

# 16th Microlensing Season of the Optical Gravitational Lensing Experiment

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OGLE: The Optical Gravitational  
Lensing Experiment  
(1992 - ....)

<http://ogle.astrouw.edu.pl>

<http://bulge.princeton.edu/~ogle>

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## Three Phases of the OGLE Project

- OGLE-I (1992-1995). 1 m Swope telescope at LCO. ~2 million stars observed. Microlensing
- OGLE-II (1997-2000). 1.3 m Warsaw telescope. ~40 million stars observed. Variable and non-Variable Stars in GB, MC
- OGLE-III (2001-....). 8k x 8k mosaic CCD. ~200 million stars observed (GB, GD, MC). Extrasolar Planets, Microlensing

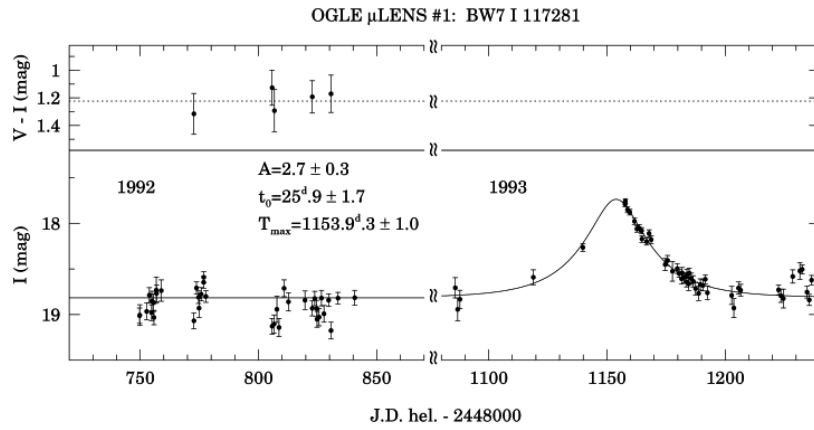
3

## Las Campanas Observatory, Chile



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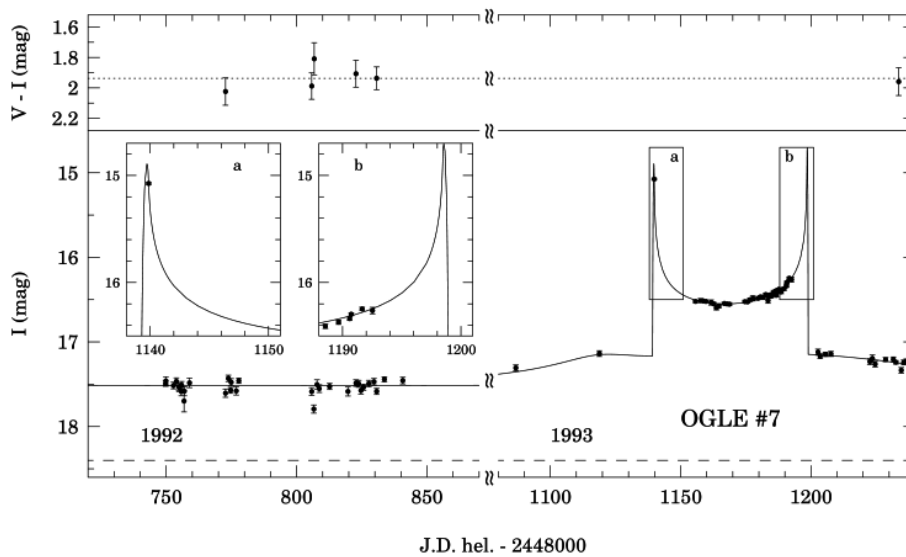
# OGLE-I Results.



Microlenses: **Discovery of the first events toward the GB (1993).**

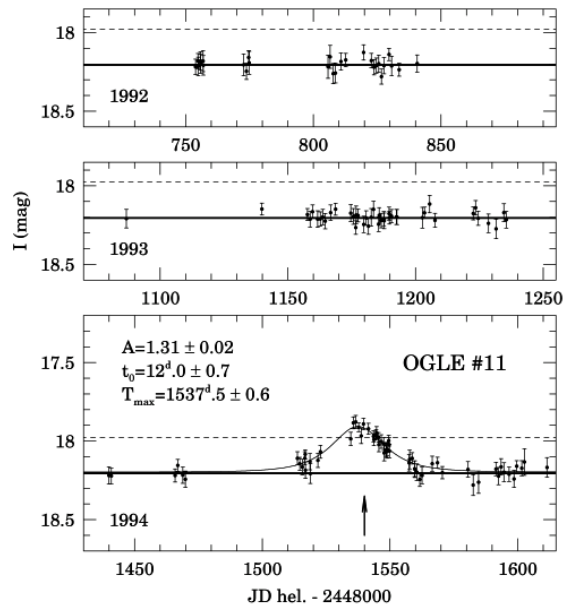
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# First Binary Microlensing (1994)



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## Early Warning System (EWS – 1994)



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## Microlensing Optical Depth:

- First empirical determination (1994):  
 $\tau = 3.3 \times 10^{-6}$

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## OGLE-II (1997—2000)

- New telescope – new targets: Magellanic Clouds
- New CCD Camera – drift scan mode
- ~40 million stars regularly observed
- Variable and non-Variable Stars in GB, MC, gravitational micro and lensing
- Distance scale

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## 1.3 m Warsaw Telescope at LCO



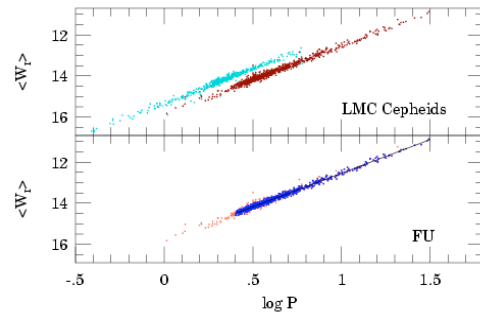
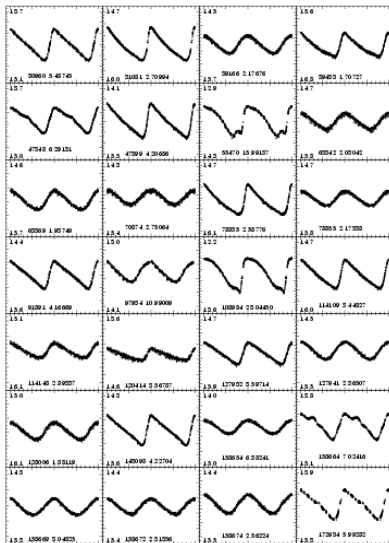
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# Night at LCO



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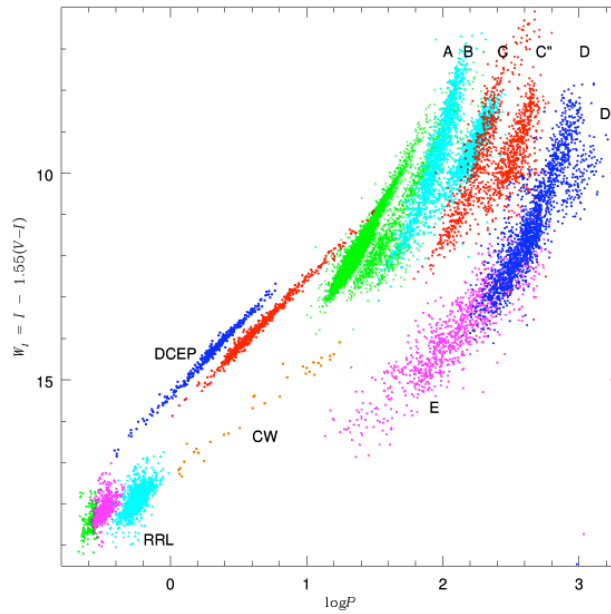
# Cepheids in the MC. PL relations.



Hubble constant is based on OGLE PL relations

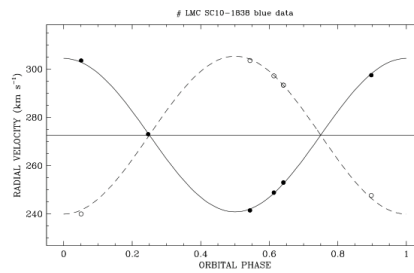
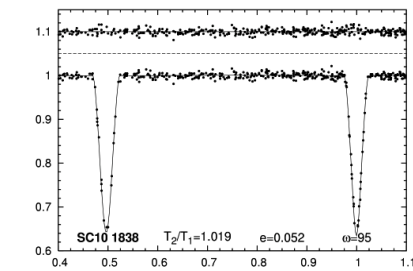
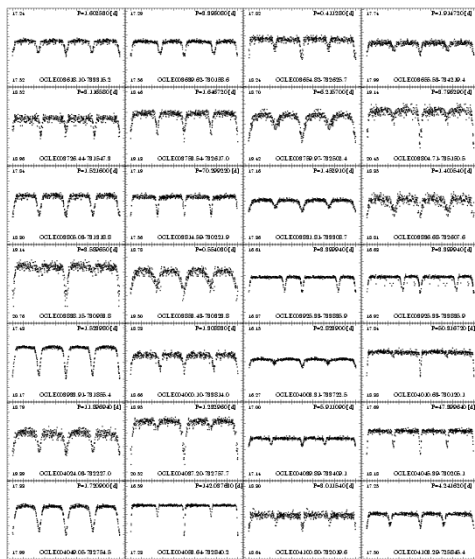
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# Pulsating Red Giants



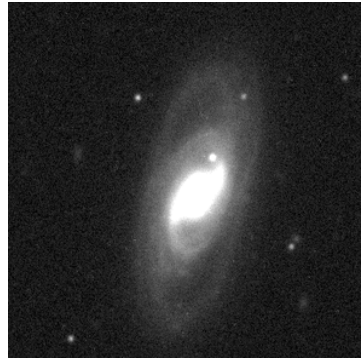
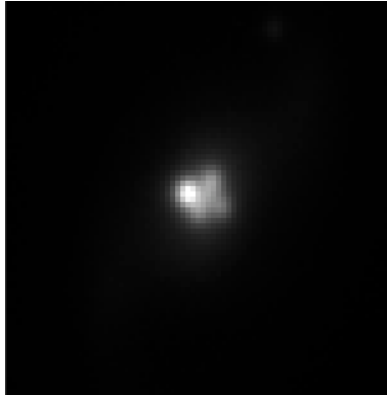
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# Eclipsing Stars (Good distance indicators)



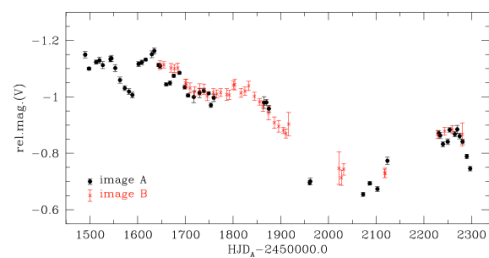
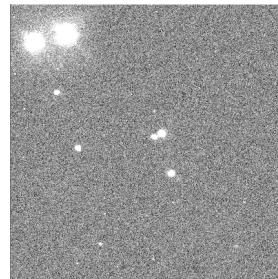
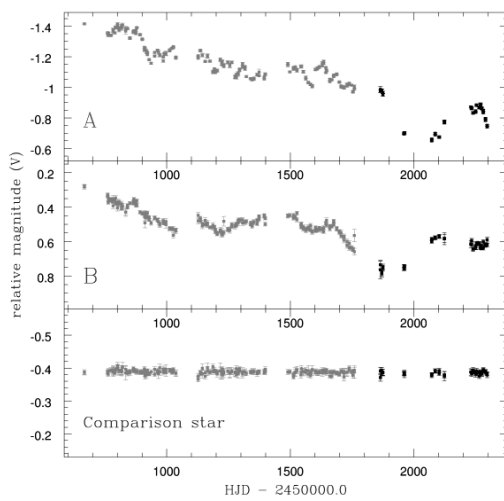
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# Gravitational Lensing. The Einstein Cross.



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# Gravitational Lensing: HE1104—1805



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## OGLE-III (2001-...)

- New 8192 x 8192 pixel mosaic CCD camera (0.26 arcsec/pixel scale): 0.5 x 0.5 sq. degree
- 1.3 m OGLE telescope at Las Campanas Observatory, Chile
- Data Pipeline: photometry derived with image subtraction method (accuracy up to 3 mmag for the brightest stars over a few months long observing run)
- OGLE back in operation on June 12, 2001
- ~200 million stars regularly observed (GB, GD, MC)
- Extrasolar planets, low luminosity objects

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## Warsaw Telescope and 8192x8192 pixel Mosaic Camera



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## Typical OGLE-III Microlensing Season

- EWS Alert System: ~600 microlensing detections (~20 during OGLE-I all four seasons; ~60 per season in OGLE-II)
- EEWS Alert System: ~25 real time anomaly detections
- Several high magnification events, several binary microlensings
- ~<2-3 planetary microlensings

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## Planetary Microlensing – Observing Strategy

- Detection of microlensing events in early phases by the large survey programs like OGLE or MOA
- Follow-up of the most promising events by follow-up programs like microFun, PLANET/ROBONET and survey programs in follow-up mode (OGLE, MOA)
- OGLE – real time alert system (EEWS) detecting anomalies in the light curve of microlensing events (enabling fast switch to from survey to follow-up observing mode)

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## 2007 Microlensing Season

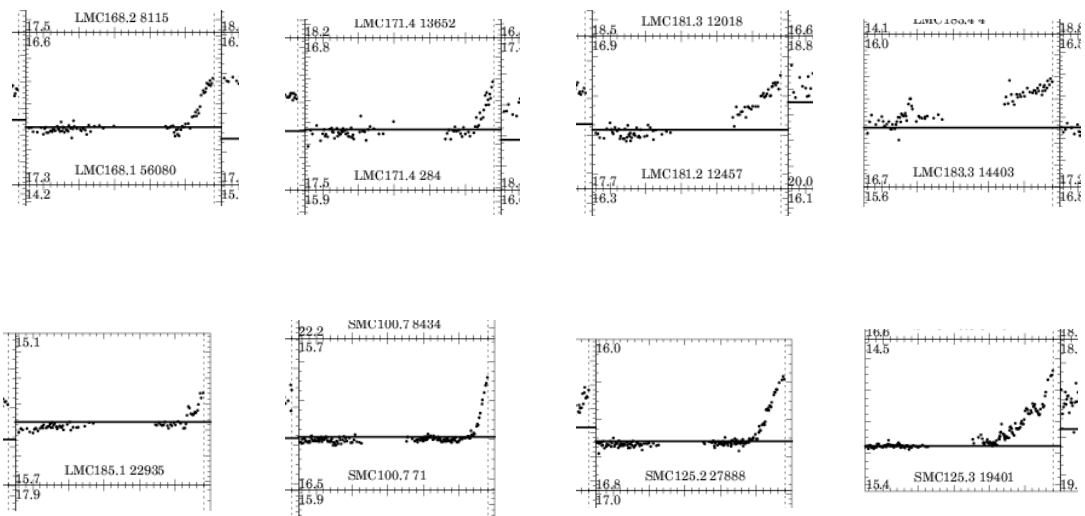
- EWS Alert System: ~600 microlensing detections
- EEWS Alert System: ~20 real time anomaly detections
- Several high magnification events, several binary microlensings

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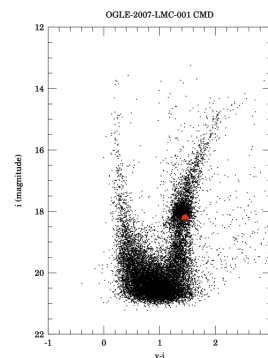
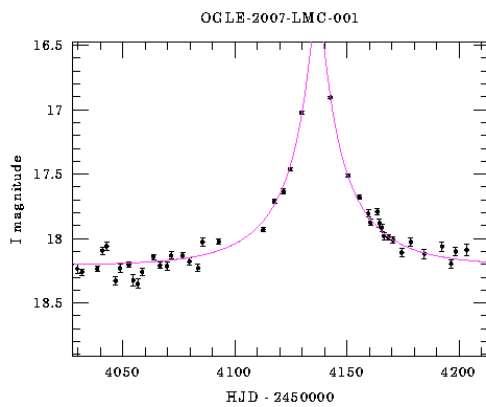
## Magellanic Cloud Microlensing

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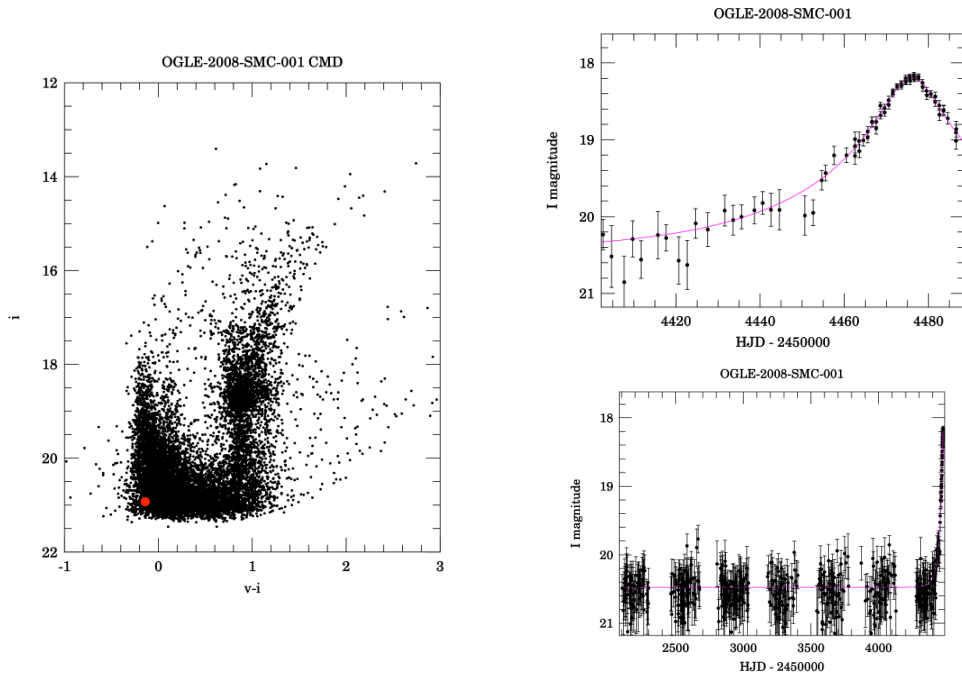
# Fake „early” microlenses



# Magellanic Clouds Microlensing OGLE-2007-LMC-001

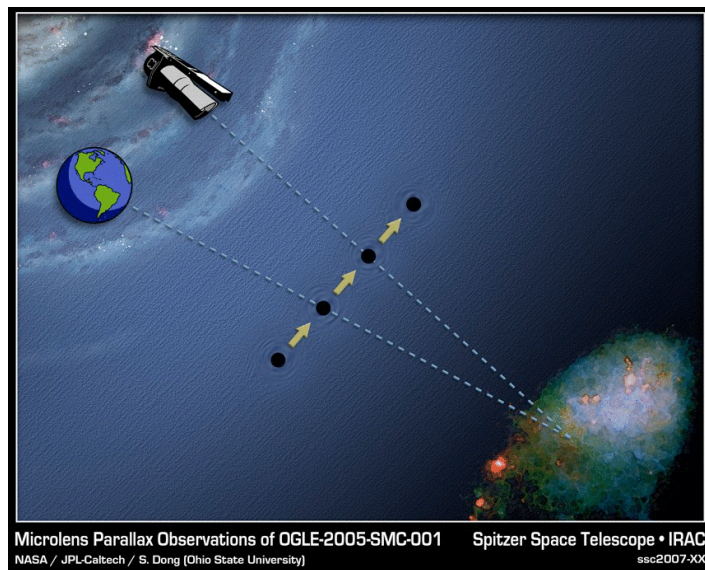


# Magellanic Clouds Microlensing OGLE-2008-SMC-001



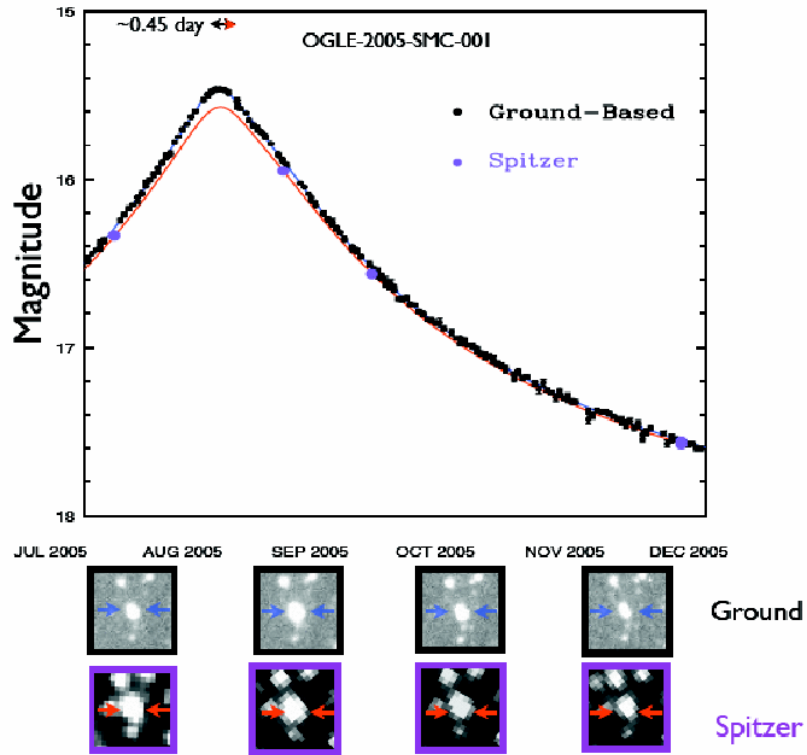
25

# OGLE-2005-SMC-001



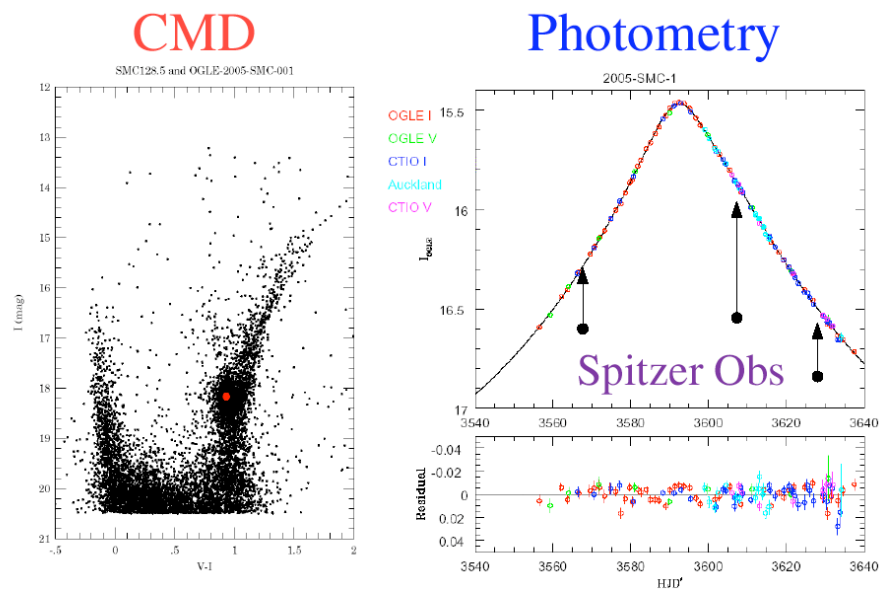
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# Micro lens Parallax



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# OGLE-2005-SMC-001

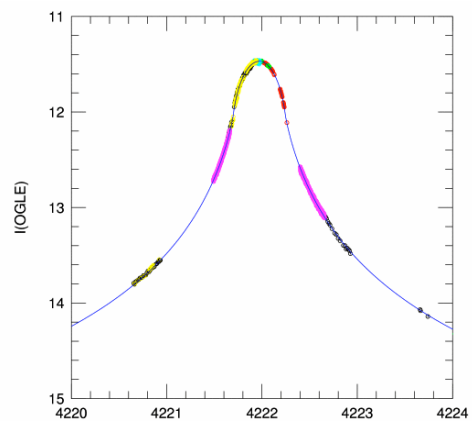
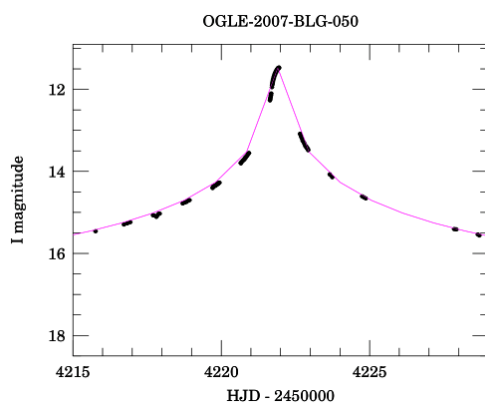


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# 2007 Galactic Bulge Microlensing Season

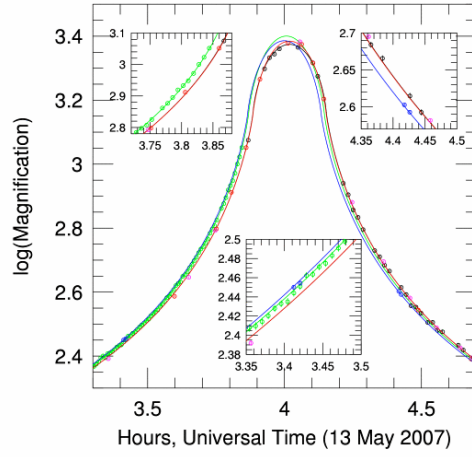
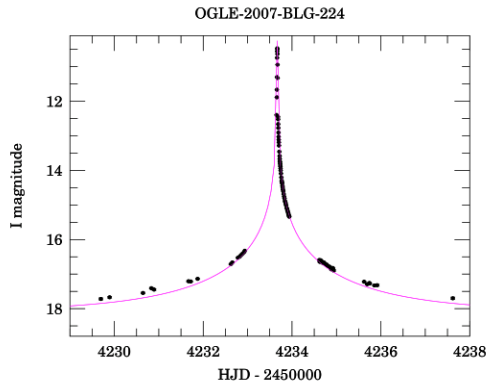
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## 2007 Season Microlensing OGLE-2007-BLG-050



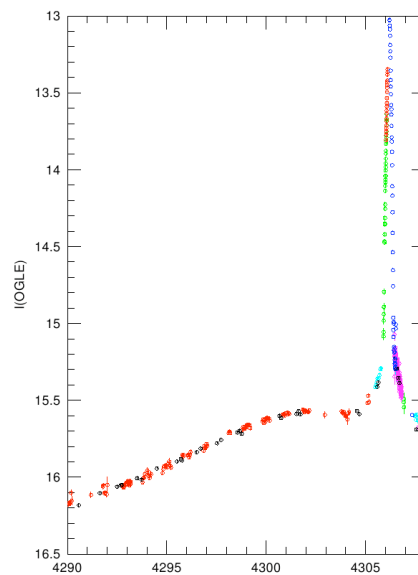
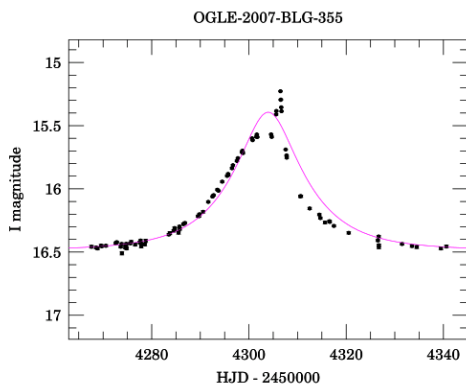
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## 2007 Microlensing Season: OGLE-2007-BLG-224



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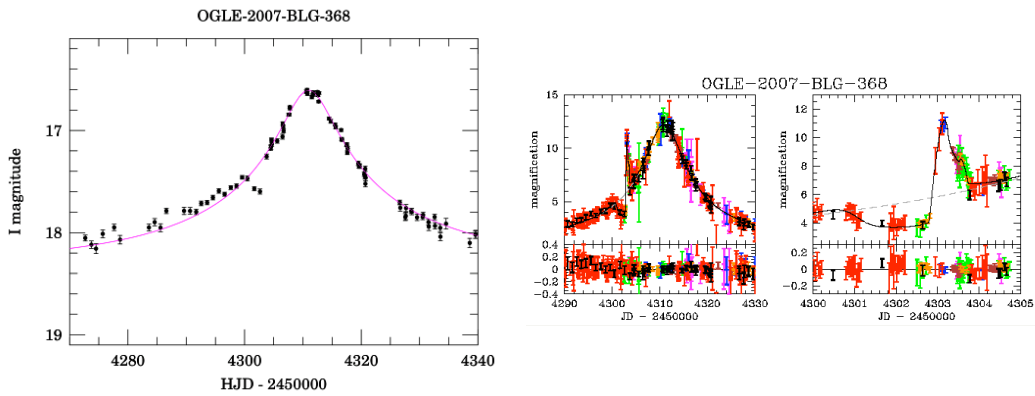
## 2007 Microlensing Season: Spectacular Event OGLE-2007-BLG-355



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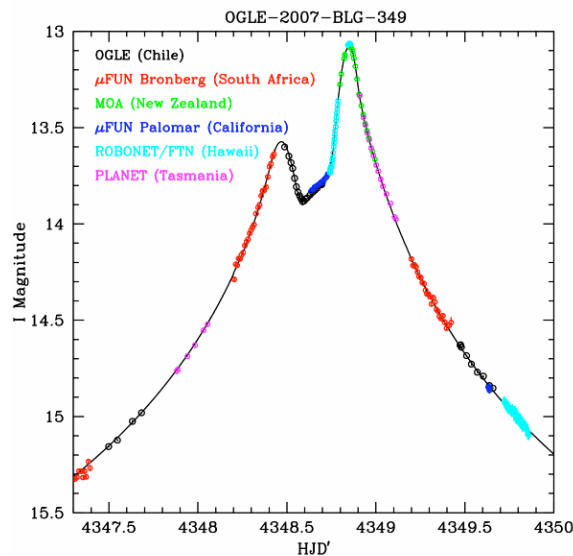
## 2007 Microlensing Season: OGLE-2007-BLG-368



Planetary microlensing.

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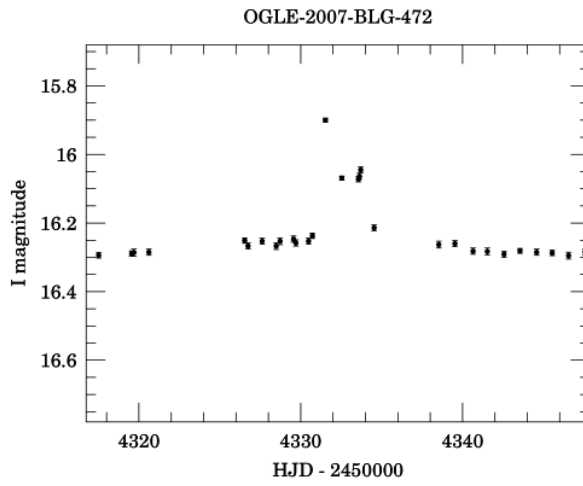
## 2007 Microlensing Season: OGLE-2007-BLG-349



Planetary microlensing

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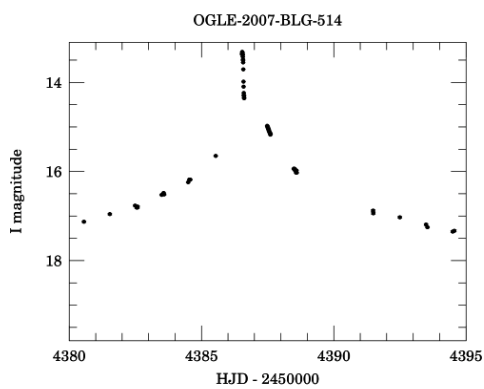
## 2007 Microlensing Season: OGLE-2007-BLG-472



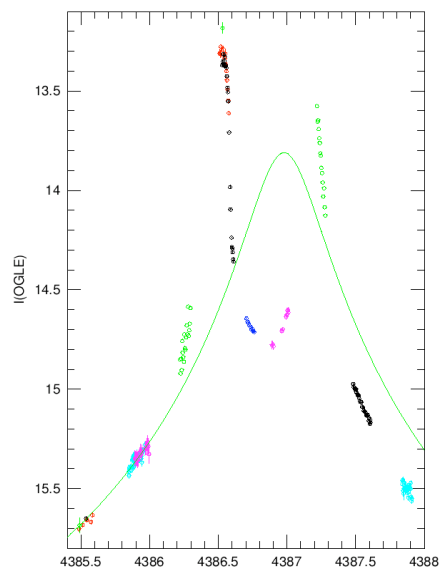
Small  $q$  microlensing.

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## 2007 Microlensing Season: OGLE-2007-BLG-514

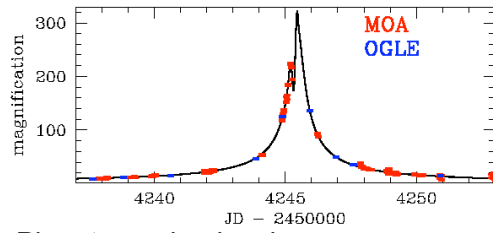
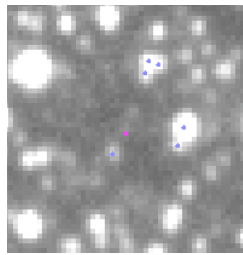
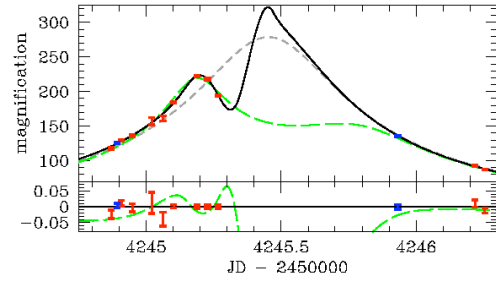
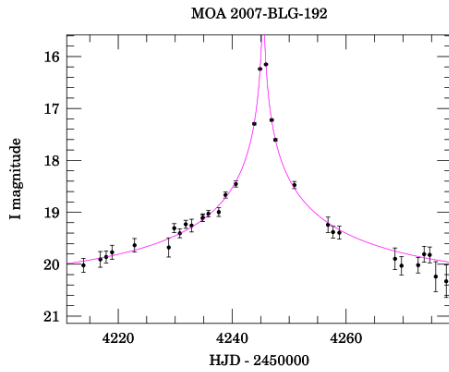


Planetary microlensing?



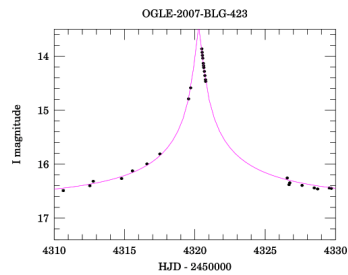
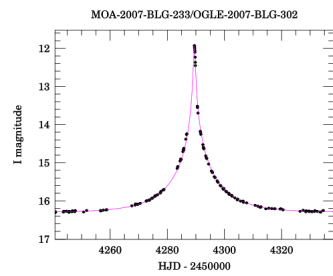
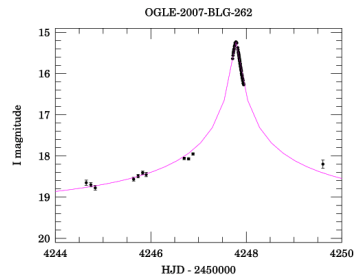
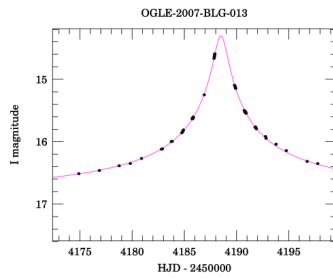
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# 2007 Microlensing Season: MOA 2007-BLG-192

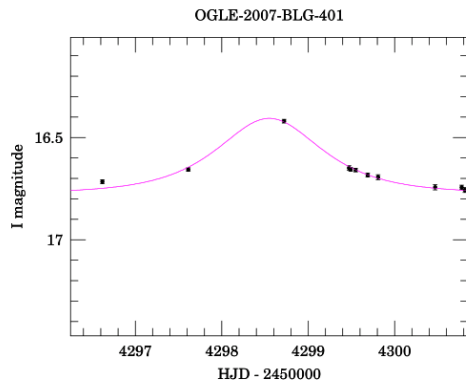


Planetary microlensing.

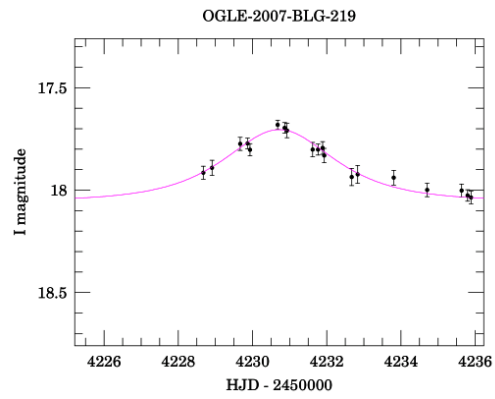
# 2007 Microlensing Season: High Magnification Events



## 2007 Microlensing Season: Short time-scale microlensing



$t_E=0.8$  days



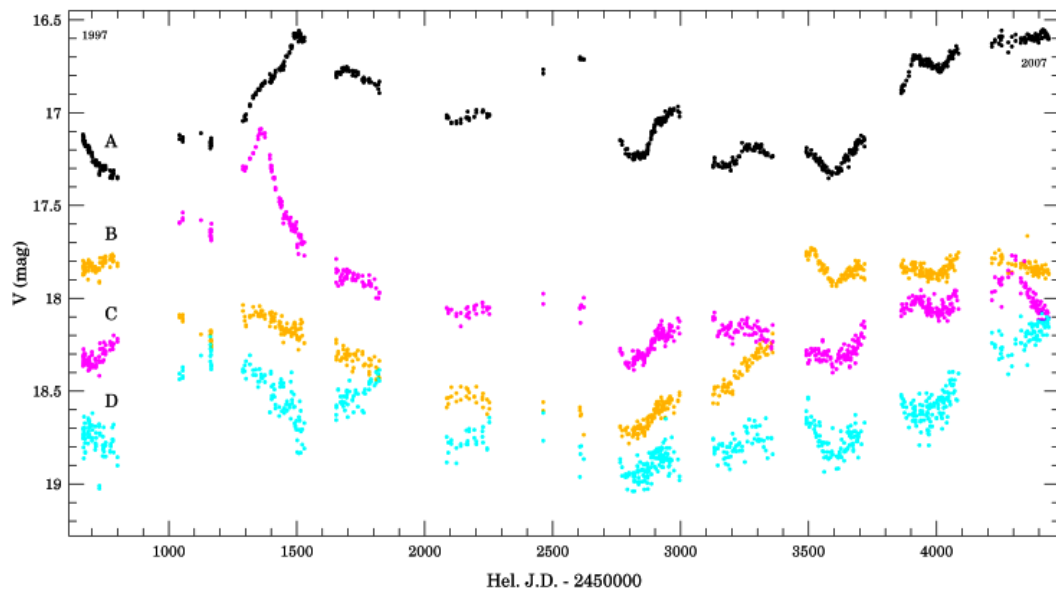
$t_E=1.8$  days

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## Gravitational Lensing Einstein Cross – 2007

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# Eleven Years Monitoring of the Einstein Cross



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# MISC

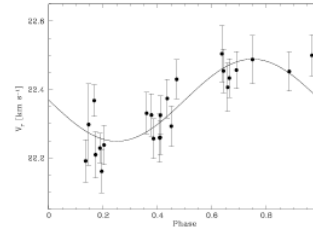
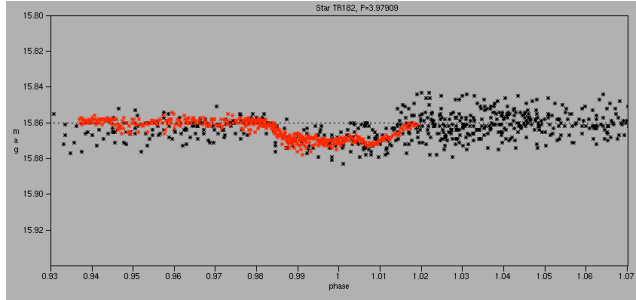
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# OGLE-TR-182

A transiting planet among 23 new near-threshold candidates from the OGLE survey\* — OGLE-TR-182

astro-ph/0710.5278

F. Pont<sup>1</sup>, O. Tamuz<sup>2</sup>, A. Udalski<sup>3,4</sup>, T. Mazeh<sup>2</sup>, F. Bouchy<sup>5</sup>, C. Melo<sup>6</sup>, D. Naeff<sup>6</sup>, C. Moutou<sup>7</sup>, R. Diaz<sup>13</sup>, W. Gieren<sup>1</sup>, M. Gillon<sup>1</sup>, S. Hoyer<sup>14</sup>, M. Kubiak<sup>3,4</sup>, M. Mayor<sup>1</sup>, D. Minniti<sup>8</sup>, G. Pietrzyński<sup>3,4,7</sup>, D. Queloz<sup>1</sup>, S. Ramirez<sup>9</sup>, M. T. Ruiz<sup>11</sup>, N.C. Santos<sup>12</sup>, I. Soszyński<sup>3,4</sup>, O. Szewczyk<sup>3,4</sup>, M.K. Szymański<sup>3,4</sup>, S. Udry<sup>1</sup>, K. Ulaczyk<sup>3,4</sup>, L. Wyrzykowski<sup>3,4</sup>, M. Zoccali<sup>10</sup>



$P=3.97910$  days,  $M_p=1.01\pm 0.15 M_J$ ,  $R_p=1.13 +0.24-0.08 R_J$   
 Typical hot Jupiter.

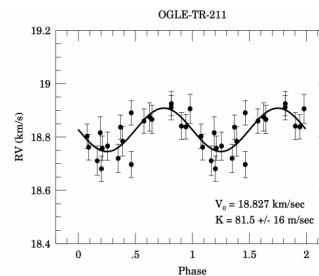
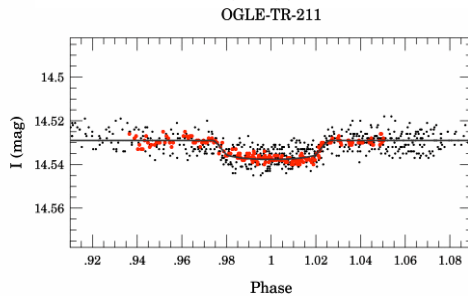
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# OGLE-TR-211

OGLE-TR-211 – a new transiting inflated hot Jupiter from the OGLE survey and ESO LP666 spectroscopic follow-up program \*

astro-ph/0711.3978

A. Udalski<sup>1,2</sup>, F. Pont<sup>3</sup>, D. Naeff<sup>4</sup>, C. Melo<sup>5</sup>, F. Bouchy<sup>6</sup>, N.C. Santos<sup>6</sup>, C. Moutou<sup>7</sup>, R.F. Diaz<sup>8</sup>, W. Gieren<sup>9</sup>, M. Gillon<sup>9</sup>, S. Hoyer<sup>10</sup>, M. Mayor<sup>1</sup>, T. Mazeh<sup>11</sup>, D. Minniti<sup>12</sup>, G. Pietrzyński<sup>12,9</sup>, D. Queloz<sup>1</sup>, S. Ramirez<sup>13</sup>, M.T. Ruiz<sup>14</sup>, O. Tamuz<sup>15</sup>, S. Udry<sup>1</sup>, M. Zoccali<sup>15</sup>, M. Kubiak<sup>1,2</sup>, M.K. Szymański<sup>1,2</sup>, I. Soszyński<sup>1,2</sup>, O. Szewczyk<sup>12,9</sup>, K. Ulaczyk<sup>1,2</sup>, L. Wyrzykowski<sup>1,2</sup>



$P=3.67724$  days,  $M_p=1.03 \pm 0.20 M_J$ ,  $R_p=1.36 +0.18-0.09 R_J$

Radius ~20% larger than that of typical hot Jupiter: another „inflated” hot Jupiter.

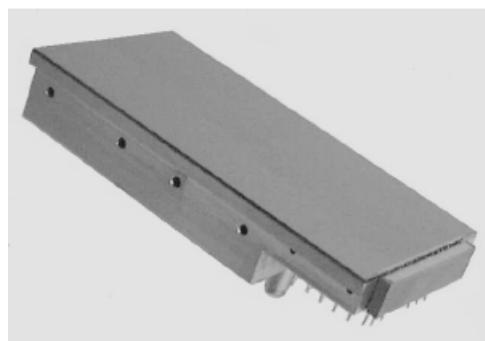
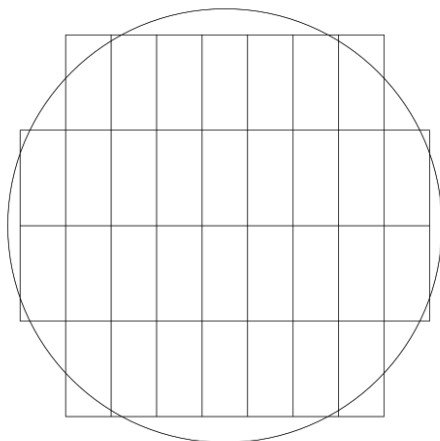
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# OGLE 2008 Plans

- Microlensing campaign – 2007 setup
- New mosaic camera with larger field of view

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## OGLE-IV



- New OGLE Mosaic Camera – 1.4 square degree field
- Contract with E2V signed – 13 chips out of 34 already delivered
  - Expected first light – Early 2009
  - ~10 times larger data flow compared to OGLE-III

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