

Automatic identification of stars in AMON data

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Ciele projektu

Analýza AMON dát pre vrcholy (peaks) a ich následné priradenie ku hviezdám v zornom poli detektora



AMON detektor

Airglow monitoring by one-pixel detector

43 127 670 záznamov

(1 záznam = 1 sekunda) ~ **499 dní** pozorovania

	longitude	latitude	altitude	location	timezone
name					
SN01	22.273810	48.934890	2643.0	Lomnický štít	Etc/GMT-1
SN02	-115.466950	31.045357	2790.0	Mexico	Etc/GMT+8
SN03	-17.894000	28.763889	2163.0	La Palma, Canary Islands	Etc/GMT
SN04	18.121744	59.329224	27.6	Stockholm	Etc/GMT-1

	counts	date	moon_zenith	sun_zenith
index				
1	0	2017-03-31 12:19:33	105.9890	129.730
2	0	2017-03-31 12:19:34	105.9850	129.728
3	0	2017-03-31 12:19:35	105.9820	129.726
4	0	2017-03-31 12:19:36	105.9780	129.725
5	0	2017-03-31 12:19:37	105.9750	129.723
...
43127666	0	2019-11-04 14:31:57	84.2855	165.796
43127667	0	2019-11-04 14:31:58	84.2822	165.794
43127668	0	2019-11-04 14:31:59	84.2789	165.792
43127669	0	2019-11-04 14:32:00	84.2755	165.790
43127670	0	2019-11-04 14:32:01	84.2722	165.788
43127670 rows x 4 columns				

Filtrácia dát

	index	date	counts	sun_zenith	moon_zenith	moon_azimuth	moon_elevation
0	1247173	2017-04-21 02:50:54	1003	161.661	98.4510	340.097172	-71.930874
1	1247180	2017-04-21 02:51:01	1036	161.669	98.4740	340.180433	-71.938728
2	1247184	2017-04-21 02:51:05	1010	161.674	98.4880	340.228041	-71.943202
3	1247185	2017-04-21 02:51:06	1028	161.675	98.4910	340.239946	-71.944318
4	1247190	2017-04-21 02:51:11	1034	161.680	98.5080	340.299493	-71.949892
...
419291	33280371	2019-05-01 02:59:56	31161	142.230	98.8009	305.679135	-52.606840
419292	33280372	2019-05-01 02:59:57	30837	142.233	98.8042	305.683875	-52.609586
419293	33280373	2019-05-01 02:59:58	30942	142.236	98.8074	305.688615	-52.612331
419294	33280374	2019-05-01 02:59:59	31092	142.238	98.8107	305.693355	-52.615076
419295	33280375	2019-05-01 03:00:00	31012	142.241	98.8140	305.698096	-52.617821

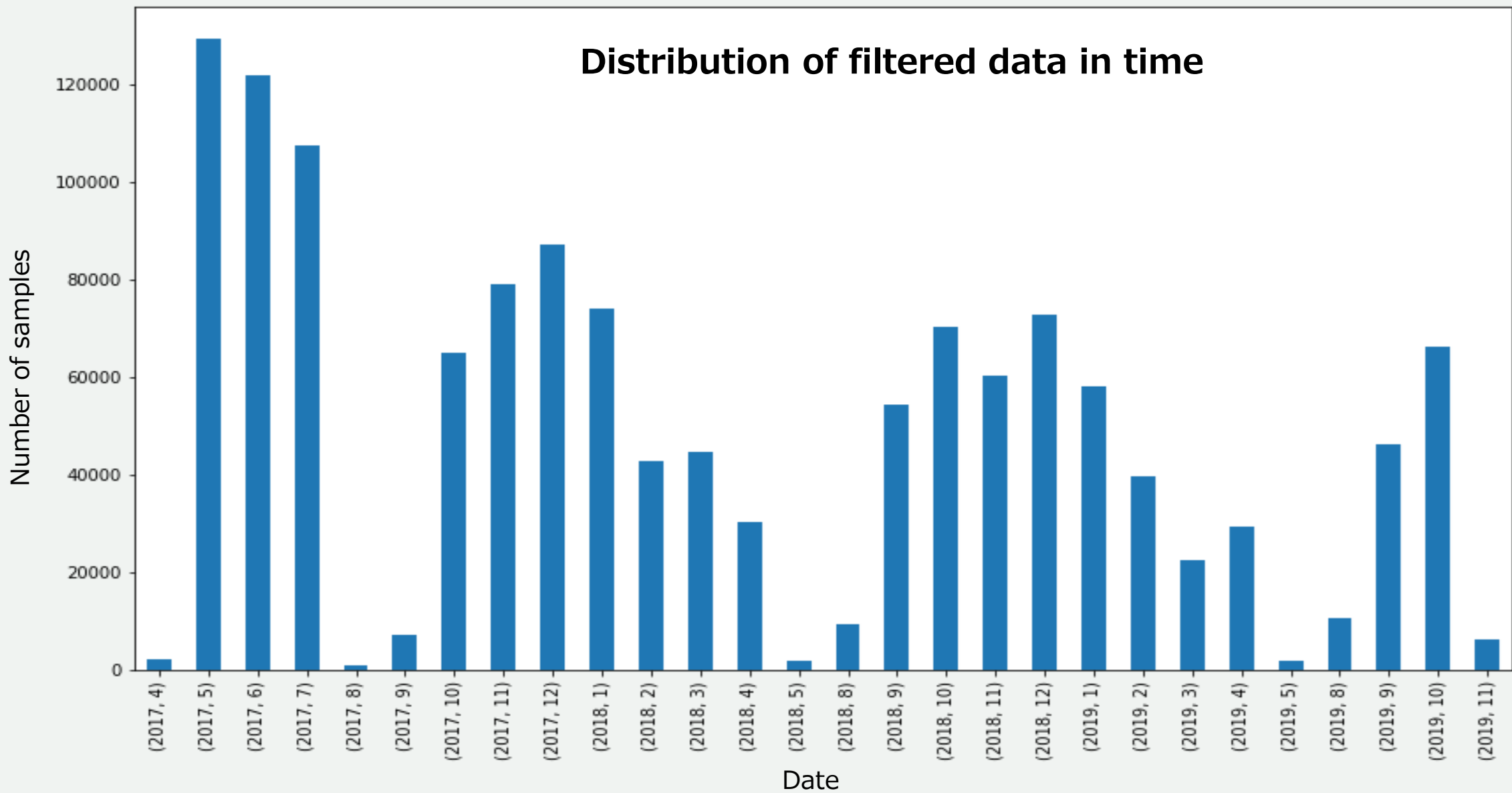
419296 rows × 7 columns

Parameter **counts** : počet fotónov ktoré dopadnú na detektor

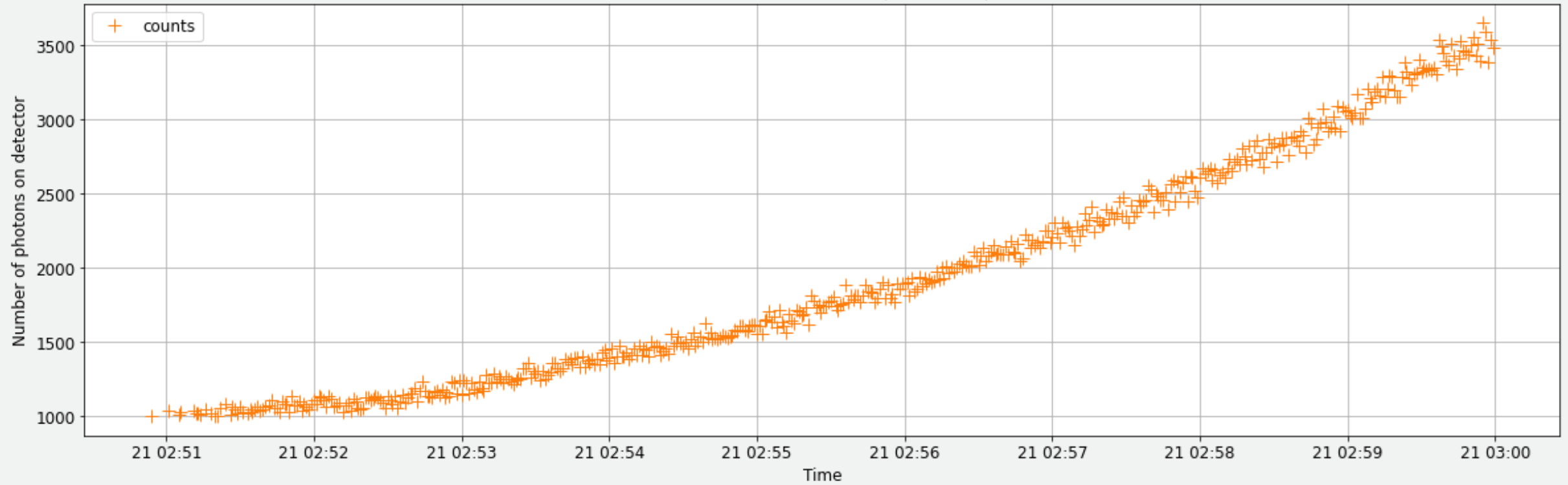
Filtrácia countov v AMON dátach nasledovným spôsobom:

- V nočných časoch od 0:00 do 3:00
- Počet countov 1000+
- Odfiltrovanie mesiaca a slnka

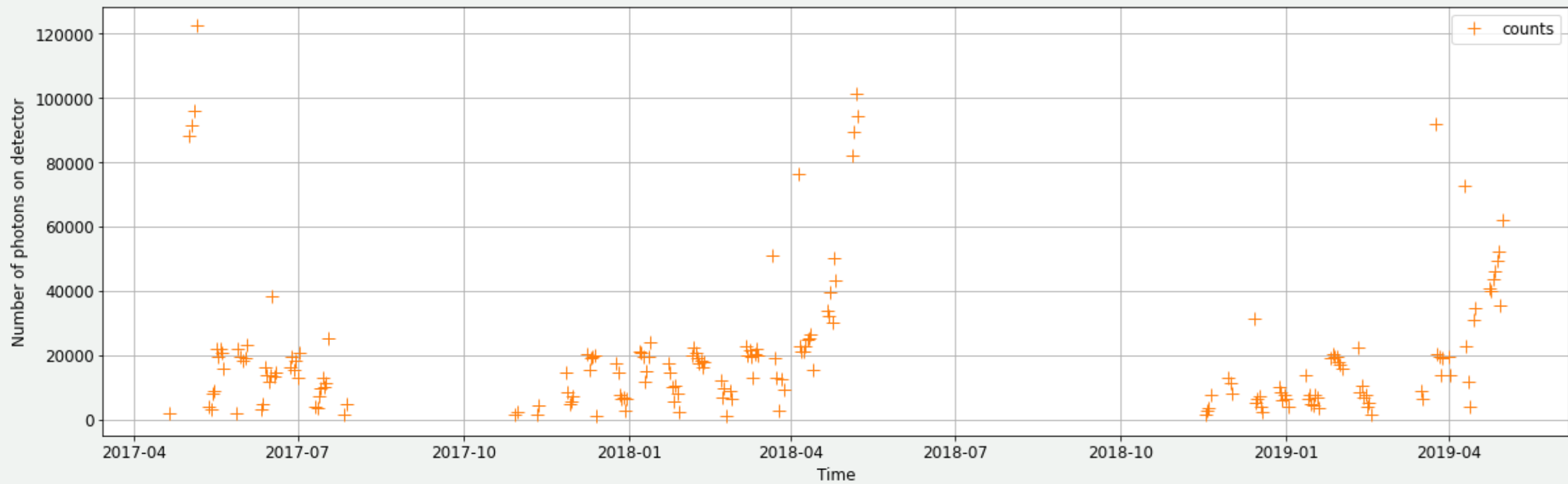
Distribution of filtered data in time

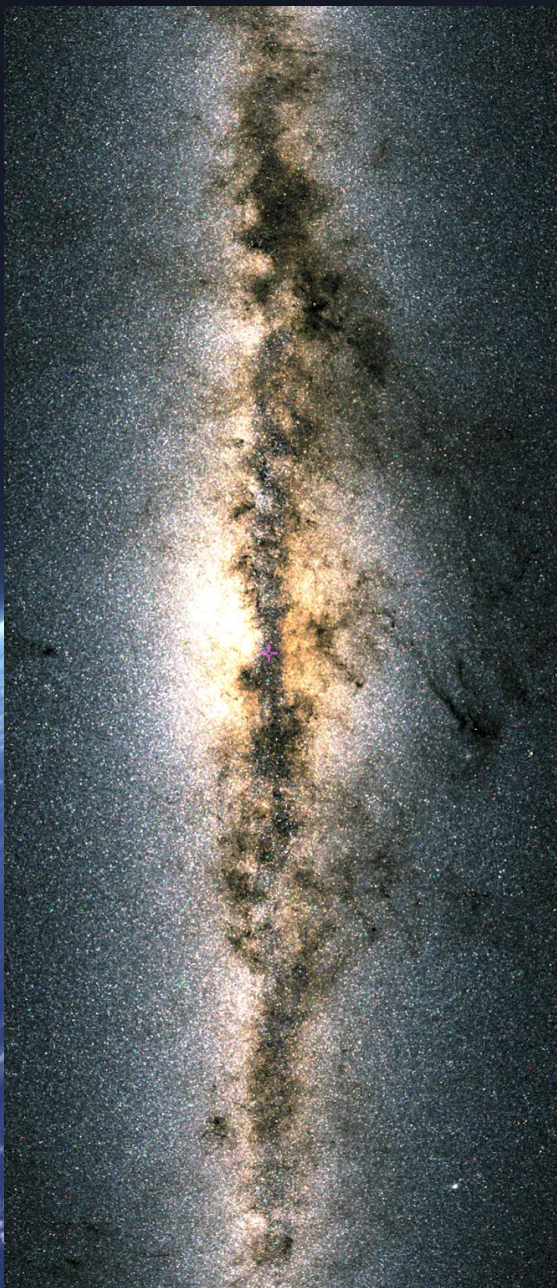


21.04.2017 Amon Data (9 minutes)



Mean hour counts





Hviezdny katalóg

GAIA EDR3 - 1,811,709,771 hviezd

Každý zdroj má mnoho parametrov

Získanie magnitúdy z countov podľa nasledujúceho vzorca:

$$\text{MAG} = -2,5 * \log_{10}(\text{counts}) + 20,08$$

Spojenie hviezdneho katalógu s AMON dátami

	date	counts	sun_zenith	moon_zenith	moon_azimuth	moon_elevation	magnitude
0	2017-04-21 02:50:54	1003	161.661	98.4510	340.097172	-71.930874	12.576748
1	2017-04-21 02:51:01	1036	161.669	98.4740	340.180433	-71.938728	12.541601
2	2017-04-21 02:51:05	1010	161.674	98.4880	340.228041	-71.943202	12.569197
3	2017-04-21 02:51:06	1028	161.675	98.4910	340.239946	-71.944318	12.550017
4	2017-04-21 02:51:11	1034	161.680	98.5080	340.299493	-71.949892	12.543699
...
419291	2019-05-01 02:59:56	31161	142.230	98.8009	305.679135	-52.606840	8.845972
419292	2019-05-01 02:59:57	30837	142.233	98.8042	305.683875	-52.609586	8.857320
419293	2019-05-01 02:59:58	30942	142.236	98.8074	305.688615	-52.612331	8.853629
419294	2019-05-01 02:59:59	31092	142.238	98.8107	305.693355	-52.615076	8.848378
419295	2019-05-01 03:00:00	31012	142.241	98.8140	305.698096	-52.617821	8.851176

419296 rows × 7 columns

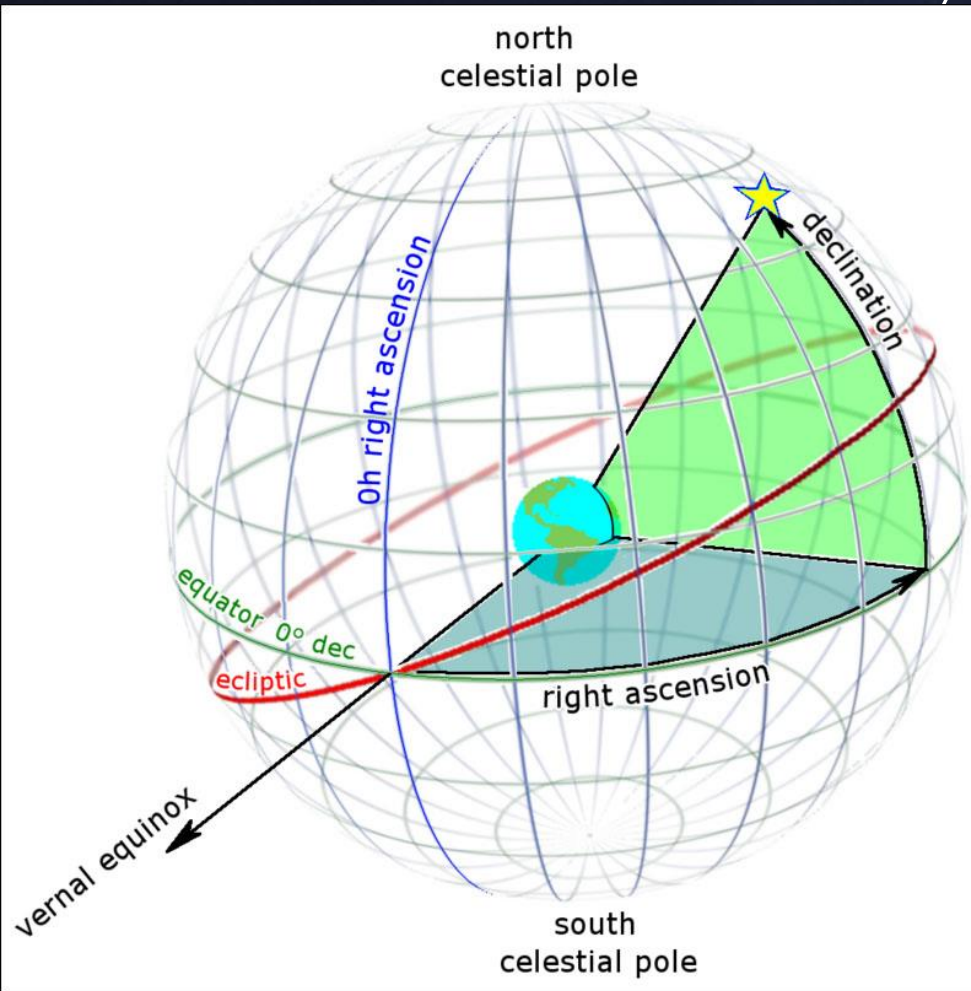
Hviezdny katalóg

Na lokalizáciu hviezd používame **RA** (right ascension) a **DEC** (declination) - tieto hodnoty sú v GAIA katalógu

Latitude = DEC

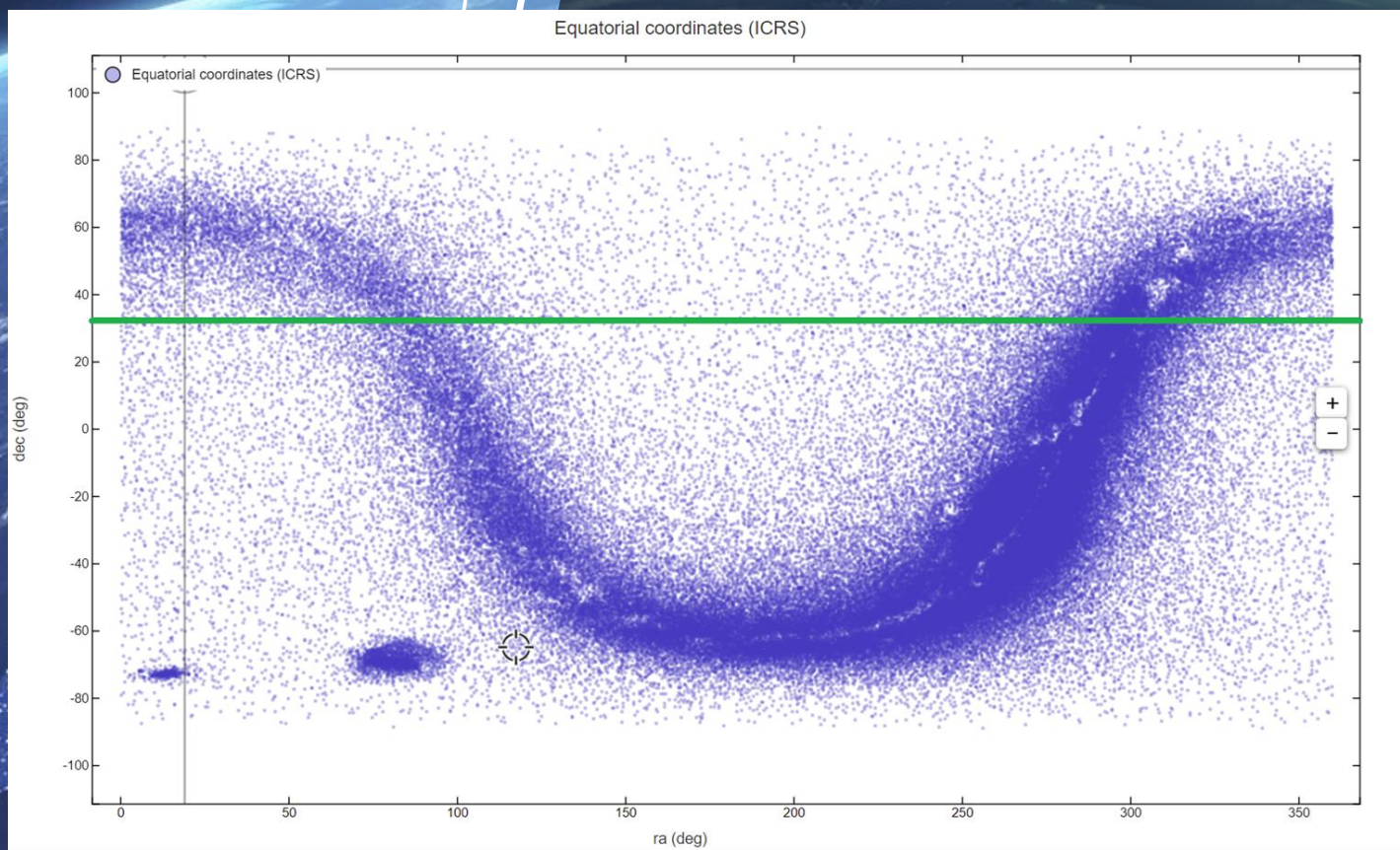
RA = LST(local sidereal time) - HA(hour angle)

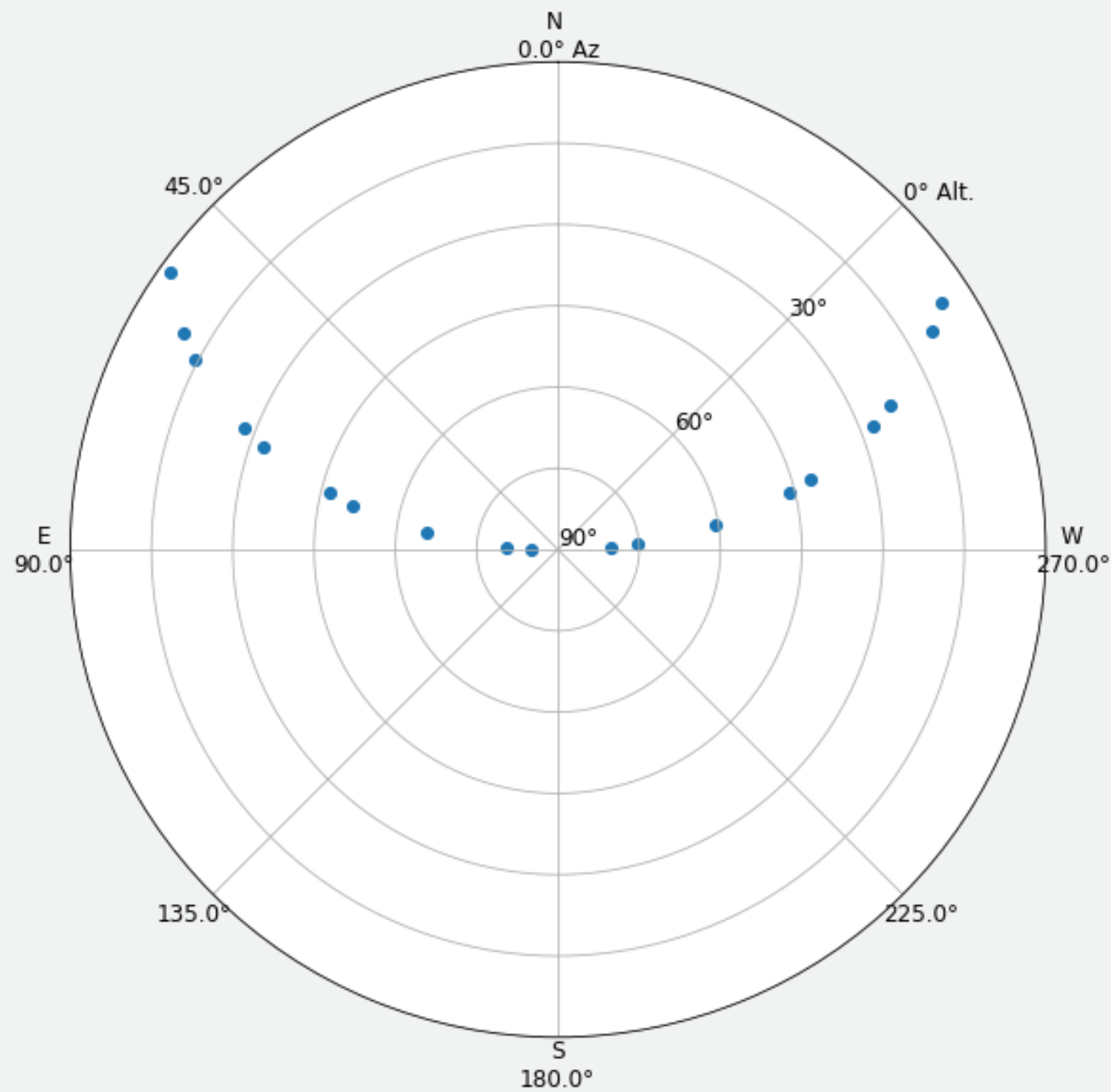
- rozdiel v LST v dátach katalógu a detektora



Hviezdny katalóg

Zelená čiara značí zorné pole detektora





● 1319109049309845760

	date	counts	magnitude	star_id
0	2017-04-21 02:50:54	1003	12.576748	180270123992396416
1	2017-04-21 02:51:01	1036	12.541601	3446359102082051712
2	2017-04-21 02:51:05	1010	12.569197	756768427191834880
3	2017-04-21 02:51:06	1028	12.550017	3444678502856403200
4	2017-04-21 02:51:11	1034	12.543699	3446359102082051712
5	2017-04-21 02:51:12	1015	12.563835	756768427191834880
6	2017-04-21 02:51:13	1021	12.557436	756768427191834880
7	2017-04-21 02:51:14	1009	12.570272	756768427191834880
8	2017-04-21 02:51:16	1042	12.535331	2033528304400483328
9	2017-04-21 02:51:18	1021	12.557436	756768427191834880
10	2017-04-21 02:51:20	1004	12.575666	180270123992396416
11	2017-04-21 02:51:21	1001	12.578915	180270123992396416
12	2017-04-21 02:51:22	1050	12.527027	736071976224823936
13	2017-04-21 02:51:24	1081	12.495436	2873600989545988096
14	2017-04-21 02:51:26	1013	12.565976	756768427191834880
15	2017-04-21 02:51:27	1067	12.509589	736071976224823936
16	2017-04-21 02:51:28	1044	12.533249	2871165094550379904
17	2017-04-21 02:51:29	1015	12.563835	756768427191834880
18	2017-04-21 02:51:30	1062	12.514689	736071976224823936
19	2017-04-21 02:51:31	1029	12.548962	3444678502856403200

Vyhodnotenie

Pomocou GAIA API bolo veľmi nepraktické zisťovať údaje o všetkých takmer 500 tisíc potrebných hviezdach.

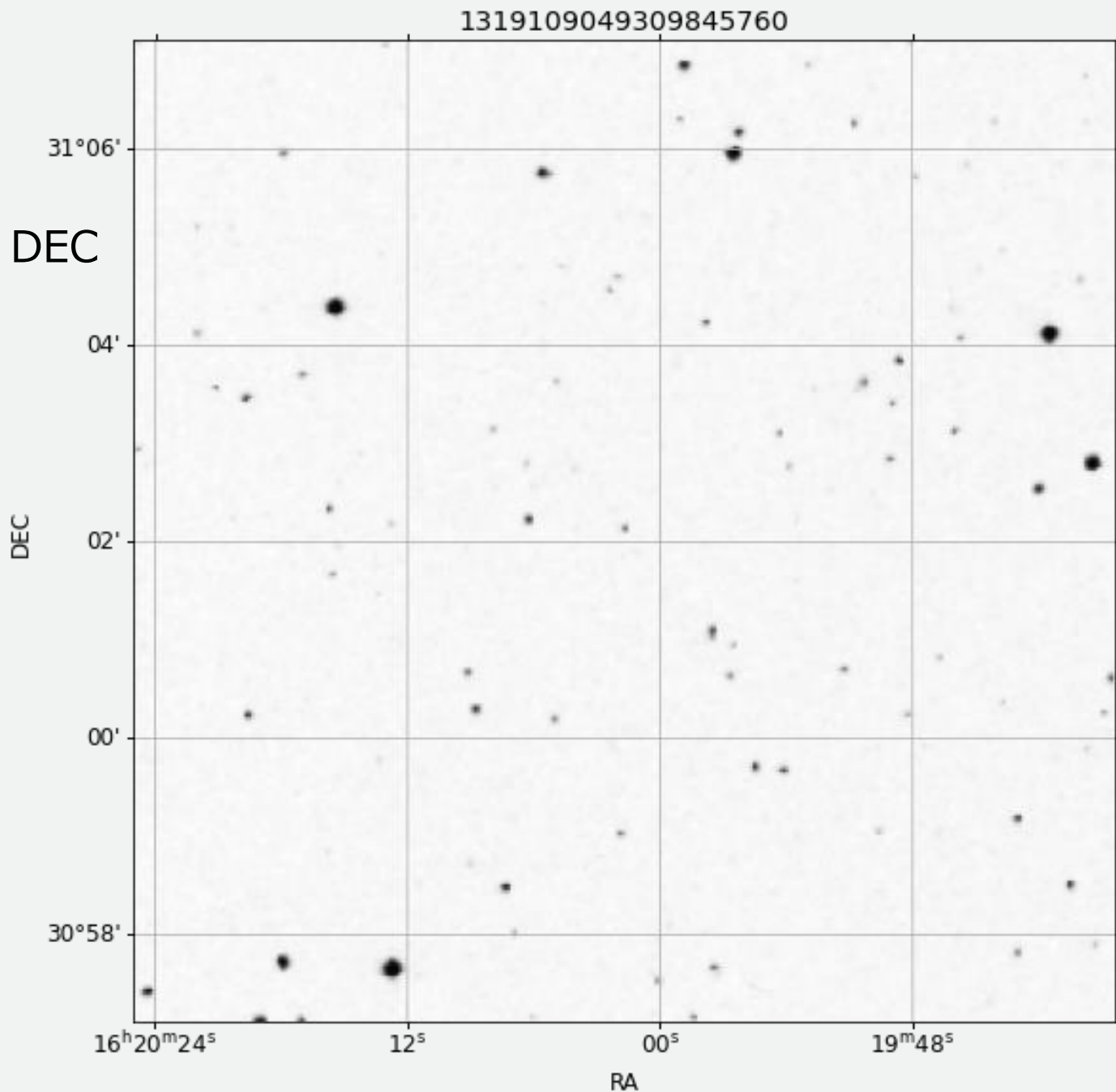
~ **3390 GB** dát = pamäťová náročnosť
GAIA API - veľký počet requestov = časová náročnosť

Kvôli tomu sme sa rozhodli že nebudeme priradovať všetkých 500 tisíc hviezd, ale určili sme si menší počet, ako názornú ukážku.

Knižnica Astroplan

Sú potrebné koordináty cieľa - RA a DEC

Zdrojové obrázky sú
získané z NASA
Goddard's SkyView
service



Automatic identification of stars

Automatic identification of stars

colab.research.google.com/drive/13MYCdnxYFEC4dxx-PM9hUW7N8mgyszY?usp=sharing#scrollTo=8D-tdHawCyg9

Automatic identification of stars in AMON data part 2.ipynb

SúborUpraviťZobraziťVložiťRuntimeNástrojePomocník

Súbory

..

sample_data

amon_star_database.csv

+ Kód

+ Text

```
import matplotlib.pyplot as plt
from astropy.coordinates import SkyCoord
import astropy.units as u
from astroplan import FixedTarget
from astroplan.plots import plot_finder_image

amon_star_database = pd.read_csv('/content/amon_star_database.csv', usecols=['date', 'counts', 'magnitude', 'star_id', 'ra', 'dec'])
amon_star_database['date'] = pd.to_datetime(amon_star_database['date'])
amon_star_database

# 2017-04-21 02:51:06
def validate(date_text):
    try:
        datetime.datetime.strptime(date_text, '%Y-%m-%d %H:%M:%S')
    except ValueError:
        raise ValueError("Incorrect data format, should be 'YYYY-MM-DD H:M:S'")

def visualize_star(date):
    if len(amon_star_database[amon_star_database['date'] == date]) == 0:
        print("Datetime not found in database!")
        return

    star = amon_star_database[amon_star_database['date'] == date].iloc[0]

    star_coord = SkyCoord(ra=star.ra, dec=star.dec, unit=(u.degree, u.degree), frame='icrs')
    target = FixedTarget(name=star.star_id, coord=star_coord)

    ax, hdu = plot_finder_image(target)
    plt.tight_layout()
    plt.show()

date = input("Input date (YYYY-MM-DD H:M:S): ")
validate(date)
visualize_star(date)
```

Operčná pamäť

Disk

Úpravy

...

Requirement already satisfied: astroplan in /usr/local/lib/python3.7/dist-packages (0.8)

Requirement already satisfied: six in /usr/local/lib/python3.7/dist-packages (from astroplan) (1.15.0)

Requirement already satisfied: astropy>=4 in /usr/local/lib/python3.7/dist-packages (from astroplan) (4.3.1)

Requirement already satisfied: numpy>=1.17 in /usr/local/lib/python3.7/dist-packages (from astroplan) (1.21.6)

Requirement already satisfied: pytz in /usr/local/lib/python3.7/dist-packages (from astroplan) (2022.1)

Requirement already satisfied: pyerfa>=1.7.3 in /usr/local/lib/python3.7/dist-packages (from astropy>=4->astroplan) (2.0.0.1)

Requirement already satisfied: importlib-metadata in /usr/local/lib/python3.7/dist-packages (from astropy>=4->astroplan) (4.11.3)

Requirement already satisfied: zipp>=0.5 in /usr/local/lib/python3.7/dist-packages (from importlib-metadata->astropy>=4->astroplan) (3.8.0)

Requirement already satisfied: typing-extensions>=3.6.4 in /usr/local/lib/python3.7/dist-packages (from importlib-metadata->astropy>=4->astroplan) (4.2.0)

Input date (YYYY-MM-DD H:M:S):

<>

Disk

K dispozícií: 69.84 GB

Vykonáva sa (13 s)

Cell > raw_input() > _input_request() > recv() > recv_multipart()

23:09

9. 5. 2022

Zdroje

https://asd.gsfc.nasa.gov/archive/galex/FAQ/counts_background.html

https://gea.esac.esa.int/archive/documentation/GEDR3/Gaia_archive/c

hap_datamodel/sec_dm_main_tables/ssec_dm_gaia_source.html

<https://github.com/skyfielders/python-skyfield/issues/510>

<https://solarsena.com/solar-hour-angle-calculator-formula/>

http://personalpages.to.infn.it/~bertaina/tesi-scaricate/Medina-Airglow_measurements.pdf

https://www.sciencedirect.com/science/article/abs/pii/S0168900218318874?casa_token=SabzEcCnM08AAAAA:DaIgb1H2b4zNk3Ek0SzX-ATymbYmzcbEtuKnMKaGTp5mKPAo6pq2kLTHXt8cRm2zzVDj1cXRGQ



Ďakujeme za pozornosť!