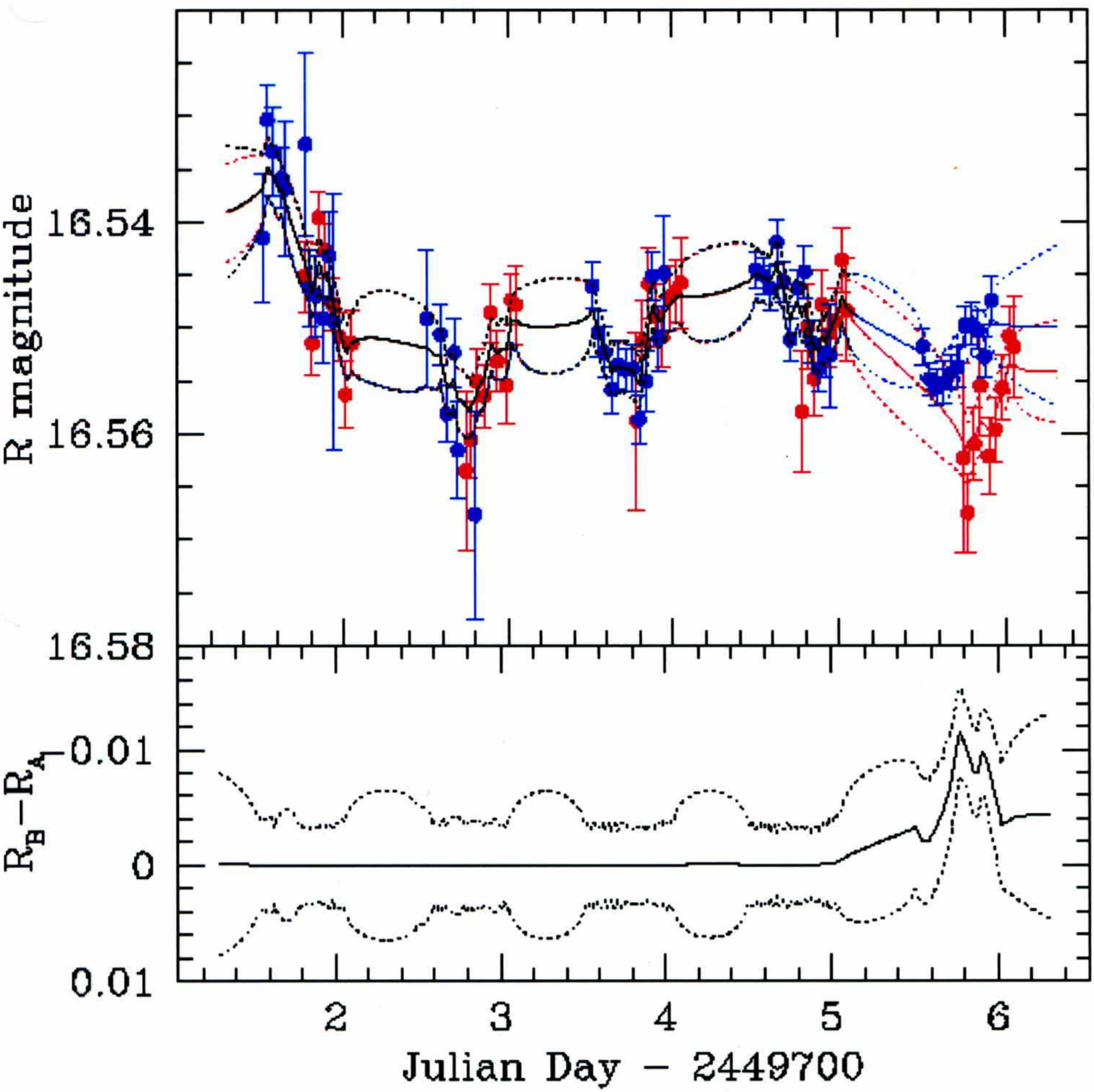


R magnitude
16.54
16.56
16.58
$R_B - R_A$
0.01
0
0.01
2
3
4
5
6
Julian Day − 2449700

GRAVITATIONAL LENSING SCALES

	Lens Mass		Angular Scale
Gravitational Lensing	10^{10} M⊙	galaxy	1 arcsec
'' millilensing	10^{6} M⊙	globular cl.	10^{-3} arcsec
'' microlensing	1 M⊙	star	10^{-6} arcsec
'' nanolensing	10^{-6} M⊙	planet	10^{-9} arcsec

ALTERNATIVE EXPLANATIONS OF RAPID MICROLENSING

1. Orbiting dark blobs eclipsing the black hole. Requires close-in dark clouds moving at relativistic velocities ~ 0.1 c

Measuring the Size of Quasar Broad-Line Clouds Through Time Delay Light-Curve Anomalies of Gravitational Lenses

J. Stuart B. Wyithe[1] and Abraham Loeb

Harvard-Smithsonian Center for Astrophysics, 60 Garden St., Cambridge, MA 02138; swyithe@cfa.harvard.edu, aloeb@cfa.harvard.edu

2. Bright objects orbiting at relativistic velocities ~ 0.2 c

SIGNATURES OF ACCRETION DISKS IN QUASAR MICROLENSING

ANDREW GOULD[1]

Department of Astronomy, Ohio State University, Columbus, OH 43210; gould@payne.mps.ohio-state.edu

AND

JORDI MIRALDA-ESCUDÉ

Departments of Physics and Astronomy, University of Pennsylvania, Philadelphia, PA 19104; jordi@llull.physics.upenn.edu

Received 1996 December 20; accepted 1997 April 16

Microlensing of Relativistic Knots in the Quasar HE1104−1805

Paul L. Schechter[1,2], A. Udalski[3], M. Szymański[3], M. Kubiak[3], G. Pietrzyński[3,4], I. Soszyński[3], P. Woźniak[5], K. Żebruń[3], O. Szewczyk[3], and Ł. Wyrzykowski[3]

ORBITING BRIGHT POINTS

1. Bright spots passing cusp pattern reduce relativistic speed requirement.
2. Produces highly periodic effects not observed (Gould and Miralde-Escude (1997).
3. Or requires thousands of hot spots, to get equal + and - peaks.
4. But this produces large statistical fluctuations, not observed (Wyithe & Loeb 2002)
5. No calculation about whether it is possible to have 1000 blobs each having a galaxy luminosity and the size of a super-massive black hole.
6. Since the fluctuations are seen in 2 systems, cannot have special circumstances.
7. All of these assertions need to be checked for the new quasar model.

ORBITING DARK CLOUDS - PROBLEMS

1. Does not produce brightness records that look like the observed ones (Wyithe & Loeb 2003). Problem is worse for the Schild-Vakulik (2003) quasar model

2. Requires coherent dark clouds moving at highly relativistic velocities.

   Why aren't these shredded by differential rotation?

3. Dark clouds in the presence of CIV ?

ORBITING DARK CLOUDS - PROBLEMS

1. Does not produce brightness records that look like the observed ones (Wyithe & Loeb 2003). Problem is worse for the Schild-Vakulik (2003) quasar model

2. Requires coherent dark clouds moving at highly relativistic velocities.

   Why aren't these shredded by differential rotation?

3. Dark clouds in the presence of CIV ?

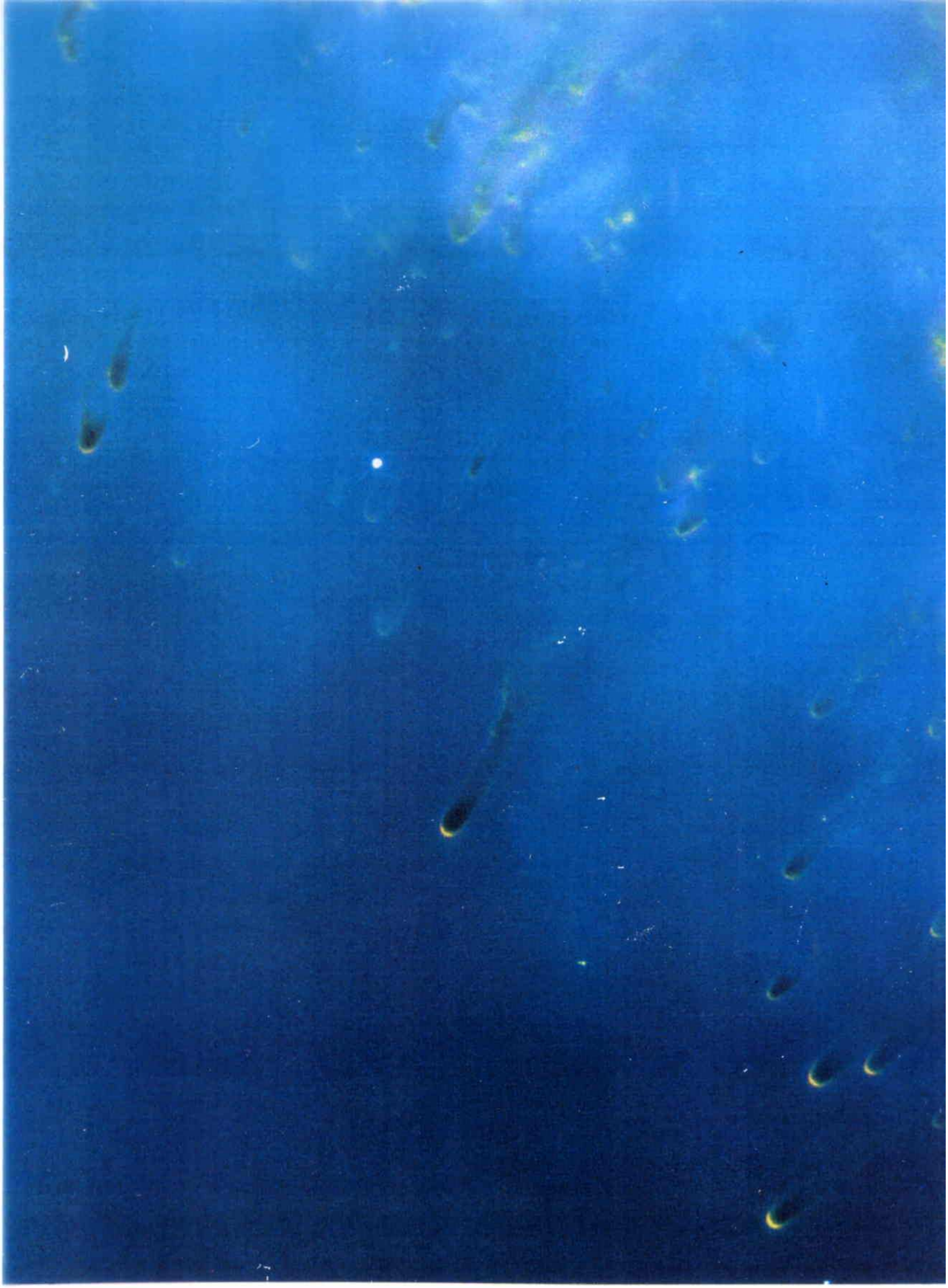


FIG. 3. A portion of Fig. 2 is shown at larger scale. The color designation and orientation are the same, while the field is 735 pixels in X
980 pixels in Y.

C. R. O'Dell and K. D. Handron (see page 1632)

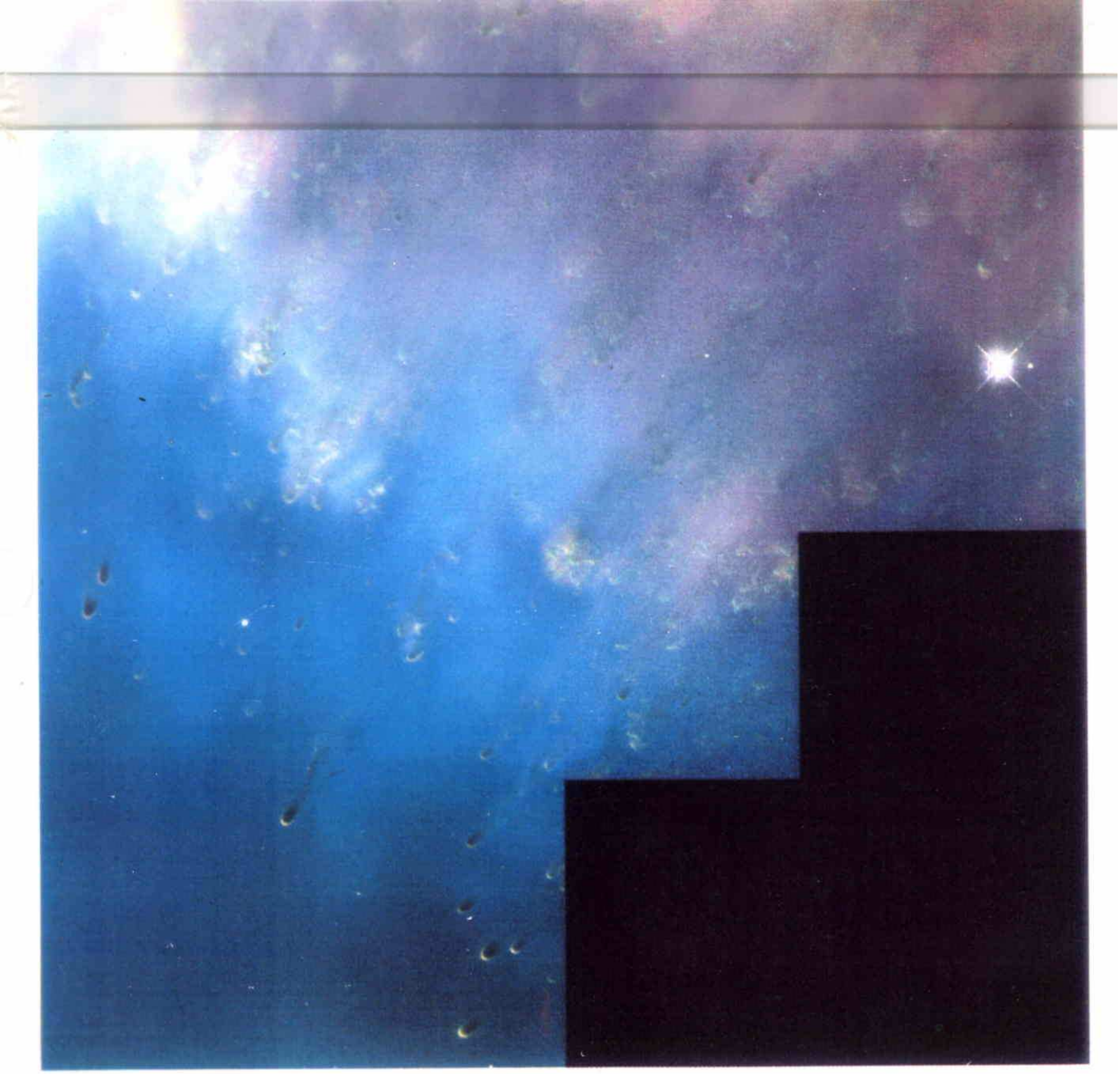


FIG. 2. The full FOV of the WFPC2 image is shown. The vertical axis is oriented towards a position angle of 27°. The illuminated area is 1486 pixels in X and 1504 pixels in Y. The color coding is [O III]=blue, Hα =green, [N II]=red.

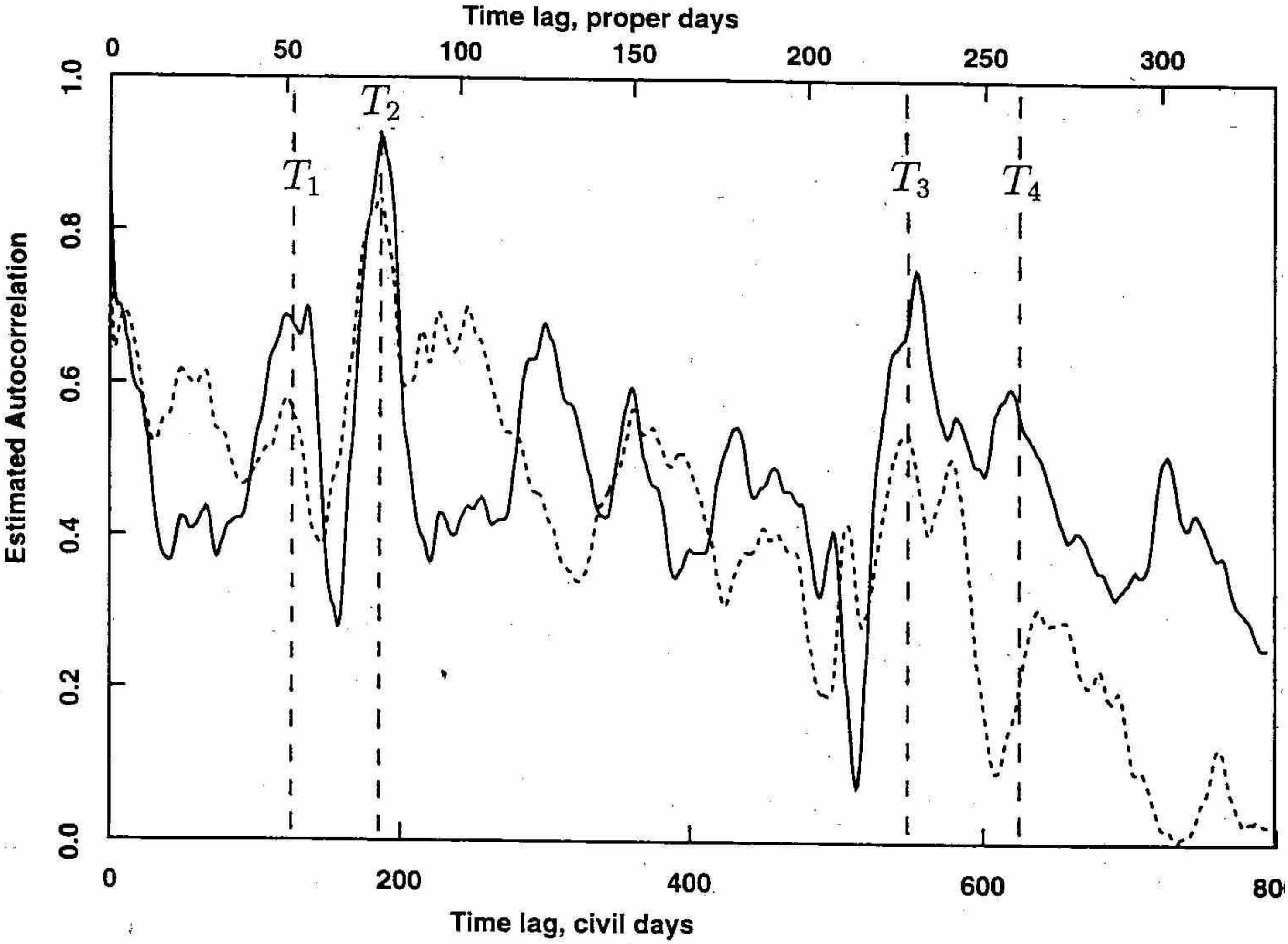
C. R. O'Dell and K. D. Handron (see page 1632)

RAPID MICROLENSING FOLLOW-UP

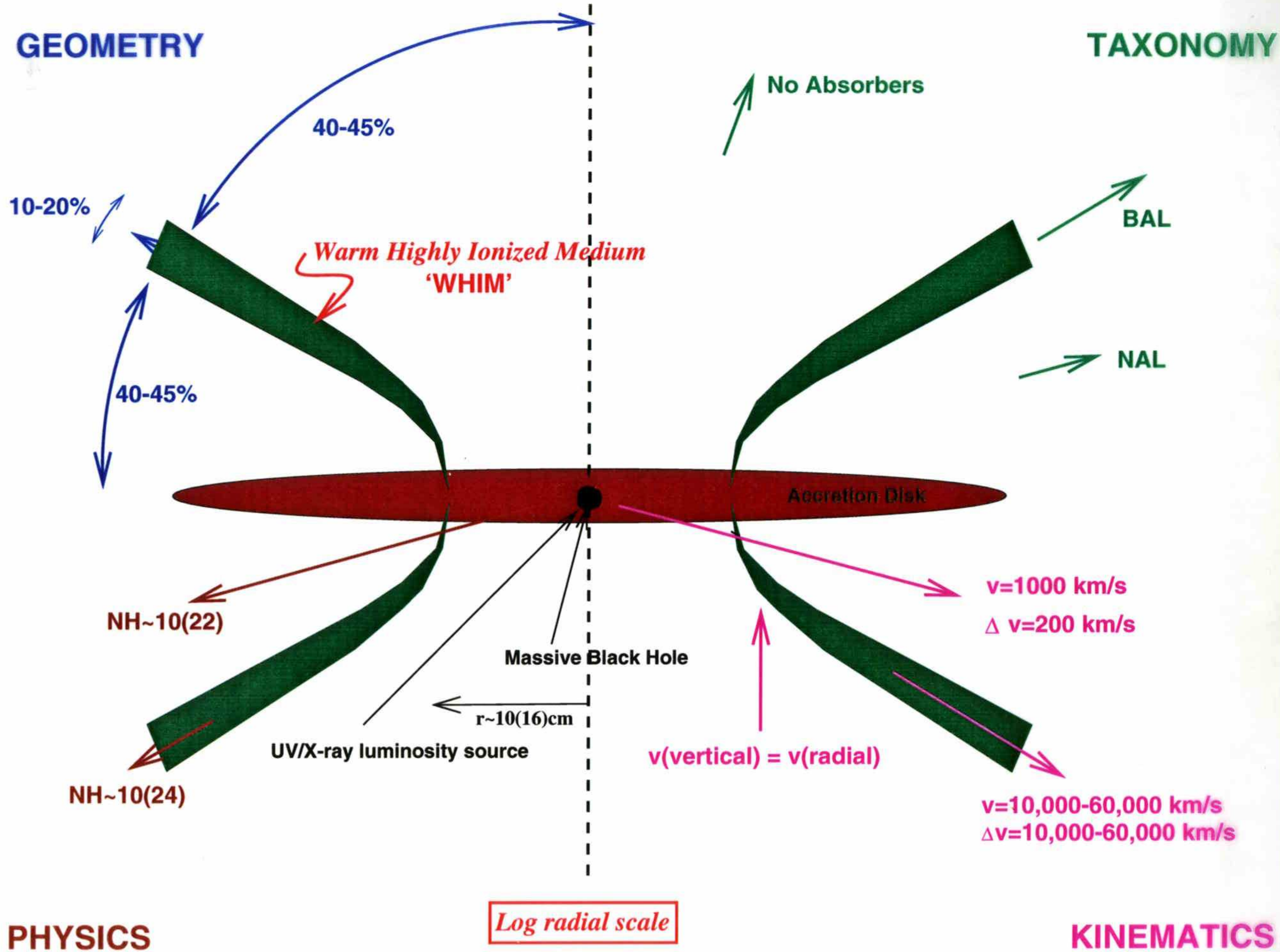
```
                        Fine Structure in      -> Primordial Planets
Lensed Qusars have     /  Baryonic Dark Matter
Rapid Microlensing -> /
                      \                                          Quasar
                       \ Fine quasar Structure -> Schild-Vakulik -> Magnetic
                                                  2003 Model        MECO
```

RAPID MICROLENSING FOLLOW-UP

```
                         Fine Structure in     -> Primordial Planets
Lensed Qusars have     /  Baryonic Dark Matter
Rapid Microlensing -> /
                      \                                           Quasar
                       \ Fine quasar Structure -> Schild-Vakulik -> Magnetic
                                                 2003 Model        MECO
```



Time lag, proper days
0
50
100
150
200
250
300
Estimated Autocorrelation
0.0
0.2
0.4
0.6
0.8
1.0
T_1
T_2
T_3
T_4
0
200
400
600
80
Time lag, civil days


GEOMETRY
TAXONOMY
No Absorbers
40-45%
10-20%
BAL
Warm Highly Ionized Medium
'WHIM'
NAL
40-45%
Accretion Disk
v=1000 km/s
Δ v=200 km/s
NH~10(22)
Massive Black Hole
r~10(16)cm
UV/X-ray luminosity source
v(vertical) = v(radial)
NH~10(24)
v=10,000-60,000 km/s
Δv=10,000-60,000 km/s
Log radial scale
PHYSICS
KINEMATICS

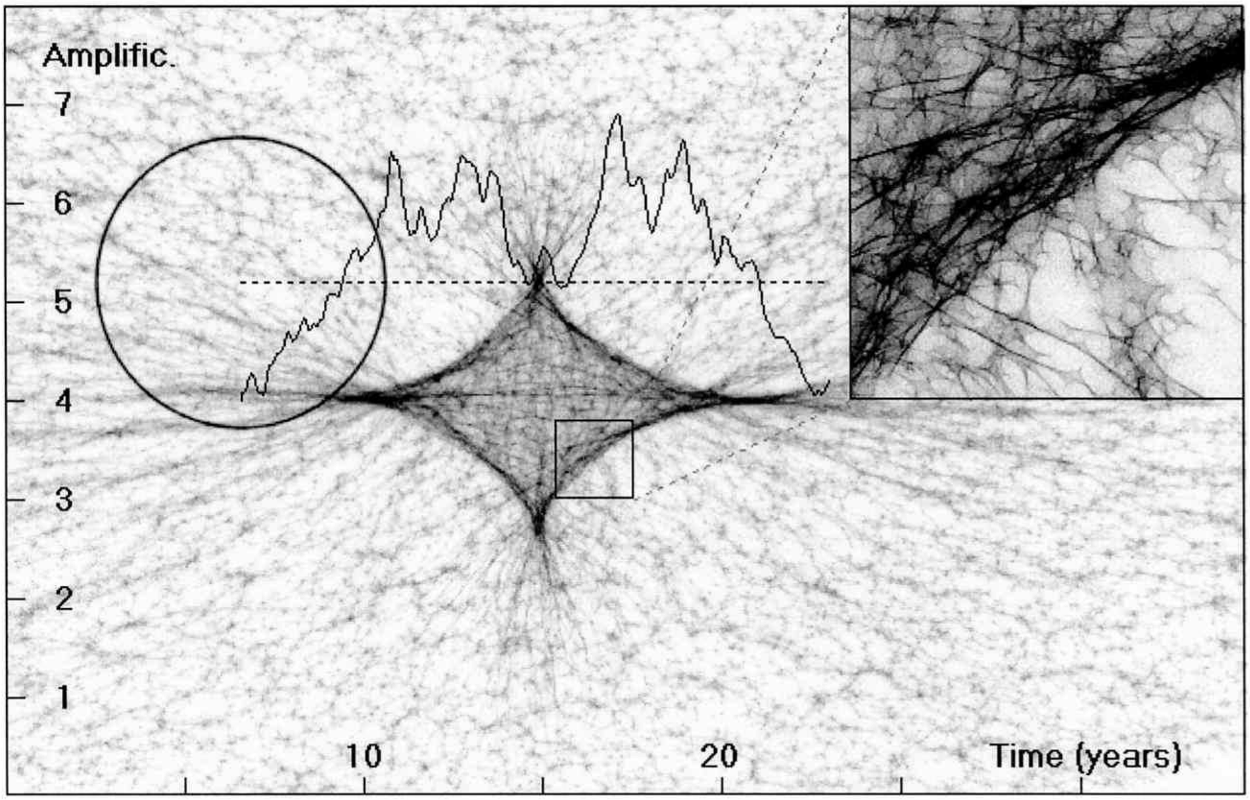


Fig. 2.— Microlensing of the inner ring-shaped luminous quasar structure. As the ring and amplification pattern cross each other, for each center of the ring on the straight line, the amplification is shown above as a broken curve. This curve has more structural detail because of the smaller diameter and thickness of the inner ring. The magnification pattern is calculated for a $0.1 M_{\odot}$ star and for a random distribution of $10^{-5} M_{\odot}$ missing mass particles constituting 90 percent of the baryonic mass.

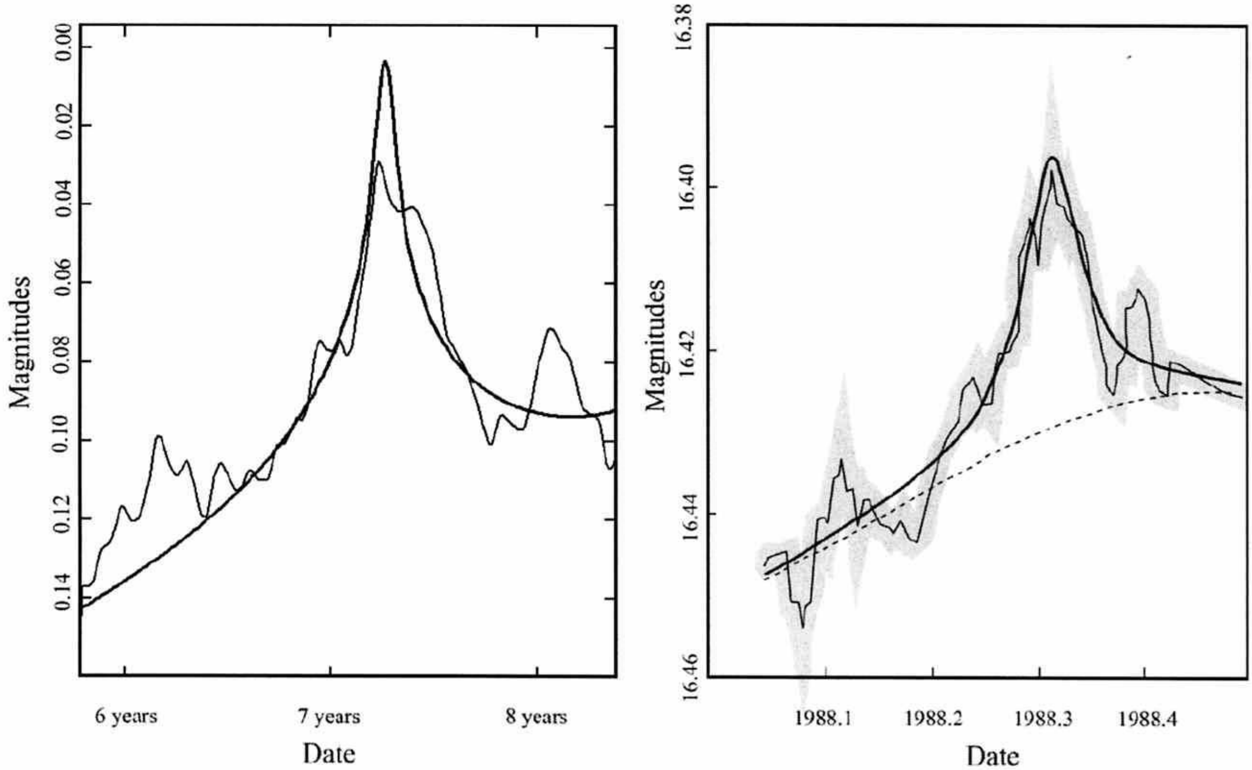


Fig. 4.— Comparison of the modeled microlensing profile and published observations. In the left panel, we repeat the curve plotted as an inset to Fig. 3 but here with magnitude and time scales shown to permit immediate comparison with observations. Thus dates and magnitudes are shown for arbitrary zero points. The heavy solid line shows the computed profile for continuously distributed dark matter, and the lighter line shows the effects of planetary mass dark matter objects. The right panel is a repeat of data published as Fig. 5 of Schild (1996) with observation dates and observed magnitudes shown. The shaded interval is a 1 sigma error interval for the 90 nightly average data points on which the profile is based. Interference between the printer's lithographic dot pattern and the original dot pattern corrupted this error zone shading in the original publication. The heavy solid line is a simple Lorentzian profile fitted to the data, and the dashed line shows a cubic fit to the residuals.

THE ASTROPHYSICAL JOURNAL, 595:1009–1031, 2003 October 1

THREE-DIMENSIONAL SIMULATIONS OF DISK ACCRETION TO AN INCLINED DIPOLE. I. MAGNETOSPHERIC FLOWS AT DIFFERENT Θ

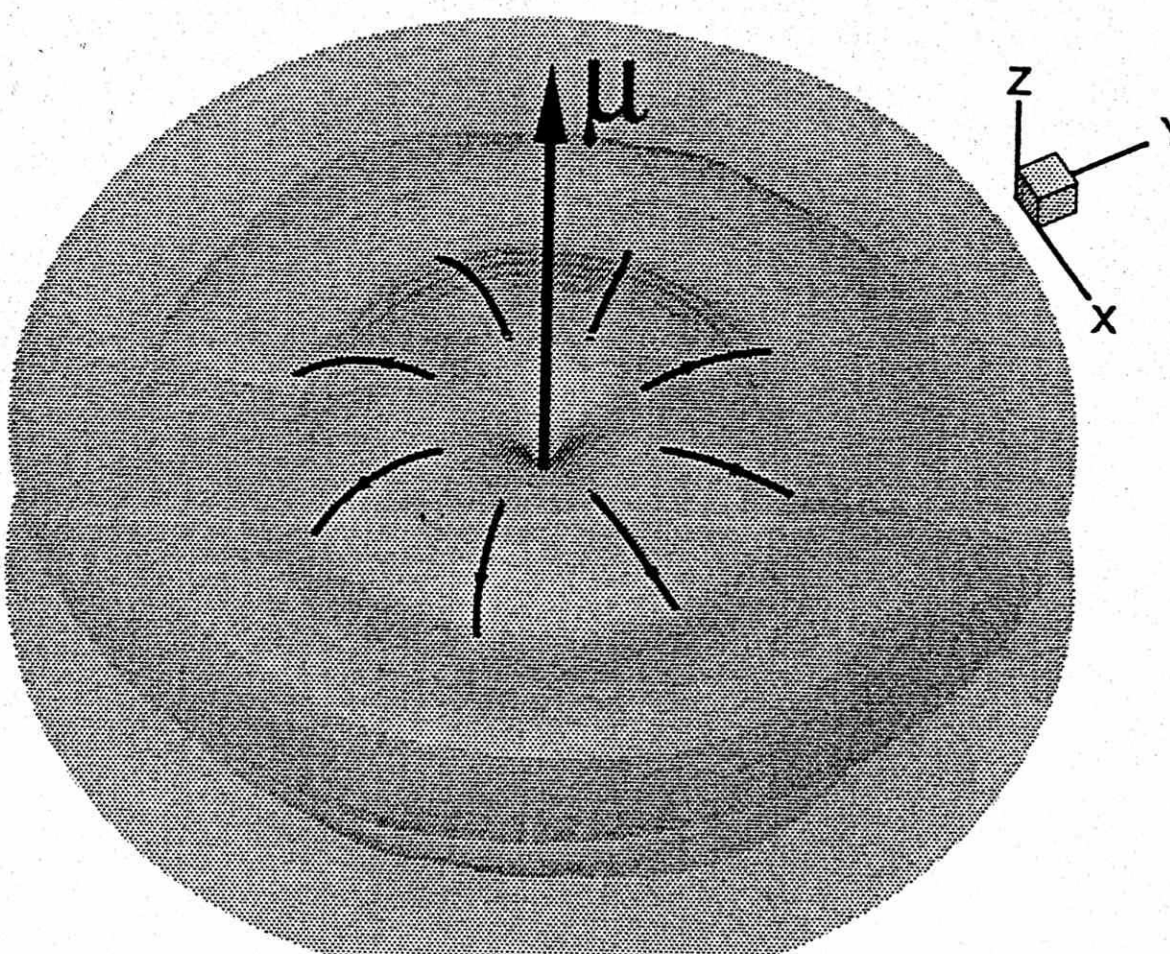
M. M. ROMANOVA
Department of Astronomy, Cornell University, Ithaca, NY 14853-6801; romanova@astro.cornell.edu

G. V. USTYUGOVA
Keldysh Institute of Applied Mathematics, Russian Academy of Sciences, Moscow, Russia; ustyugg@spp.Keldysh.ru

A. V. KOLDOBA
Institute of Mathematical Modeling, Russian Academy of Sciences, Moscow, Russia; koldoba@spp.Keldysh.ru

AND

J. V. WICK AND R. V. E. LOVELACE
Department of Astronomy, Cornell University, Ithaca, NY 14853-6801; jvw3@cornell.edu, rvl1@cornell.edu
Received 2003 April 12; accepted 2003 June 12



MAGNETOHYDRODYNAMIC SIMULATIONS OF ACCRETION ONTO A STAR IN THE "PROPELLER" REGIME

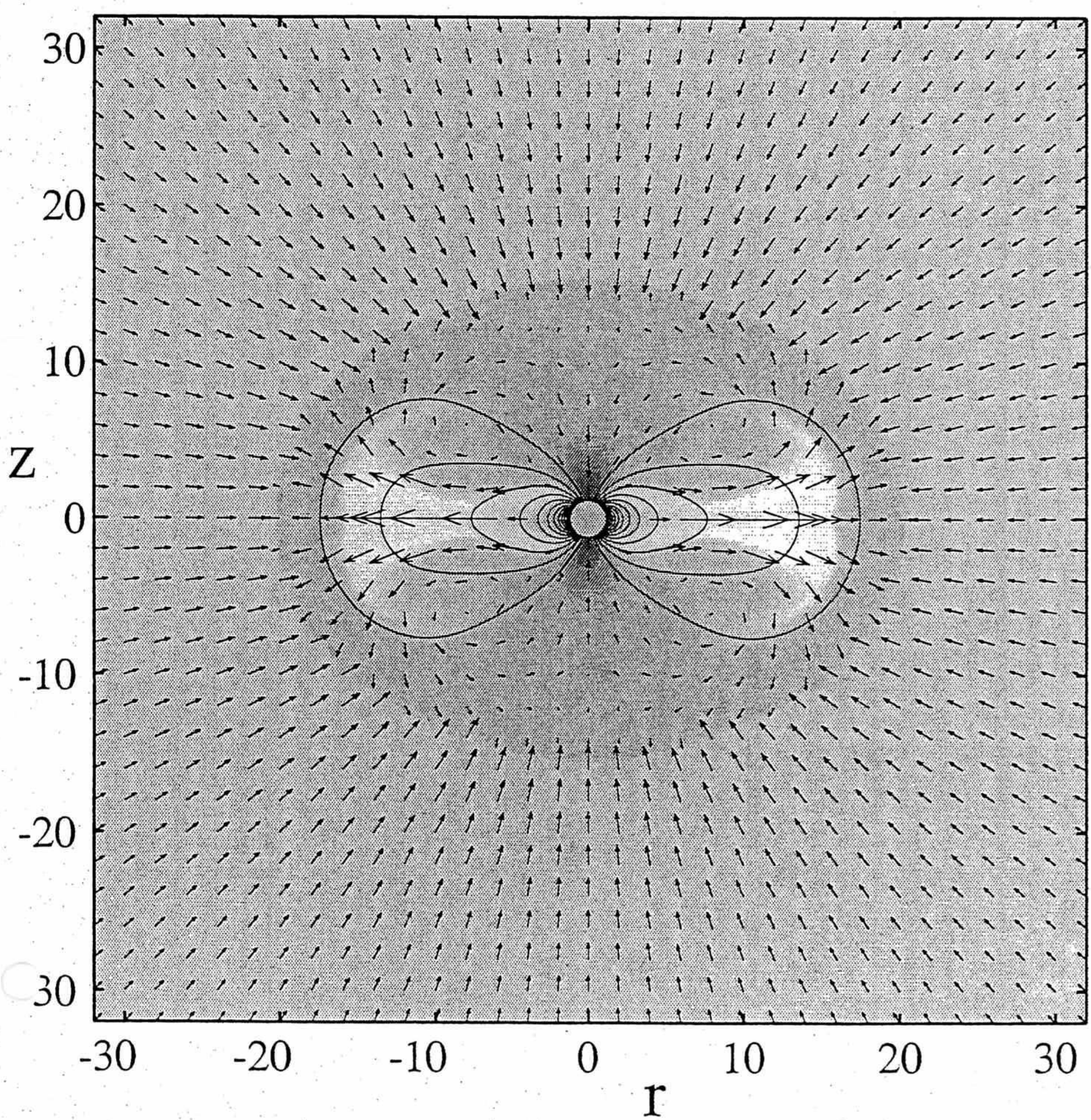
M. M. Romanova
Department of Astronomy, Cornell University, Ithaca, NY 14853-6801; romanova@astro.cornell.edu

O. D. Toropina
Space Research Institute, Russian Academy of Sciences, Profsoyuznaya 84/32, Moscow 117997, Russia; toropina@mx.iki.rssi.ru

Yu. M. Toropin
CQG International Ltd., 10/5 Sadovaya-Karetnaya, Building 1, Moscow 103006, Russia; yuriy@cqg.com

and

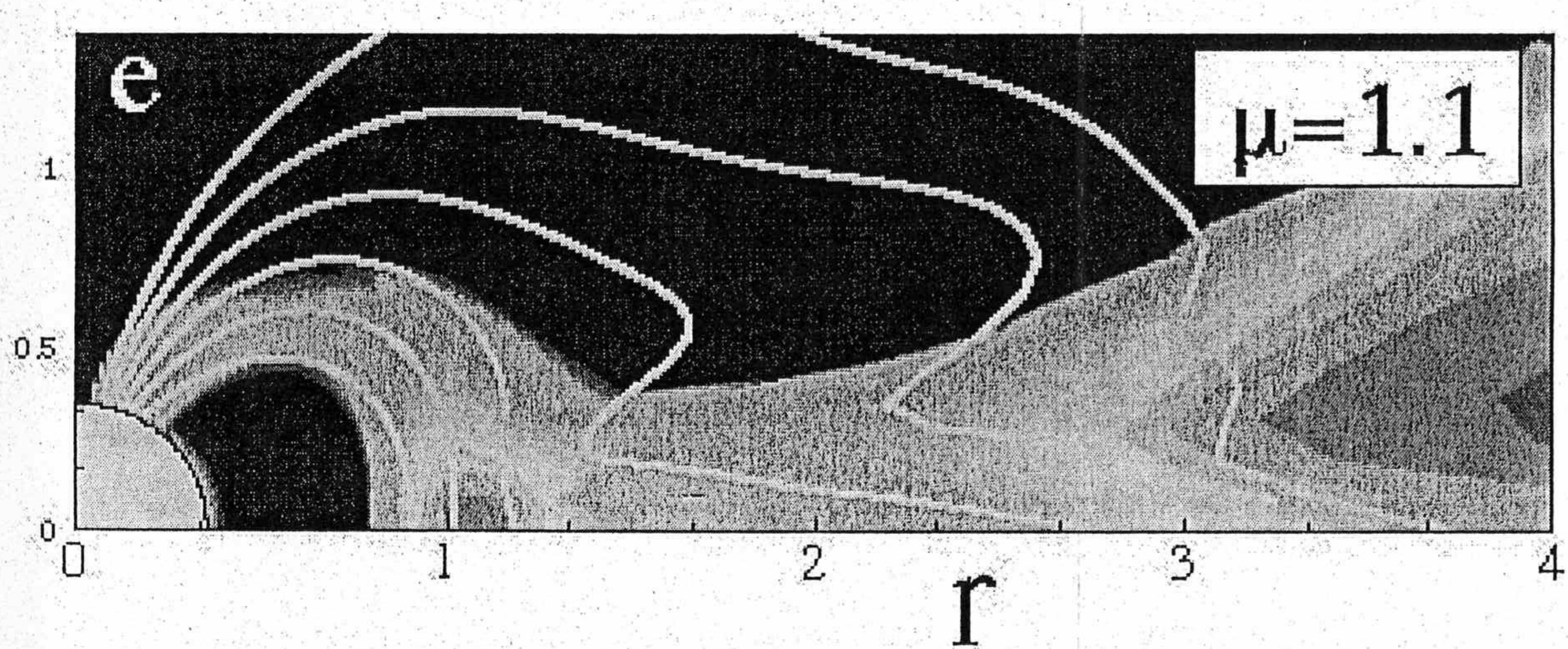
R. V. E. Lovelace
Department of Astronomy, Cornell University, Ithaca, NY 14853-6801; rvl1@cornell.edu
Received 2002 September 14; accepted 2003 January 3

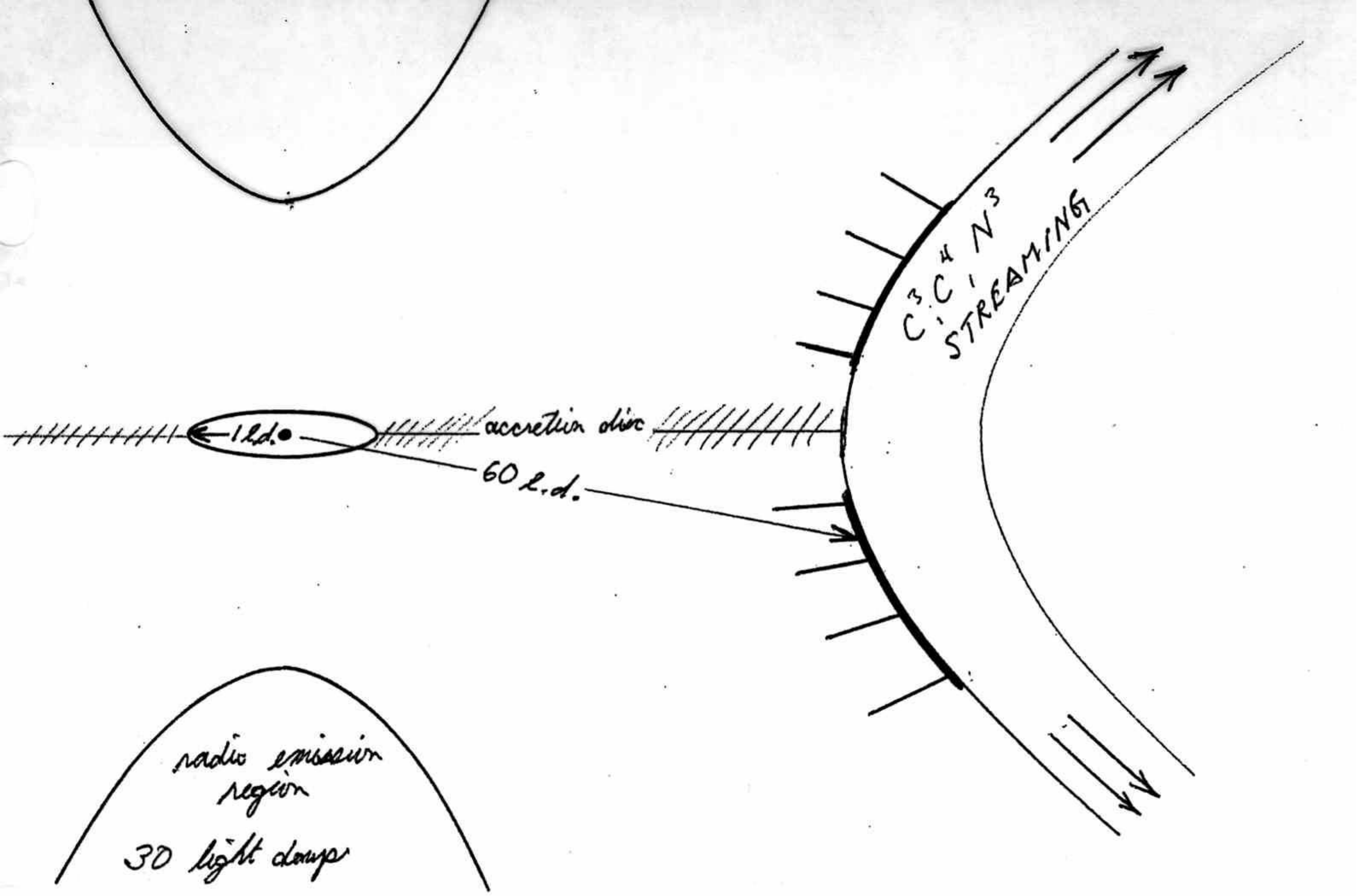


The Astrophysical Journal, 578:420–438, 2002 October 10

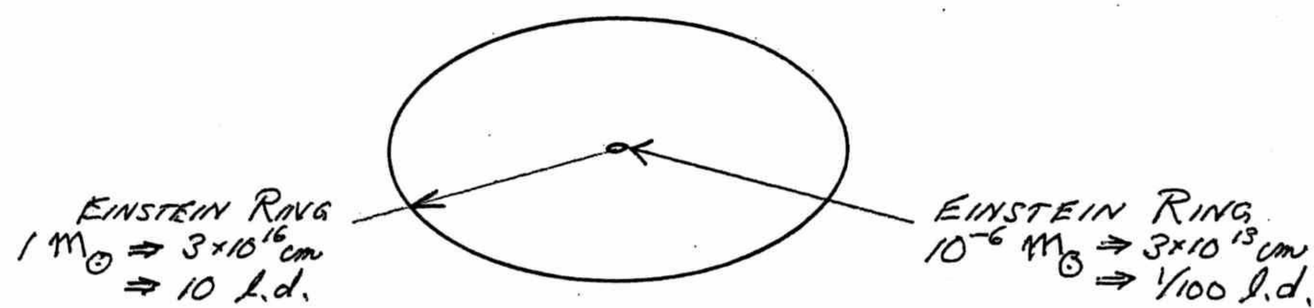
MAGNETOHYDRODYNAMIC SIMULATIONS OF DISK–MAGNETIZED STAR INTERACTIONS IN THE QUIESCENT REGIME: FUNNEL FLOWS AND ANGULAR MOMENTUM TRANSPORT

M. M. Romanova,[1] G. V. Ustyugova,[2] A. V. Koldoba,[3] and R. V. E. Lovelace[4]
Received 2001 November 7; accepted 2002 June 20




1 l.d.
accretion disc
60 l.d.
STREAMING
radio emission region
30 light days

Q0957 etc.

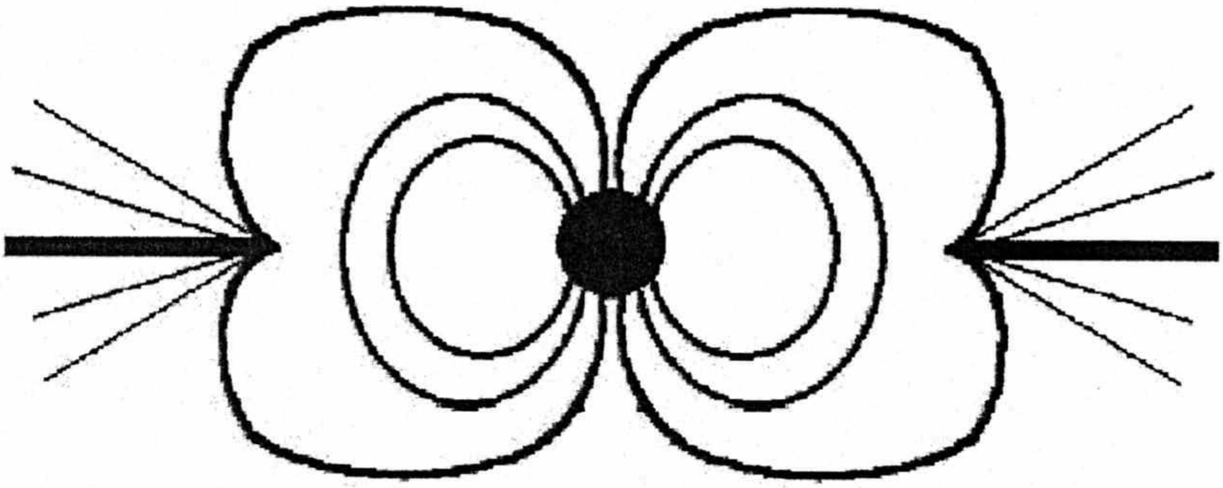

EINSTEIN RING
1 M⊙ ⇒ 3×10^16 cm
⇒ 10 l.d.
EINSTEIN RING
10^-6 M⊙ ⇒ 3×10^13 cm
⇒ 1/100 l.d.

THE ASTROPHYSICAL JOURNAL, 596:L203–L206, 2003 October 20

ON INTRINSIC MAGNETIC MOMENTS IN BLACK HOLE CANDIDATES

STANLEY L. ROBERTSON[1] AND DARRYL J. LEITER[2]

Received 2003 August 13; accepted 2003 September 5; published 2003 October 1



$\mathbf{r \gtrsim 20 - 30\ R_g}$

The Quasar-MECO in a Low Hard state has a gas pressure dominated inner disk whose magnetospheric radius r = 20 –30 Rg lies between the light cylinder and co-rotation radius. A hard spectrum is produced by photons from the disk which are Comptonized by outflow over the disk and thru the corona covering the disk. In this state disk ionized winds and jets are driven out by the MECO magnetic propeller to form the inner and outer rings associated with the Schild-Vakulik structure. In addition outflows of electrons on open magnetic field lines produce synchrotron radiation associated with radio emissions.

Chain of Observations and Simulations Supporting Existence of a Central MECO in QSO Q0957

```
Refsdal-Stabell Theory    \
                           \
Autocorrelation Estimates   \
                             Outer Structure\
Quasar Spectroscopy         /                \
                           /                  \
Em. Line Microlensing     /                    Schild-Vakulik 03
                                               Empirical Model
                                               For QSO Q0957   \
                                                                --------> Intrinsic Magnetic Moment in Q0957 ---> MECO-QUASAR
                                              Romanova Mass    /
                                              Scale Invariant Magnetic
                                              Propeller Simulations
Rapid Microlensing          \                 For Magnetic Proto-Stars
                             Inner Structure  /
Small Blue Bump             /
```