Five-page amateur radio astronomy report

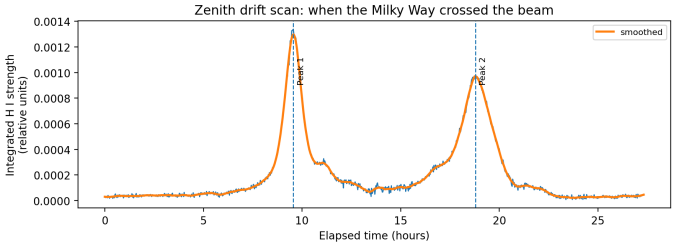
2.1 m zenith-pointed radio telescope - Glendora, California - 2026-04-29 to 2026-05-01

Executive summary

The observation is a successful neutral-hydrogen detection. The receiver covered the 21 cm H I line band near 1420.405752 MHz over 1,000 spectra and 512 channels. After smooth bandpass removal, the dynamic spectrum shows two strong emission windows as Earth's rotation carried different Milky Way directions through the zenith beam. The data are best treated as relative power spectra: useful for line shape, velocity, and repeatability, but not yet for absolute brightness temperature.

Spectra	1,000
Channels	512
Frequency span	1419.205-1421.600 MHz
Channel spacing	4.6875 kHz
Velocity step	0.99 km/s
Duration	27.319444444444442865460587199777 h
Median cadence	97 s
Beam estimate	7.0 deg FWHM

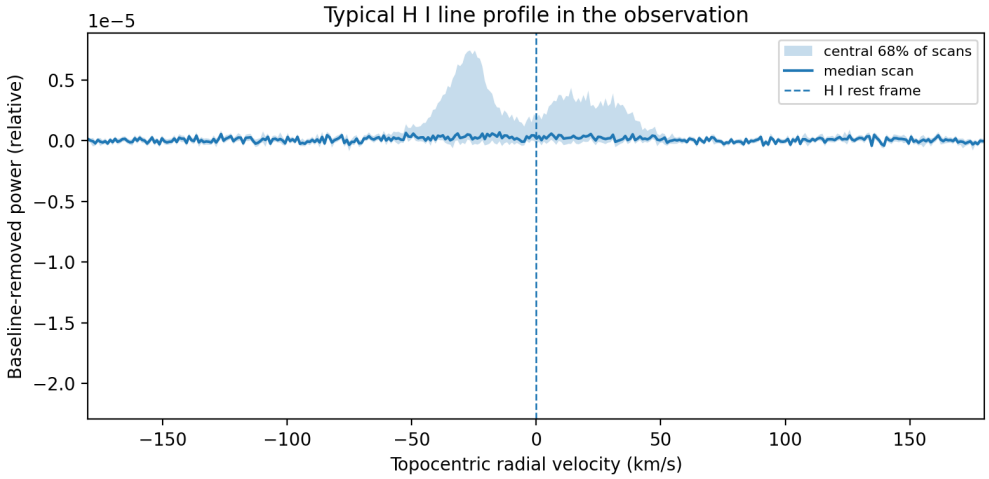
Quick-look graph



Two main increases in integrated H I line strength were found during the 27.3 hour zenith drift.

Observation highlights

The strongest window occurs near local file time 2026-04-30 06:29:11 with peak velocity about -29.5 km/s. A second strong window occurs near 2026-04-30 15:42:55 with peak velocity about 25.9 km/s.



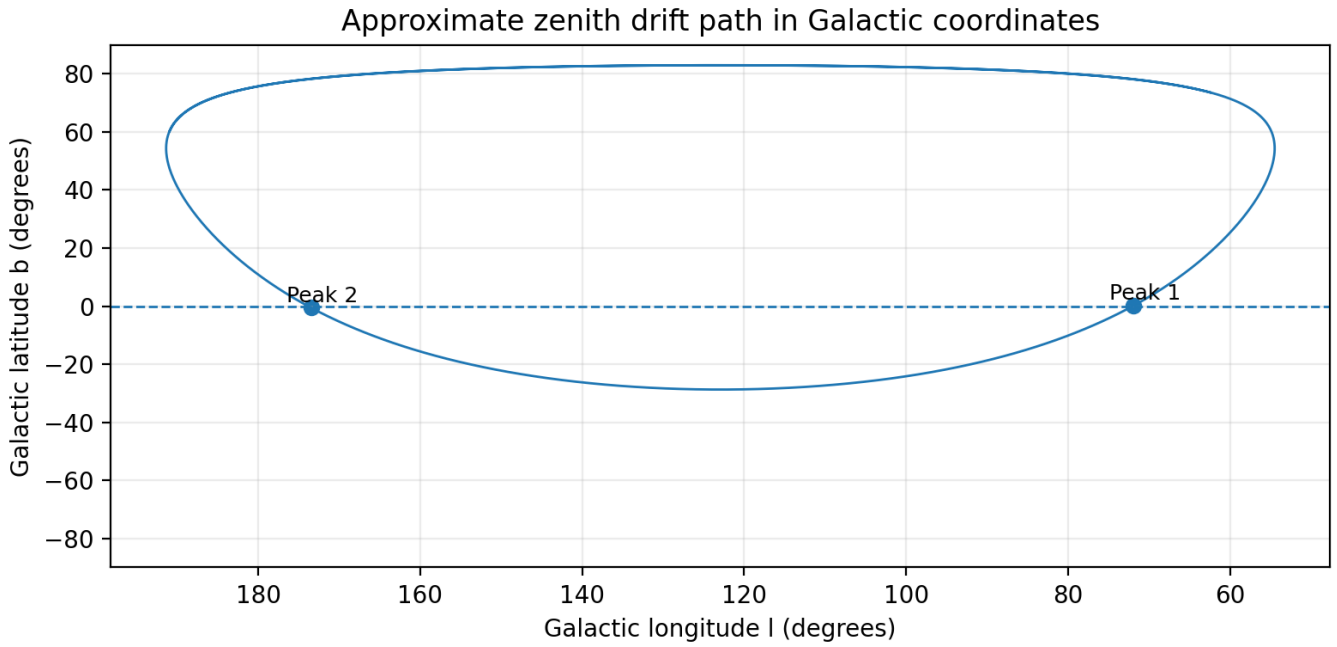
Median spectrum after baseline removal. The profile is broad because a 7 degree beam sees large Galactic structures.

1. Instrument and drift-scan mode

The dish was held at zenith. For a fixed zenith-pointed dish, the declination is approximately the site latitude (Glendora: about +34.1 deg), while the right ascension of the beam changes with local sidereal time. This turns the observation into a natural drift scan. At the 21 cm wavelength, a 2.1 m aperture has a broad beam, so each spectrum averages a large patch of sky rather than a pinpoint source.

Beam estimate used in this report

```
lambda = c / nu0 = 0.211 m
theta_FWHM approx 1.22 lambda / D
theta_FWHM approx 1.22 * 0.211 / 2.1 = 0.123 rad = 7.0 deg
```



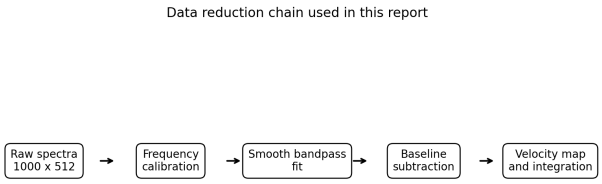
Approximate Galactic path of the zenith beam, assuming the file times are PDT. The exact sky path depends on time-zone interpretation; the spectral H I detection does not.

Practical observing note

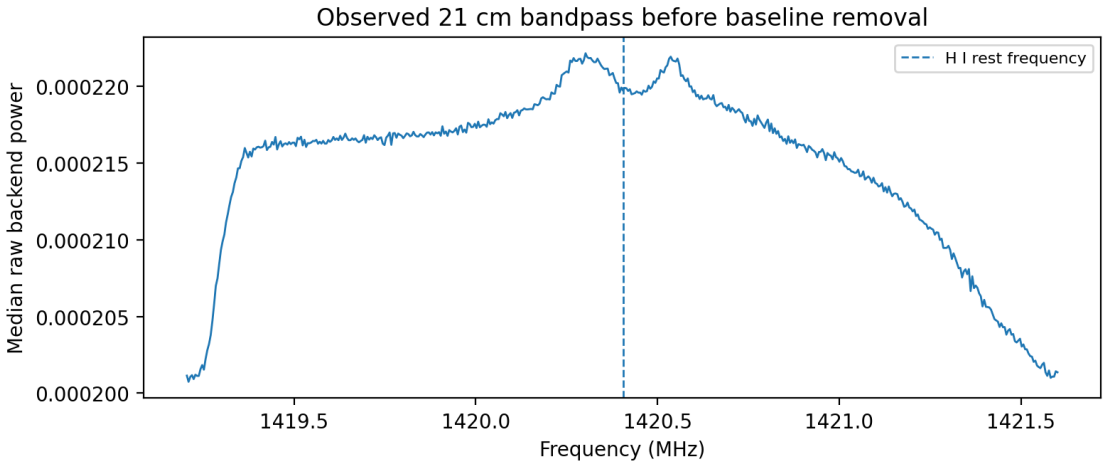
- A zenith drift scan is mechanically simple and repeatable. Repeating at the same local sidereal time should reproduce real sky features.
- The broad beam makes bright Galactic-plane crossings easy to see, but it blends together structure across several degrees.
- Local RFI can still appear, especially as narrow vertical or horizontal artifacts in a dynamic spectrum. Repeatability and off-line checks are the best safeguards.

2. From raw spectra to H I line signal

The raw backend power includes receiver gain, bandpass shape, sky continuum, and the spectral line. The reduction therefore estimates a smooth baseline for each spectrum and subtracts it. The remaining residual power emphasizes frequency-localized H I emission.



High-level processing chain. This is a relative-power analysis; no hot/cold or noise-diode calibration was applied.



Median raw bandpass. Smooth receiver/bandpass structure is much stronger than the astronomical line and must be removed carefully.

Velocity scale

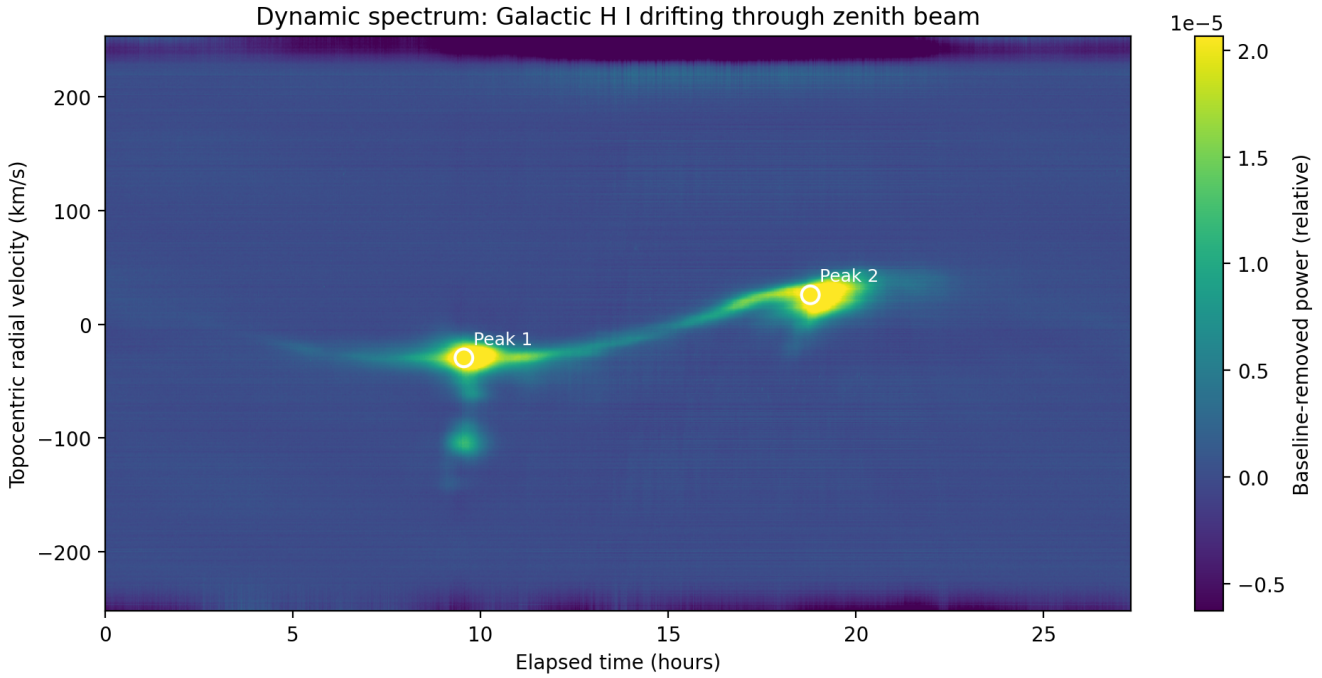
The frequency coverage corresponds to a topocentric velocity range of about -252 to 253 km/s with the radio definition. The channel spacing is roughly 0.99 km/s per channel. No correction to the Local Standard of Rest was applied, so velocities should be considered topocentric.

Frequency-to-velocity conversion

```
v_radio = c * (nu0 - nu_obs) / nu0
Delta_v = c * Delta_nu / nu0 = 0.99 km/s per channel
nu0 = 1420.40575177 MHz
```

3. Detected H I emission

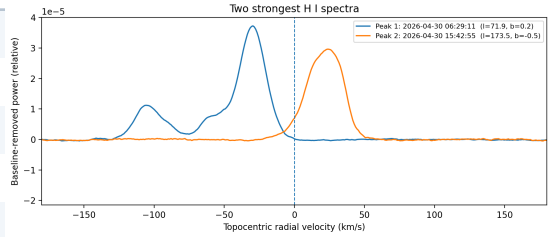
The dynamic spectrum is the clearest view of the observation. Time runs left to right and velocity runs vertically. Bright regions are excess power after baseline subtraction. The two strongest windows are separated in time and velocity, consistent with the beam drifting through different Galactic longitudes.



Dynamic spectrum. The circled points mark the strongest residual spectra in the analyzed line window.

Strongest line windows

Peak 1 time	2026-04-30 06:29:11
Peak 1 sky path	l=71.9 deg, b=0.2 deg
Peak 1 velocity	-29.5 km/s
Peak 2 time	2026-04-30 15:42:55
Peak 2 sky path	l=173.5 deg, b=-0.5 deg
Peak 2 velocity	25.9 km/s



Two strongest spectra overlaid.

4. What this data can support

- Reliable: detection of Galactic neutral hydrogen, relative line strength over time, topocentric Doppler velocity structure, and repeatability tests by sidereal time.
- Promising: comparison to public H I surveys after smoothing them to a roughly 7 degree beam and applying a matching velocity frame.
- Not yet reliable: absolute brightness temperature, flux density, H I column density, or gas mass. Those require calibration.

Recommended next observing campaign

- Repeat the same scan on several nights and stack by local sidereal time, not clock time. True sky features repeat in sidereal time.
- Add calibration. A simple hot/cold load or calibrated noise diode lets you convert relative power into antenna temperature.
- Create an RFI log. Save local weather, nearby electronics status, antenna cabling notes, and waterfall screenshots.
- Apply barycentric/LSR velocity correction before comparing to professional surveys.
- Observe a few deliberate pointings along the Galactic plane if your mount can steer. A longitude scan would turn this from detection into mapping.

Selected references and data source

Data: MLO-Lewin_20260429_451000_1000.zip and supplied timelapse MPEG. Reference context: Verschuur, The Invisible Universe (21 cm H I line); Condon & Ransom, Essential Radio Astronomy (radiometers, atmospheric windows); ITU-R Handbook on Radio Astronomy (H I and radio astronomy service characteristics).

Highest-value next step

Best next product: a multi-night, sidereal-time-stacked H I drift scan with calibration. That would let you produce a stronger amateur astronomy report and a first brightness-temperature scale.