Creating a 2,500-hour map of the Milky Way using hydrogen line (1420MHz) using Lichfield Radio Observatory's LRO H1 radio telescope

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The Lichfield LRO H1 Radio Telescope

Lichfield Radio Observatory (LRO) is located at latitude 52.6815 north, longitude -1.8255 (1.8255 west). Lichfield is a cathedral city and civil parish in Staffordshire, England. One of eight civil parishes with city status in England, Lichfield is situated roughly 16 mi (26 km) north of Birmingham. The LRO H1 Radio Telescope is composed of a Ptarmigan Triffid ex-military 4x4 dipole array. Filtering is two-stage using a 1400-1427MHz cavity filter, followed by a Nooelec SAWBird H1 LNA/filter. The system uses an RTL-SDR Blog V3 Software Defined Radio and data for this paper was recorded using Easy Radio Astronomy Software Suite (ezRA; Ted Cline; https://github.com/tedcline/ezRA).

The telescope is mounted on a simple wooden mount that allows variation in elevation. It points at the same azimuth constantly – data is collected using 24-hour drift scans which allow individual azimuth points to be calculated by the software during the sidereal day.

Ptarmigan Triffid Band 3 Ex-Military Dipole Array (below):

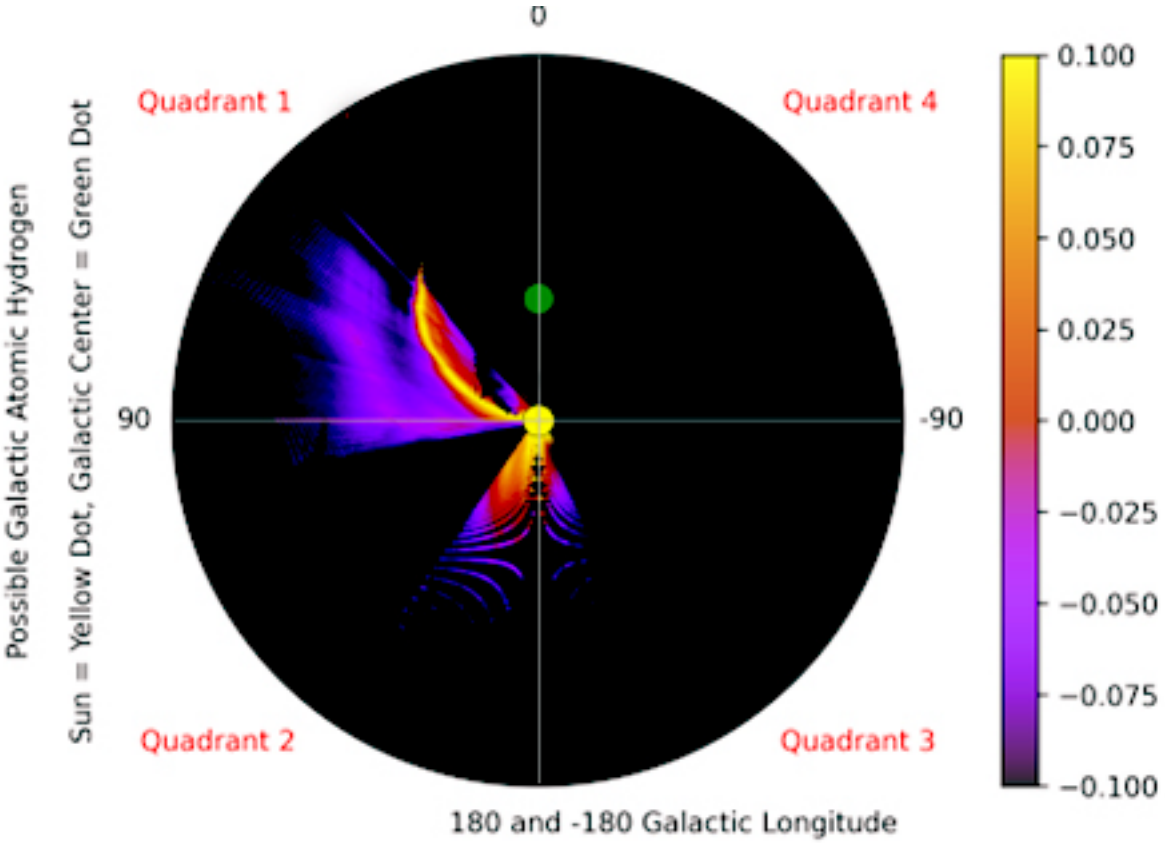
Simple wooden mount for telescope (below):

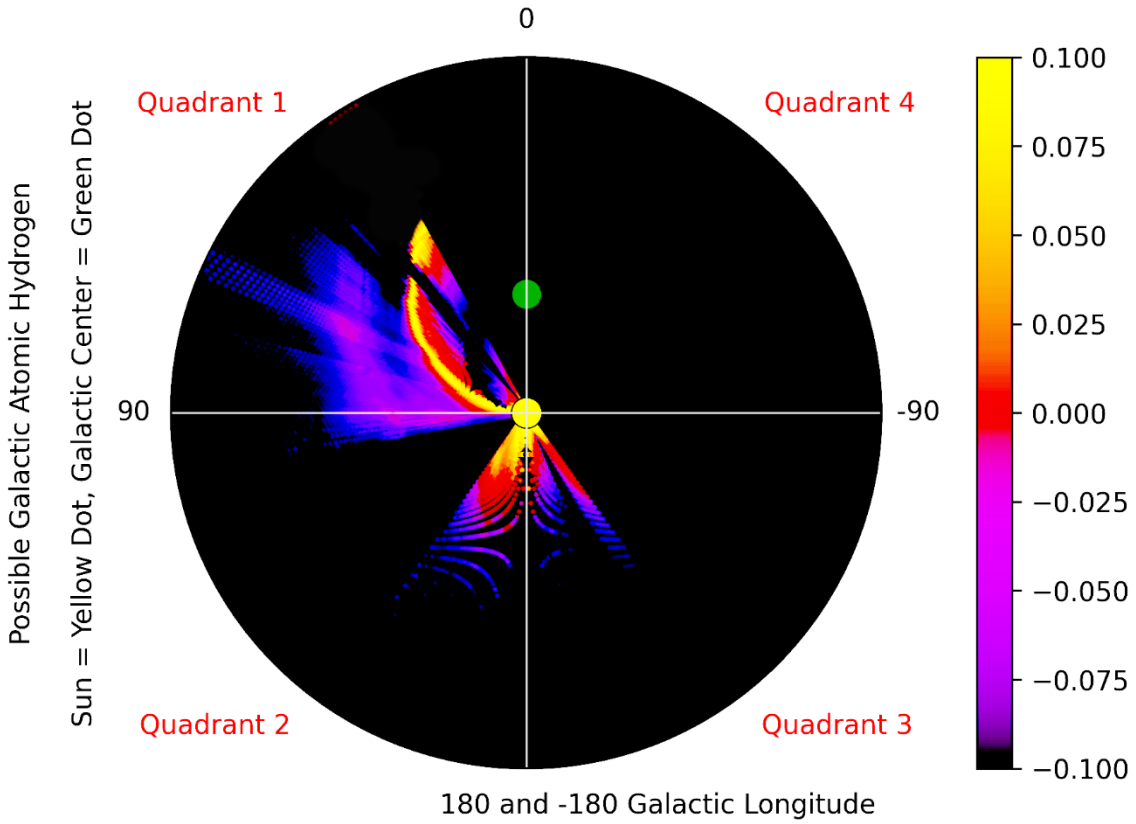
Ptarmigan array on mount below. Each measurement indicated on the photograph is 86cm (so array is 86cm x 86cm in size):

Data collected for this paper

Data was collected for this paper between 6th January 2024 and 16th November 2024. It is composed of 582,492 samples (approx. 2,500 hours of data). Most of the data is within Milky Way galactic longitudes 0-90 degrees. It demonstrates several galactic arm features.

Latest map of Milky Way from LRO using 582,492 samples (in the three versions of this map, I have highlighted different layers of structure in hydrogen):


0
Quadrant 1
Quadrant 4
90
-90
Quadrant 2
Quadrant 3
Possible Galactic Atomic Hydrogen
Sun = Yellow Dot, Galactic Center = Green Dot
180 and -180 Galactic Longitude
0.100
0.075
0.050
0.025
0.000
−0.025
−0.050
−0.075
−0.100


0
Quadrant 1
Quadrant 4
90
-90
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Quadrant 3
Possible Galactic Atomic Hydrogen
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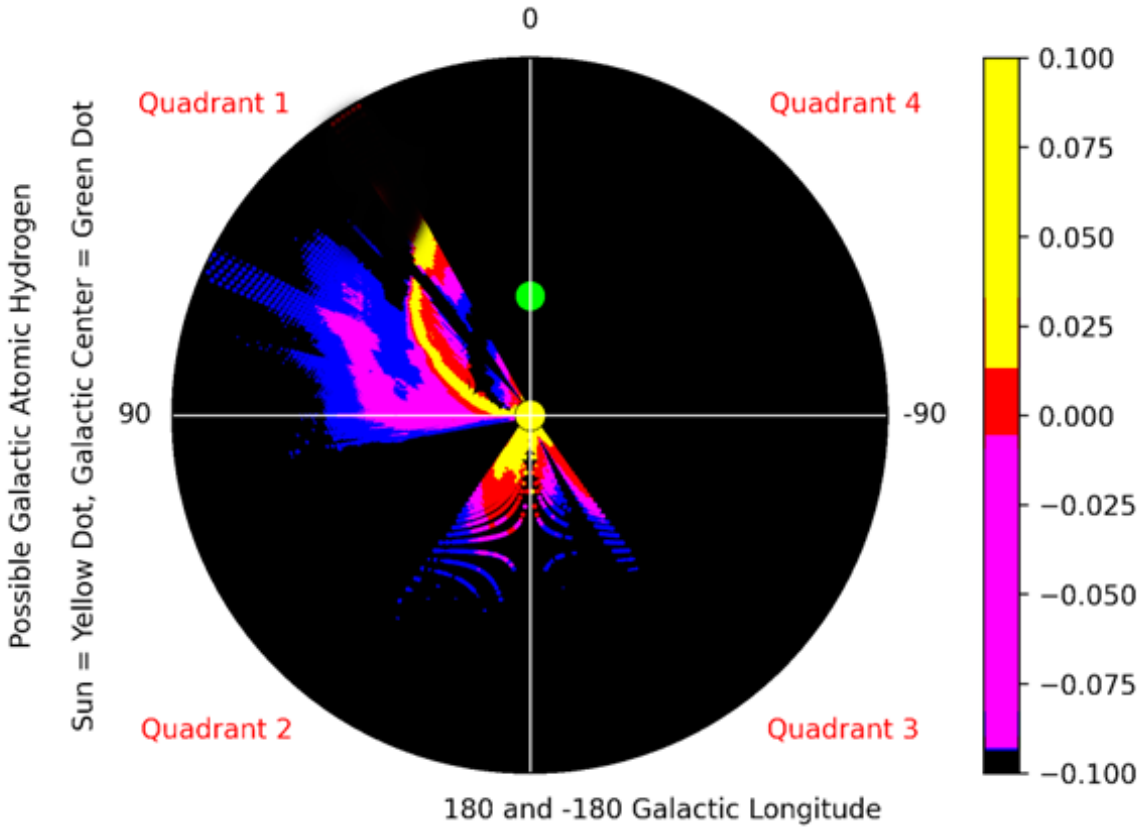
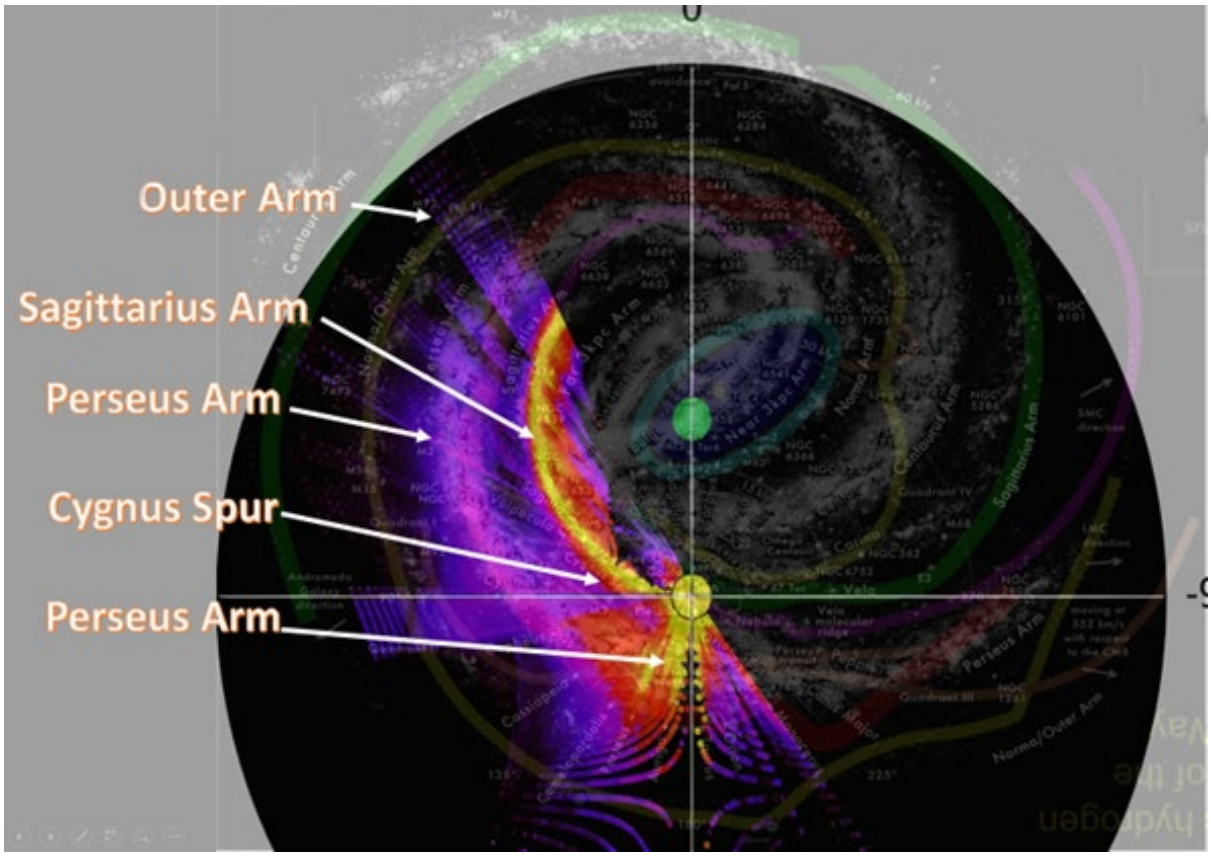
0.100
0.075
0.050
0.025
0.000
−0.025
−0.050
−0.075
−0.100

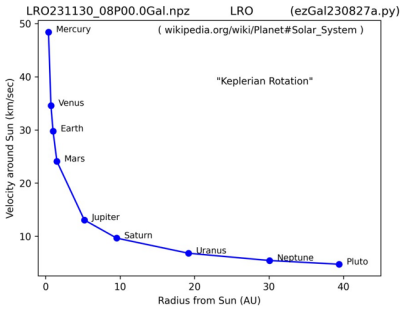


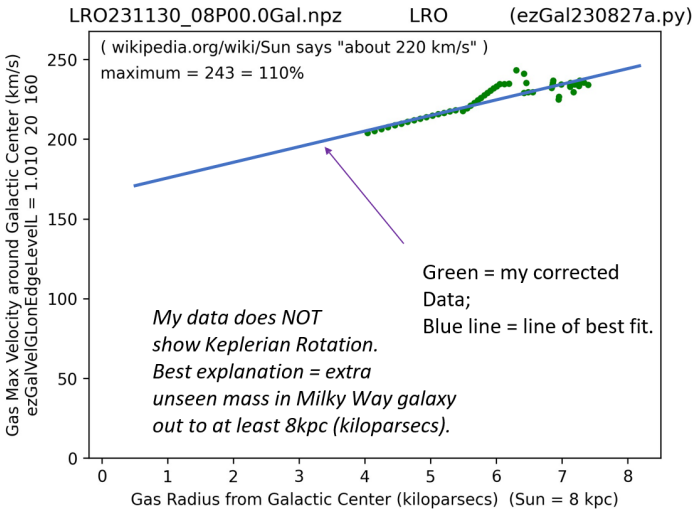
Features of the structure of the galactic arms of the Milky Way demonstrated in the data (below):



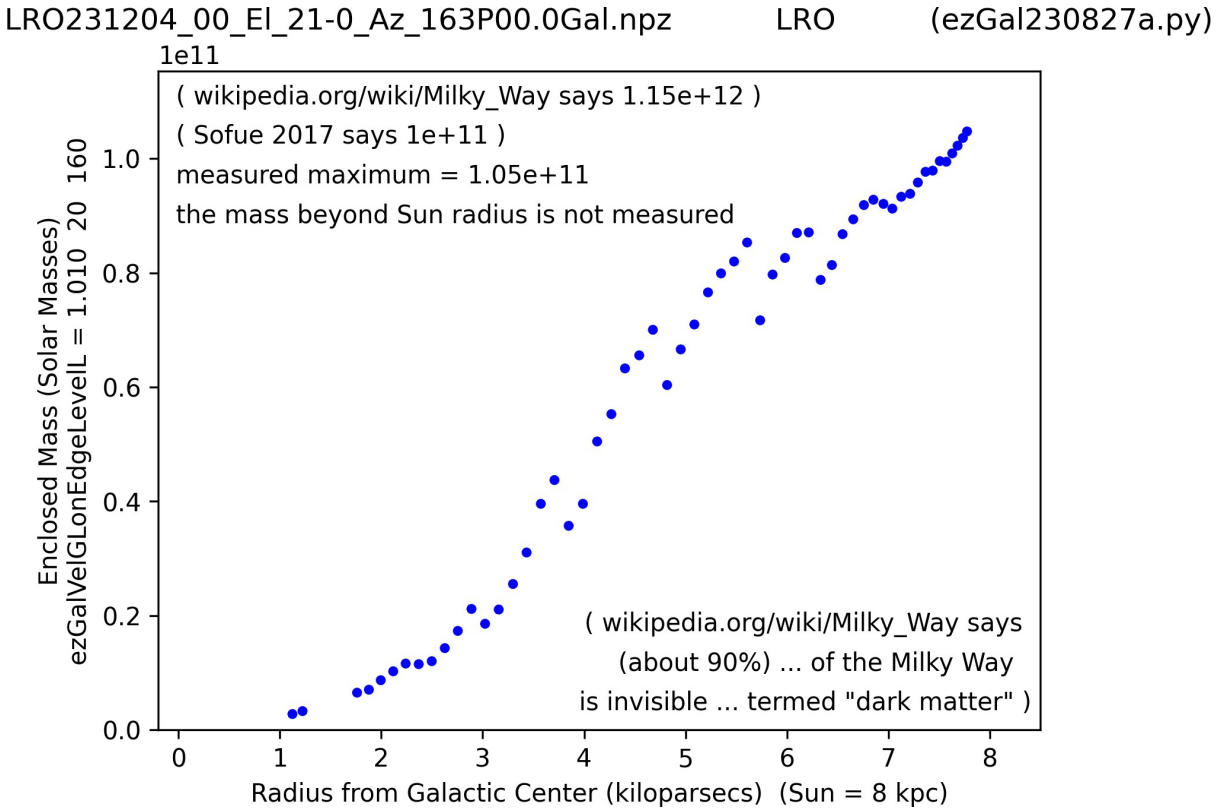
Demonstrating "smoking gun" for dark matter – rotation curve does not follow Keplerian predictions in my data (below):

Below is typical Keplarian Rotation Curve which would be expected without dark matter, on right my data (ezRA suite/Pharmigan array)





Weighing the Milky Way with LRO data (below) – the Sun is at 8kpc so this is limit of what can be seen in this data below and above:



Further information.

Further information about this project is available on the www.astronomy.me.uk website or by contacting me using the “contact us” page on that website.