WFIRST Microlensing & the community

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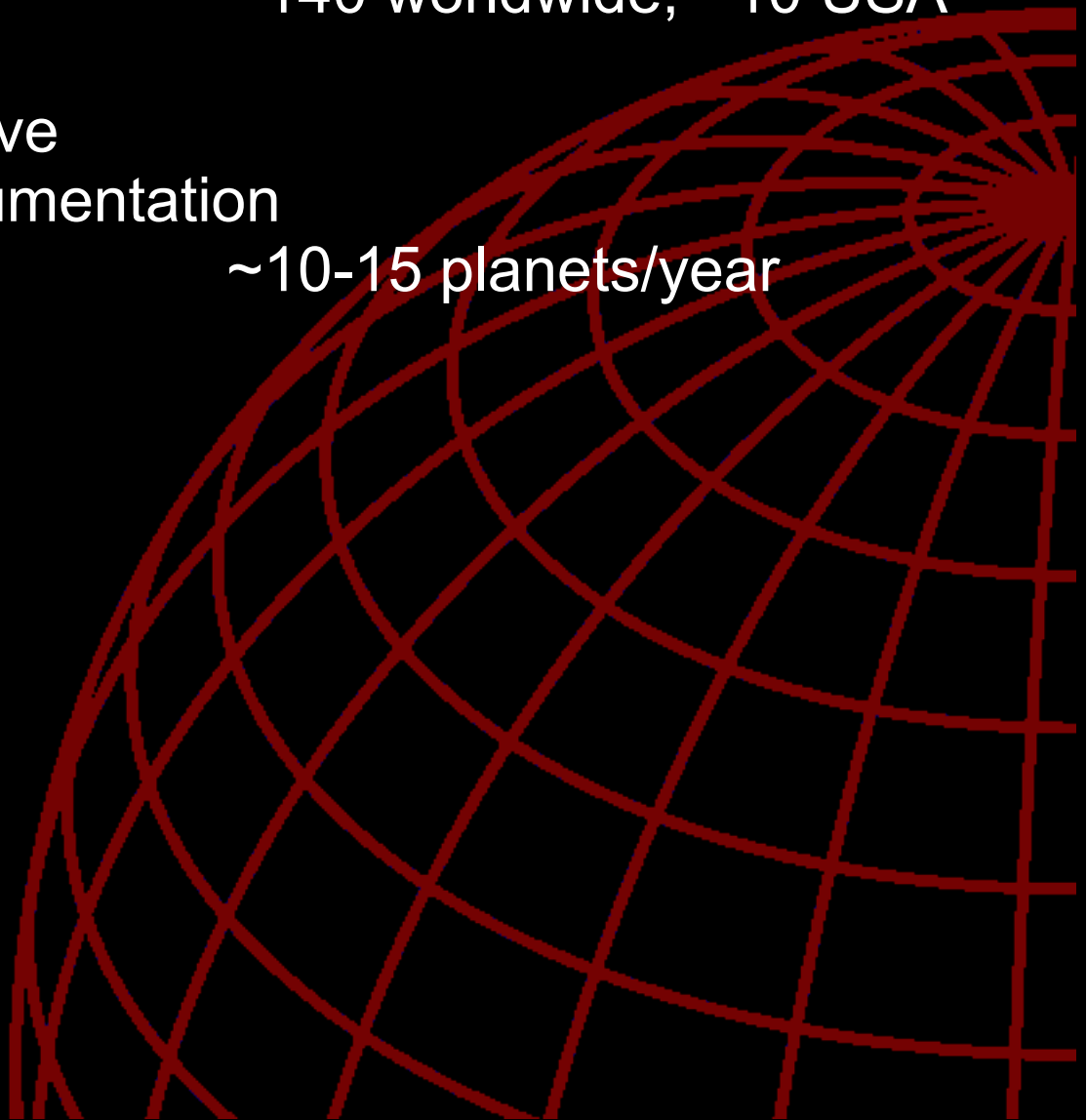
WFIRST Microlensing SIT

Motivations

Microlensing's Small Community

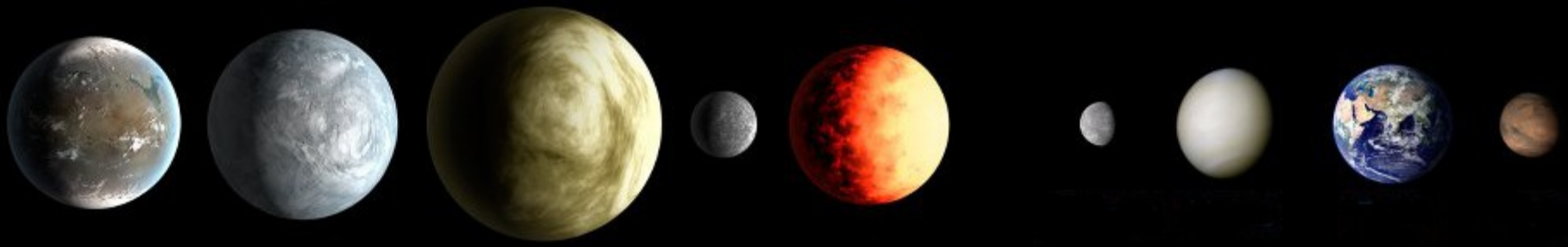
- Few people ~140 worldwide, ~10 USA
- Rarely taught in depth
- Steep perceived learning-curve
- No public software, little documentation
- Heavily manual analysis ~10-15 planets/year
- “Image problem”

→ *Inaccessible*



Motivations

WFIRST bonanza coming!



3000 planets

1000 superEarths

300 Earth-mass planets

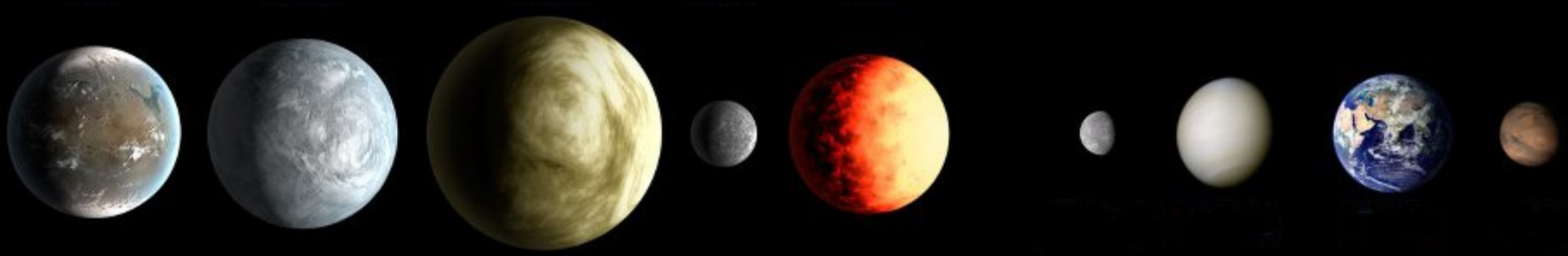
40 Mars-mass planets

40 Earth-mass FFPs?

WFIRST Science Definition Team 2015

Motivations

WFIRST bonanza coming!



Plus wealth of other events...

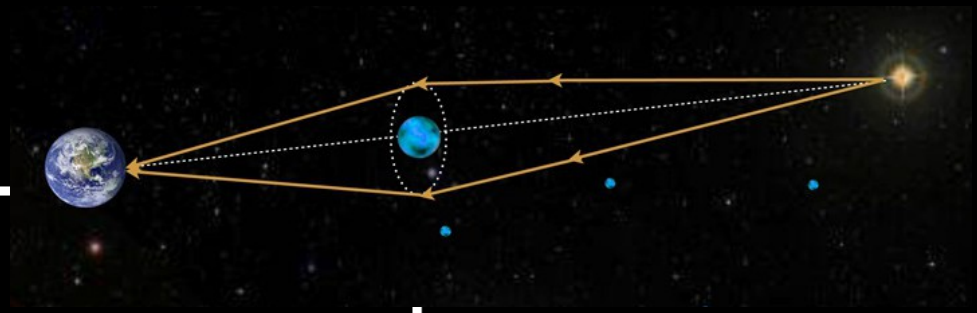
- Stellar binaries and higher multiple systems
- Lensing by compact objects
- ….

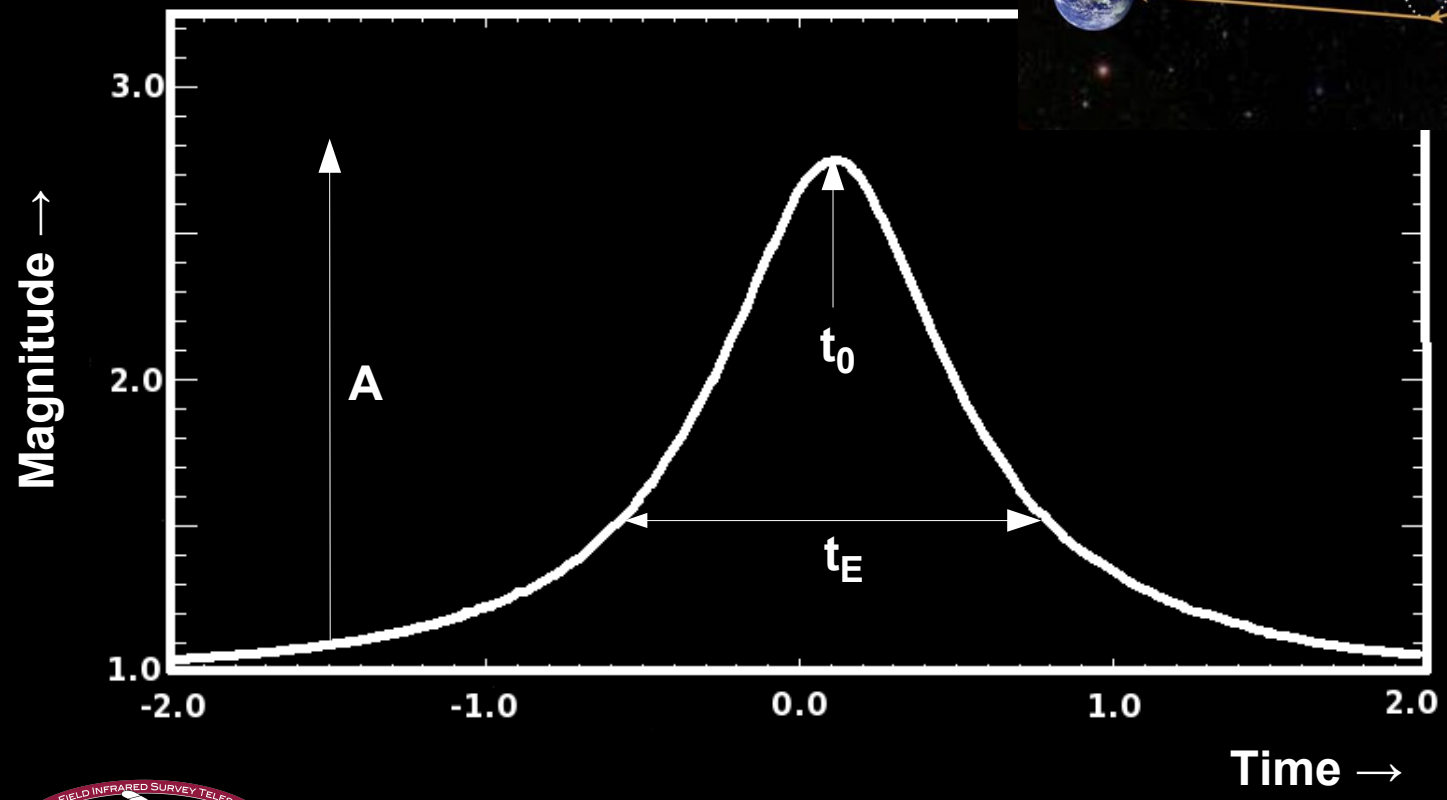
Need people to analyse the data

Event Analysis

Current situation

- Well understood for majority of events

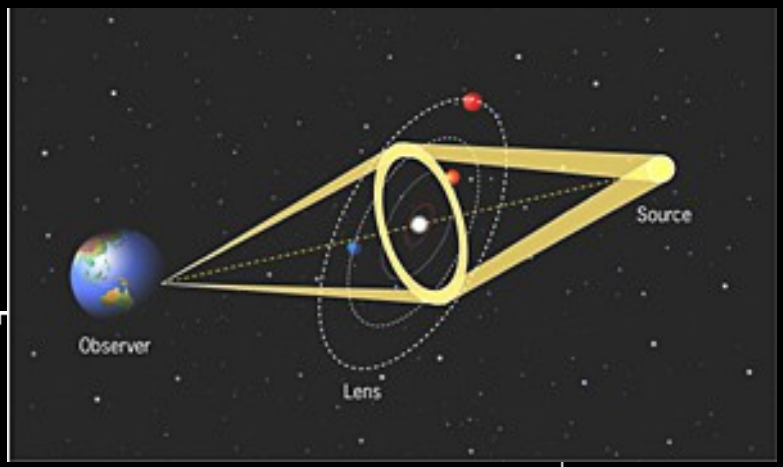


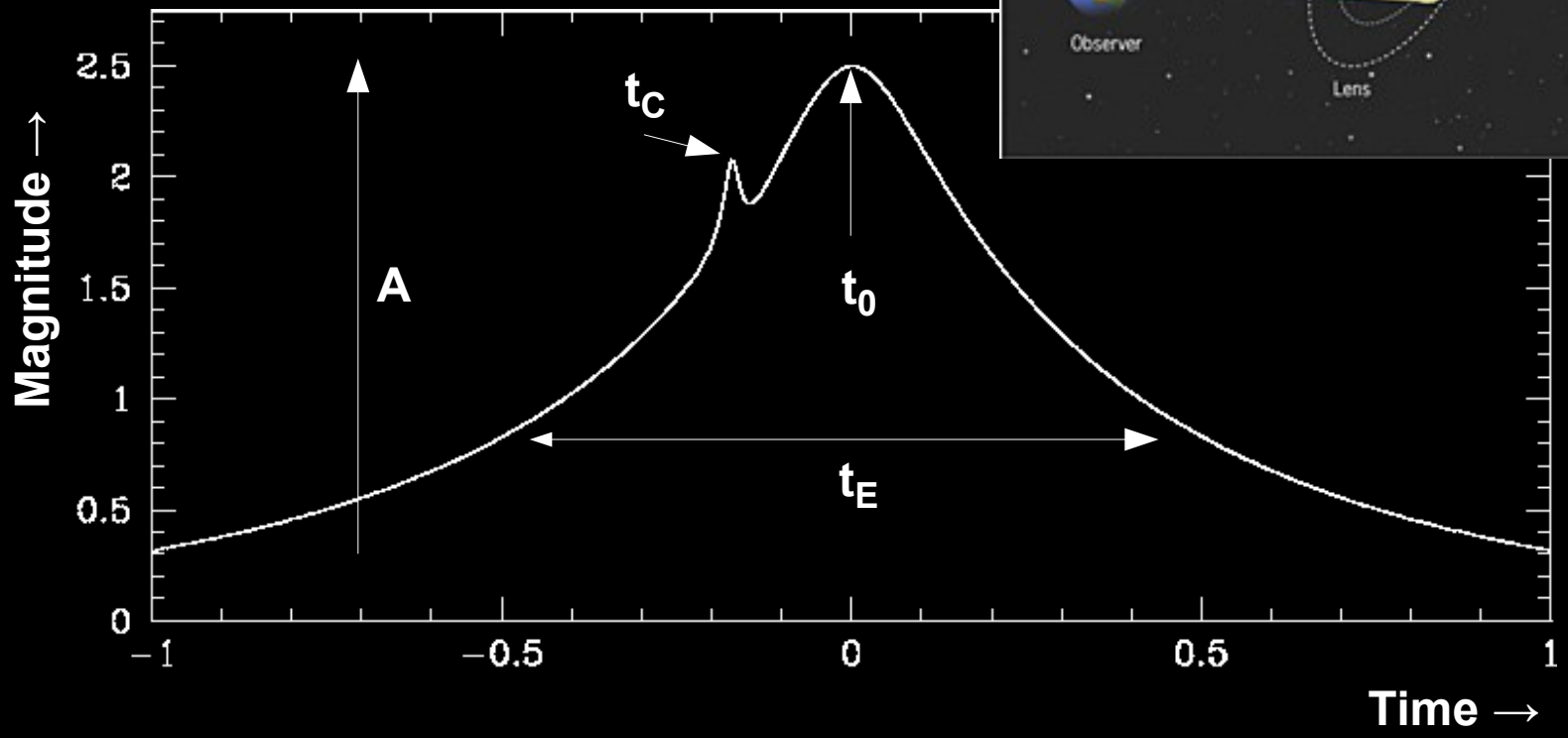


Event Analysis

Current situation

- Well understood for majority of events
- Mostly manual analysis can be automated





Automated Event Analysis

Current situation

Operational for single and most caustic-crossing events

Dipartimento di Fisica "E.R. Caianiello"

Università degli Studi di Salerno

Gravitational Physics and Astrophysics

RTModel

Real-Time Microlensing Modelling by Valerio Bozza

About RTModel

Events modelled in 2015

Planetary

OB150051 OB150966 OB151179 OB151395 OB151609

OB151726 OB151737

Binary or Planetary

KB150085 OB150232 OB151785

Binary

KB150020 KB150052 KB150079 KB150483 OB150001

∗ *RTModel by Valerio Bozza – University of Salerno* ∗

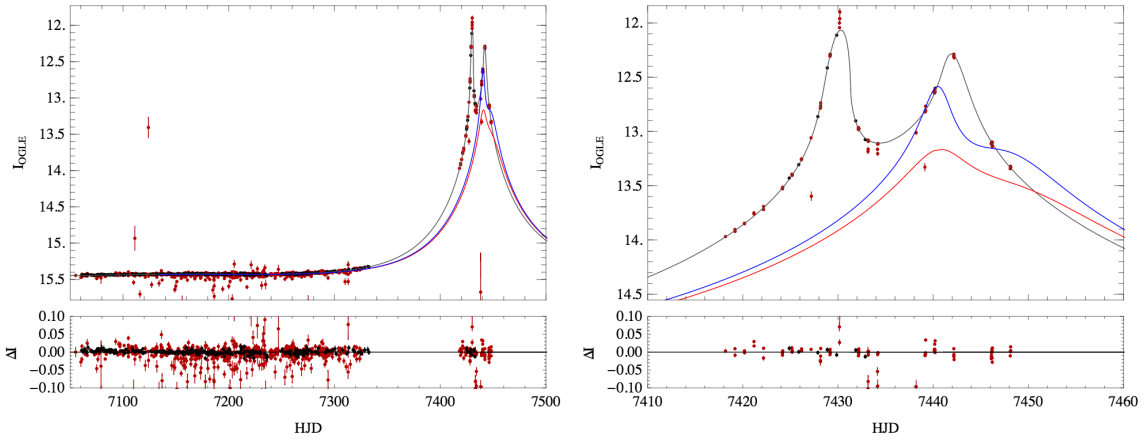
OB167093 – Model: Binary Lens with parallax 1 29 February 2016 UT 20:22:30

s=3.00064±0.0974231 q=0.375336±0.0478645 u0=0.378877±0.0300352

θ=5.59787±0.0788729 ρ_*=0.0101201±0.00695211 tE=84.7476±12.3653

t0=7388.4±2.42869 π1=−0.161103±0.0702203 π2=0.0227062±0.187556

χ2= 50680.2



WIDE-FIELD INFRARED SURVEY TELESCOPE WFIRST ASTROPHYSICS • DARK ENERGY • EXOPLANETS

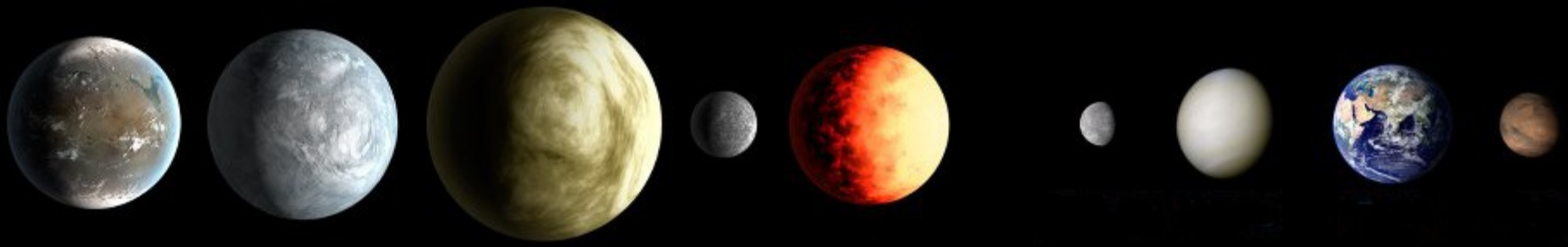
Event Analysis

Current situation

- Automated analysis good...with limitations
  - requires caustic crossings
  - triple/multiple lens modeling
  - …
- Most analysis still manual
- Thorough search of parameter space time consuming
- Human-limited!

Motivations

WFIRST bonanza coming!



3000 planets *stellar binaries* *triple/multiple systems*

Compact objects free-floating planets

We need more people,
bringing diversified expertise

Goals of Community Engagement

- To communicate interest and discovery potential
- To grow and diversify research community
- To make the subject more accessible

Multiple Practical Avenues

Analysis
Public software
Public data

Reference & Training
Reference materials
Online course

Engagement
Data Challenge
Workshop

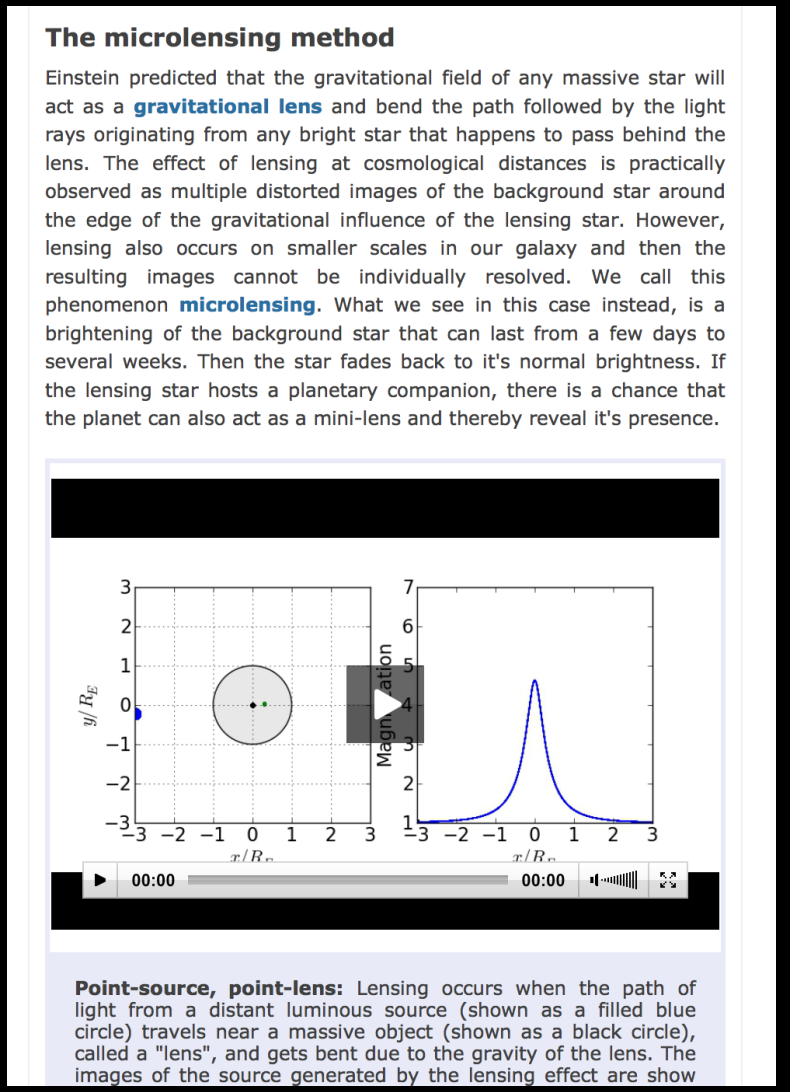
Online Resources

Reference and Training

Students
- Online course materials
- Interactive iPython Notebooks

Reviewers, Educators
- One-stop location for quick reference

Presenters, Outreach
- Illustrations, movies



Analysis Software

Current Software

- Private
- Undocumented
- Little systematic testing or verification
- User unfriendly
- Mostly not automated
- Often time-consuming

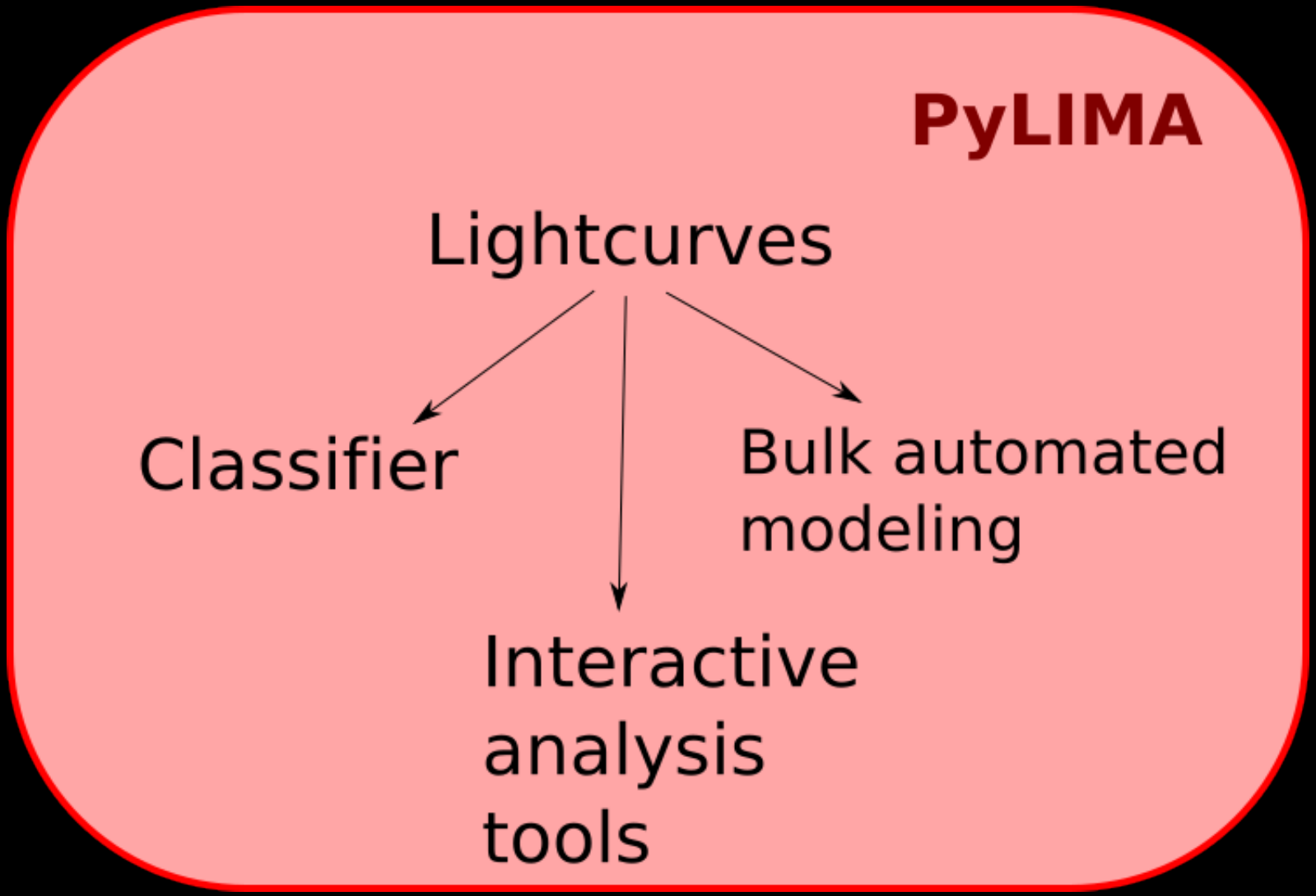
PyLIMA Analysis Software

Under development

- Open source (via GitHub)
- Python-based
- Automated bulk analysis + interactive “toolkit”
- Modular framework designed for community participation
- Professional coding standards & testing process
- Documented

Etienne Bachelet, LCOGT
Valerio Bozza, Salerno

Public Analysis Software



PyLIMA Analysis Software

Progress

Module	Progress	Release
PSPL	Complete	Now
FSPL	Test	June 2016
Binary	Start	End 2016
Parallax	Test	June 2016
Others	Start	Asap !

Public Data...and a Challenge!

- SIT tasked to produce simulated WFIRST dataset
- Will engage astrostats and astroinformatics community to develop new techniques
- Data Challenge dataset will include wide range of lensing events

Real Data Challenges

- Existing ground-based programs have data

  OGLE MOA KMTNet

  RoboNet MicroFUN PLANET MiNDSTEp

- Ongoing efforts to encourage public data access

Summary

- WFIRST is a huge opportunity in microlensing but we need more people!
- Developing several public resources
- Exploring Citizen Science programs
  - “Microlensing PlanetHunters”
- Work begun on public software base
  - On track for end of Phase A