Rotational Curve of the Inner Galaxy

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On 7/3/2024 we went out and took data for the inner galaxy. Our goal was to get a rotational curve that covered the inner galaxy. To do this we figured out where we needed to point the horn in the galactic longitude from 0 to 90 degrees going up in 10 degree increments. Since the center of the galaxy or the zero degree mark is only in our view for certain periods of time, we had to go out from 10:00 pm till 12:30 am on 7/4/2024.

Set up/Procedure

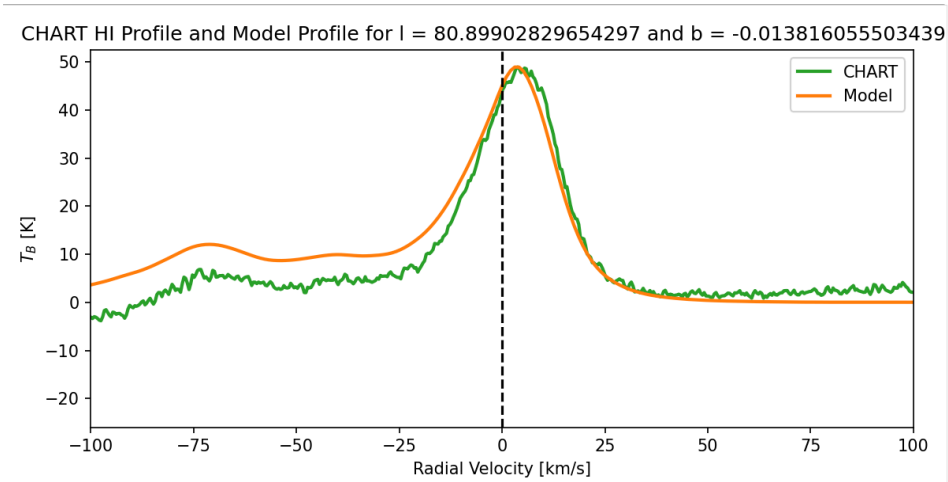
We used the same materials and set up from Trial 4 in memo 11 from the CHART website (https://astrochart.github.io/memos/TestingNewUpdatesforCHART.pdf) and followed the same procedure from the CHART Procedure Document on the CHART website (https://astrochart.github.io/memos/CHART_procedure.pdf).

We set up in a park near the small lake in Winona. We had 10 different trials we took:

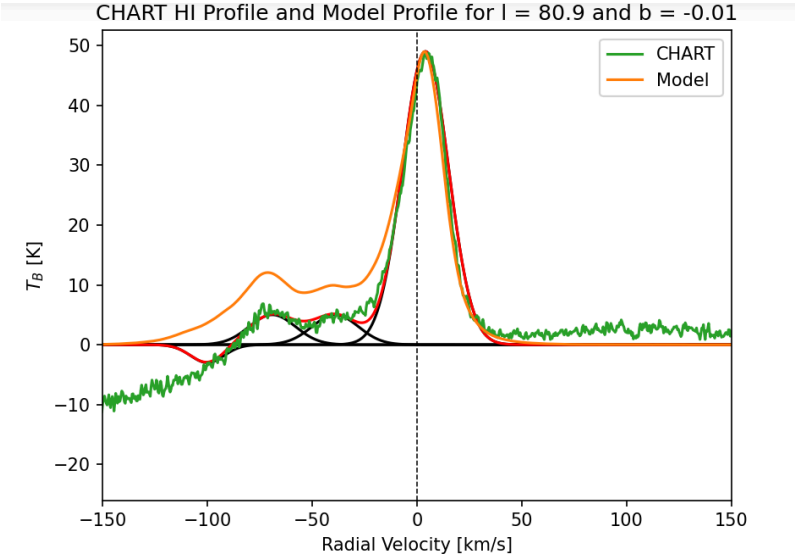
Time	Azimuth (degrees)	Altitude (degrees)	Galactic Longitude (degrees)
~~10:00 pm~~	~~54~~	~~35~~	~~90~~
10:15	67	40	80
10:30	82	47	70
10:45	99	46	60
11:00	114	42	50
11:15	130	38	40
11:30	144	34	30
11:45	159	31	20
12:00	172	24	10
12:15	182	18	1
12:30	68	56	90

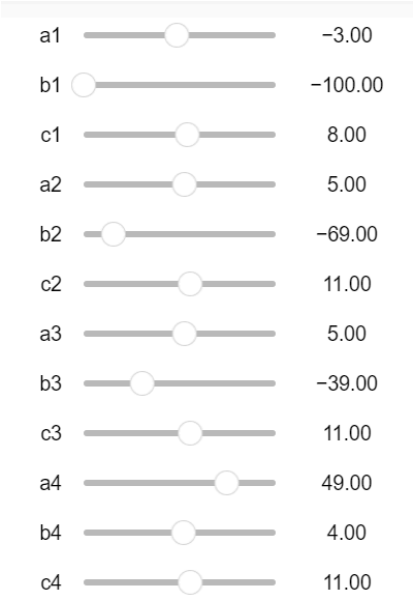
Note that during our first trial we forgot to actually plug the radio into the horn, but luckily we already accounted for a backup trial in case we had a late start.
Trial 1 (Galactic Longitude: 80°):

A good Portion of the time when we were taking our data fireworks were going off, we don't think it affected our results in any way but it is important to note.



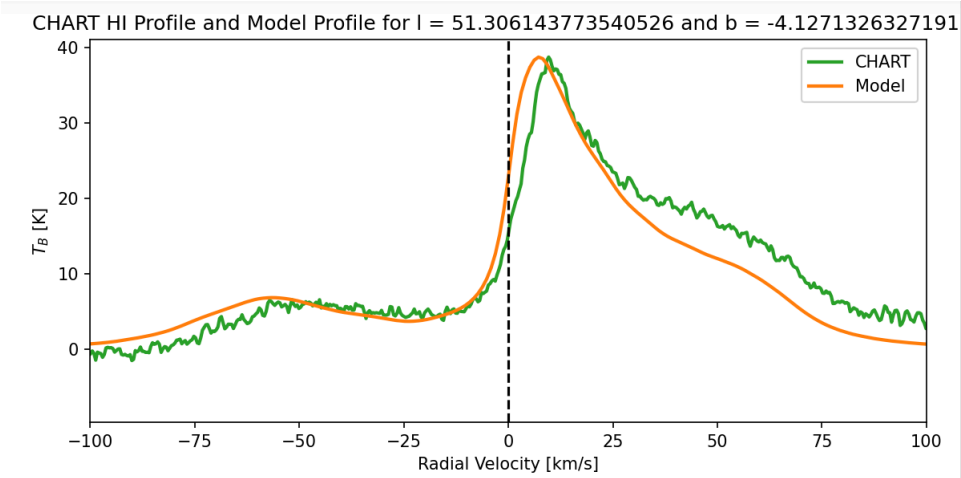
Overall, the trials like the one above were all comparable to the model and looked reasonable. We can see the graph is slightly off compared to the model, which is due to the way our noise calibration is set to subtract the noise off at -100 to -75. This doesn't work because it's not always guaranteed to be flat there, which is what happened in this trial. This is something that can be fixed in the future and has been acknowledged in github (https://github.com/astrochart/CHART/issues/212).



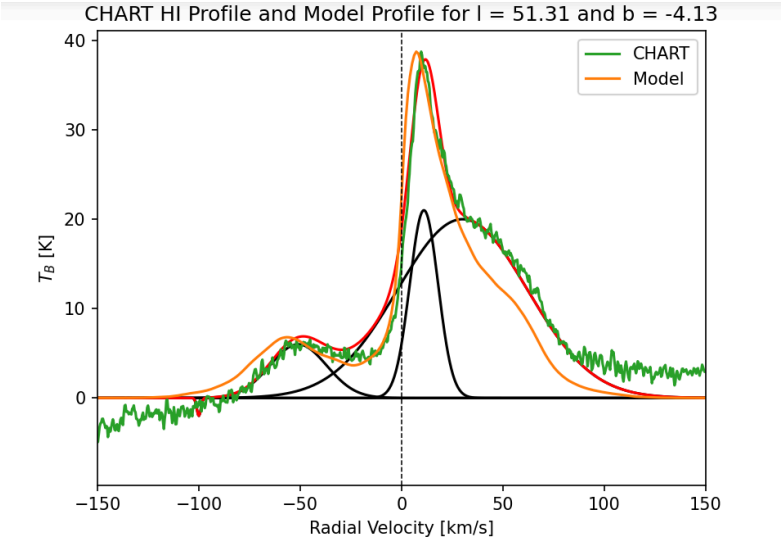


Initially when getting our rotational curve from the analysis tutorial, it looked like a straight line and not a curve. To remedy this we had to use sliders programmed into the tutorial, that can adjust the height, width, and where they're located on the graph. These can be used to help account for multiple clouds of hydrogen gas that could be in the area. As seen above the black lines represent the different clouds and the red line is putting them all together. The goal when doing this is to make the red line the same shape as the CHART line. When getting the velocity you then use the black peak with the largest velocity.

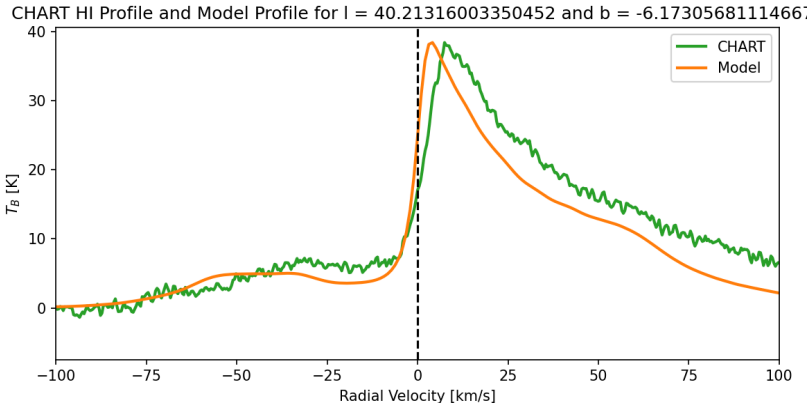
Trial 4 (Galactic Longitude: 50°):



During this trial our battery died, we still got eight tunings though, which we felt was enough to still get a good result.

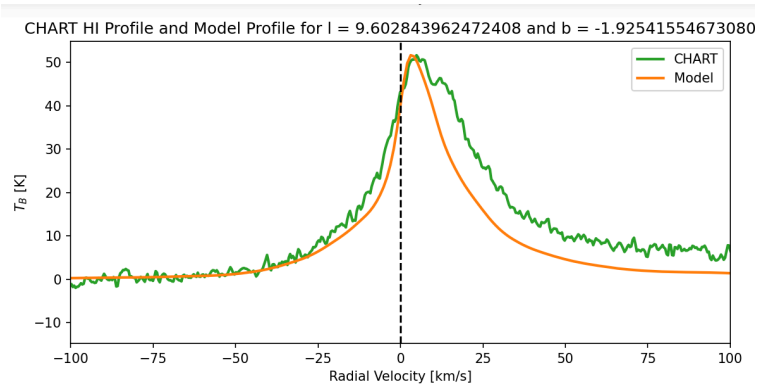


Trial 5 (Galactic Longitude: 40°):

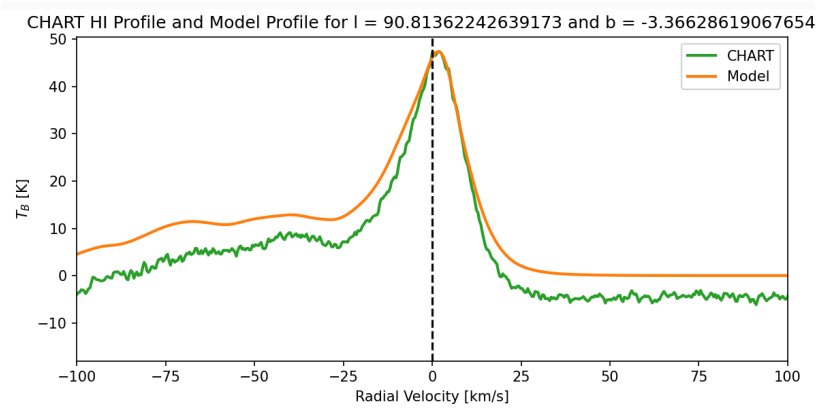


We had to keep moving the horn to point closer to where the fireworks were going off. Looking at the data, it doesn't appear to have affected the results.

Trial 8 (Galactic Longitude: 10°):



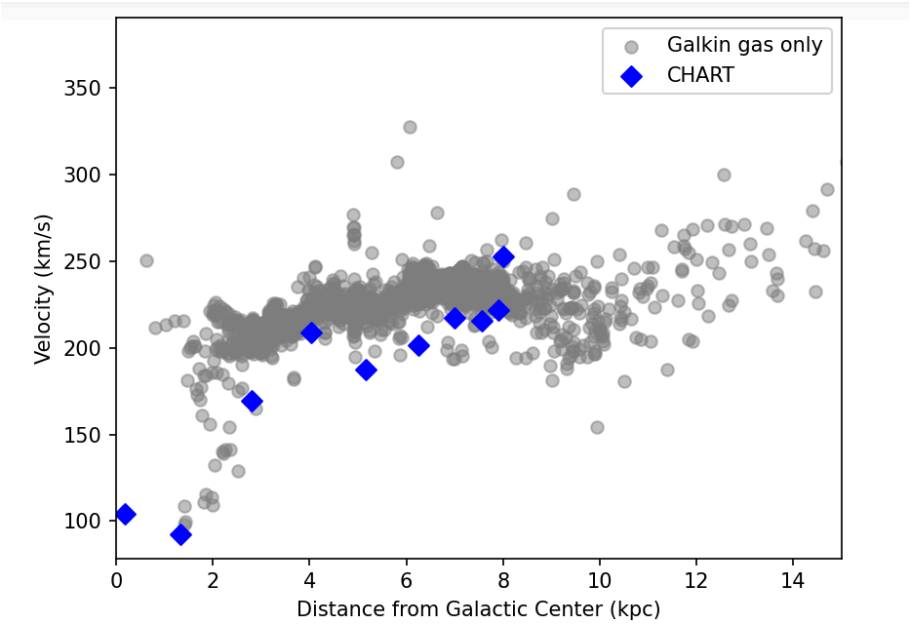
Trial 10 (Galactic Longitude: 90°):



The final trial, while the script did complete taking data, for some reason the file was smaller than normal.

Rotational Curve:

Galactic Longitude (degrees)	Velocities (km/s)
80	4.6
70	7.6
60	25.1
50	29.9
40	45.6
30	98.2
20	92.2
10	55.9
1	99.5
90	32.9



The rotational curve we got from our data is reasonable when compared to the Galakin Gas model. We can see our top point, or our trial 10 point, is above where the rotational curve is, as well as the bottom point or trial 9. It's important to note that velocities for galactic longitudes less than 20° are considered unreliable so that could explain our 9th trial. It's uncertain why the 10th trial is off, some outside factor likely played a role.

Conclusion:

Collecting data for the inner rotational curve was a success. Overall, besides from a couple outliers, the rotational curve we got from our data looks logical. In the future it might be worth analyzing our data again when the noise calibration gets adjusted.