

CATCHing Near-Earth Objects in Archival Survey Data

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Motivation

- Ground-based **NEO surveys** are producing millions of images per year.
- **Specialized tools** are necessary to keep them accessible and relevant.
- A key application is **object precovery**.

CATCH: Comet Asteroid Telescopic Catalog Hub

Designed to quickly find comets and asteroids in wide-field time-domain survey data.

Searchable

Accessible

Generalizable



COMET ASTEROID TELESCOPIC CATALOG HUB



<https://catch.astro.umd.edu>



Github

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CATCH APIS

CATCH SWAGGER UI [PROD] ^{4.0}

[Base URL: /api]

<https://catch.astro.umd.edu/api/swagger.json>

This is a swagger interface to the APIs for SBN's CATCH Tool.

The frontend can be found [here](#). See the [Apis](#) section for descriptions on how to use these api routes.This interface is generated automatically by the [flask-restplus](#) library.

Catch moving targets

 Query for moving target

Caught moving targets

CATCH

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DATA: 65P

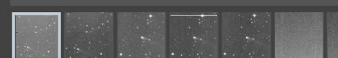


<input type="checkbox"/>		Source	RA/Dec	
<input checked="" type="checkbox"/>		NEAT Palomar	177.5101 / 15.2501	2.833
<input type="checkbox"/>		NEAT Palomar	177.5099 / 15.2508	2.833
<input type="checkbox"/>		NEAT Palomar	174.6224 / 17.9759	2.491
<input type="checkbox"/>		NEAT Palomar	174.6207 / 17.9769	2.491
<input type="checkbox"/>		NEAT Palomar	174.6190 / 17.9779	2.491
<input type="checkbox"/>		NEAT Maui	8.1476 / -10.7502	2.438
<input type="checkbox"/>		NEAT Maui	8.1456 / -10.7507	2.438

View Zoom Scale Color Regions

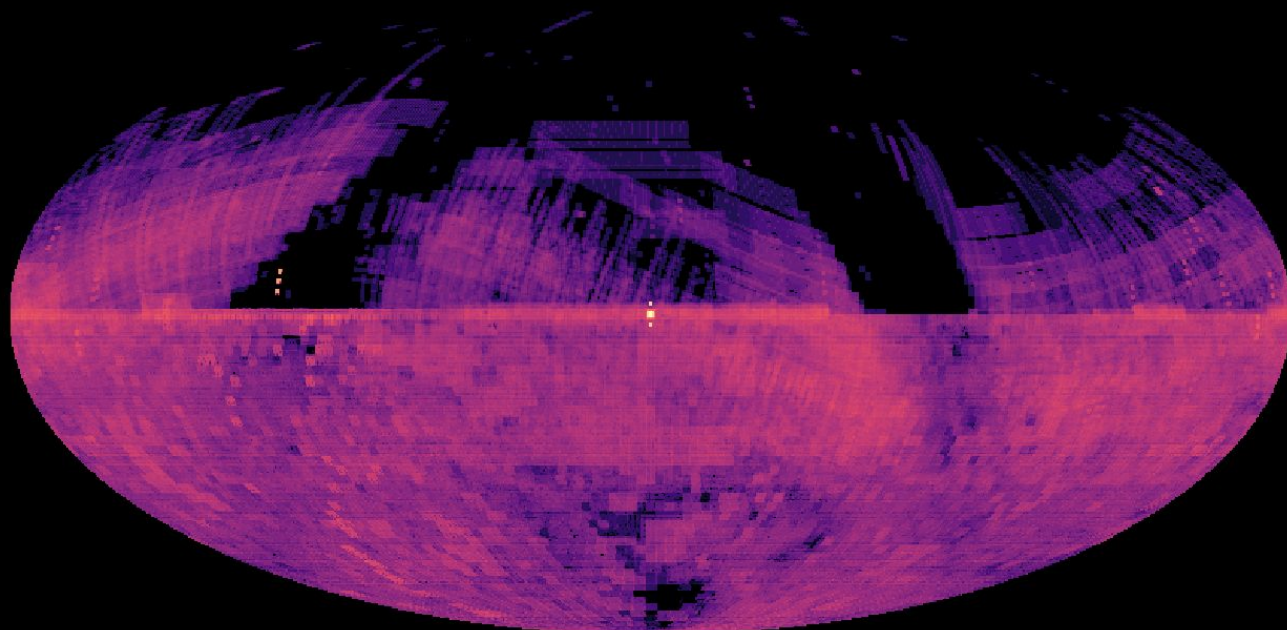
1581.9958 11:50:13.653 +15:15:49.87 (FK5) 127,000 250,000
(physical)

1612.5 1710.7 1899.8 1908.0 2007.2 2105.3 2203.5 2302.7 2400.9



Currently loaded surveys

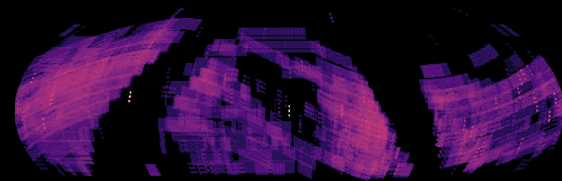
CATCH Sky Coverage



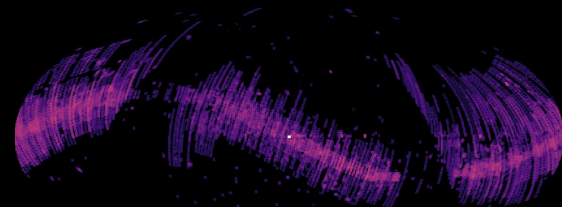
$\log_{10}(N_{images})$



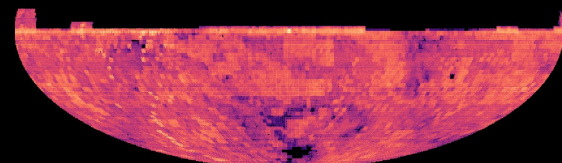
NEAT Palomar Tricam



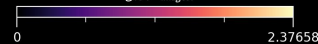
NEAT Maui GEODSS



SkyMapper DR2

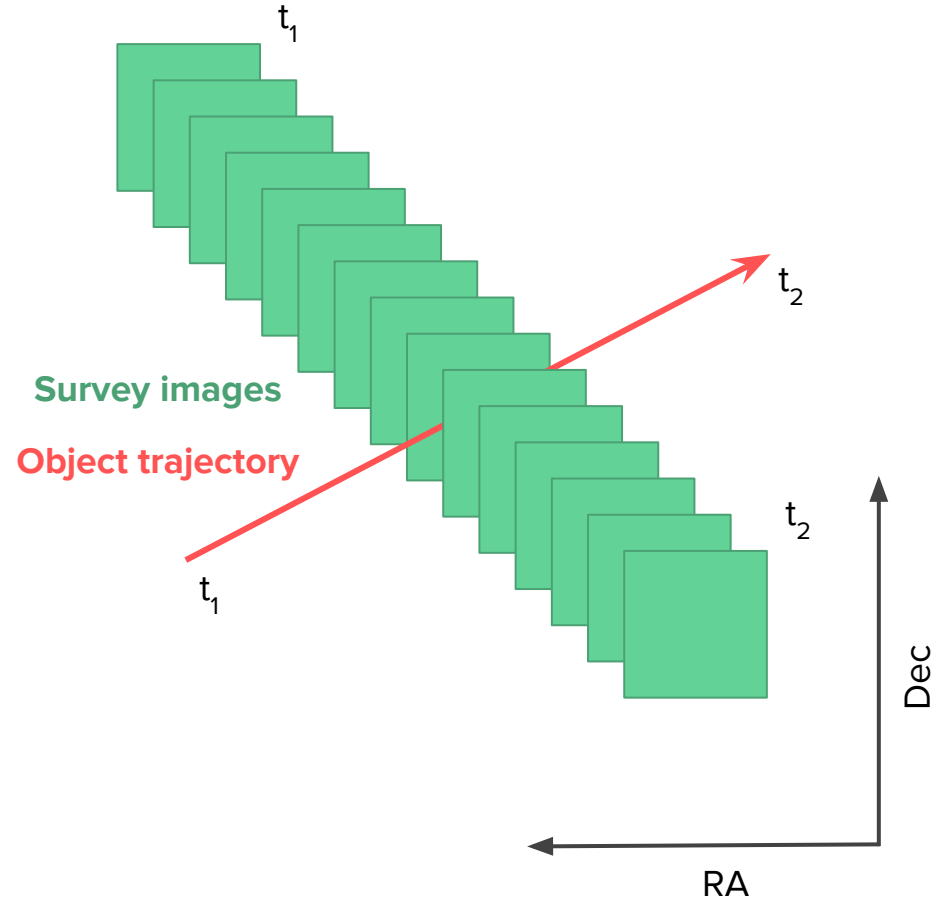


$\log_{10}(N_{images})$



Needle in the haystack

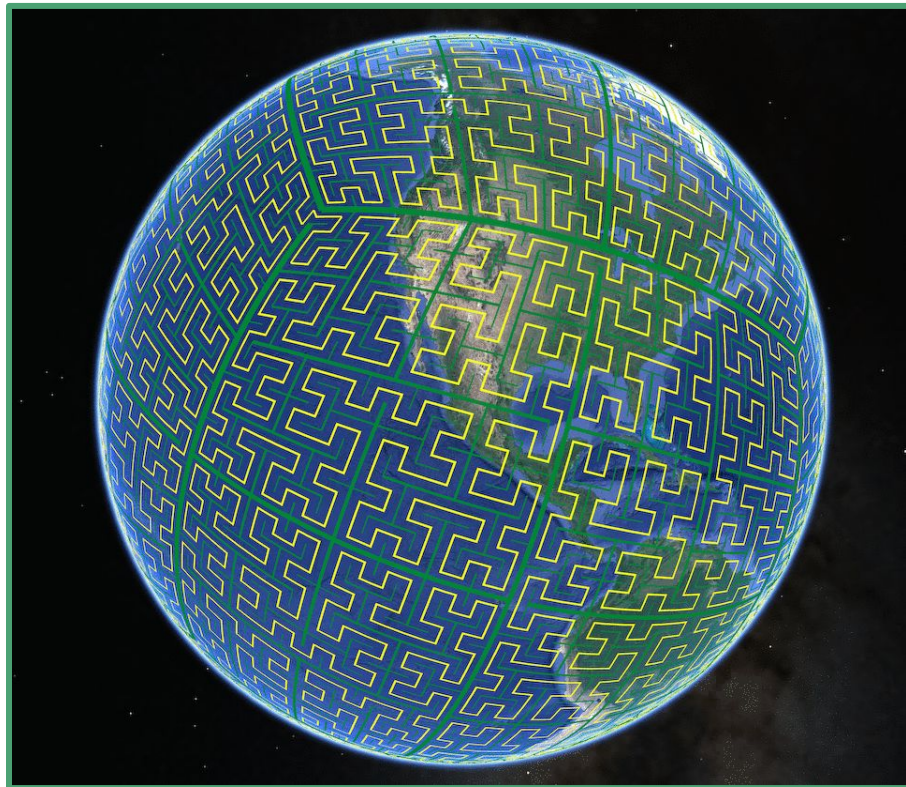
- Efficient search algorithms foremost about eliminating objects that do not match, leaving a few objects to examine in detail.
- CATCH uses an approach motivated by geolocation searches, e.g., to find the nearest COVID testing sites in Google Maps.

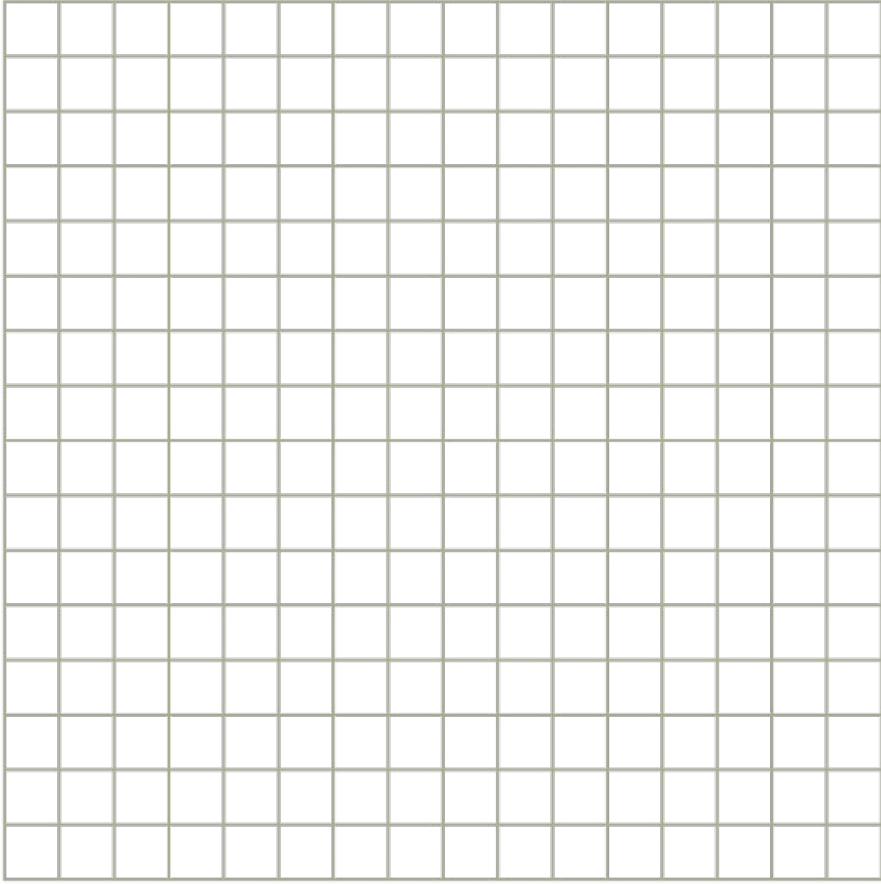


s2geometry (CATCH dev)

Google's s2geometry indexes the sphere with a space-filling (fractal) curve. Benefits:

- The (Hilbert) curve maximizes locality.
- Cell boundaries are geodesics.
- E-W flip from Earth to Celestial Sphere does not affect results.
- 100x faster than equivalent Hierarchical Triangular Mesh (HTM) indexing.

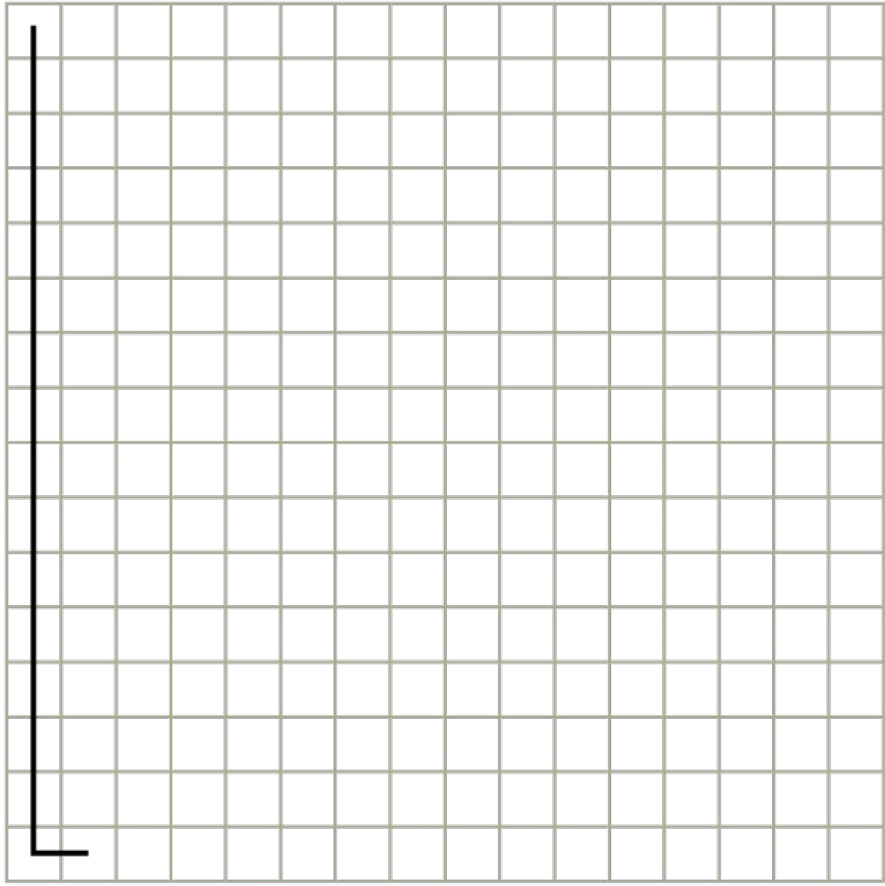




← RA

Dec ↑

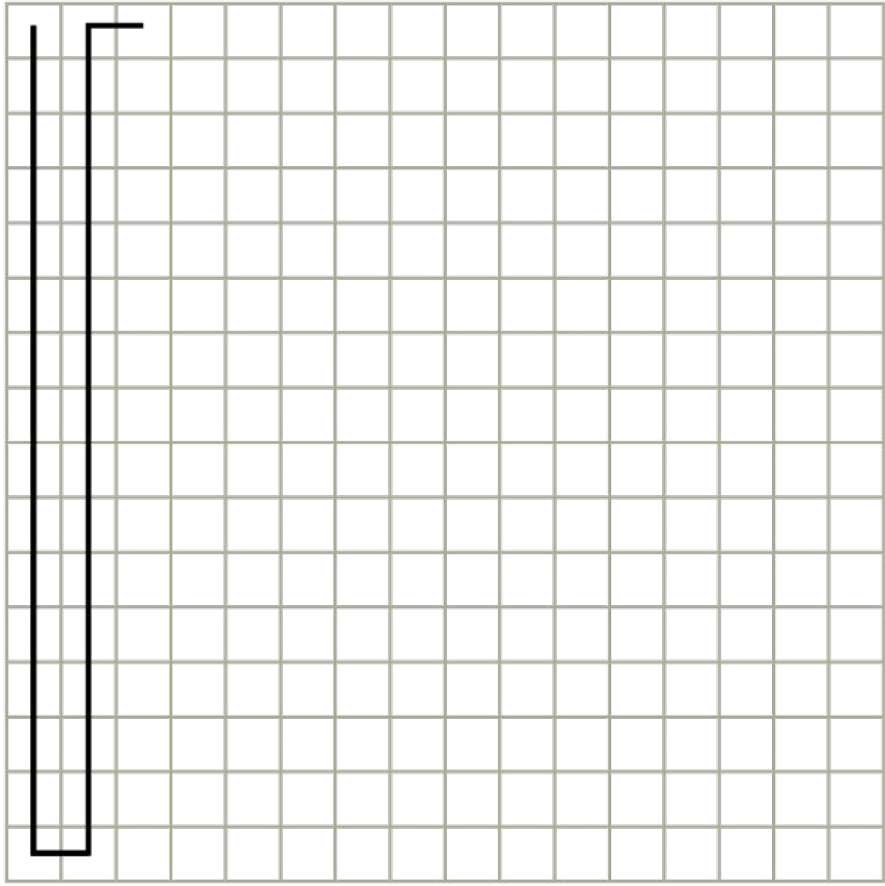
0



← RA

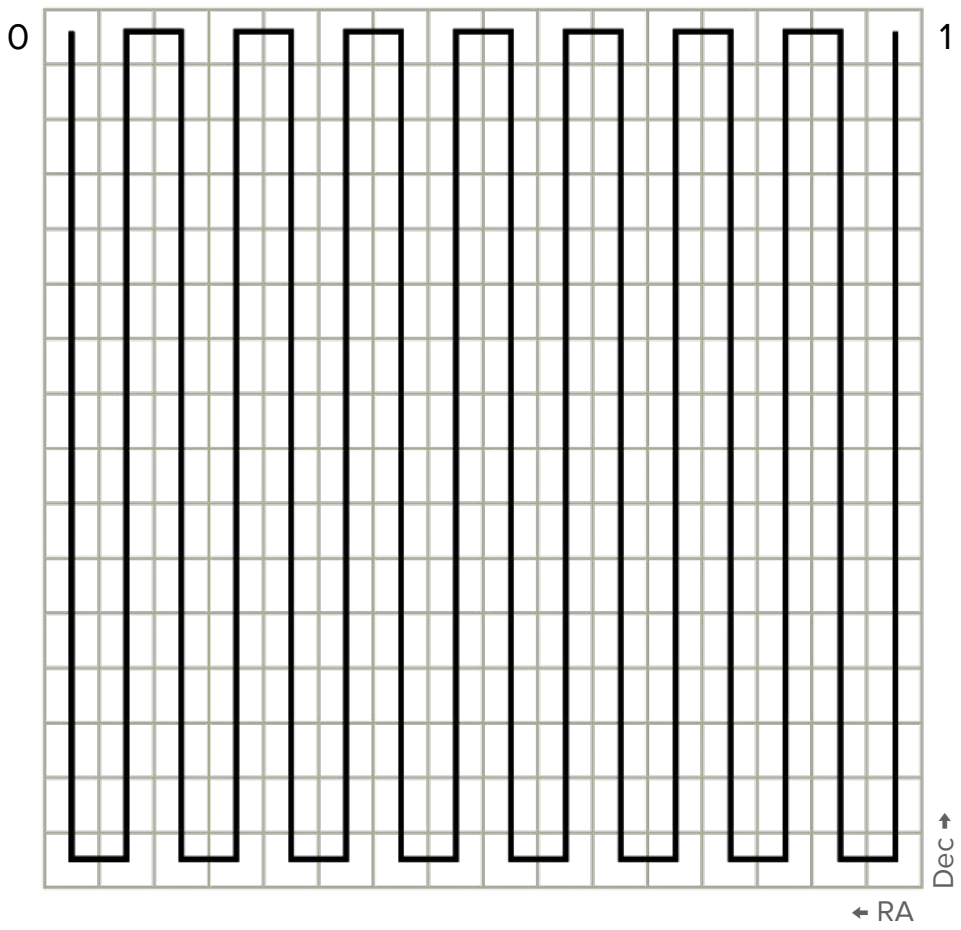
Dec ↑

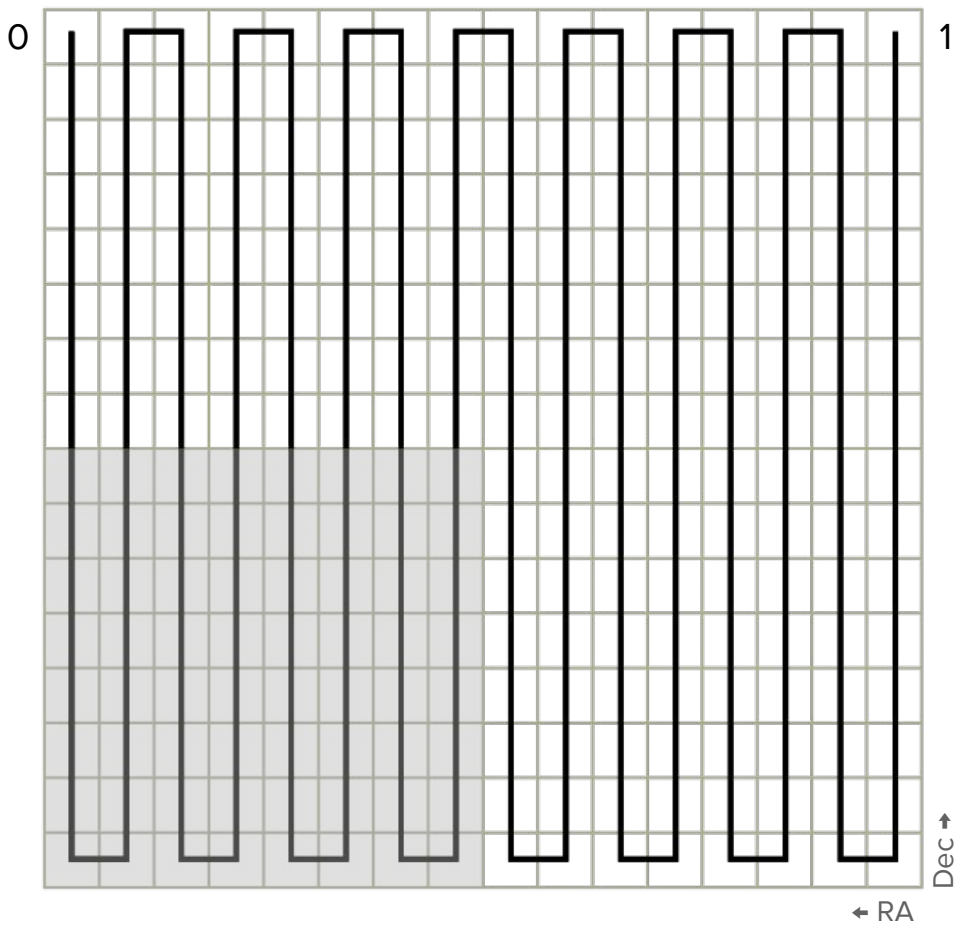
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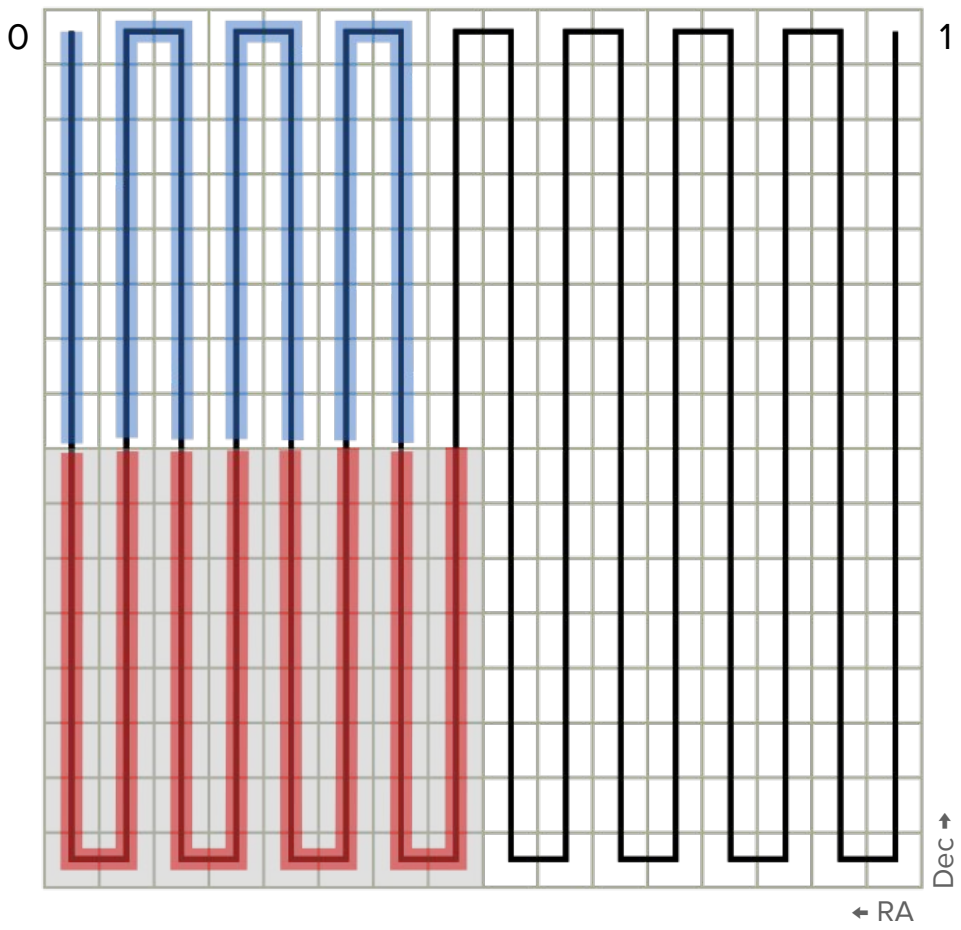


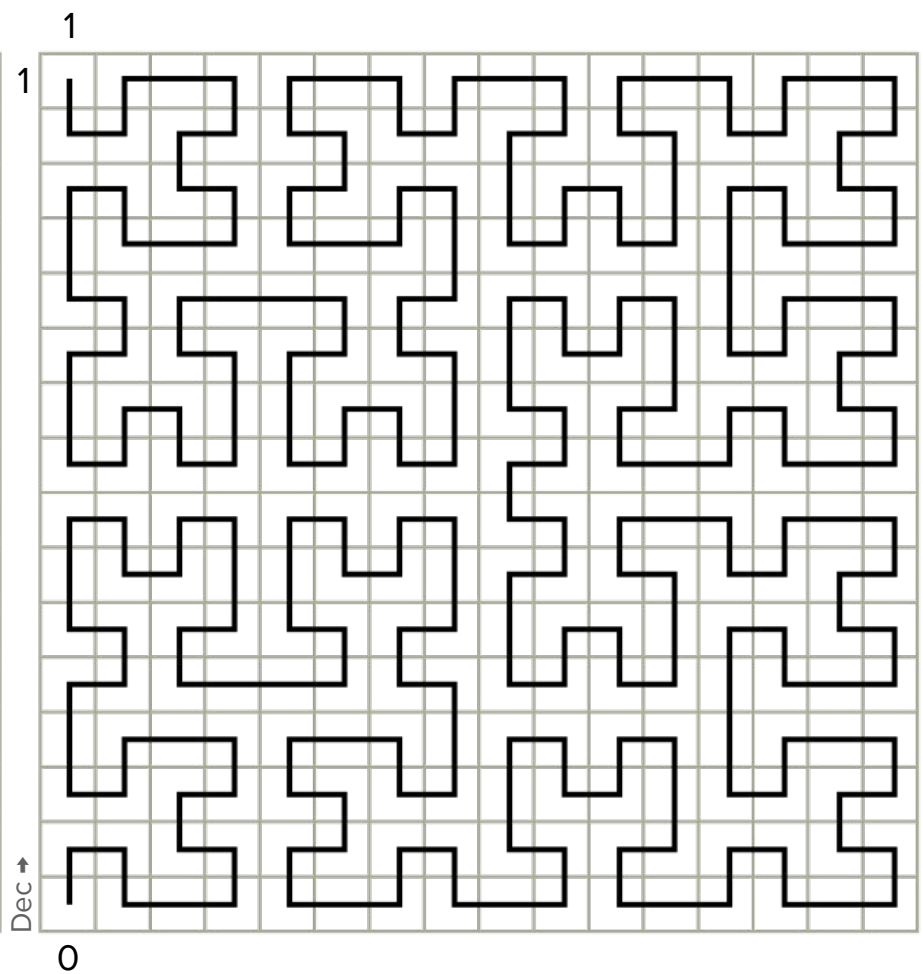
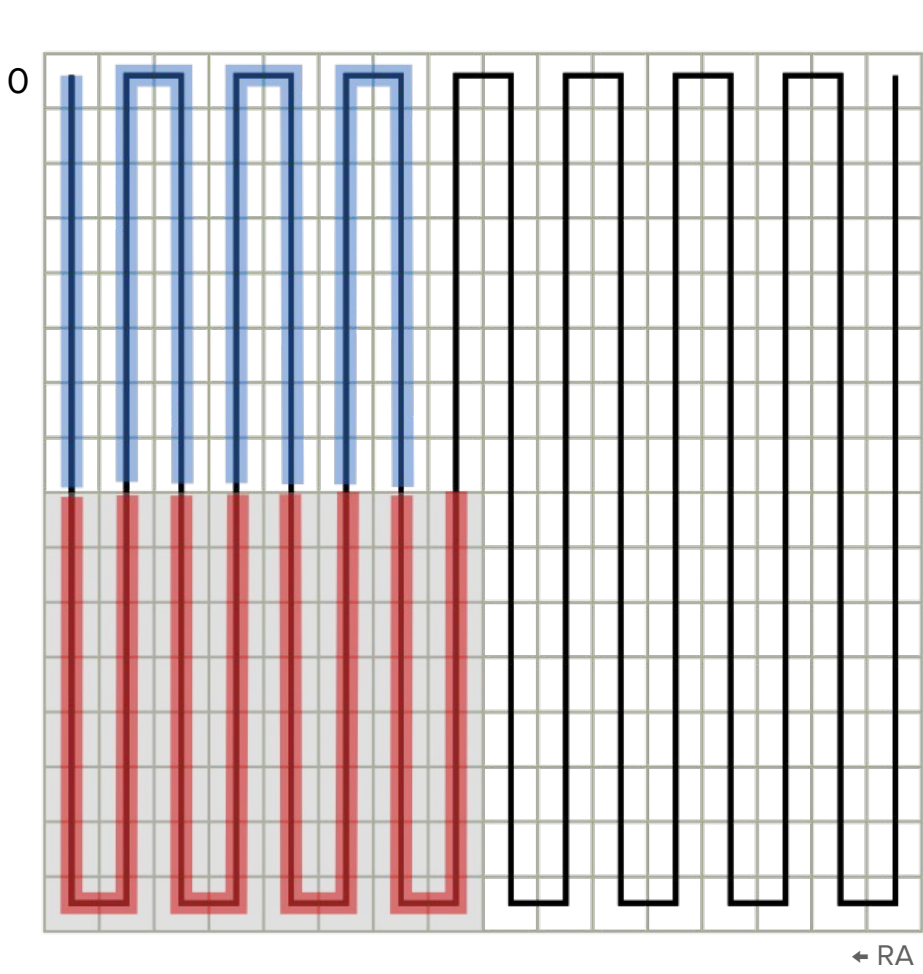
← RA

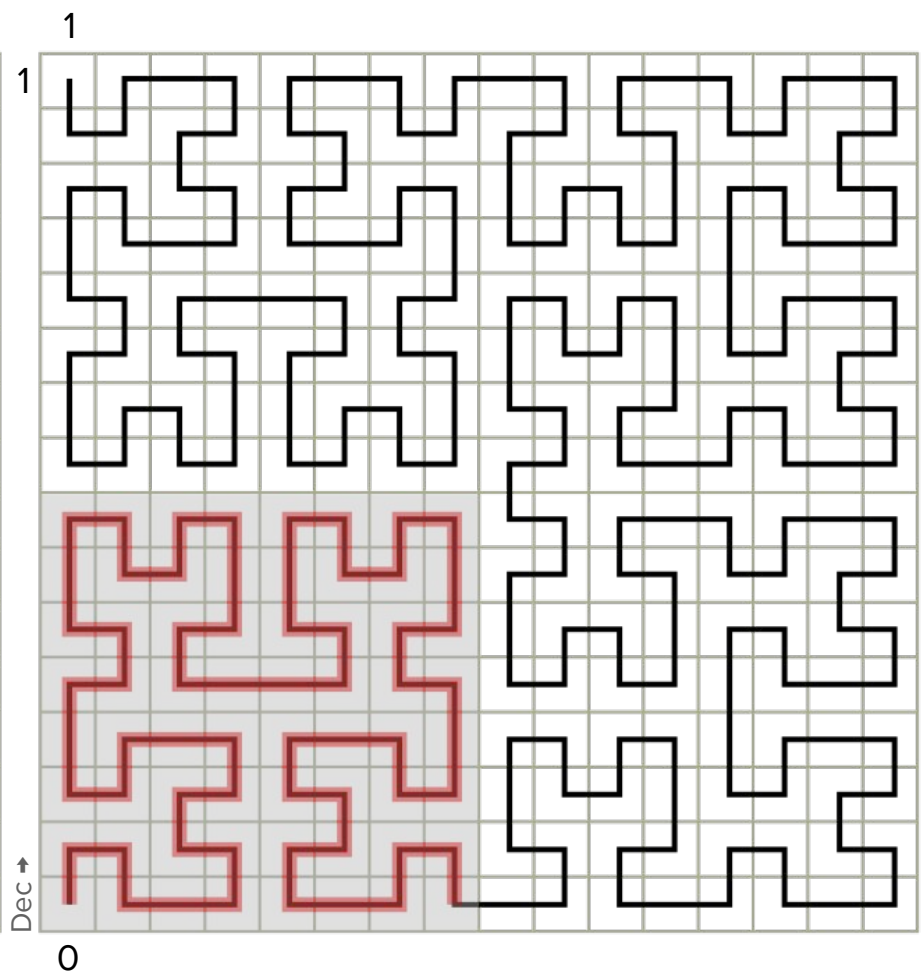
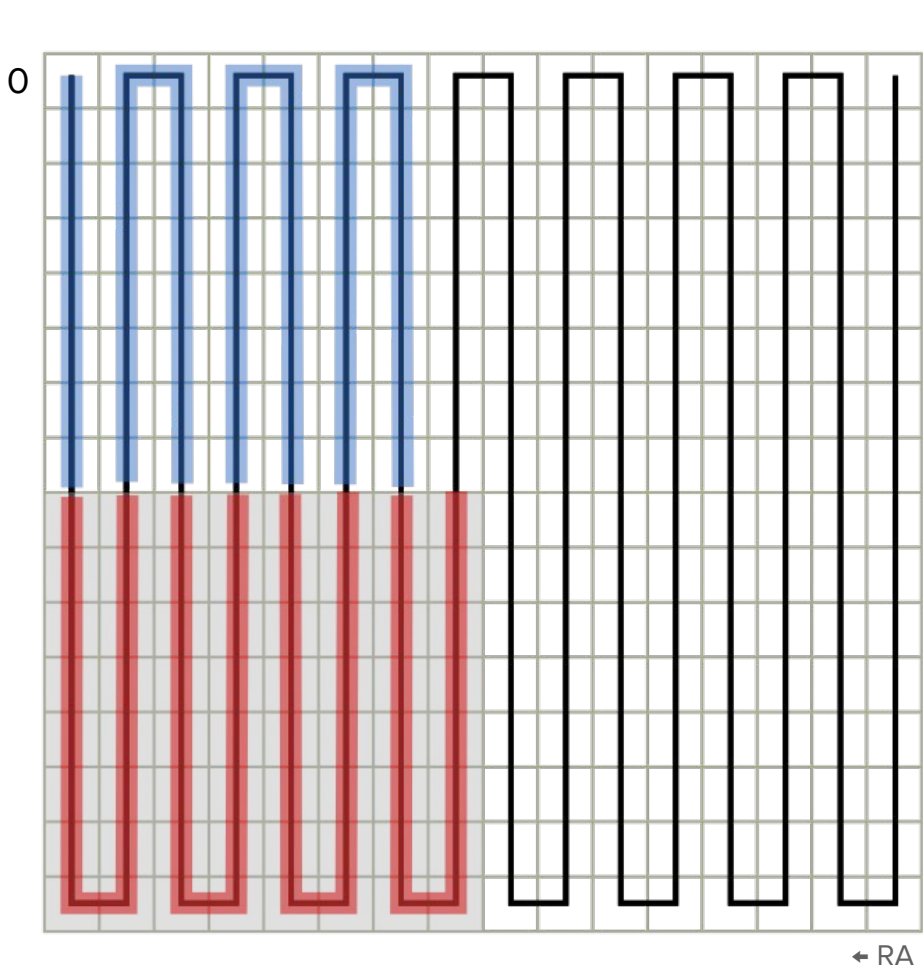
Dec ↑











Future Developments

- ***More surveys:***

- PanSTARRS DR2 (STScI/MAST).
- ATLAS and Catalina Sky Survey (NASA PDS).

- ***Performance updates.***

- **Sidereal queries:**

- Astrophysical applications, transient sky.
- IVOA Simple Image Access protocol (separate tool).

- Search by uncertainty ellipse.

- **Minor Planet Center integration:**

- Candidate object searches (NEOCP & PCCP).
- Considering MPC observation database visualization.



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Search for Object

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GET /query/moving Query for moving target

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