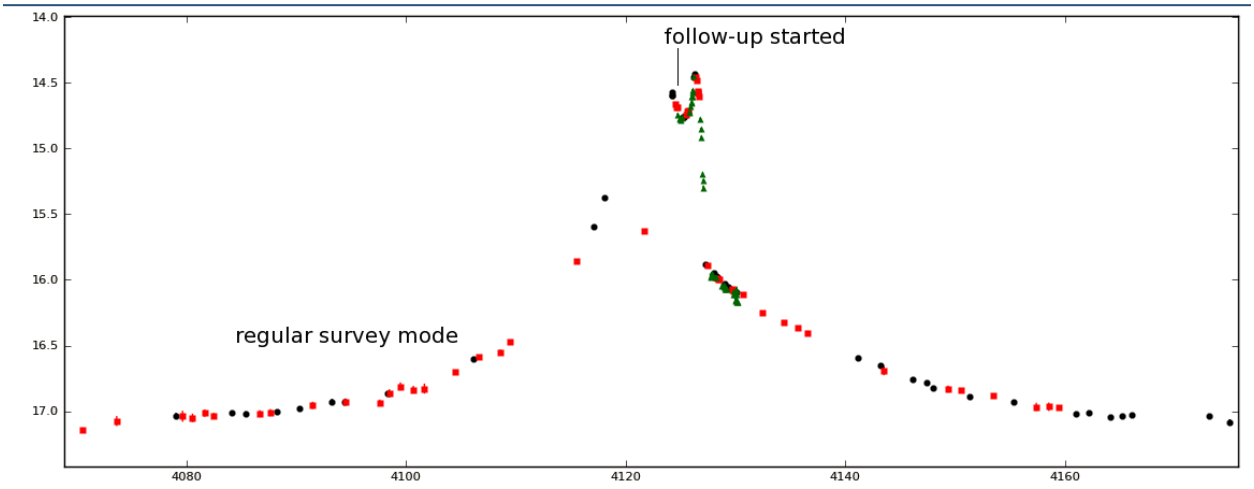
Sagan Workshop Hands-on Sessions (Modeling)

At present, searching for planets with microlensing requires selecting a few targets out of hundreds discovered by the survey groups to do intensive follow-up observations. The time-sensitive nature of microlenisng and complexity in model parameter space makes it both challenging and exciting.

We will have a website simulating the OGLE “Early Warning System (EWS)” (i.e., microlensing alert system) releasing light curves on an hourly basis throughout the workshop (1 workshop hour means many hours for a simulated event). The hands-on session participants are asked to join one of the groups (~10 members each group) to analyze events together. The eventual goal is to search for and characterize planetary signals in these simulated events.



The cadence of the light curves will normally be made similar to those according to the survey groups, by having a couple of points per couple of nights. While there are two chances (by the end of Tuesday and Wednesday) when the group members can vote for which events they would like to follow up. For each group, a restricted number of events that get the most votes will have high-cadence follow-up data.

The three different modeling sessions help to build up skills in microlensing

planet hunting. The focuses of the three sessions are single-lens fitting, planetary-lens model generation and planetary-lens fitting, respectively. The participants are encouraged to analyze events in their free time and have discussions on their follow-up decisions.

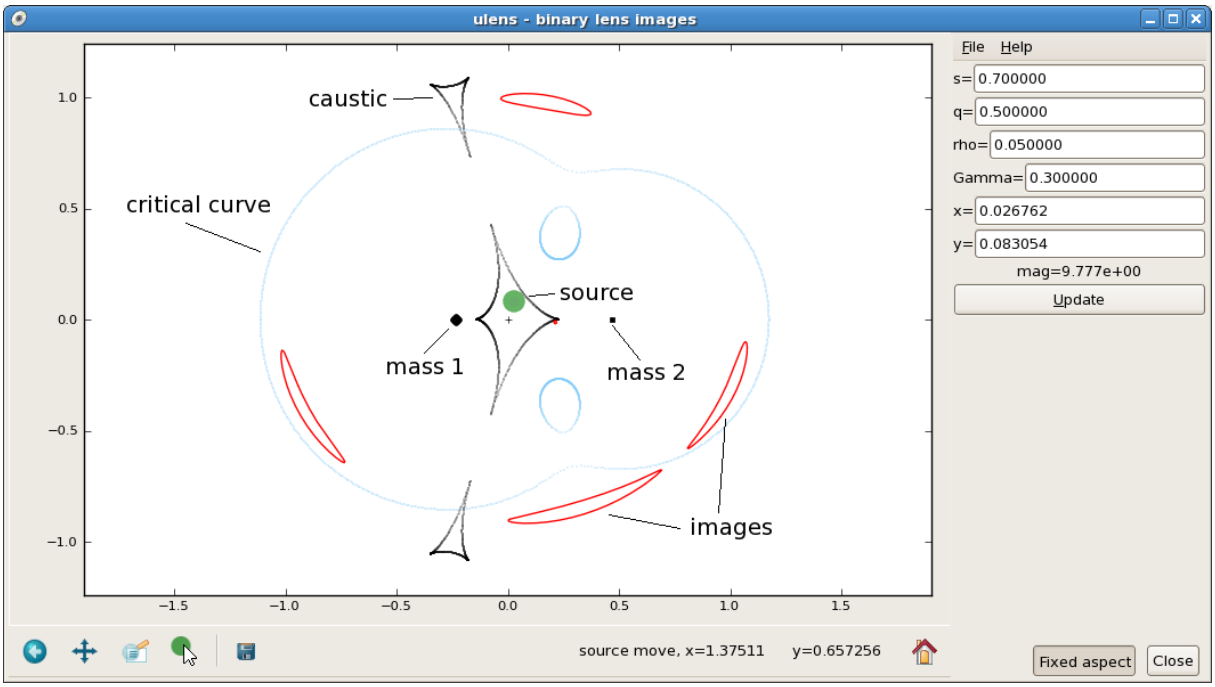
Wed. Session 3. Fitting Single-lens events

Single-lens model is the simplest form of microlensing, and yet it sets the basis for any microlensing model fitting. In planet search, fitting single-lens model is generally the first step to identify ongoing anomalies in the light curve. To model complicated microlensing events, single-lens fitting parameters usually serve as an important starting point.

In this session, participants will be provided with software to practice single-lens fitting with both (non-linear) least square and Markov chain Monte Carlo (MCMC) methods. The first activity in this session is to model the photometry they obtained from their previous DIA data reduction session. It will be complemented by data obtained on the same event from other observatories to practice multi-site event fitting. Detailed instructions on installing and using both sets of code will be given on the workshop website a couple of weeks in advance. Brief instructions on how to use these code will be presented at the beginning of this session, and a helper will be assigned to offer support for each individual group.

The rest of the session will be on fitting the light curves appeared on the simulated EWS to identify events of interest for follow-up on the next day. This includes finding high-magnification events and predicting their peak magnifications, identifying anomalous events, etc. By the end of Tuesday, group members vote for events to have high-cadence follow-up observations on Wednesday. There is another opportunity to vote for events by the end of Wednesday to have high-cadence release on Thursday, which can override the Tuesday decision.

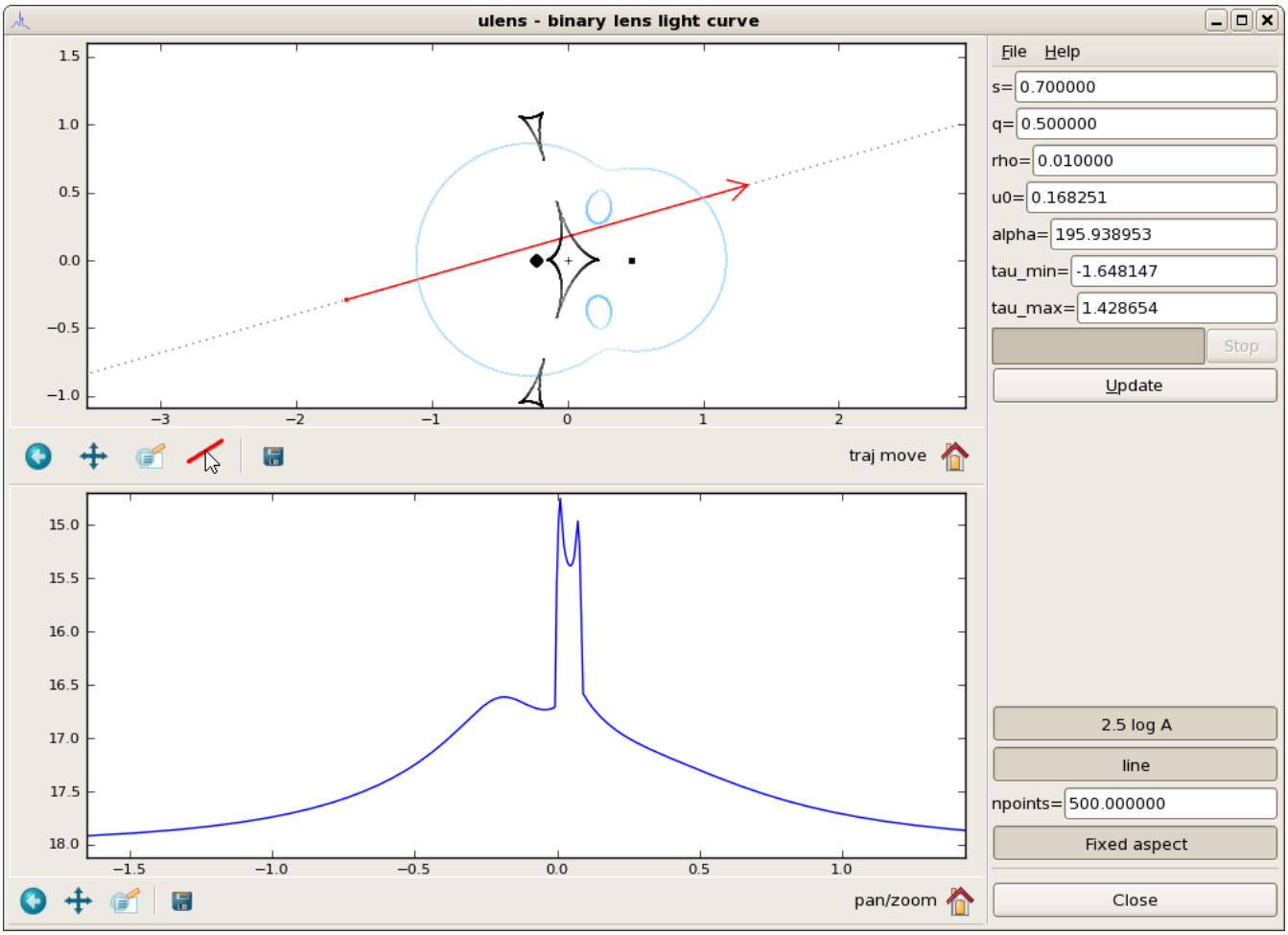
Thursday, Session 4 & 5. Generating Binary/Planetary-lens models and Binary/Planetary-lens Model Fitting



With the Python or IDL graphical tool (GUI), participants can generate binary/planetary-lens model light curves by using various lensing parameters and interactively changing source trajectories. There is also a GUI to help understand image generation for various caustics topologies.

This session starts with a demonstration on how to operate the codes, and participants will be able to see whether the analytical calculations they made in the first session work well.

By the start of this sessions, each group will already have a few anomalous events from the EWS to work on. The goal of this session is to 1. use the single-lens fitting code to estimate the relevant parameters for the underlying single-lens model (such as the impact parameter u0) 2. apply the interactive tool to find possible geometries and guess approximate parameters for a given event.



At the beginning of Session 5., a demonstration of planetary-model fitting with MCMC will be given. The basic fitting scheme is similar to that of the single-lens MCMC modeling, while important elements of the fitting procedures will be reviewed. Participants will first be asked to try the example event from Session 1., and compare their fitting results with the literature. Then they will fit the events they evaluated in the previous session to get the best-fit parameters.