Sterrenstelsels op 21 centimeter

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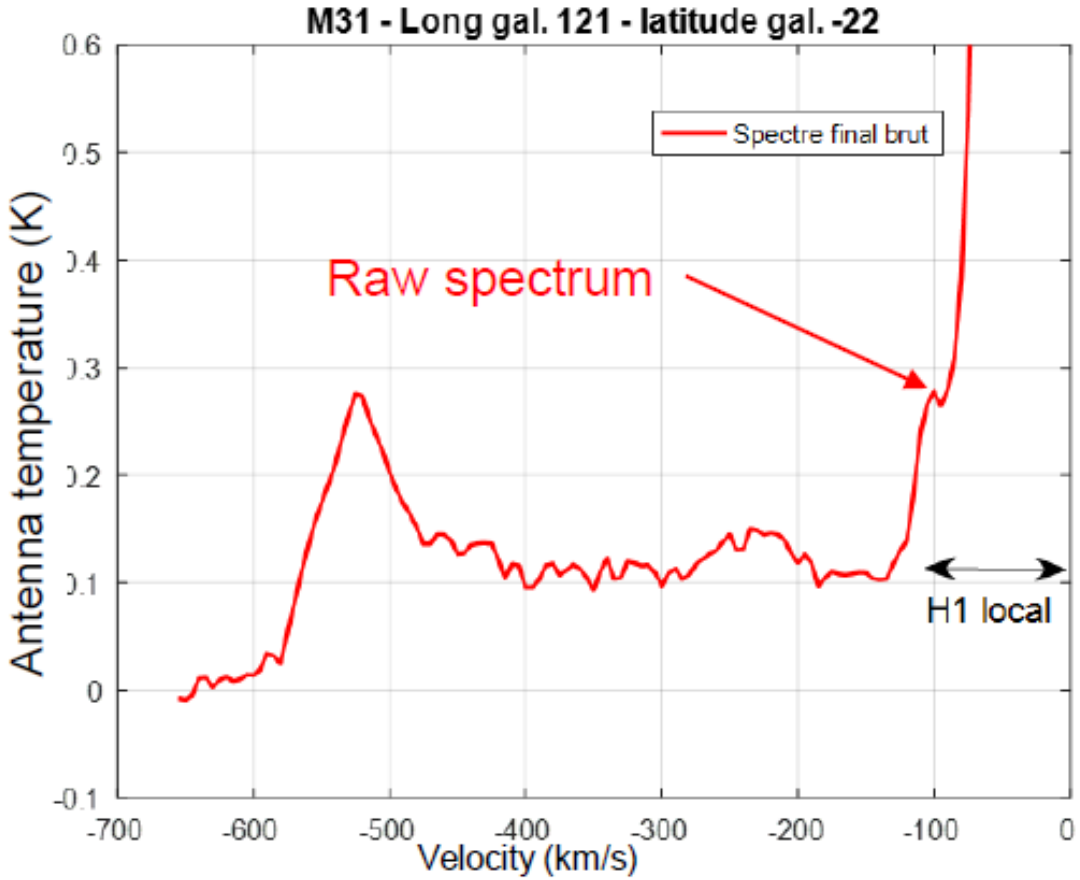
Society of Amateur Radio Astronomers

Kunnen we verder kijken dan de Melkweg?

- Steve Olney (2016): LMC en SMC met 3 meter TVRO schotel
- JJ Maintoux F1EHN (2015): M31 en M33 met 3.3 meter schotel
- Jason Burnfield (2023-24): M31, M33 en M101 met 2.4 meter schotel



M31 21-centimeter spectrum door J.J. Maintoux F1EHN

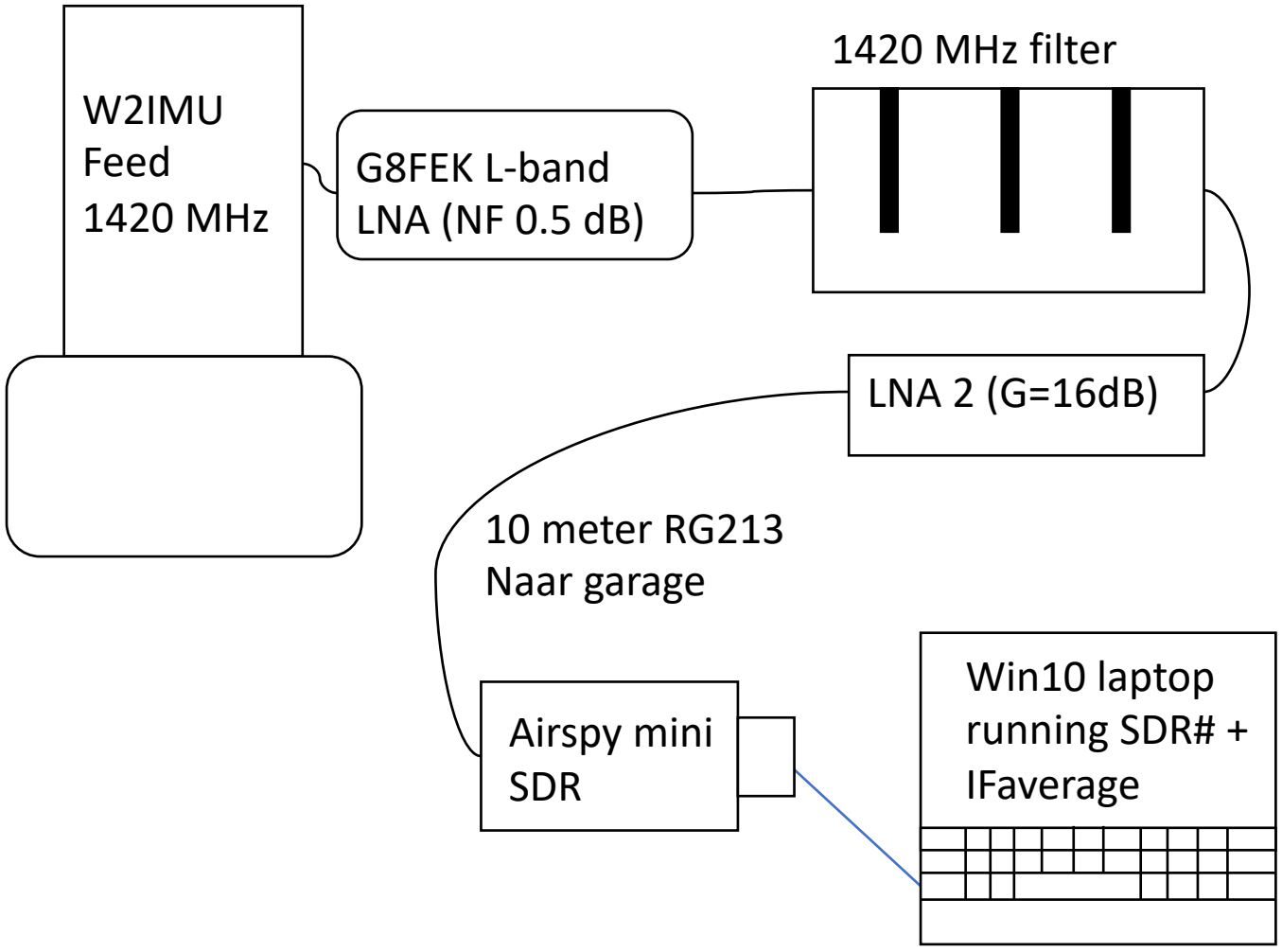
https://sites.google.com/view/hawkrao/extra-galactic-hydrogen-line-observations

M31 and M33 observations @21 cm- J.J. Maintoux 2016

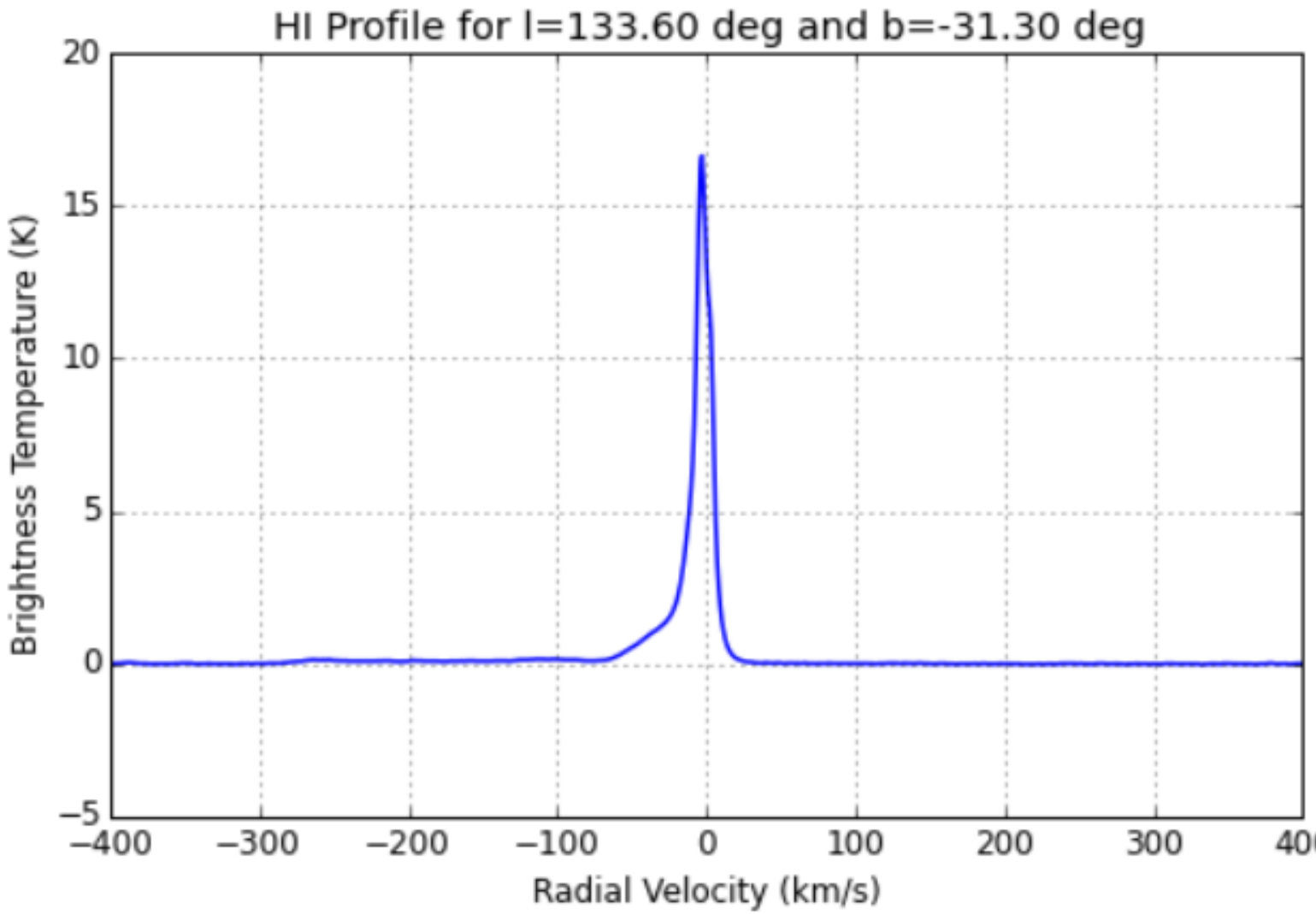
3 meter schotel

- Gebouwd in 2017- 18
- Meerdere keren gewijzigd
- 4 segmenten rond centraal deel
- f/d 0,5
- Constructie: hout/ multiplex
- Oppervlak: aluminium horrengaas
- Feed supports: 40mm PVC buis
- Alleen opgebouwd bij stabiel weer (niet teveel regen en wind)
- Tsys ~110 – 130K

3 meter schotel-blokdiagram



Wat te verwachten? LAB survey simulatie M33 met 3 meter schotel



https://www.astro.uni-bonn.de/hisurvey/euhou/LABprofile/index.php

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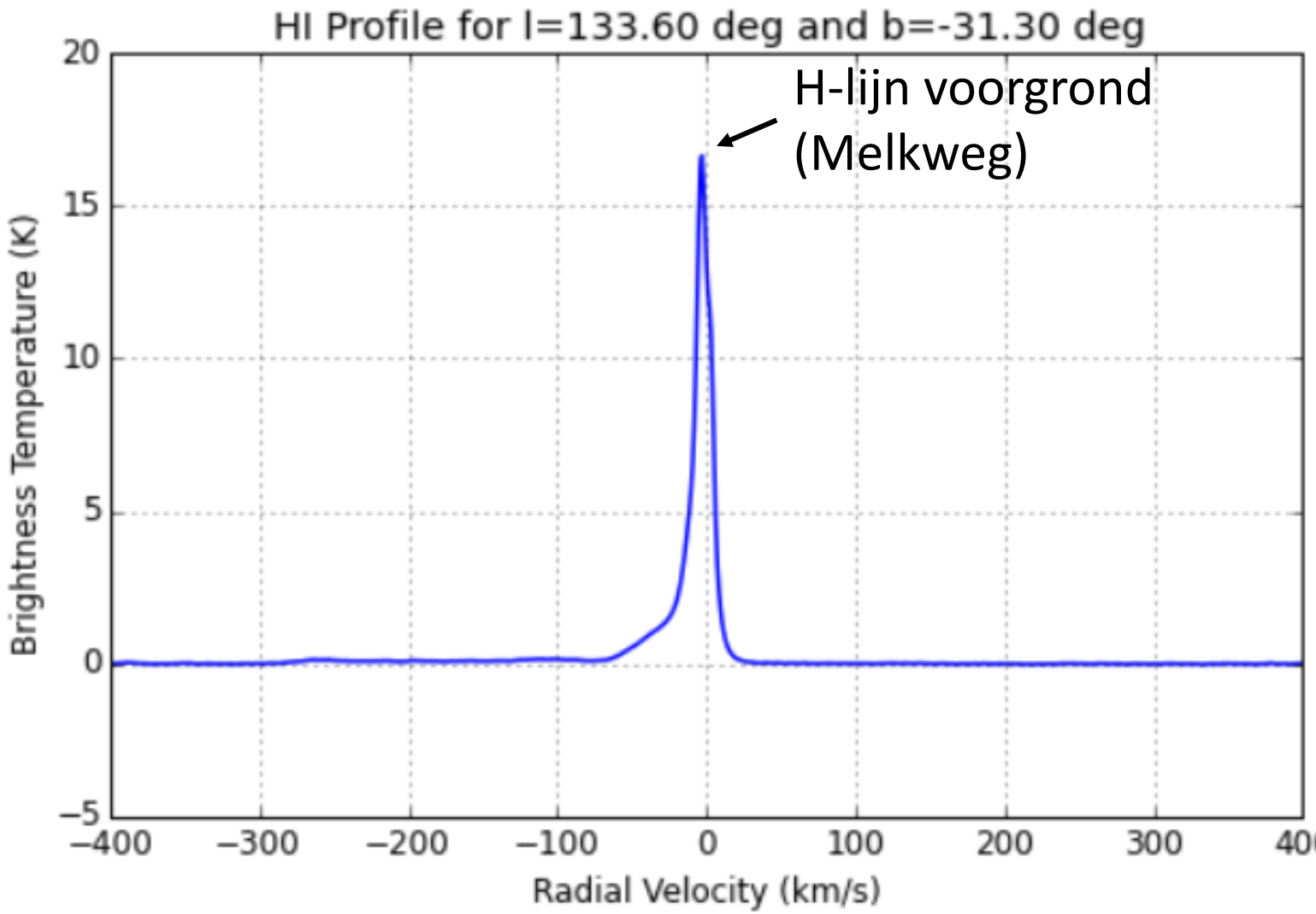

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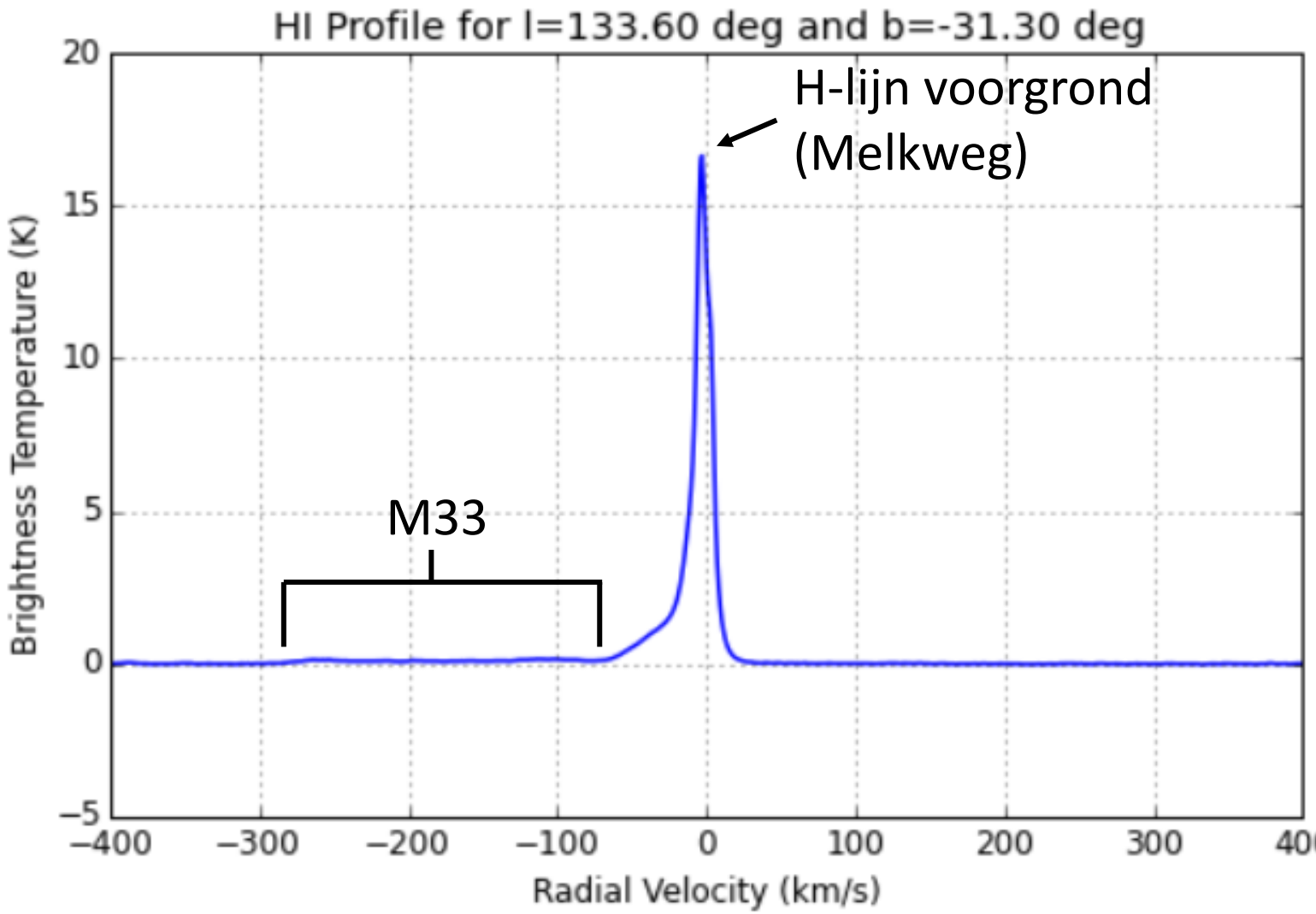

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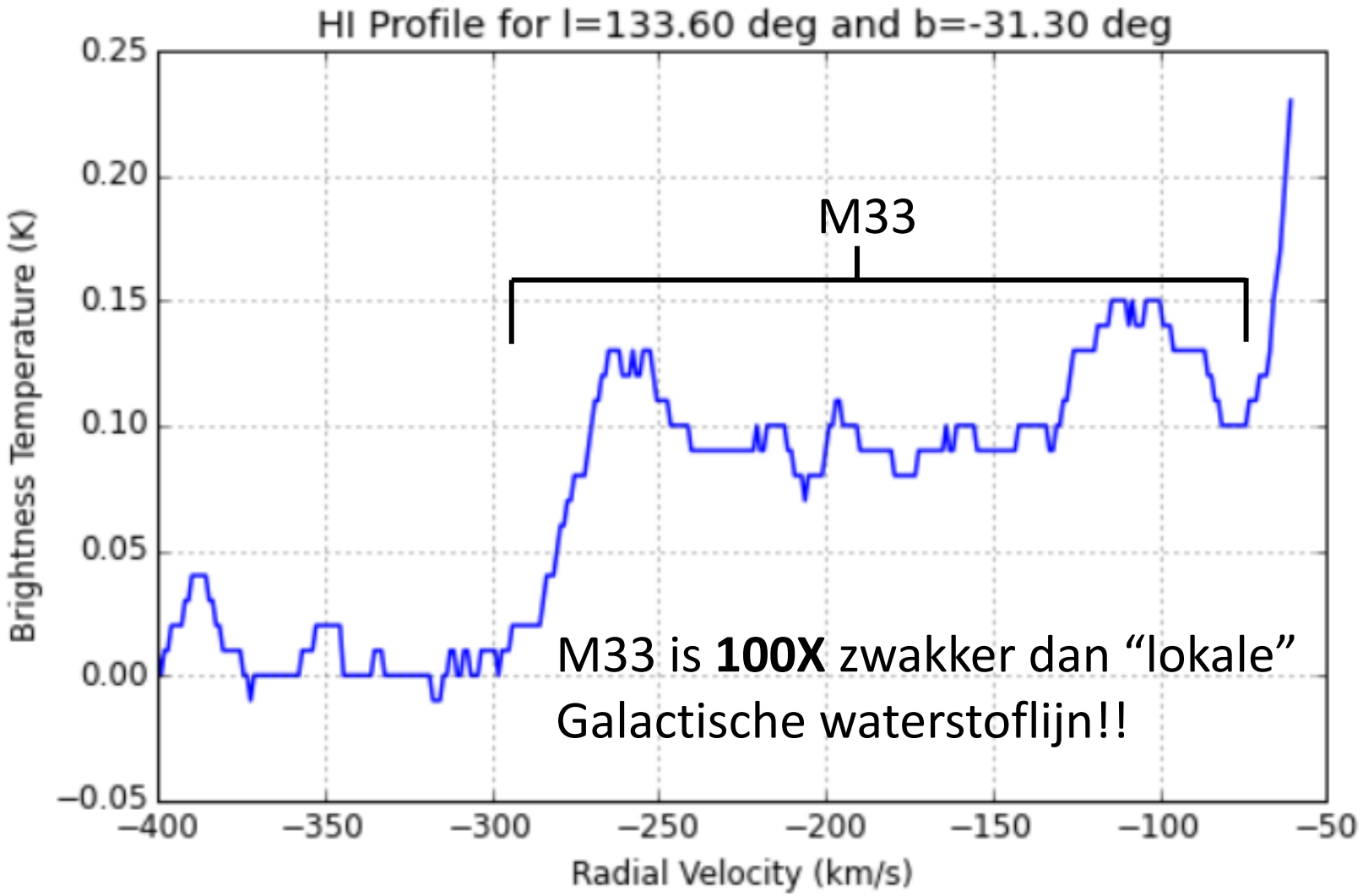
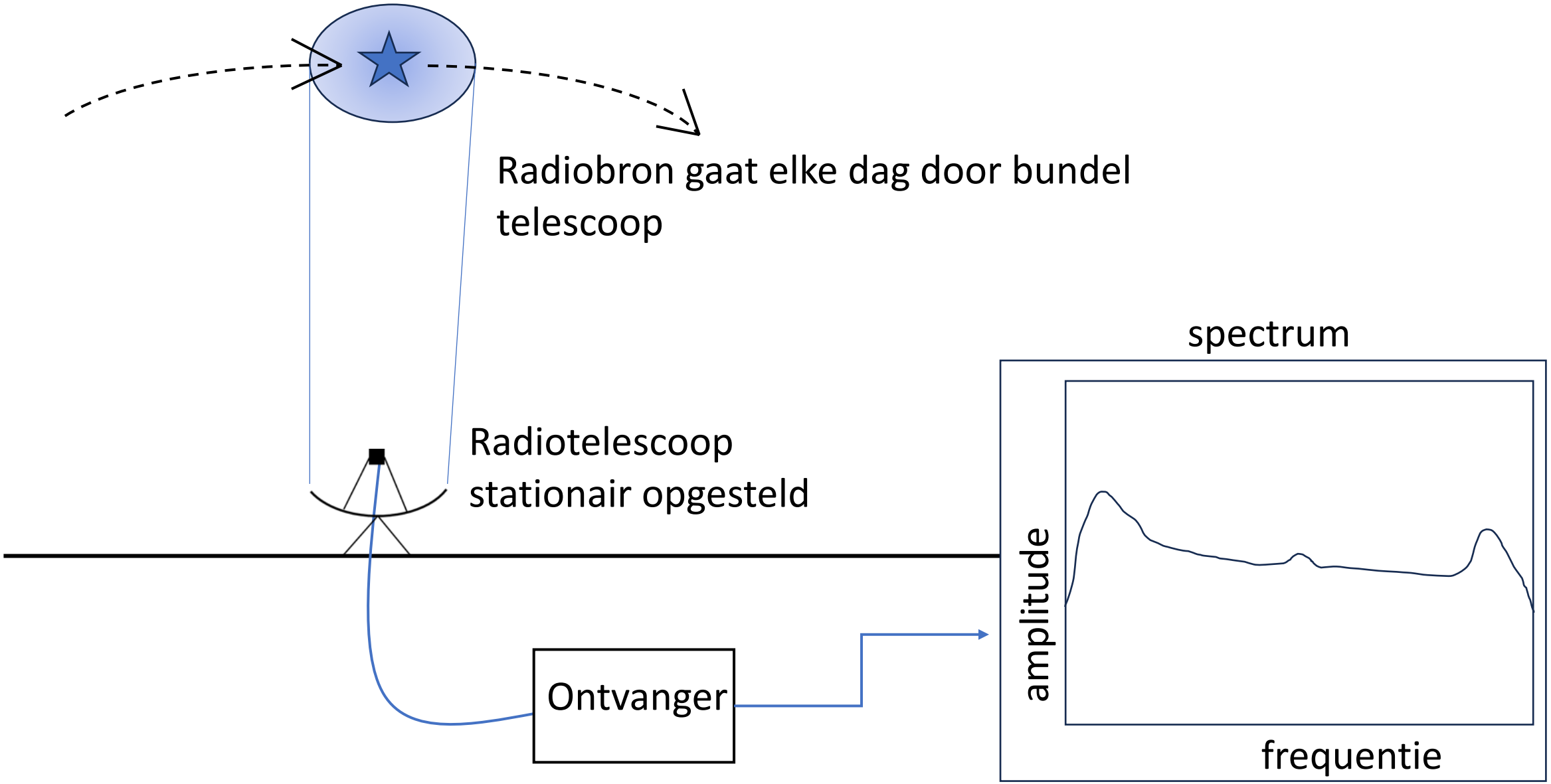


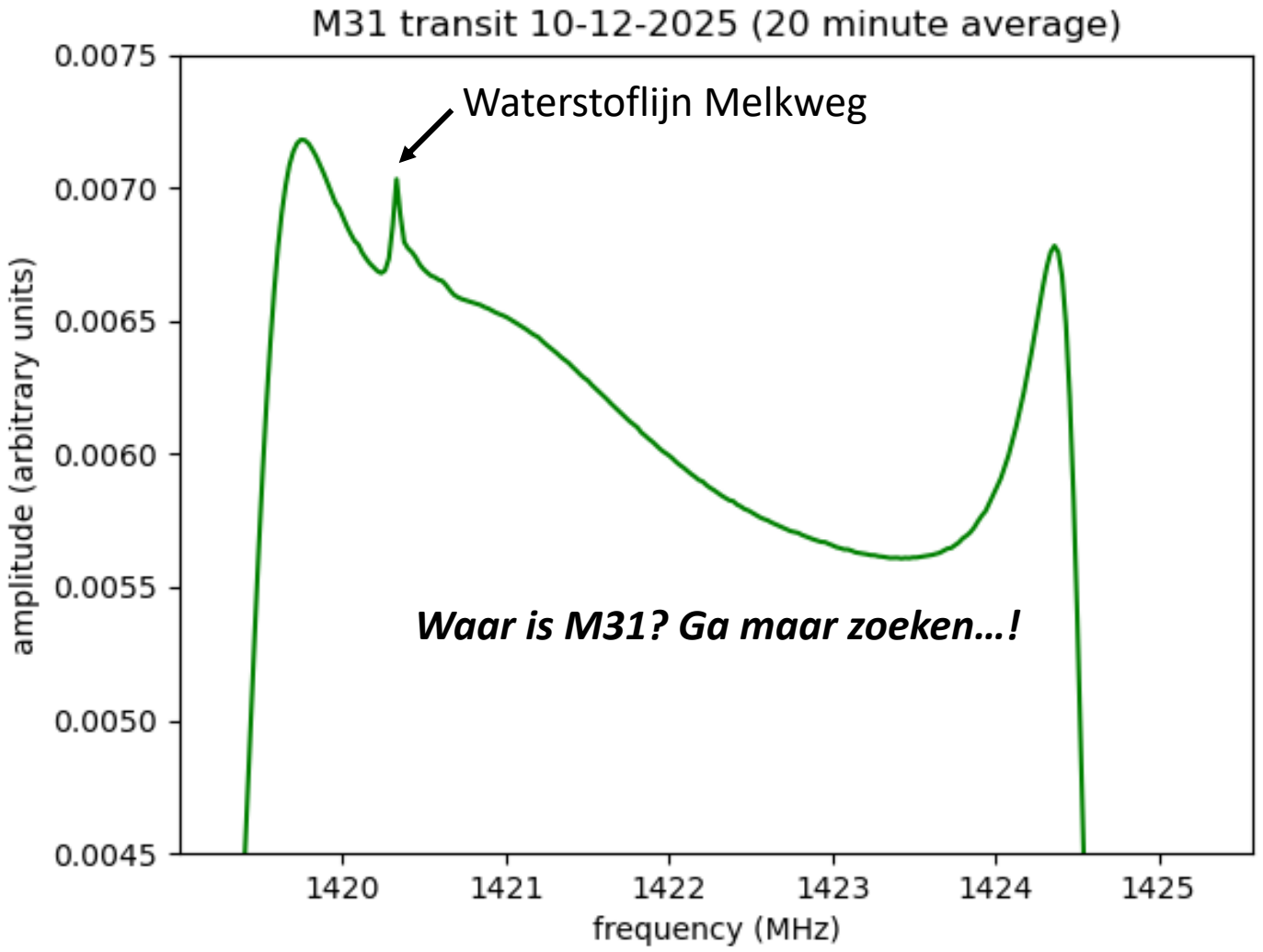
https://www.astro.uni-bonn.de/hisurvey/euhou/LABprofile/index.php

Driftscan methode

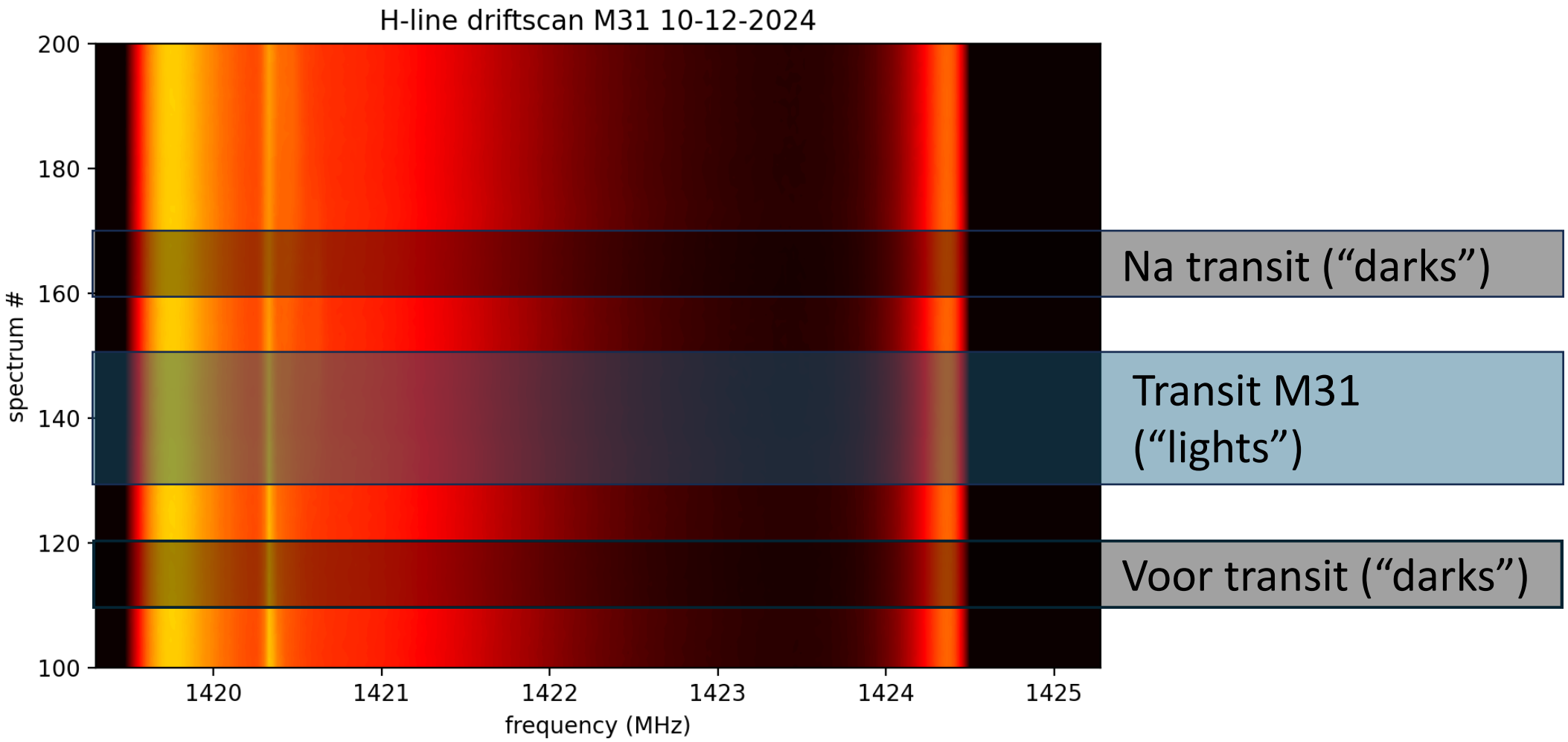


Zoeken naar een puistje op een olifant

- H-lijn sterrenstelsel valt in het niet t.o.v ontvanger artefacten
- “Bandpass” curve moet zorgvuldig verwijderd worden

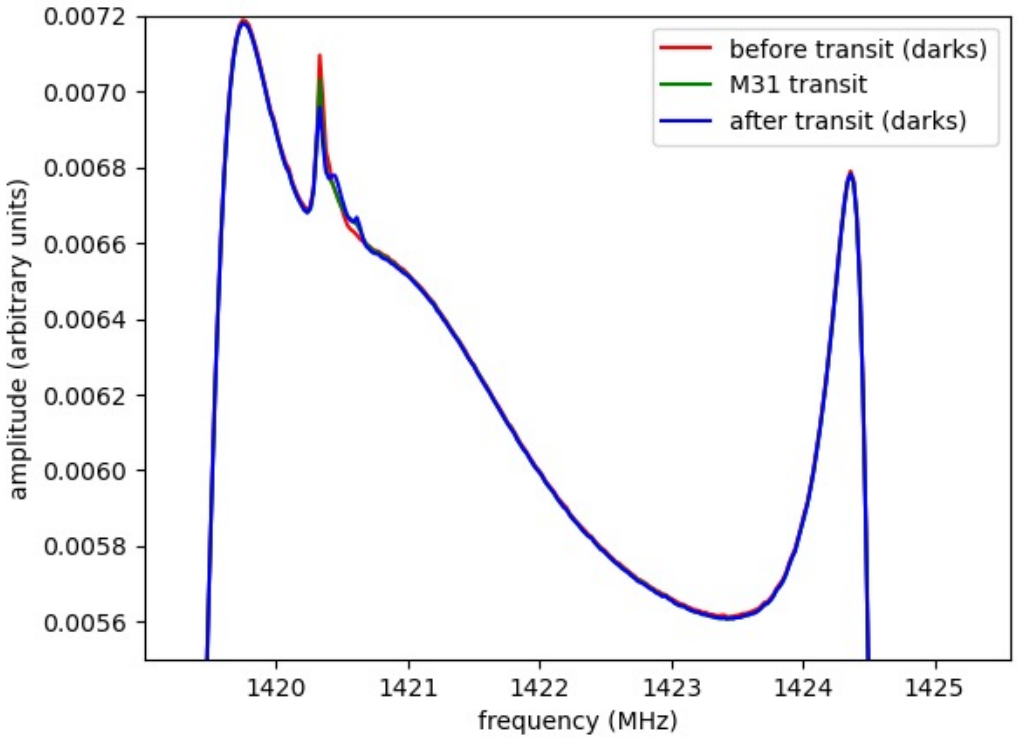


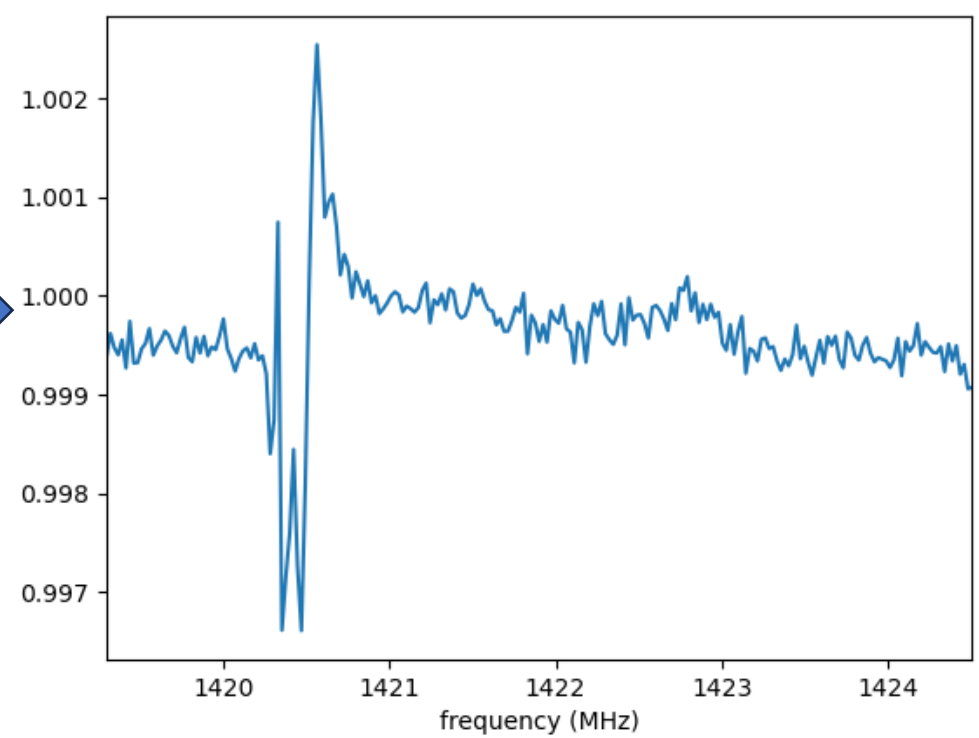
Dark subtractie



Dark subtractie

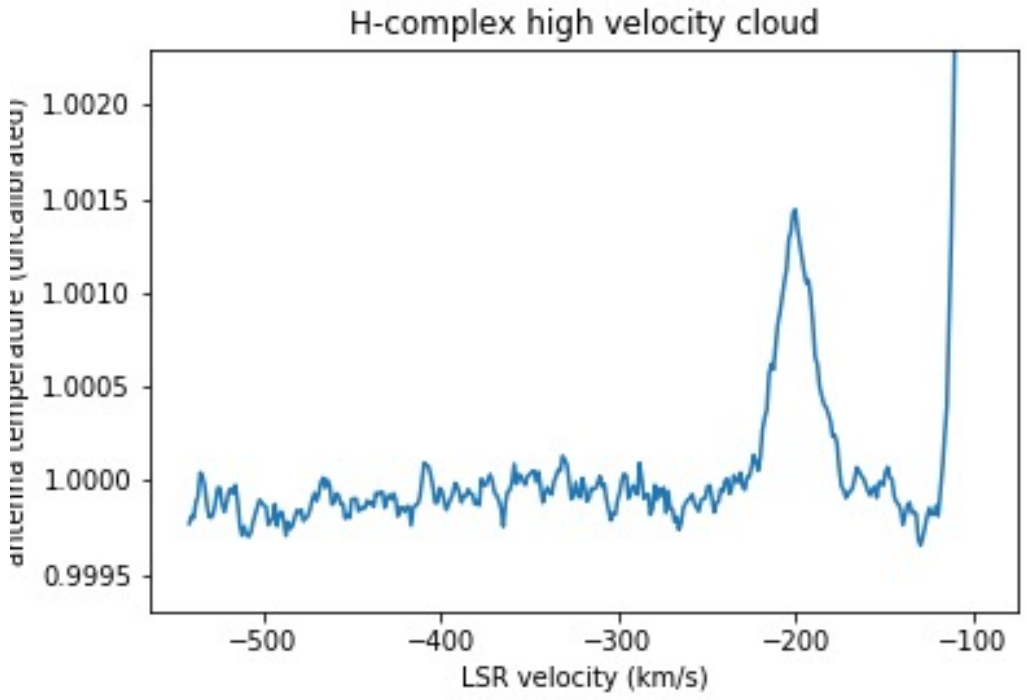
$$\frac{\text{Gemiddelde lights (transit)}}{\text{Gemiddelde darks (voor + na transit)}}$$

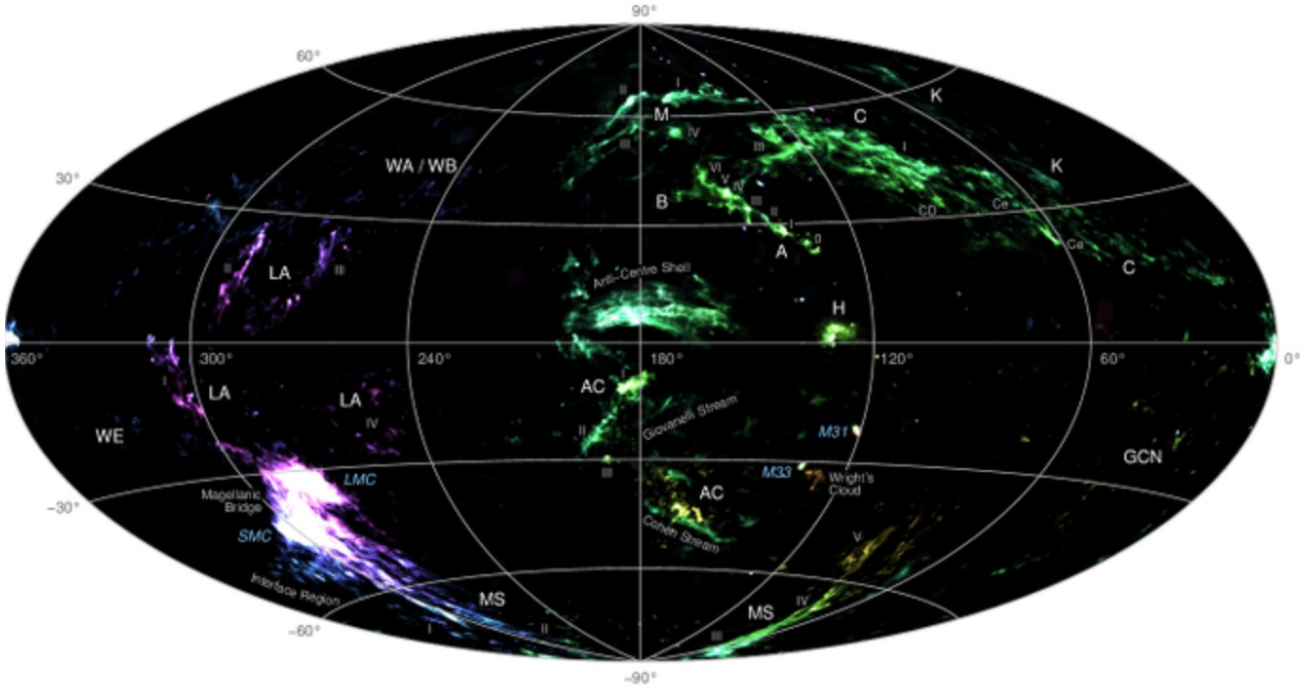




HVCs – stapstenen naar M31

- HI wolken met afwijkende hoge rood- of blauwverschuiving
- Meerdere complexen in galactische halo
- Veel zwakker dan “gewone” H-lijn maar vaak helderder dan M31

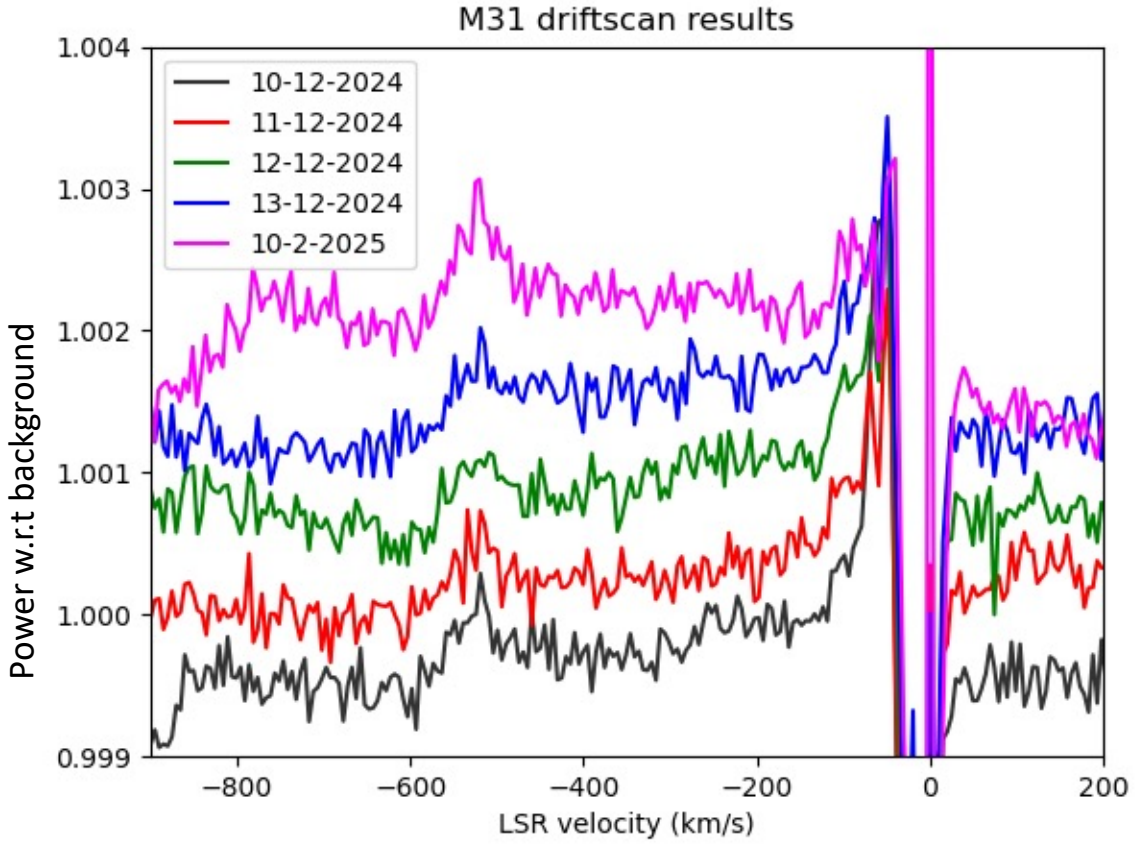


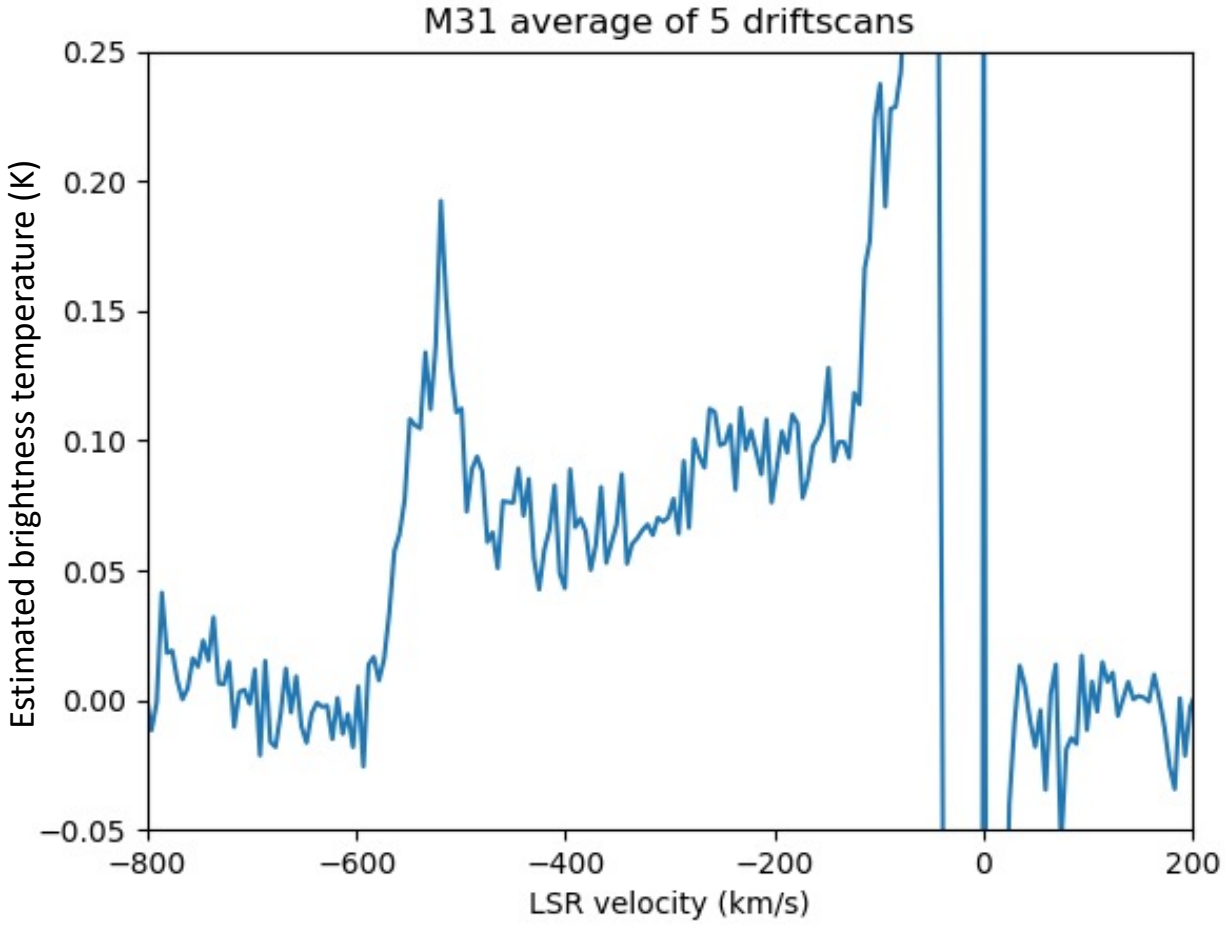


Tobias Westmeier, https://astro.tobias-westmeier.de/research_hvcsky.php

M31- Andromedastelsel

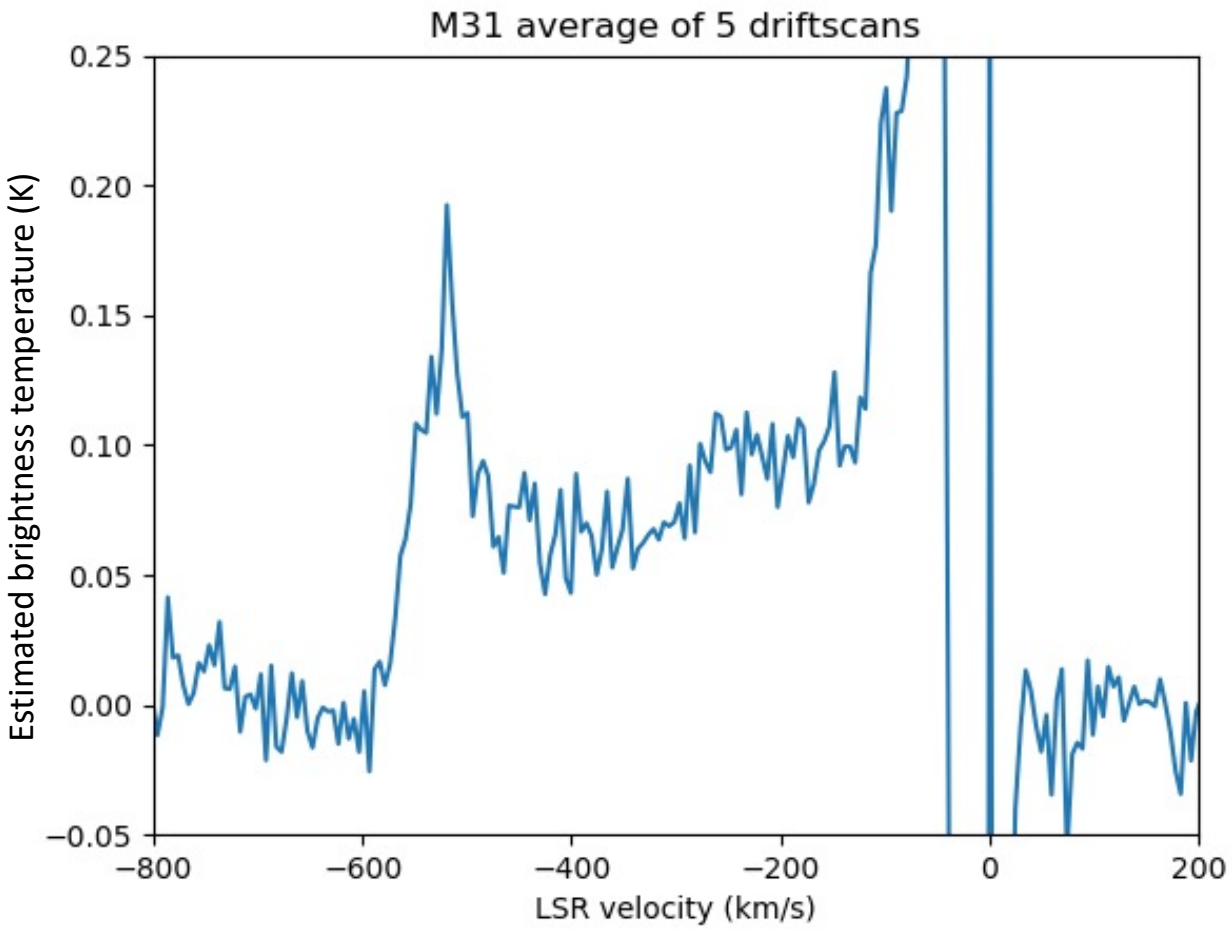
- Gemiddelde 5 driftscans



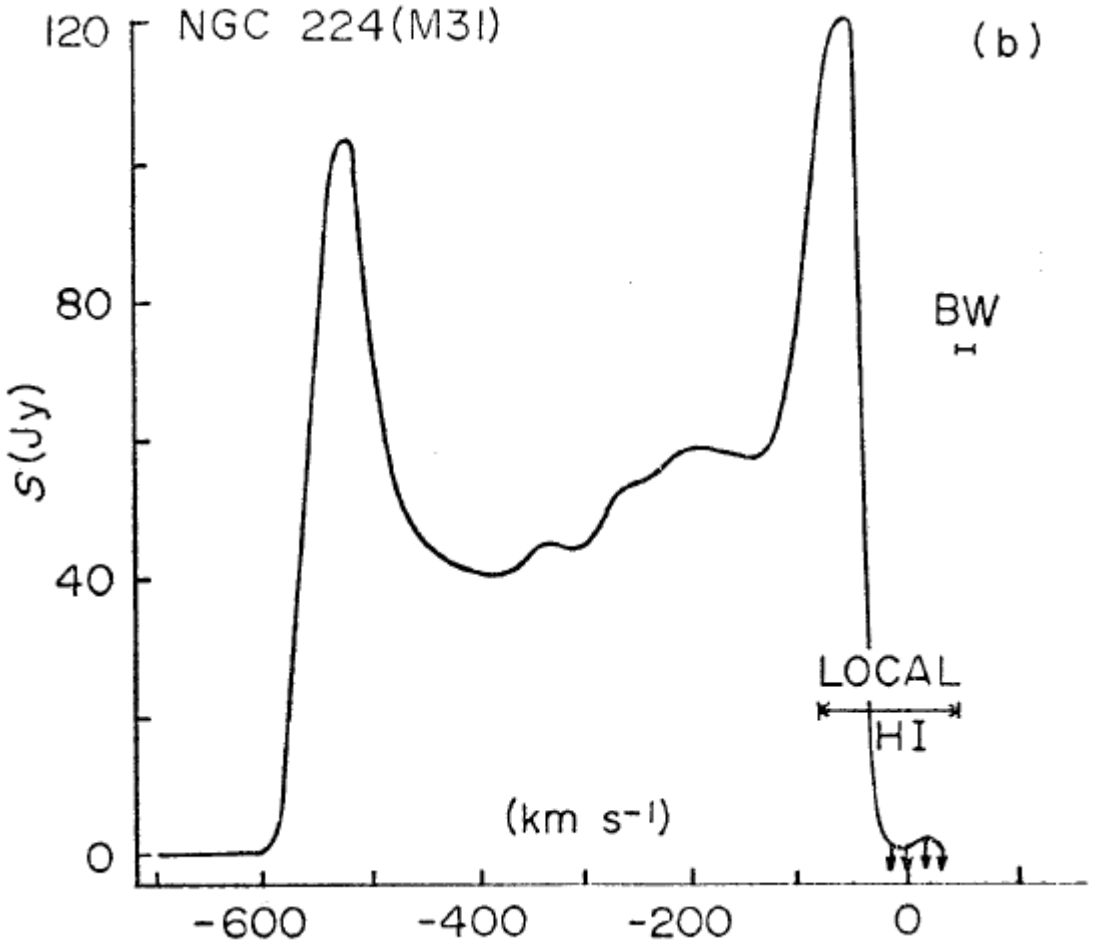


M31- Andromedastelsel- vergelijking

Eigen resultaat

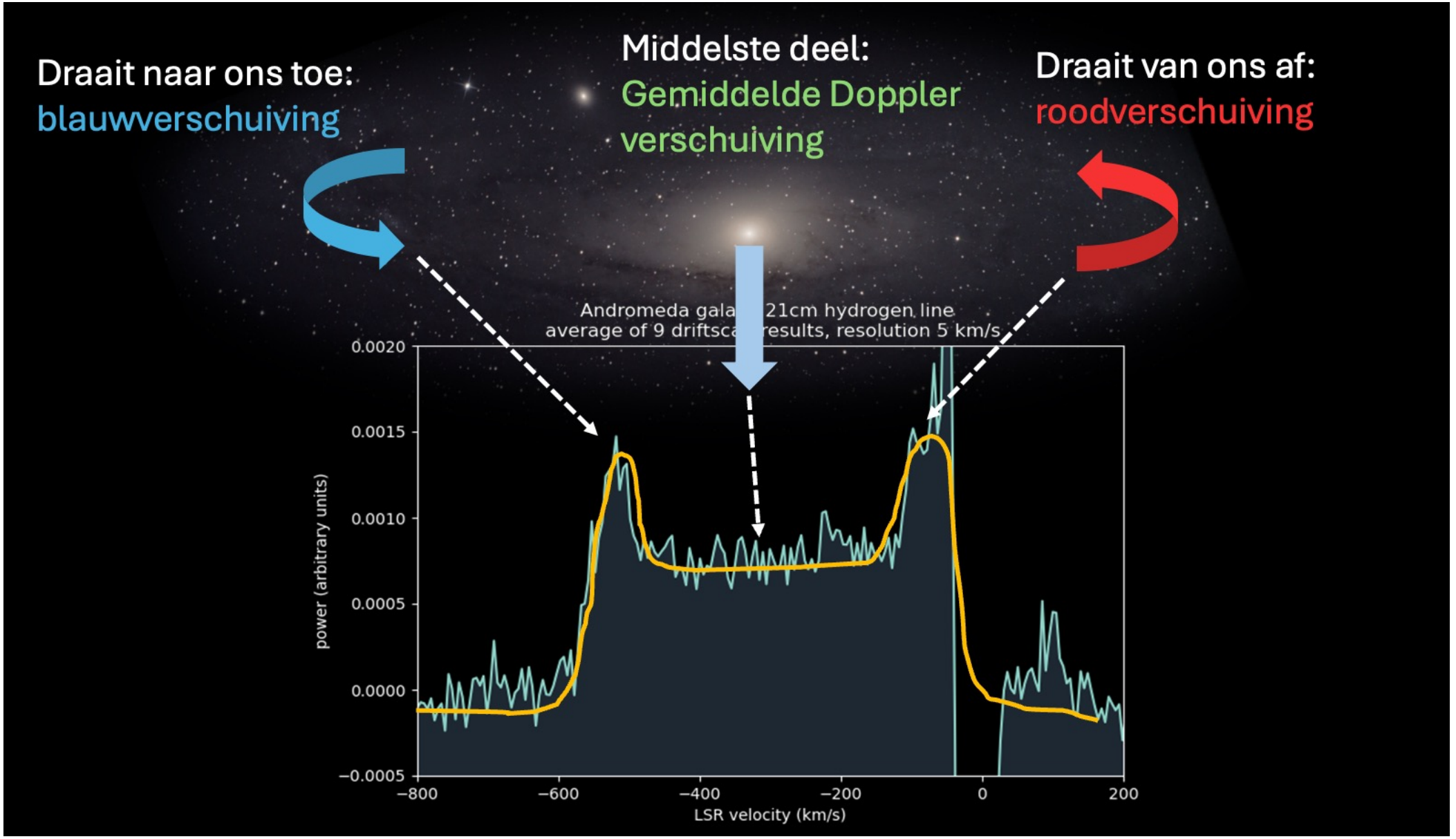


Dean & Davies (1975)

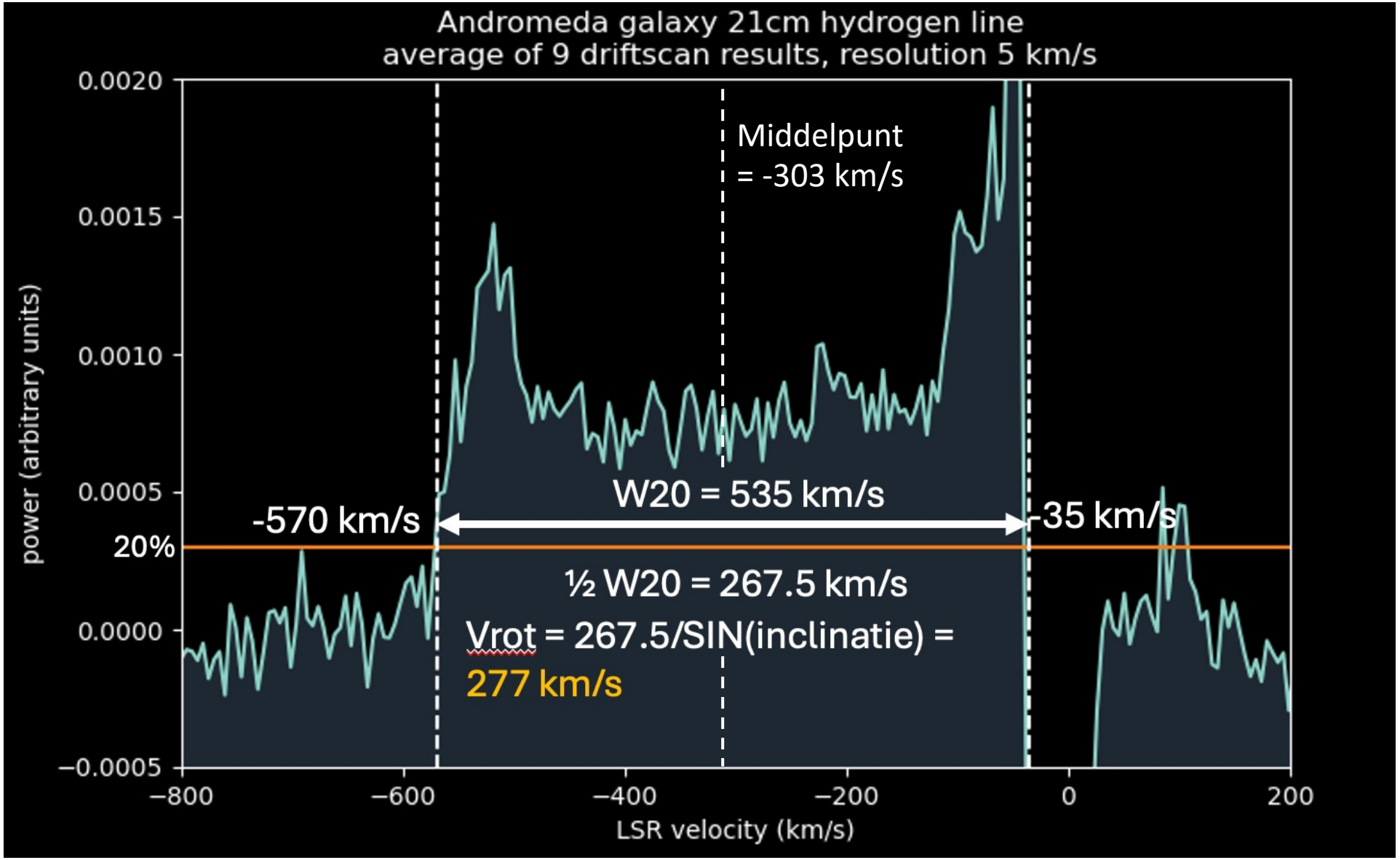


Dean, J. F., & Davies, R. D. (1975). The integrated neutral hydrogen properties of nearby galaxies. Monthly Notices of the Royal Astronomical Society, 170(3), 503-518.

M31- Andromedastelsel- rotatie



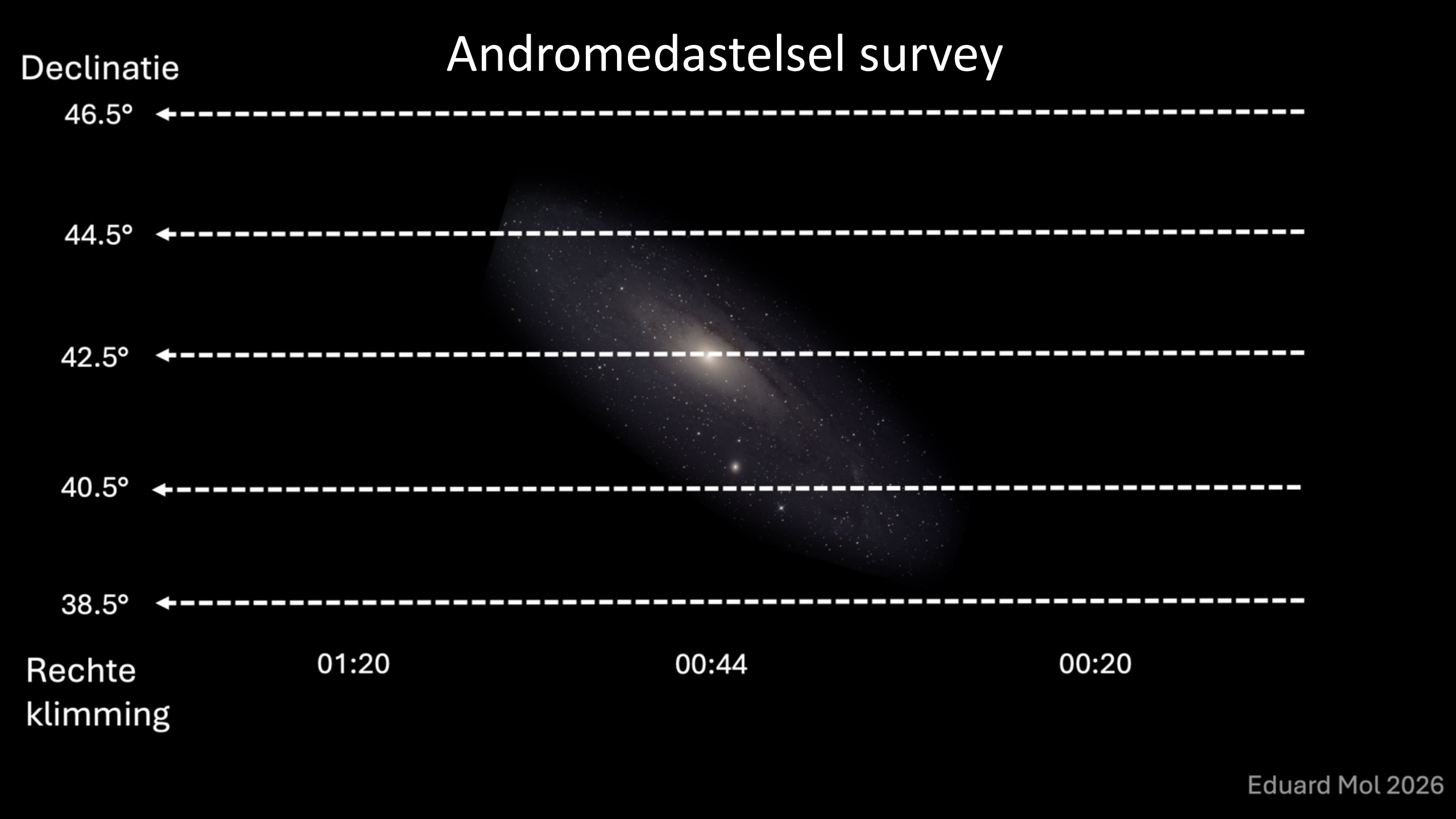
M31- Andromedastelsel- rotatie en snelheid

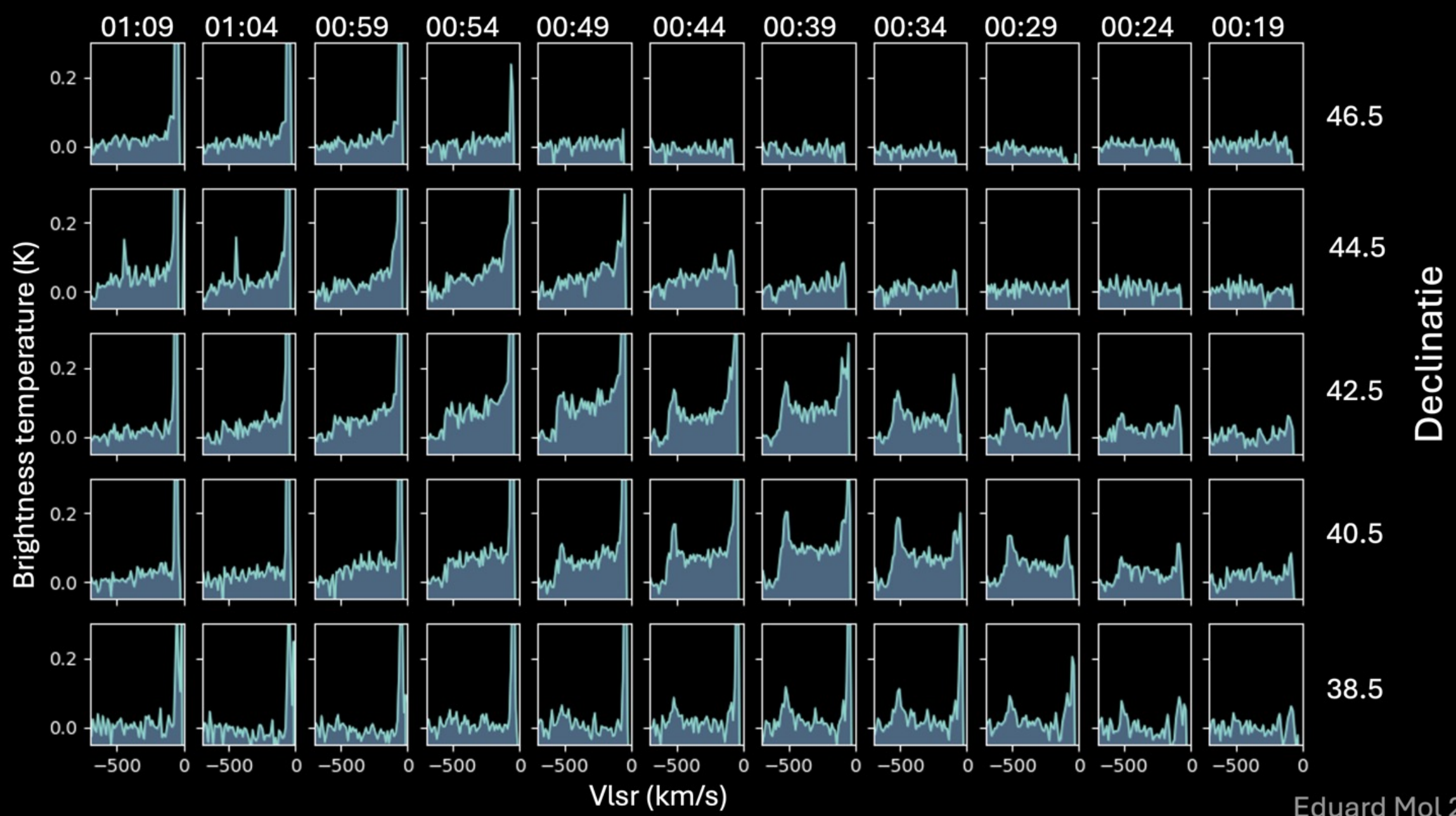


Property	Estimates from sources [1] and [2]	Own estimates
W20	533 ±3 km/s [1]	535 km/s
Rotation velocity	275 km/s [1]	277 km/s
System velocity w.r.t Solar system	-297 ±3 km/s [1]	-303 km/s
System velocity w.r.t Milky Way galaxy	-123 km/s [2]	-115 km/s

1. Dean, J. F., & Davies, R. D. (1975). The integrated neutral hydrogen properties of nearby galaxies. Monthly Notices of the Royal Astronomical Society, 170(3), 503-518.
2. Watkins, L. L., Evans, N. W., & An, J. H. (2010). The masses of the Milky Way and Andromeda galaxies. Monthly Notices of the Royal Astronomical Society, 406(1), 264-278.

Andromedastelsel survey

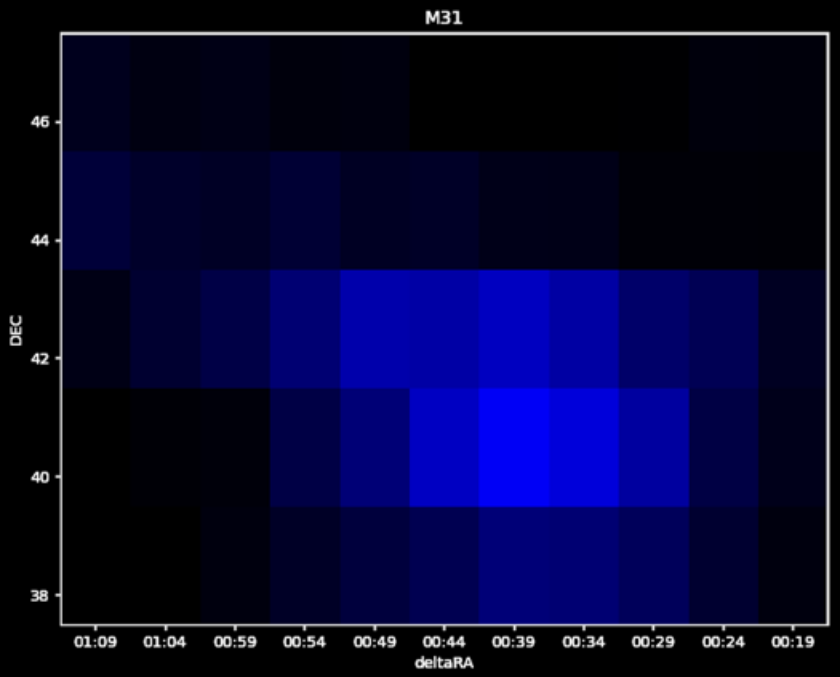


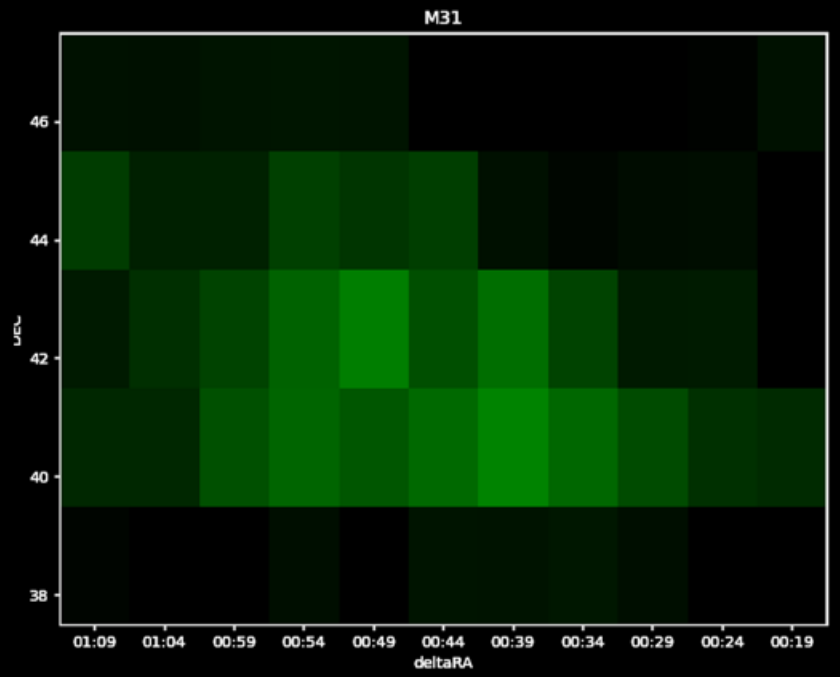


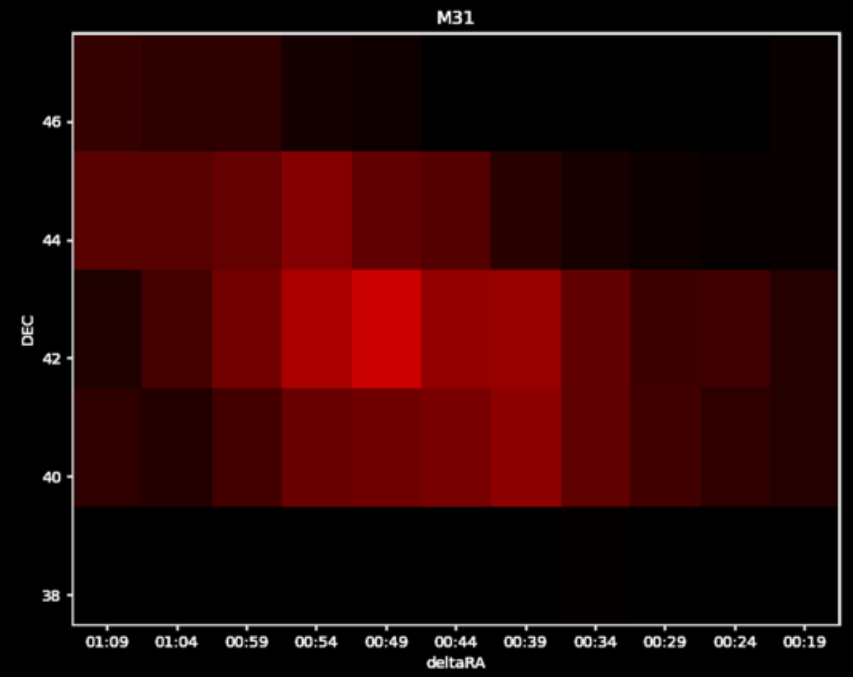
Blauwverschoven piek
-600 –400 km/s: blauw

“Plateau” gedeelte
-400 –200 km/s: groen

Roodverschoven piek
-200 –100 km/s: rood







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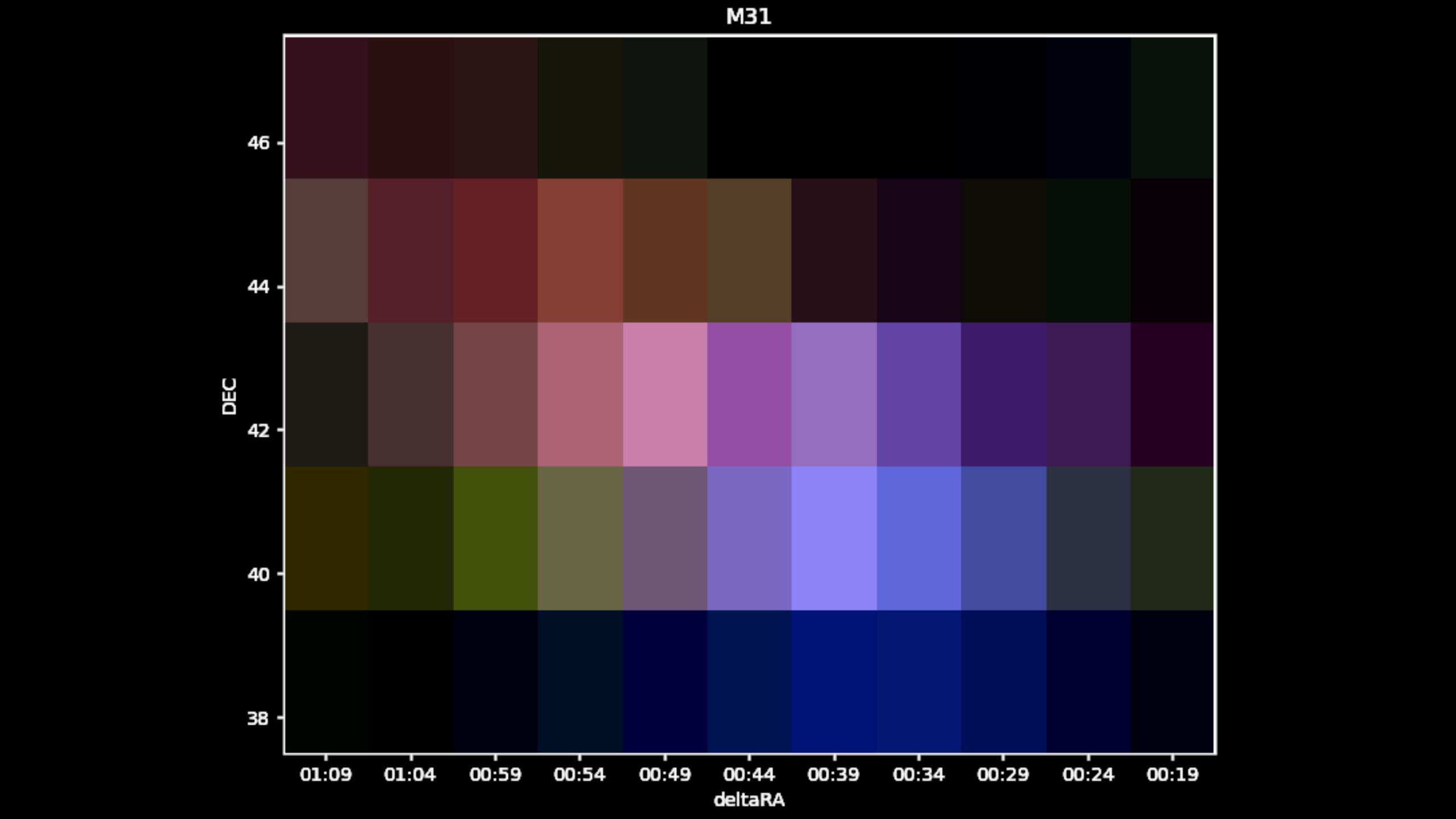
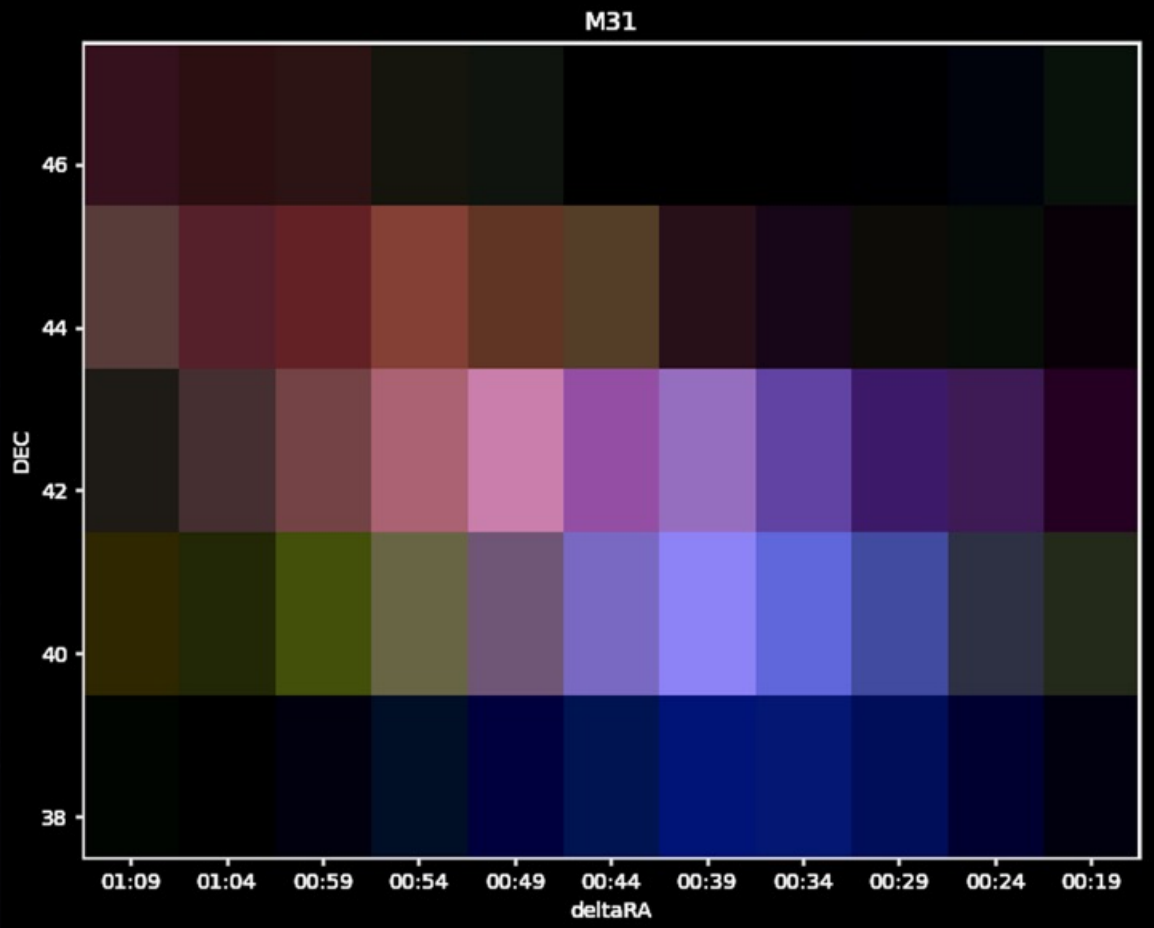

M31
46
44
42
40
38
DEC
01:09
01:04
00:59
00:54
00:49
00:44
00:39
00:34
00:29
00:24
00:19
deltaRA

Zichtbaar licht (~ 800– 400 nm)

Radiogolven (H-lijn 21 cm)

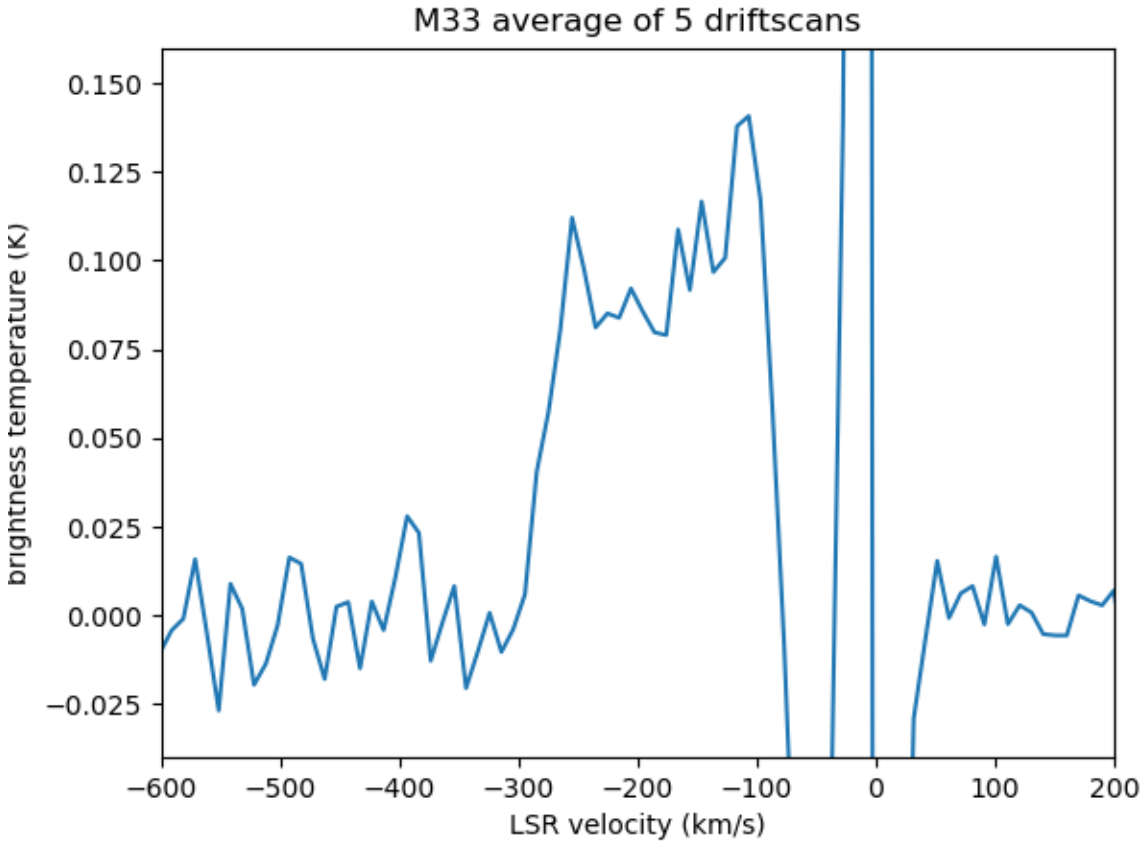


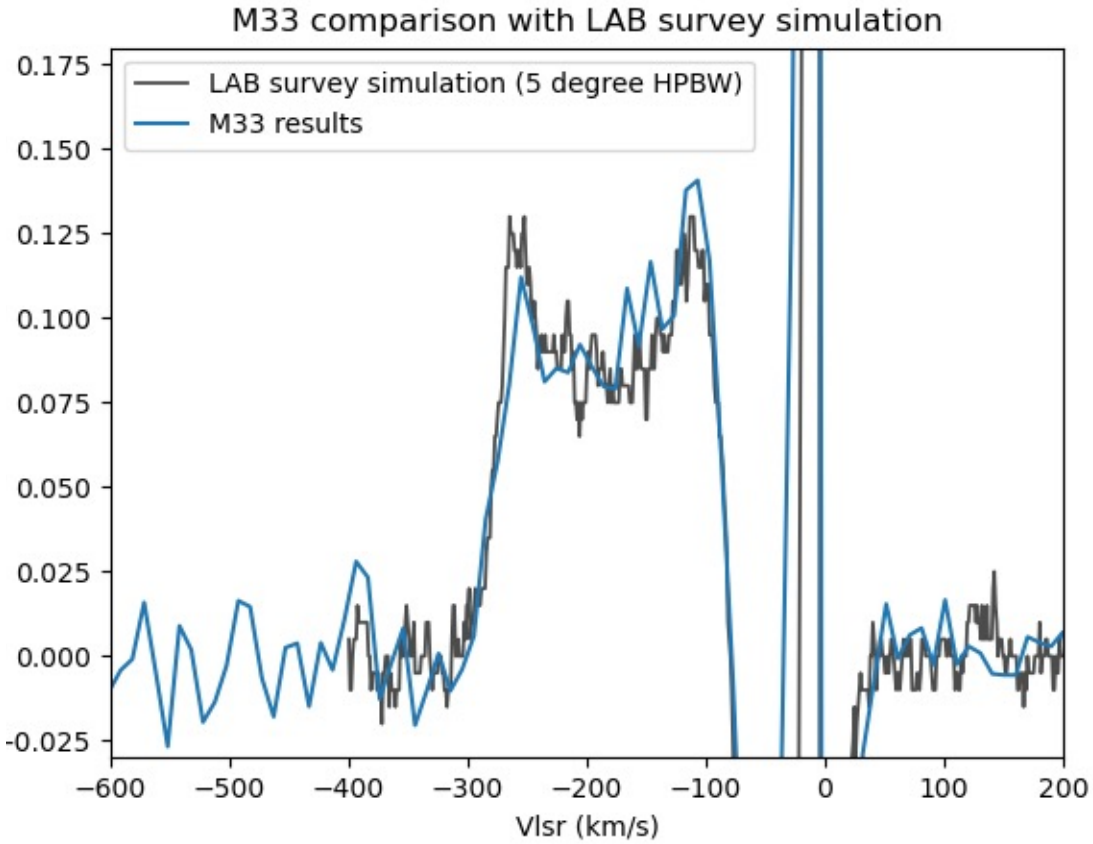
Zichtbaar licht(~ 800– 400 nm)

Radiogolven (H-lijn 21 cm)

M33- Triangulum-stelsel

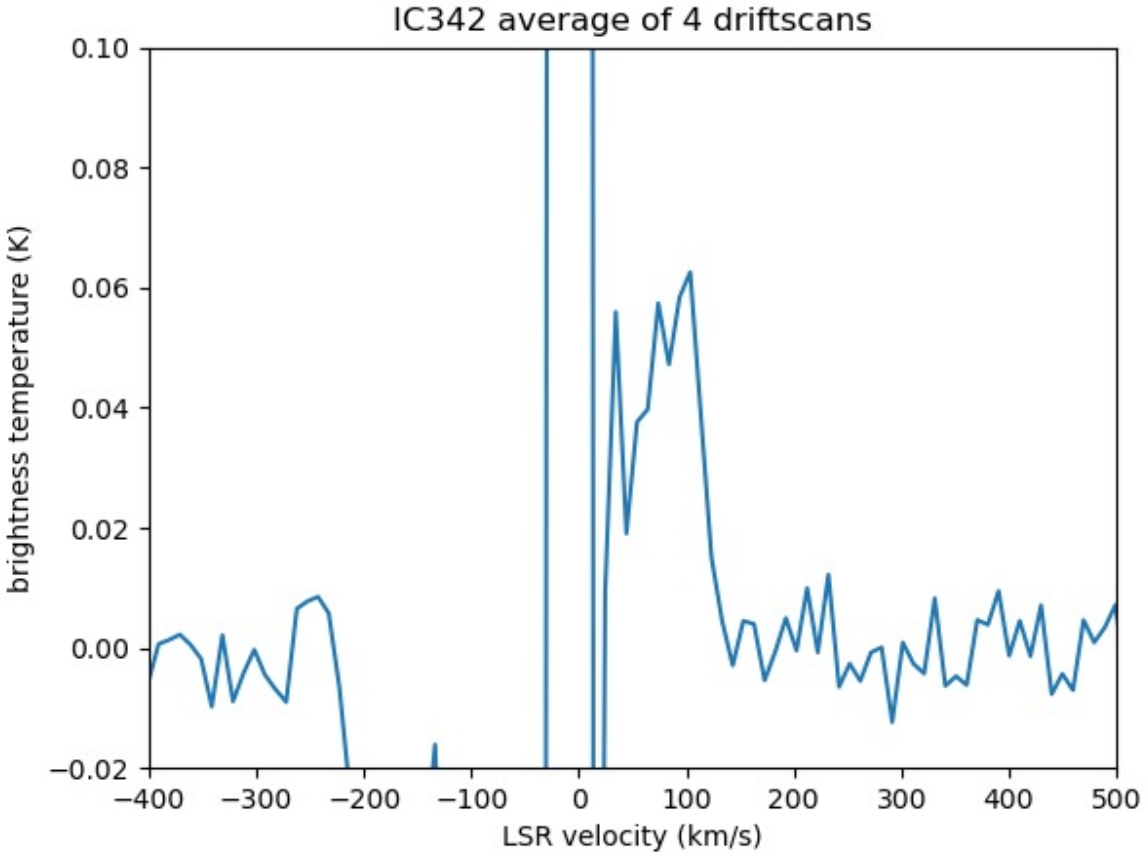
- Gemiddelde 8 driftscans

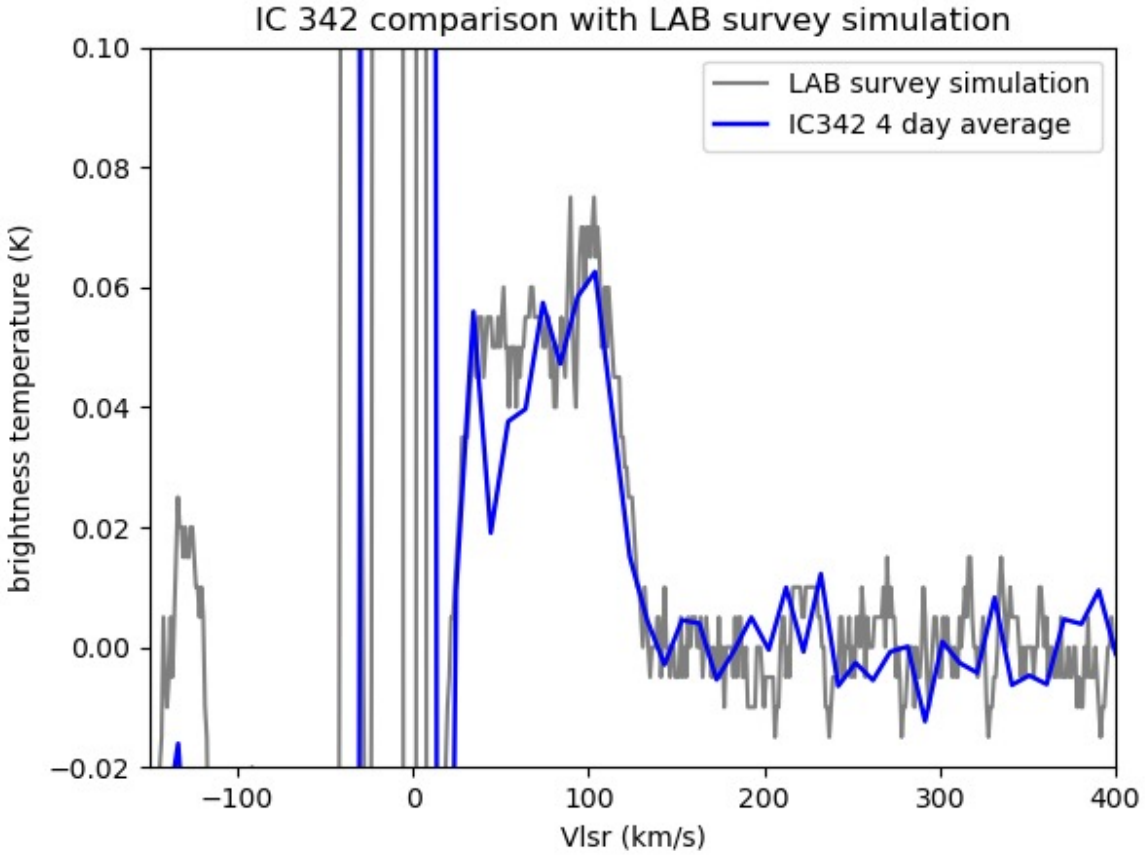




Nog verder weg: IC342 (11 miljoen lichtjaar)

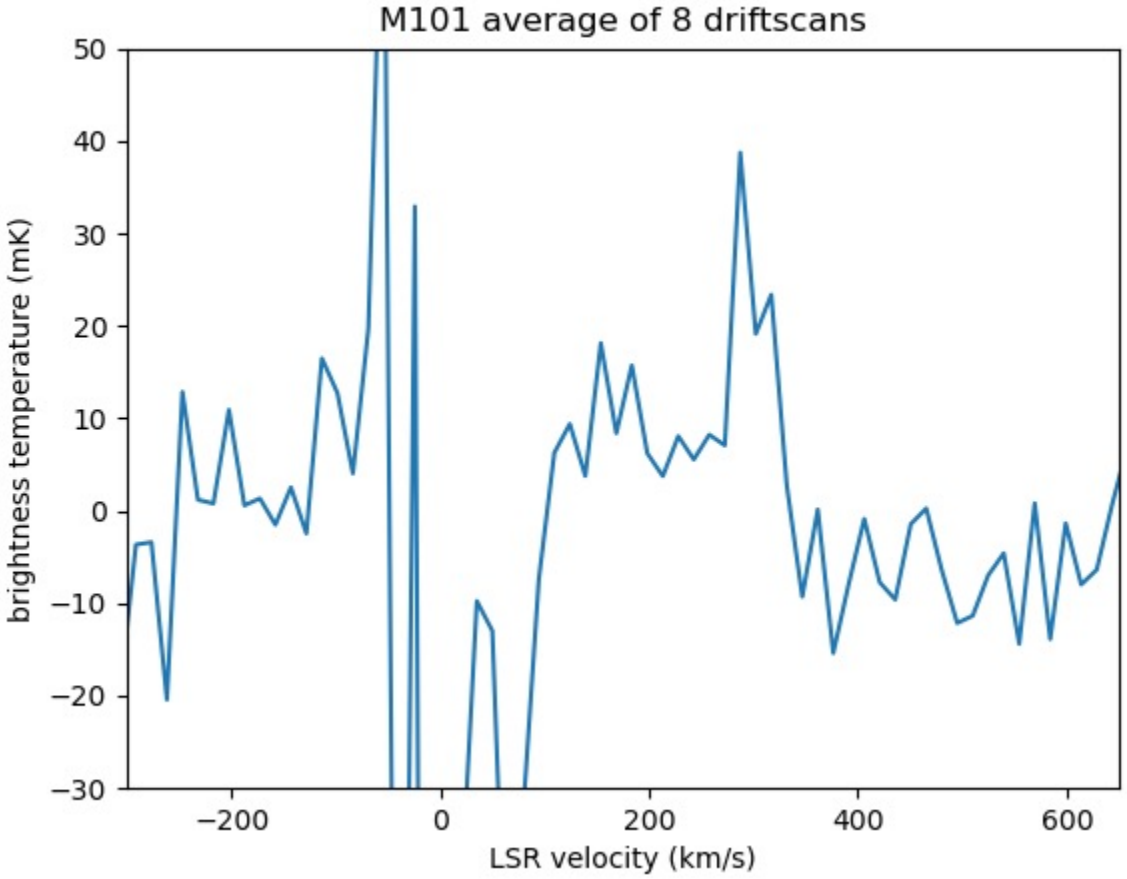
- 32 Jy- 0.08K: ~2X zwakker M33
- Gedeeltelijke overlap met 21 cm lijn Melkweg

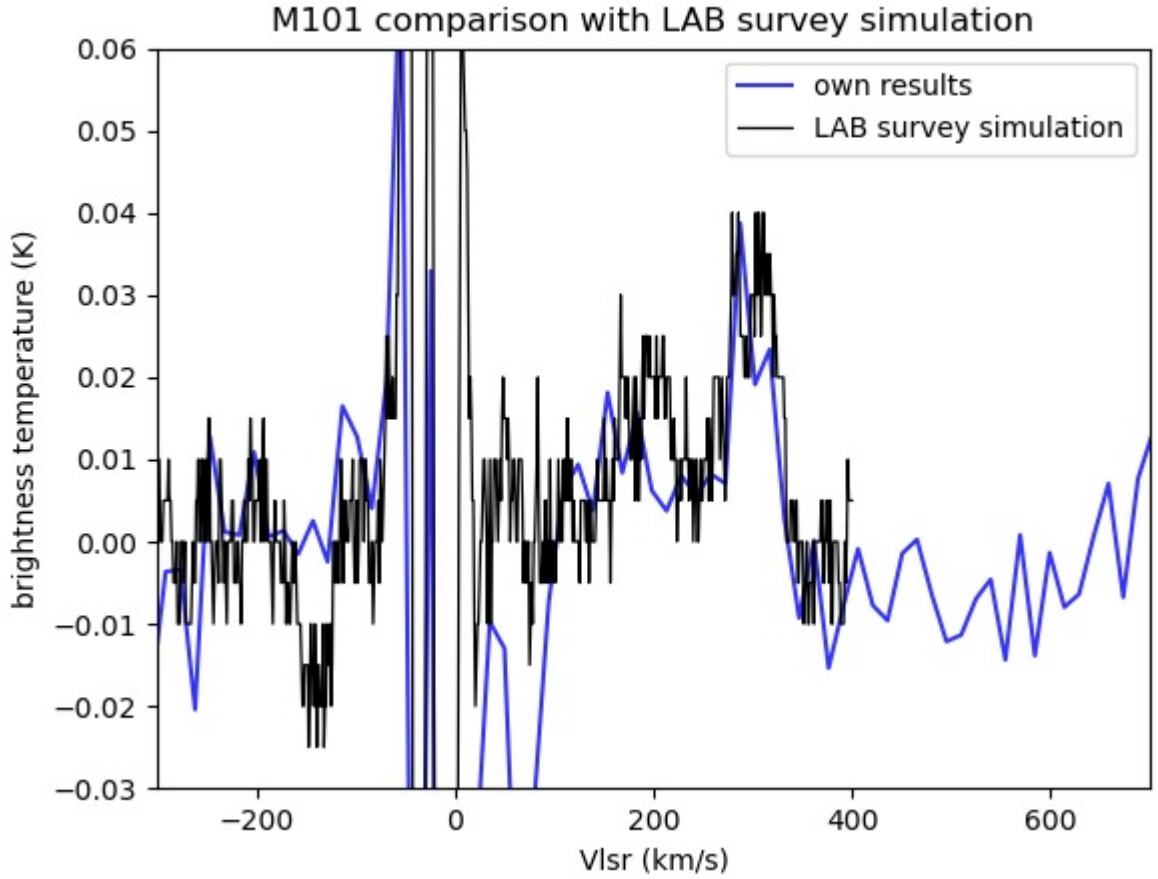


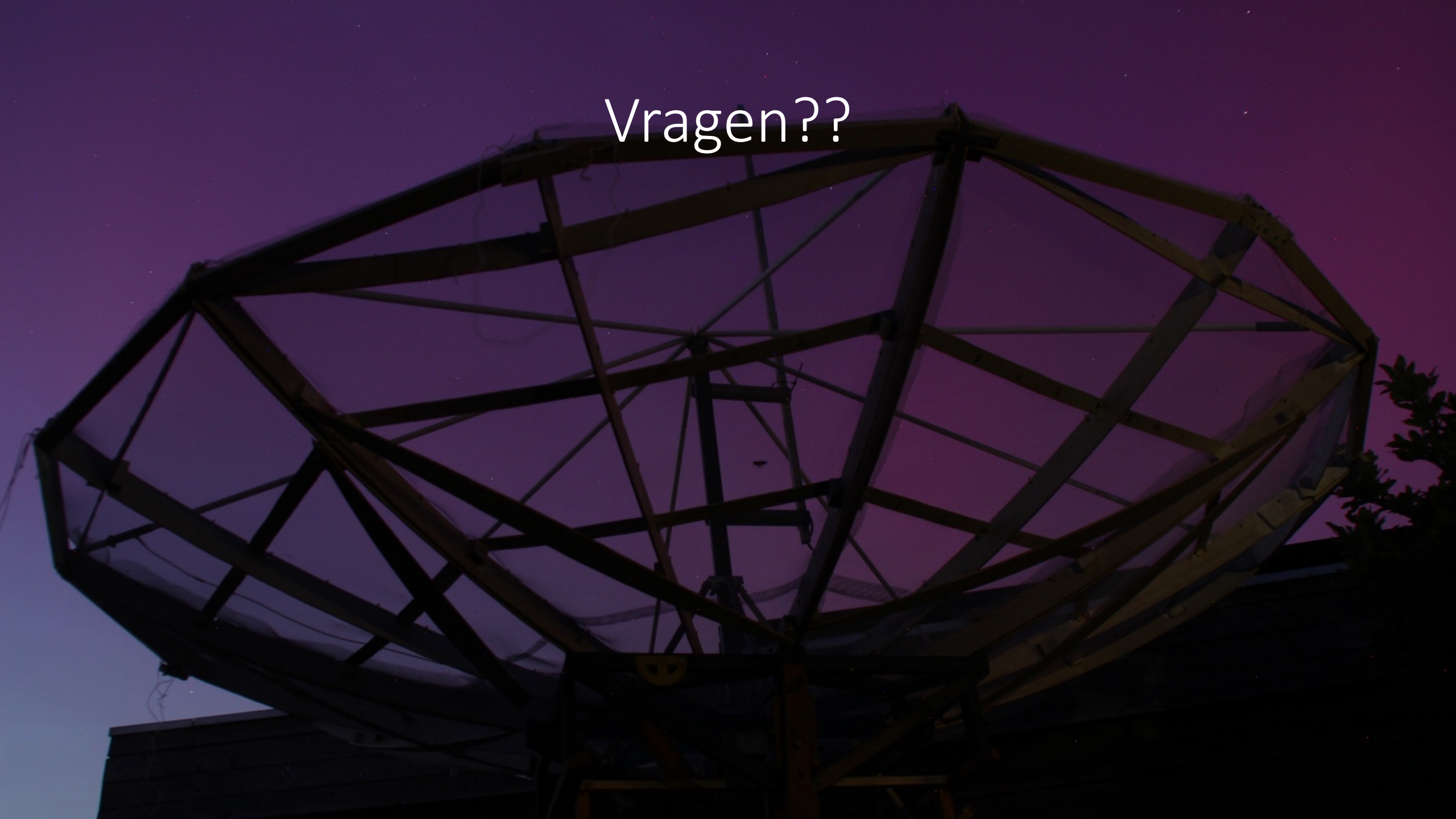


Nog verder weg: M101 (21 miljoen lichtjaar)

- 16 Jy- 0.04K: nog veel zwakker dan M33!
- Afstand 21 miljoen LJ; roodverschuiving 250 km/s






Vragen??