Guillaume Dubus, Caltech (ITP Black Holes Conference 2-28-02) Transient BH X-ray systems

THE LIGHTCURVES OF BLACK HOLE TRANSIENTS

BLACK HOLES ACCRETING FROM LOW MASS STARS ARE TRANSIENT

Kuulkers 1998
SIMILARITIES BETWEEN LMXBs AND CVs SUGGEST ACCRETION PROCEEDS IN THE SAME WAY: THIN ACCRETION DISK

**BUT**: MASS OF THE COMPACT OBJECT INNER RADIUS OF THE DISK

**THIN, KEPLERIAN DISK**
Angular momentum transport with viscosity $v = c_s \frac{H}{R}$
Typical temperatures $10^5 - 10^6$ K, optically thick
Change in opacity when H ionizes/recombines destabilizes the disk/thermal and viscous perturbations

Review: Lasota 2001
The Disk Instability Model

Predicts which system should be stable and which should be transient

Describes evolution of accretion onto the compact object in transients

Black hole / neutron star LMXB

Cataclysmic Variables

α_{isc} ~ 0.1

α_{out} ~ 0.21

Failure

OK

Failure

~ OK with

α additional physics

Standard Dim Applied to BH/NS Transients

1.4M_\odot neutron star

7M_\odot black hole

Weak Outbursts

Short Recurrence Time

Reflores

R_{in}=8.6\,\text{R}_\odot

q_1=0.3

M_{in}=10\,\text{M}_\odot

d_{in}=10^6\,\text{km}

Cantiello et al. (1999)
Guillaume Dubus, Caltech (ITP Black Holes Conference 2-28-02) Transient BH X-ray systems

Soft X-ray Transients

Fig. 2: ASM light curves (1998-97) for 4 recurrent transients.

Not all lightcurves of BH transients are 'FREDs'.

Additional physics?

Keeping irradiation heating constant (superorbital modulations).

Varying disk wind.

Varying the irradiation strength.

Varying mass transfer from companion (long outbursts e.g. KS 1735-260).

Kuulkers 1998

Regillard 1999