SORA

Stellar Occultation Reduction and Analysis

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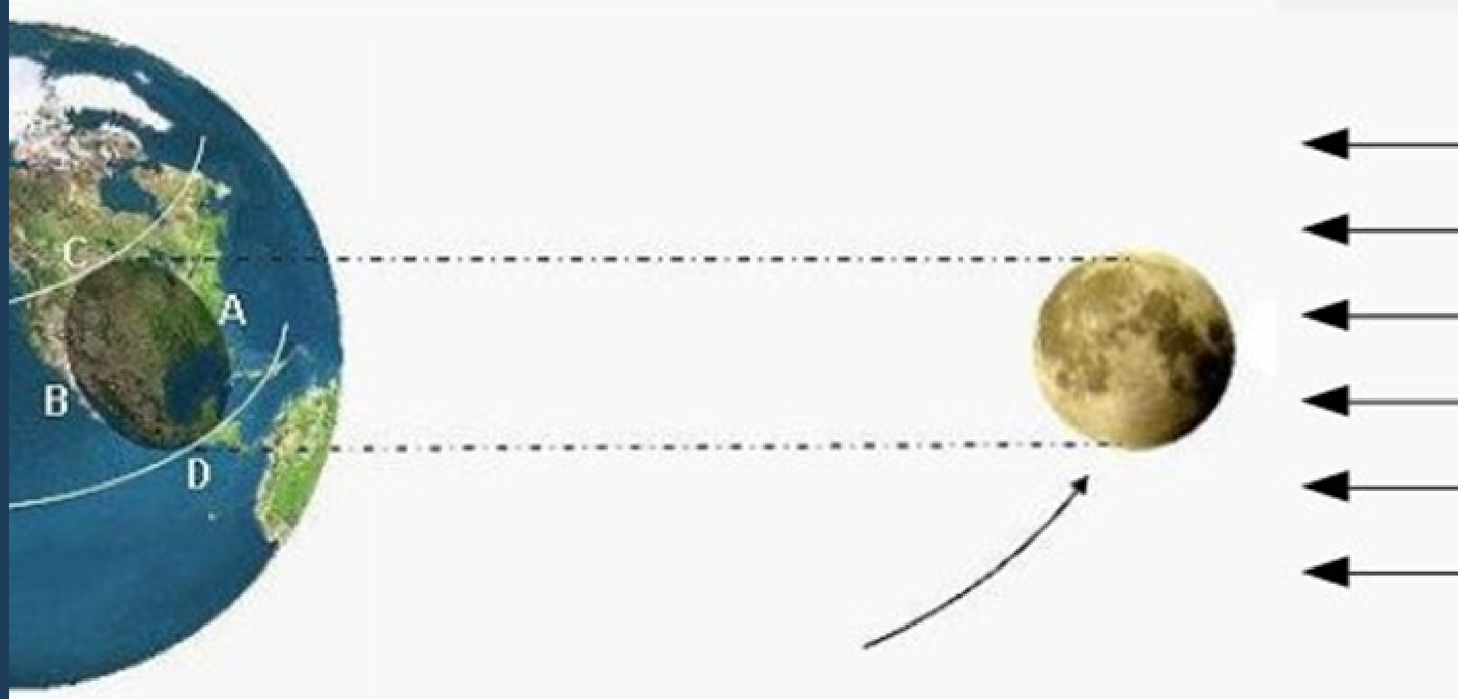
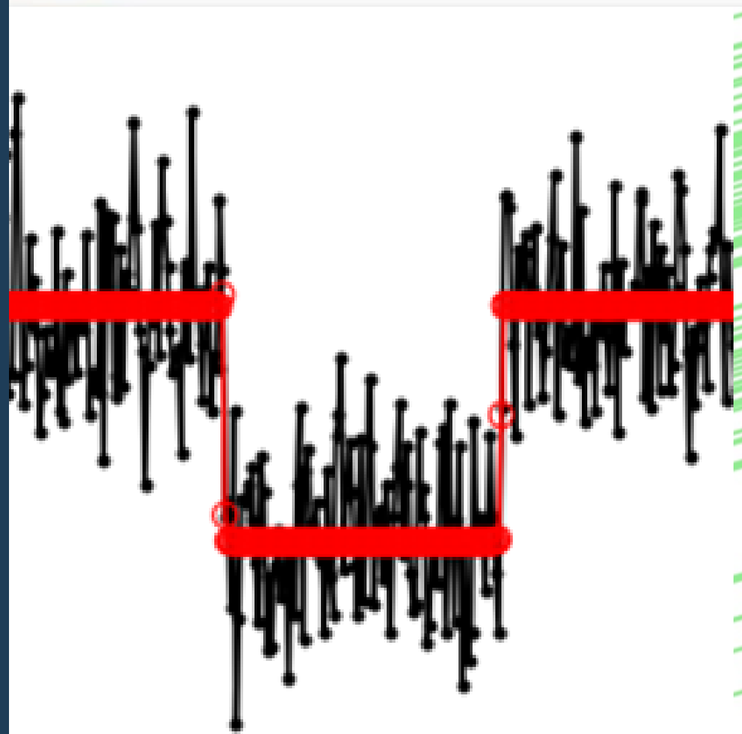
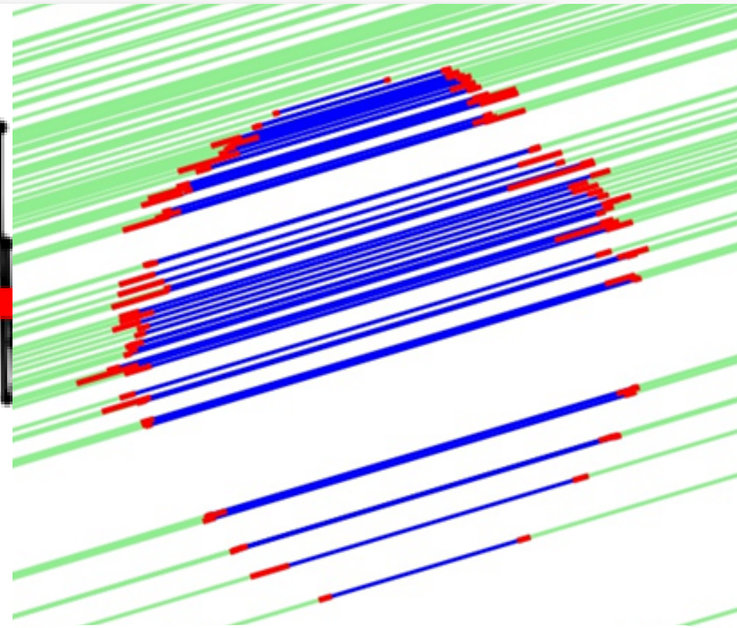
Stellar Occultation

Stellar Occultations occur when a Solar System Object crosses in front of a star for an observer on Earth. Each observer will obtain a light curve, showing a flux drop (event). That is converted into the sky plane, where the 2D apparent shape can be determined.







Rommel et al., 2021

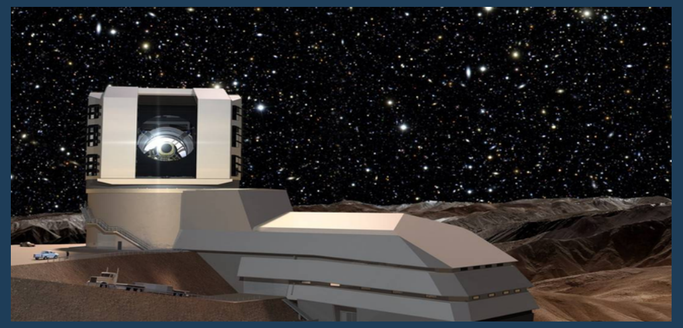
MOTIVATION

GAIA CATALOG

With the release of the Gaia catalog, the position of the stars is now very accurate. The Gaia EDR3 has positions for more than 1.8 billion sources with uncertainties below 1 mas (Mag. G < 21)

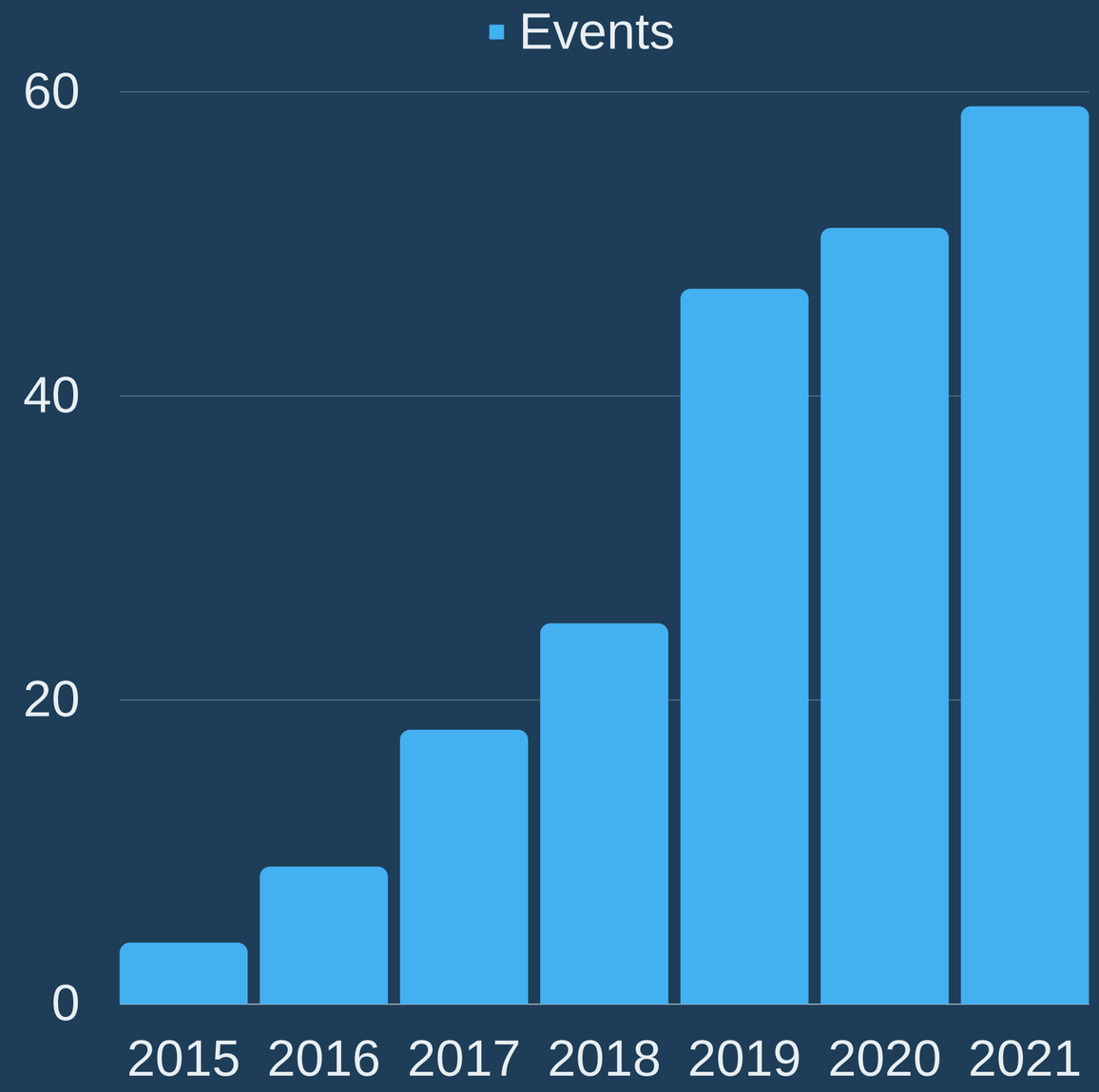
IMPROVED ORBITS

Previous stellar occultation combined with the effort to obtain precise astrometry of the occulting objects allows more accurate predictions, resulting in a larger number of detections and chords.



LSST PROSPECTS

Legacy Survey of Space and Time (LSST) at the Vera C. Rubin Observatory will provide positions of Solar System bodies and an unprecedented number of discoveries.



Big Data Era!

Increase of events over the years

A more significant number of events, combined with many chords, highlights the need for an efficient and as automated as possible toolkit to work with these data sets.

Basic Principles

The user can create their own pipeline.

- A Python library with various functionalities and tools to reduce and analyze Stellar Occultation data.
- Modern, faster, more efficient...
- Access to online databases (Gaia, JPL Horizons, VizieR, etc.).
- Many levels of automation, from manual to fully automated.
- The library is separated into modules.

MAJOR CAPABILITIES

1

Predicting Stellar Occultations

It can predict stellar occultations for a single ground-based observer, the geocentre, and even space telescopes or probes.

2

Light Curve Analysis

After the photometry, SORA can be used to normalize the light curve, detect events and determine the dis- and re-appearance times.

3

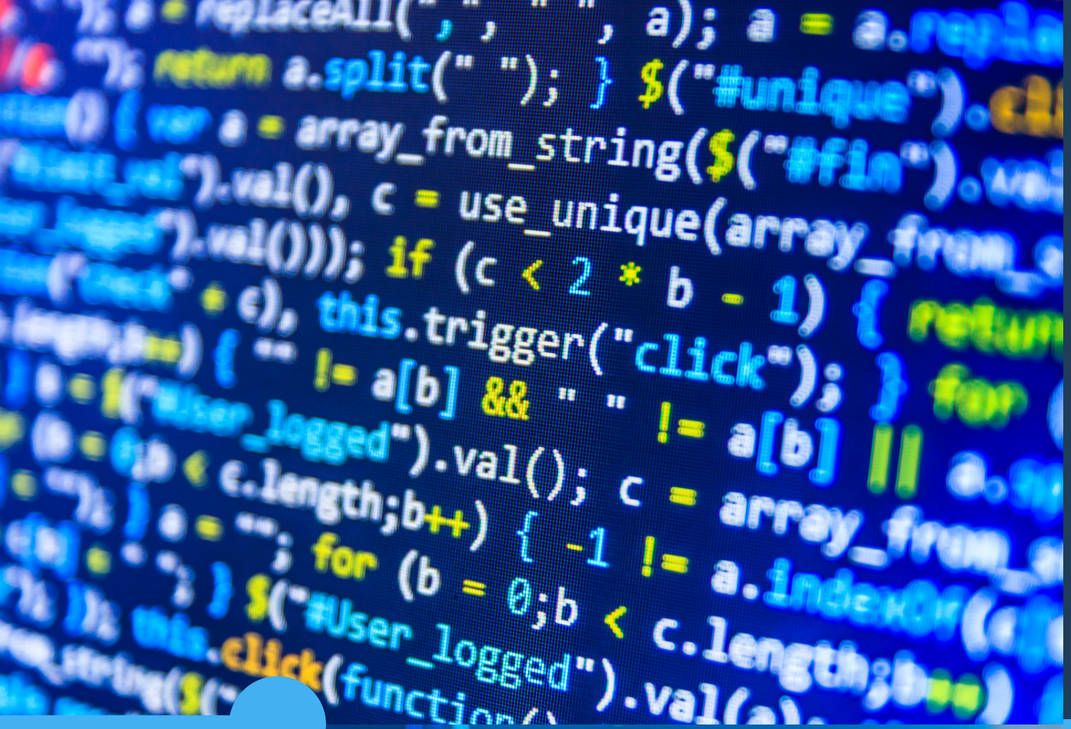
Fitting the 2D size and shape

Assuming a circular or elliptical shape, SORA fits the chords extremities and determines the occulting object's 2D apparent size and shape.

4

And more...

As an open-source code, functions on SORA can be used as a first step for other analysis, for instance, searching for material around objects.



Open Source

All the codes are freely available at GitHub (*https://github.com/riogroup/SORA*) and it can be installed using <*pip install sora-astro*>

Open Development

We welcome anyone that can contribute with new ideas, corrections, applications, and the development of new tools.

TO BE DEVELOPED

UNIT TESTS

These automated tests are written and run to ensure the the functionality of the package.

3D SHAPE

Comparing previously determined 3D shapes with the occultation chords.

ROTATIONAL ELEMENTS

Combining multiple stellar occultations data with rotational light curves.

IMPROVED FITTING METHODS

Include new and more efficient methods to determine the parameters and their uncertainties.

Thanks!

Documentation

https://sora.readthedocs.io/.

GitHub

https://github.com/riogroup/SORA

Scientific Publication

Gomes-Júnior et al., 2021, MNRAS