Solution

1. (a) (Without the fitted orange lines) - also see spreadsheet in the folder

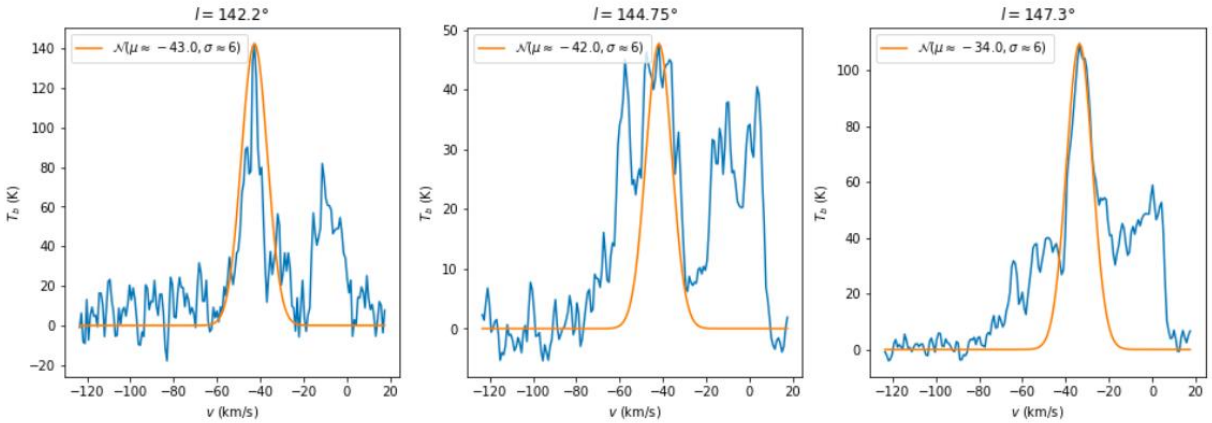

Figure S1. Sample spectra.

Marking Scheme:

- Check how many plots at different longitudes they include in their solution. Each plot should include the correct scale and axis labeling (see Fig. S1): **1 point per plot. Maximum 20 points.**
- If they maintain equal longitude spacing between consecutive plots: **5 points**
- Correct identification of the 21 cm v_{LOS} peak in each spectrum, within ±2 km/s for each of the plots: **1 point per plot**. **Maximum 20 points.**
  Note: Use Table S1 to check v_{LOS} values (not *R*, they are checked later). Keep in mind that they will not necessarily use the same longitude values, so they may be slightly different (within ±2 km/s of the nearest *l* value).

l	v_{LOS}	*R*
142.195	-42.69	11.586
142.51	-41.04	11.423
142.83	-41.86	11.560
143.15	-37.33	11.059
143.47	-40.21	11.433
143.79	-42.69	11.785

144.11	-41.04	11.613
144.43	-41.86	11.762
144.75	-42.27	11.861
145.07	-39.39	11.523
145.39	-39.39	11.564
145.71	-38.15	11.445
146.03	-37.33	11.378
146.35	-36.09	11.259
146.67	-34.85	11.141
146.99	-32.79	10.922
147.31	-32.38	10.906

Table S1. Possible values of v_{LOS}, R for 17 equally spaced longitude values.

(b) Assuming that the Sun is not located at the inner rim of our Local Arm, along any given line of sight we would not be able to pick up all the H emission, as some H belonging to our arm would be behind each line of sight and therefore would not show up in our observations.

Marking Scheme:

- The core of the solution is that they realize that each measurement does not include all the gas in our arm, but it does include all the gas in the Perseus and the Norma arm. Therefore, it is not straightforward to compare the amount of gas in our arm vs. the other arms from these measurements. **5 points for a correct answer, 0 points for all other answers.**

2.

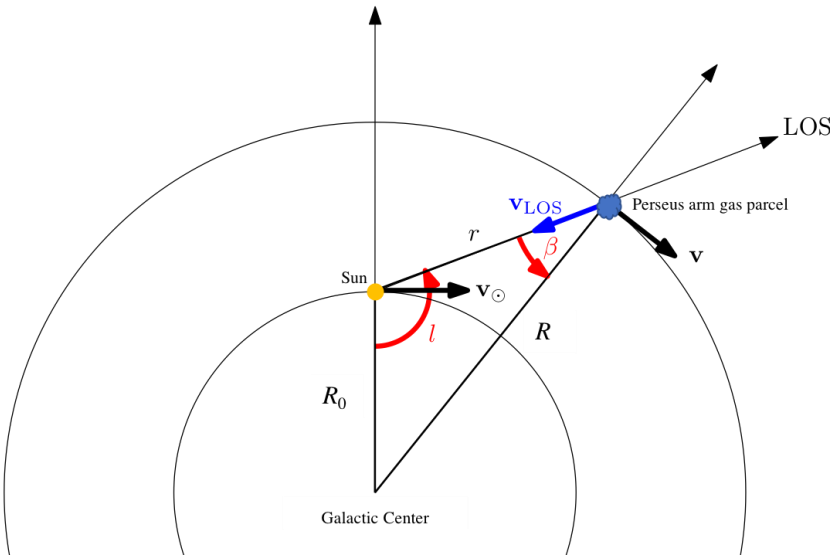

Figure S2. Geometric layout with additional angle β.

Marking scheme:

- If they include a clear figure similar to Fig. S2 accompanying their deduction: **5 points**.
- Check that the deduction follows the same mathematical/geometrical principles as the following:

  Inspection of the velocity vector components along the LOS in Fig. S2 yields,

$$\mathbf{v}_{\mathrm{LOS}} = (\mathbf{v} - \mathbf{v}_\odot) \cdot \hat{\mathbf{v}}_{\mathrm{LOS}}$$

$$v_{\mathrm{LOS}} = v \cos\left(\frac{\pi}{2} - \beta\right) - v_\odot \cos\left(l - \frac{\pi}{2}\right)$$

$$v_{\mathrm{LOS}} = v \sin\beta - v_\odot \sin l = v_\odot \sin\beta - v_\odot \sin l$$

$$\therefore \sin\beta = \frac{v_{\mathrm{LOS}} + v_\odot \sin l}{v_\odot} \qquad (1)$$

  Correctly deducing this equation: **10 points**.

  By the law of sines,

$$\frac{R}{\sin l} = \frac{R_0}{\sin\beta}$$

  Substituting (1) above,

$$R = R_0 \frac{v_\odot \sin l}{v_{\mathrm{LOS}} + v_\odot \sin l} \quad . \quad (2)$$

Correctly deducing this equation: **5 points**.

3. Perseus arm radius: R = 11.4 ± 0.3 kpc. Mean value and stdev as reported by libreoffice calc.

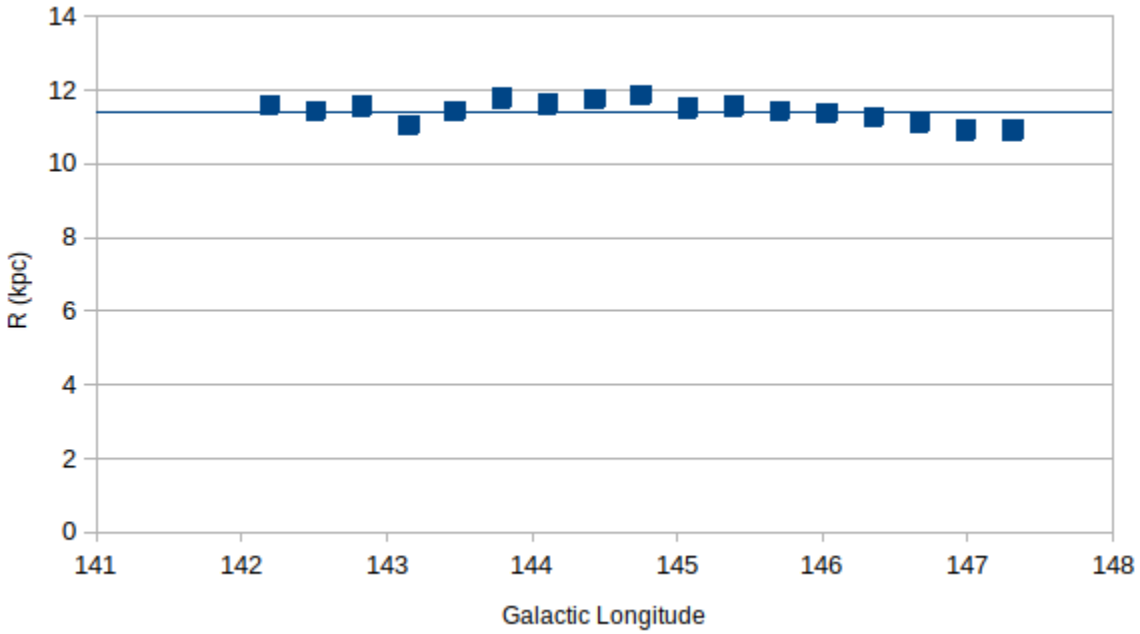

Figure S3. Estimated radii of gas parcels in the Perseus arm for 20 pointings in the dataset according to the values in Table S1.

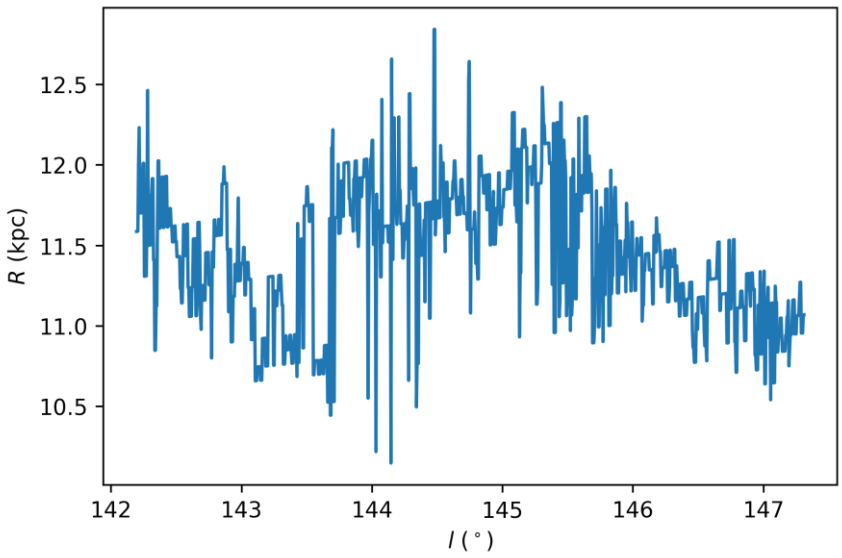

Figure S4. Estimated radii of gas parcels in the Perseus arm for all pointings in the dataset.

Marking scheme:

- Finding *R* values within 0.2 kpc of data points in Figs. S3 or S4 for more than 5 longitudes: **10 points**.
- Note: Use Fig. S4 to compare data points in case their longitude values selection does not match the longitudes in Table S1.
- Check that they include a plot similar to Fig. S3 (properly labeled axes) from their data in part 1 of this problem. They should include at least 5 data points to make their conclusions meaningful and get full marks: **5 points.**
- Get the final result with standard deviation (11.4 ± 0.3 kpc): **5 points**
  Note: Their value should not differ by more than 0.2 kpc from this solution.

4. Norma arm radius: *R* = 14.3 ± 0.3 kpc. Mean value and stdev as reported by libreoffice calc from 7 data points near the middle of the longitude range.

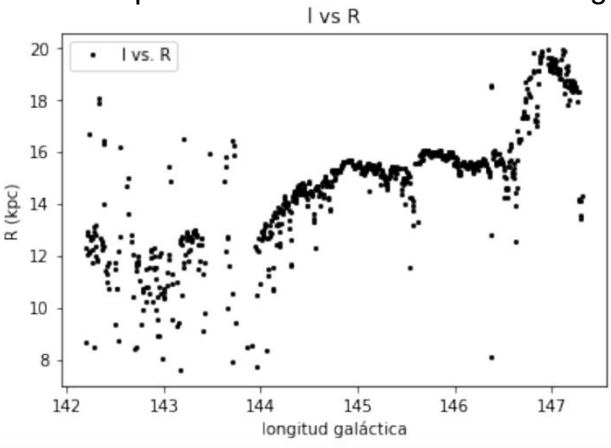

Figure S5. Estimated radii of gas parcels of the Norma Arm for all pointings in the dataset.

Marking scheme:

- Finding peak v_{LOS} for more than 5 longitudes near l = 145º: **8 points**.
- Finding *R* values within 0.2 kpc of data points in Fig. S5 for more than 5 longitudes: **7 points**.
- Check that they include a plot similar to Fig. S5 (properly labeled axes) from their data in part 1 of this problem. They should include at least 5 data points to make their conclusions meaningful and get full marks: **5 points.**
  Note: Use Fig. S4 to compare *R* values.
- Get the final result with standard deviation (14.3 ± 0.3 kpc): **5 points**
  Note: Their value should not differ by more than 1 kpc from this solution.