Disks Around Variably Accreting Young Stars

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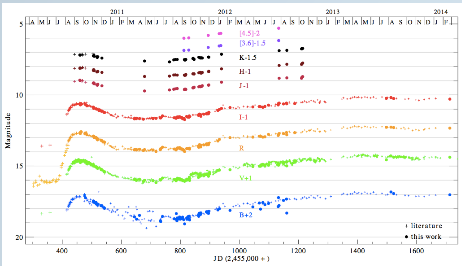
ABSTRACT

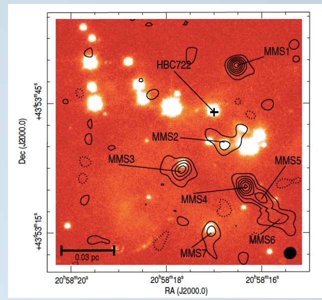
FU Orionis objects (FUors) are young stars observed to flare by several magnitudes in the optical and remain bright for decades or longer, with the flares attributed to enhanced accretion from surrounding disks. FUors may represent the optically visible, late stages of a cycle of episodic accretion throughout the protostellar stage of star formation, or they may represent an extreme, unique class of young stars; debate continues on this topic. A range of possible driving mechanisms for the accretion bursts have been proposed, including disk gravitational instabilities, thermal instabilities, a combination of gravitational and magneto-rotational instabilities, and binary interactions. Characterizing FUor disks and comparing their bulk properties (mass, size, etc.) and physical structure to disks around normal young stars is crucial for constraining the various driving mechanisms. We report preliminary results from an SMA survey of FUor disks aimed at better elucidating the nature of these extreme objects.



Optical and IR light curves of HBC722
From Kospal et al. (in prep.)
Literature data from AAVSO, *Semkov et al. (2010), A&A, 523, L3* and *Miller et al. (2010), ApJ, 730, 80*

HBC722

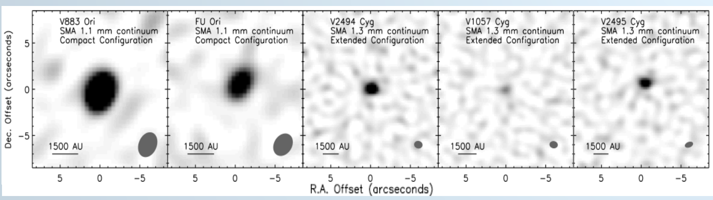
Newest FUor (outburst started in 2010)
Not detected at 1.3 mm by SMA
Disk mass limit: M < 0.02 solar masses
Pre-burst spectrum: K7-M0 star
Disk/Star mass ratio < 4%
Not enough mass for gravitational instabilities
Can GI be ruled out for most (all?) FUors?



SMA 1.3 mm continuum contours overlaid on K-band image of the environment of HBC722.
(*Dunham et al. 2012, ApJ, 755, 157*)

We are conducting an SMA survey of FUors to characterize disks

SMA Observations of FUors



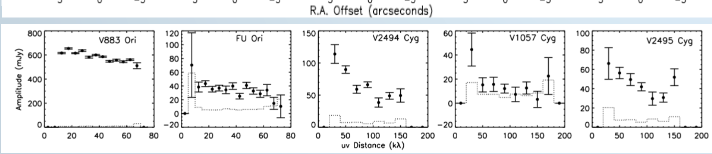
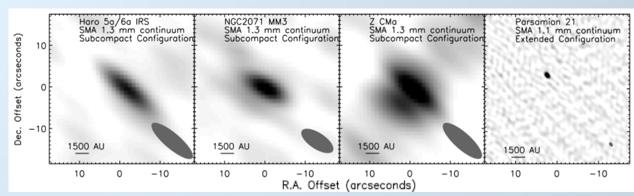


Table 1: FUors Observed to Date

FUor	RA (J2000)	Dec (J2000)	Distance (pc)	Configuration	Detected?	Disk Mass ($M_\odot$)
V883 Ori	05:38:18.1	07:02:26	460	Compact	Yes	0.8
FU Ori	05:45:22.4	+09:04:12	450	Compact	Yes	0.05
V1515 Cyg	20:23:48.0	+42:12:26	1000	Extended	No	<0.11
HBC722	20:58:17.0	+43:53:43	520	Compact	No	<0.02
V2494 Cyg	20:58:21.4	+52:29:27	750	Extended	Yes	0.3
V1057 Cyg	20:58:53.7	+44:15:29	650	Extended	Yes	0.09
V2495 Cyg	21:00:25.4	+52:30:16	800	Extended	Yes	0.3
V1735 Cyg	21:47:20.7	+47:32:04	900	Extended	No	<0.05
V733 Cep	22:53:33.3	+62:32:24	800	Extended	No	<0.11

SMA Observations of FUor-like Objects



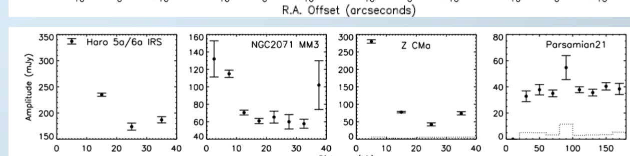


Table 2: FUor-like Objects Observed to Date

FUor	RA (J2000)	Dec (J2000)	Distance (pc)	Configuration	Detected?	Disk Mass ($M_\odot$)
Haro 5a/6a IRS	05:35:26.6	−-5:03:56	450	Subcompact	Yes	0.49
NGC2071 MM3	05:47:36.6	+00:20:06	450	Subcompact	Yes	0.15
AR 6a/6b	06:40:59.3	+09:35:52	800	Subcompact	No	<0.07
Z CMa	07:03:43.2	−11:33:06	1000	Subcompact	Yes	0.70
Parsamian 21	19:29:00.7	+09:38:39	400	Extended	Yes	0.04

Preliminary disk mass estimates:
Assume flux detected on longest baselines is from emission from optically thin, isothermal (30 K) dust in the disk
To be confirmed with higher resolution, follow-up SMA observations and radiative transfer models (in progress)

FU Orionis disks show great diversity – no typical disk evident
Some show evidence for very massive disks, others do not
Suggests diversity in driving mechanisms