

# Mining the Data Cubes in Sub-mm and Optical Astronomy

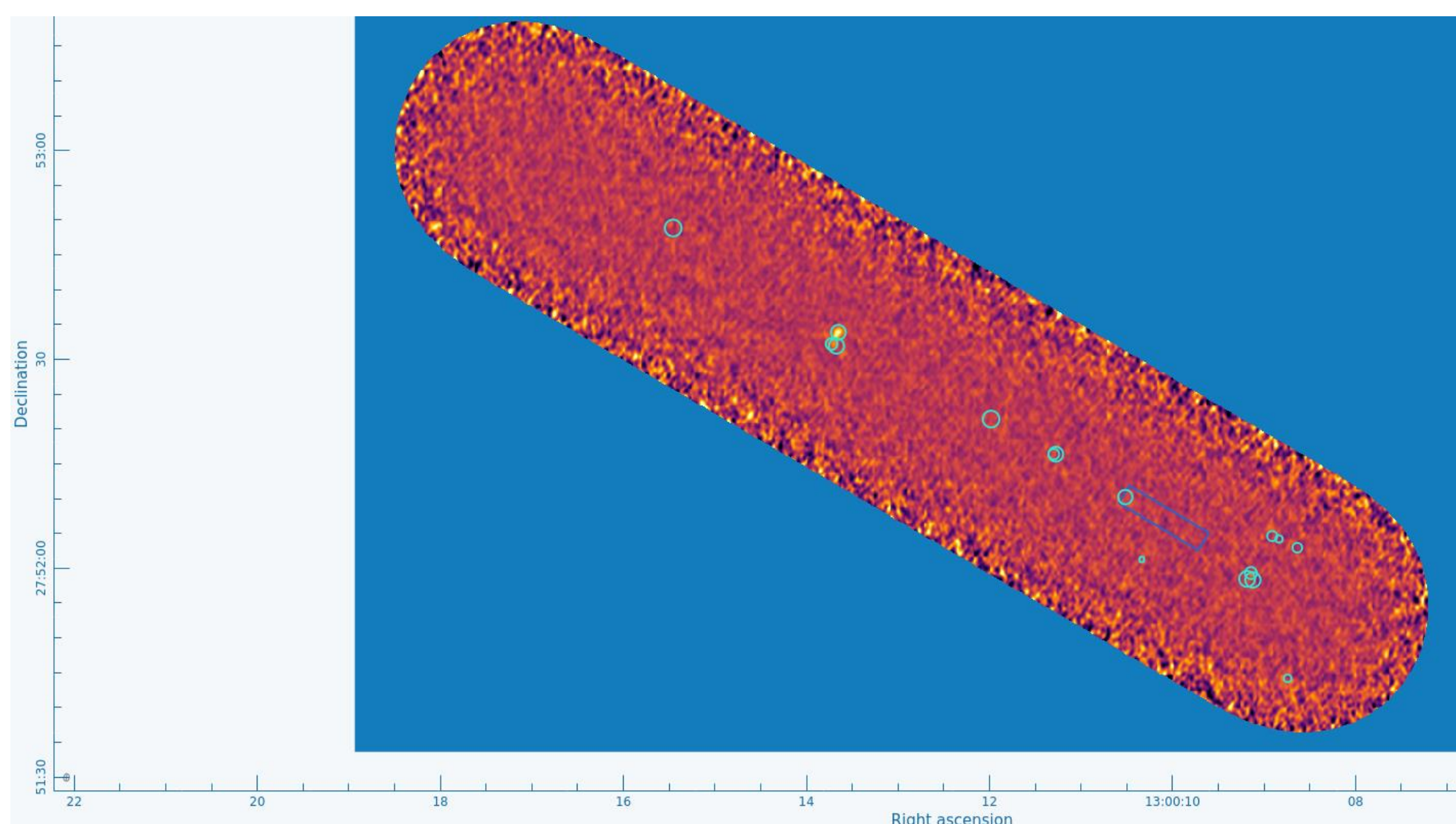
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## Overview

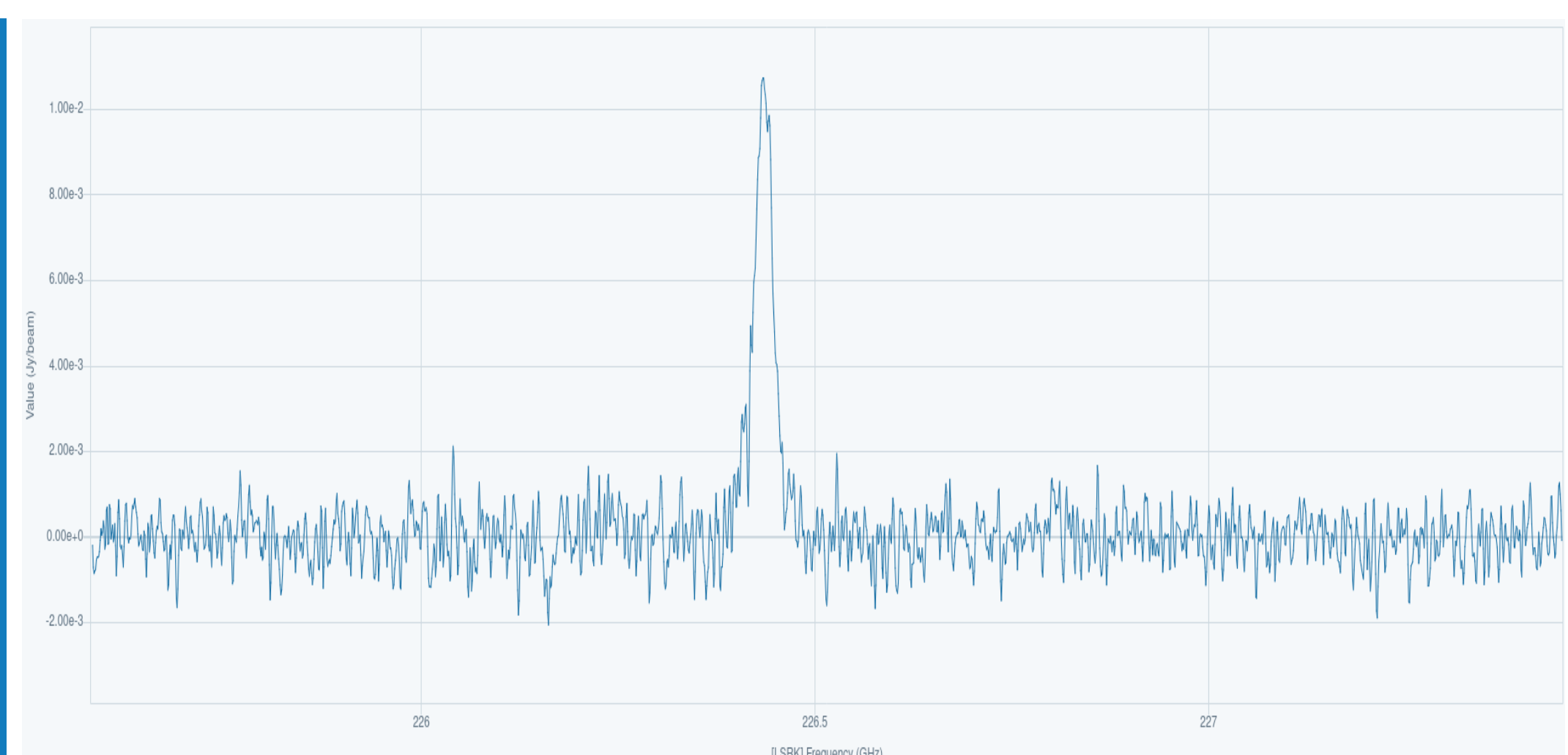
- State of the art data from telescopes like the *Atacama Large Millimeter/Submillimeter Array (ALMA)* comes in the form of data cubes.
- Data cubes are the spectra for every pixel in an image. The data in these cubes is visualized using tools such as ds9 or the *Cube Analysis and Rendering Tool for Astronomy (CARTA)* for analysis and source detection.
- A collection of 24 *ALMA* data cubes for galaxies in several different clusters were analyzed with a focus on looking for spectral features in the tails.

## Results

- For each of the 24 cubes, analysis was conducted using pycprops. Other python codes were generated to assist analysis.
- Rebinning the data spatially to near the limits of following Nyquist sampling, along with minimal spectral rebinning, gave the best speed while maintaining results.
- Using larger rectangular masks on the cubes kept more diffuse clouds in the analysis, but also resulted in longer run times and large output.
- Output regions were trimmed to only those with possible features above a certain signal to noise ratio and exported in a ds9 file.



**Figure 1:** d100 cube with generated ds9 region file.



**Figure 2 (above):** Spectra for the bright spot in the middle of **Figure 1**.



**Figure 3 (left):** Color image of d100 made from Hubble data.<sup>1</sup>

## Conclusions

- The methods used gave results similar to **Figure 1** for 17 of the 24 cubes. The seven other cubes had only slight features along the sides.
- The cubes with minimal features could be due to the galaxy and tail being very diffuse or the data needing to be rerun through the *CASA* pipeline.

## References

1. H-alpha Tail of D100. *HubbleSite.org*  
<http://hubblesite.org/content/media/images/2019/05/4296-Image>.

## Acknowledgements

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## Explanation

- The regions found are mainly in the frequency range for CO(2-1) emissions.
- Finding these sources in data cubes allows for further studies of the kinematics of the galaxies based on the changes between the spectral peaks in the regions.