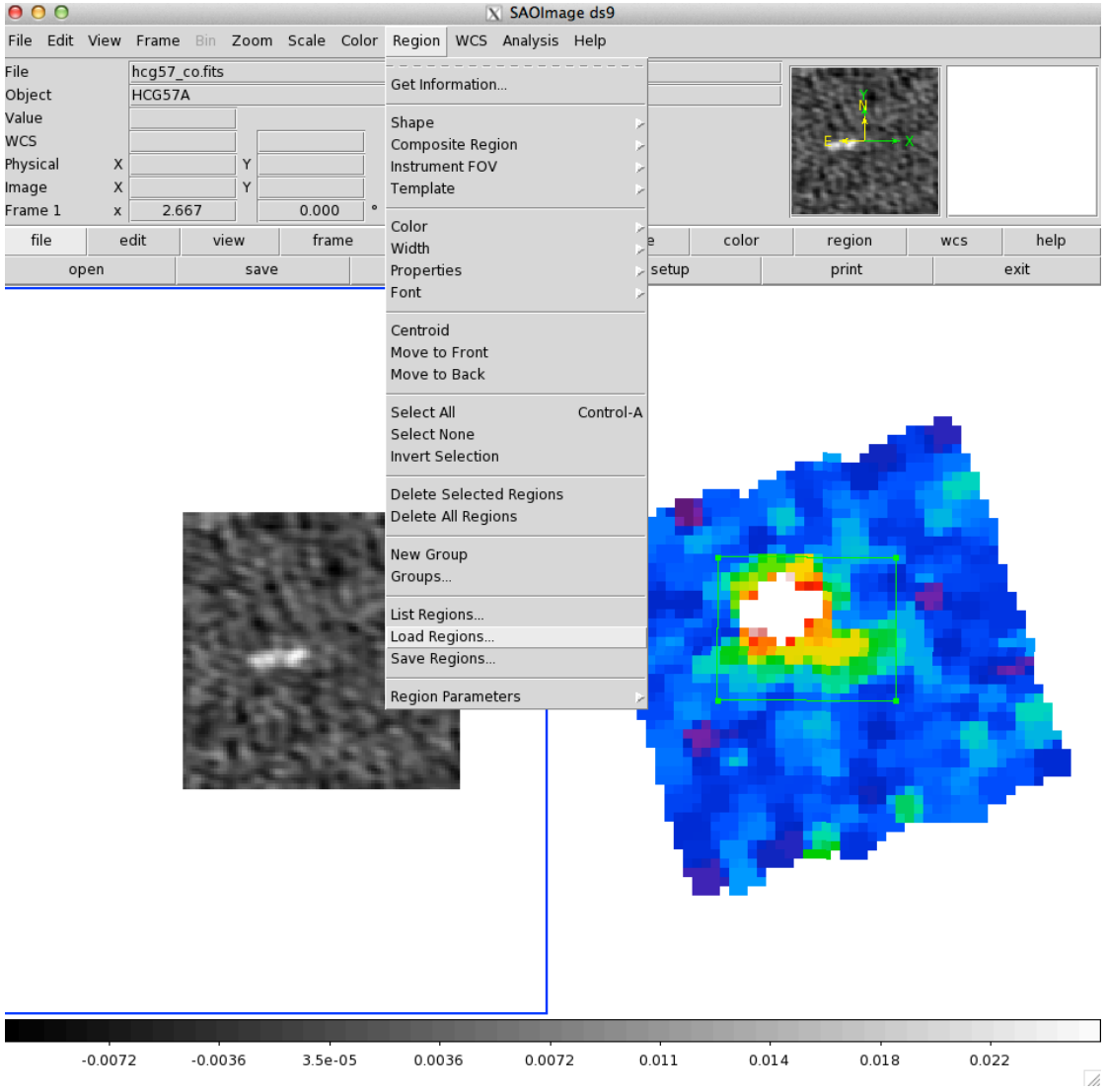
NOTE: PACS SPECTRA CURRENTLY DON"T HAVE WAVELNGTH SCALE ATTACHED (See Fix)

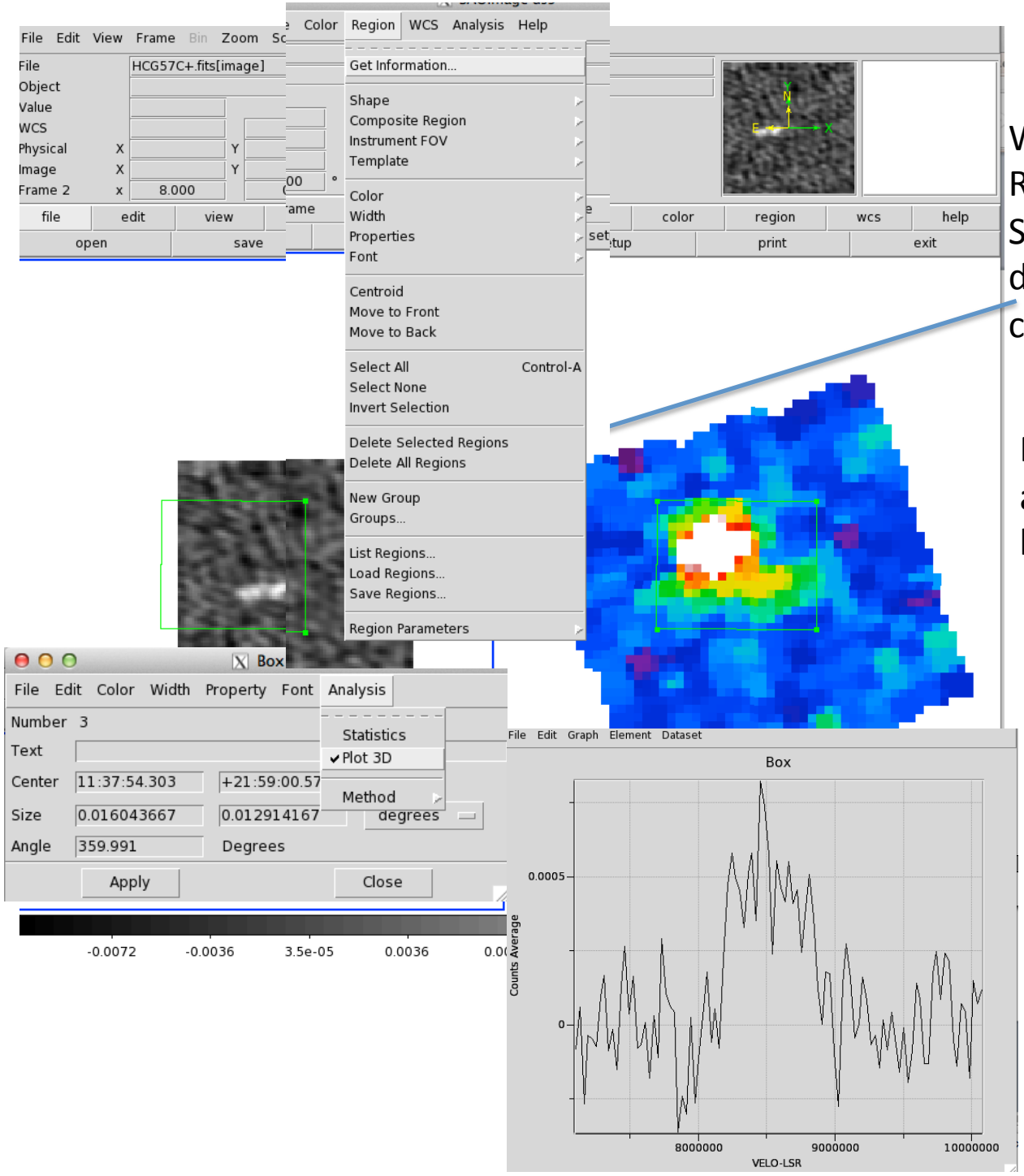
REMEDY IN HIPE 13

6) Save Region



Then save region and move to other image
Then Load the C+.reg file to new image





When you load new Region:
Spectrum from new cube does not automatically come up

Need to :

a) Click on region
b) Go to region/get-information in pull down

c) Goto analysis/plot3d in pop-up box
(Note Statistics give you Details of box)

Status of Third Dimension

- Third Dimension will be channel number on PACS until HIPE 13 (see next slide for fix)
  - Currently third dimension has variable width of channel—Lamda's as 8th FITS extension in HIPE12.1
- Third Dimension is FINE for HIFI/SPIRE cubes because both cubes have evenly spaced channel intervals

(show example of HIFI spectral cube)

Workaround for PACS requires a script to create a spectrum with correct interval

```
pro ds9specP

; to convert an extracted spectrum from ds9 and convert to wavelength units
; on x axis
;IMPORTANT  : It is assumed that spectrum is “average” over extraction area
; and not a SUM. Units would be Jy/pixel unless sum is used
hipecube=''
proj=''
read,hipecube,prompt='Name of original cube e. g. cube.fits ’
w=mrdfits(hipecube,8,h)
wav=w.DEPTHINDEX
n=n_elements(wav)
print,'There are ',n,' wave elements--middle one is ',wav[n/2]
; now read the ds9 spectrum

namedata=''
read,namedata,prompt='name of ds9 dataset  e. g. spec.dat '
readcol,namedata,ic,f
line=''
plot,ic,f,title='rawdata'
;create new ascii file containing flux versus wavelength for data
scale = 1.0 ; this assumes average spectrum for exatraction
openw,12,namedata+'.txt'
for i=0,n-1 do printf,12,wav[i],f[i]*scale,f='(f,1x,f)'
close,12
print,'Created new file called ',namedata+'.txt'

; here user is asked which line—only two are given here—user should modify
read,line,prompt='Which line ? C for C+, O for OI ‘
lcII=157.741
loI=63.1837
c=2.997925e5
```

```
openw,12,namedata+'-helio.txt'

if (line eq 'C') then begin
print,'working with C+ data lambarest = ',lcII,' microns'
print,'writing C+ data in Vhelio data to ', namedata+'-helio.txt'
vel=c*(wav-lcII)/lcII
for i=0,n-1 do printf,12,vel[i],f[i]*scale,f='(f,1x,f)'
endif
if (line eq 'O') then begin
print,'working with [OI] data lambarest = ',lOI,' microns'
print,'writing [OI] data in Vhelio data to ', namedata+'-helio.txt'
vel=c*(wav-lOI)/lOI
for i=0,n-1 do printf,12,vel[i],f[i]*scale,f='(f,1x,f)'
endif

close,12
wait=''

plot,wav,f*scale,xtitle='wavelength (microns)', ytitle ='line flux density (Jy)'
read,wait,prompt='Hit return for Velocity plot'
plot,vel,f*scale,xtitle='heliocentric velocity (km/s)', ytitle ='line flux density (Jy)'

print,' program ended properly'

end
```