The Big Milky Way Galaxy

A project to capture a huge part of the Milky Way galaxy and beyond with the J.R.T. (Job’s Radio Telescope)

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On a dark clear night you can see the Milky Way, the Galaxy in which we live.
This document will explain how I got to this:
We see the Milky Way in visible light. But it also emits Neutral Hydrogen.

Neutral hydrogen is a normal hydrogen atom with one proton and one electron.

Neutral hydrogen is a normal, electrically neutral hydrogen atom with one proton and one electron. It is commonly referred to as HI (pronounced H-one), and is located throughout galaxies as HI clouds or external to galaxies as part of the intercloud gas. It is detected via the spin-flip transition at 21cm in the radio, and HI clouds were used to determine the structure of our Galaxy from our location within it.
The detection of neutral Hydrogen we do with a Radio Telescope
tuned at 1.420 Ghz

My FULLY REMOTE controlled Radio Telescope is 1.5 meter
with 2 LNA’s and a filter.
Capture Software is partly developed by myself in Python
The idea was to capture a big part of the Galaxy, almost fully automated.

So first I had to rewrite the software. That means …… learn Python
The Matrix

Then determine with a matrix which part of the galaxy I wanted to record. The part which is visible on my location within the matrix is roughly between latitude -50 to 50 and longitude 20 to 230
THAT IS 903 EXPOSURES OF 150 SECONDS EACH!

So I made a longitude latitude Excel matrix
The write a new Python script

This one converts LONG LAT to RA DEC and then to ALT AZ. When the observation is to be done.

```python
import os
import sys
import time
import sleep
import socket

os.system('clear') if os.name == 'nt' else 'clear'

raw_input("Press Enter to continue and delete the old ra_dec.txt, ELSE press Central 2")

f = open("ra_dec.txt", "a")
sleep(3)
ms.remove("ra_dec.txt")

print("================================================================================")
sleep(3)
print("C C C C C C C C C C C C C C C C C C C")
sleep(3)
print("C V V V V V V V V V V V V V V V V V V V")
sleep(3)
print("C V V V V V V V V V V V V V V V V V V V")
sleep(3)
print("C C C C C C C C C C C C C C C C C C C")

# CONVERT Galactic Longitude to RA DEC (in xxyyyza)!

print("")
print("Version 1.0 June 2020")
sleep(3)
print("Please enter your desired parameters...
")
sleep(3)

# Input parameters

x = int(input("Enter Epoch Year for coordinates : ")
print(\'\n\')
year = int(input("How many long/lat coordinates do you want to enter: ")
for i in range(0, totalnumbers):
    long = int(input("long: [degrees] : "))
    lat = int(input("lat: [degrees] : "))

# INPUT LONGITUDE LATITUDE IN DEGREES

c = SkyCoord("%s %s", unit=units.deg, frame="galactic")

# RA
dec = c.transform_to(SkyTransform(ellipsoid='WGS84'))

f = open("ra_dec.txt", "a")
print("--- Done ---")
```

Time to run the software and have a sleep
And hopefully it has gathered the data the next morning
Every night I did 105 exposures with a total 8 nights and mornings
Finally I had 903 Signal to Noise text files which contained the data for each exposure.
Time to Process the Data!

I have processed all the data in different ways.

1) With a Python script which generates the graphics
2) Manual processing in Excel with a 2 color mode (Black White)
3) Manual processing in Excel with a 3 color mode (the higher values more visible)
4) A ‘Mollweide’ Cartographic representation of the 3 Graphs
First I get rid of negative data by transforming it with Python. Here you see 1 exposure the original and the new one without negative values. The peaks are the TYPICAL Hydrogen where I am looking for in all the exposures...
Add all the data PER Sample

Because there is more Hydrogen than 1 peak I add all the data to 1 number.
So finally I get 903 different numbers which represent the TOTAL of the data per exposure.

```python
import sys
import os
import datetime
time import sleep
os.system('cls' if os.name == 'nt' else 'clear

print("~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~")
sleep(0.3)
print("TTTTTT TTTTTT AAAAAA L1")
print("TTTTTT TTTTTT AAAAAA L2")
print("TTTTTT TTTTTT AAAAAA L3")
print("TTTTTT TTTTTT AAAAAA L4")
print("TTTTTT TTTTTT AAAAAA L5")

print("Find total of all values in nrad.txt files and place them in Excel .csv file")
print("")
print("Developer Job Gehainer")
print("")
print("Update 1.x June 2020")
sleep(0.3)
print("~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~(n)")

print("[=] Please enter your desired observation parameters...\n")
sleep(0.3)

#Input observation parameters
observations = str(input("How many observations ?: "))
total = 0
# number of observations

for cycle in range(1, int(observations) + 1):
    for line in line:
        try:
            num = float(line)
        except:
            print("Input line is not a number!\n")
    f = open("input\total\{}\".format(total), 'w')
    for line in line:
        f.write(line)
    f.close()
    total += 1

import numpy as np
with open("nradtotal.csv", 'w') as f:
    for i in range(1, int(observations) + 1):
        print(i)
tempstr = tempstr.replace("\", tempstr.replace("", tempstr.replace("", ")f.close()
print("done")
```
Manual Data Processing in Excel

We have 21 latitude exposures per longitude.
We have 43 longitude exposures
We put those 903 numbers in an Excel Sheet

| Longitude | 20  | 25  | 30  | 35  | 40  | 45  | 50  | 55  | 60  | 65  | 70  | 75  | 80  | 85  | 90  | 95  | 100  | 110  | 120  | 130  | 140  | 150  | 160  | 170  | 180  | 190  | 200  | 210  | 220  | 230  |
|-----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Latitude  | 56  | 51  | 46  | 41  | 36  | 31  | 26  | 21  | 16  | 11  | 6   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   | 1   |
With conditional Formatting we can give a COLOR to EACH NUMBER
Delete the Numbers
Blur a little and you get representations of our Galaxy in Neutral Hydrogen

1) The Black White is the difference with highest and lowest number (quantity of Hydrogen)
2) The 3 Color one is more concentrated on the highest numbers (the red)
3) The Python Graph has another algorithm which generates a slightly different view but still clearly the Galaxy and its neighbourhood are visible

REMEMBER THIS IS ALL DONE WITH A RELATIVE SIMPLE RADIO DISH TELESCOPE WITH A DIAMETER OF 1.5 METER!
Black White
3 Color
Python Automated Script
Black And the Final State is generating a ‘MOLLWEIDE’ Representation

A Mollweide Cartographic is the whole Universe in 1 ‘Globe’ picture. From -180 to 180 degrees horizontal en -90 to 90 degrees vertical.

Because there is a significant part of the Universe which is NOT visible in The Netherlands, you see some ‘gaps’ in the final picture.

Also I didn’t record the latitudes -50 to 90 and 50-90 because there is hardly H I (Hydrogen)
Mollweide 3 Color
Mollweide Python Algorithm
Thanks to my parents, Apostolos Spanakis-Misirlis, Simon Bijlsma, Eduard Mol, Andries Boone, Michiel Klaassen, Raydel Abreu and many others
press play