Simultaneous optical and X-ray variability in the stars with disks in NGC 2264

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Introduction

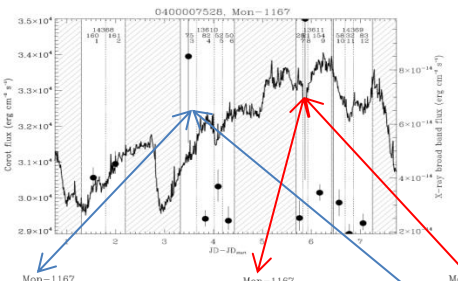
The Coordinated Synoptic investigation (CSI, Cody et al. 2014; Stauffer et al 2014) of NGC 2264 is an unprecedented simultaneous observation of this cluster involving 15 space and ground telescopes, to study the time variability of young (1-5 Myrs) stars. We present the analysis of simultaneous optical (CoRoT) and X-ray (Chandra/ACIS-I) variability in 53 stars with disks with variable extinction or accretion bursts.

Analysis of the simultaneous CoRoT and ACIS data

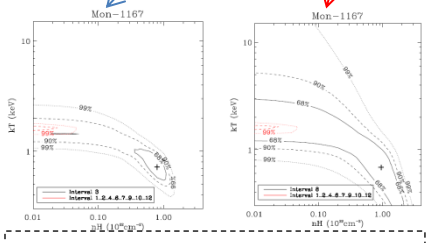
For each star, we split the time frames where both CoRoT and Chandra data are available in time intervals, defined in order to isolate interesting features in the CoRoT light curves such as dips and bursts. In each time interval we perform X-ray spectral fits to analyze the variability of the X-ray properties.

Increasing X-ray absorption during optical dips

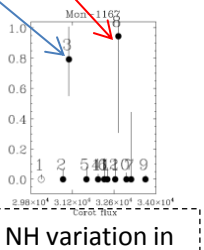
In 27% of the stars with optical dips observed increasing X-ray absorption during the dips.



CoRoT light curve, X-ray photon flux and defined time intervals.

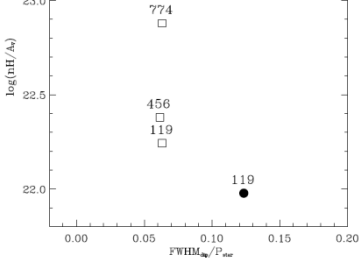


C-stat space solutions



NH variation in the time intervals

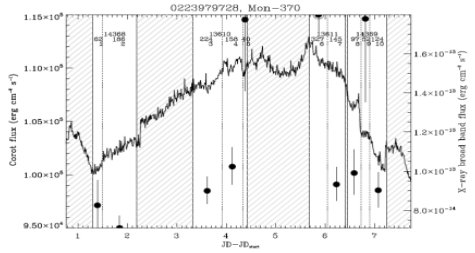
Star	Interval	ΔF_{CoRoT}	ΔAv	ΔnH_{dip}	nH_{over}	nH/Av	$FWHM_{dip}$	P_{star}	$FWHM_{dip}/P_{star}$
MON-name		%	mag	$10^{22}cm^{-2}$	$10^{22}cm^{-2}$	$10^{22}cm^{-2}mag^{-1}$	days	days	
119	4	8.9	0.12	$0.21^{0.44}_{0.08}$	$0^{0.03}$	1.75	0.2	3.3	0.06
119	6	15.7	0.22	$0.21^{0.41}_{0.08}$	$0^{0.03}$	0.95	0.4	3.3	0.12
412	6	3.5	0.05	$1.20^{1.58}_{0.82}$	$0.04^{0.12}$	23.2	0.2	6.8	0.03
456	6	15.2	0.21	$0.51^{0.74}_{0.33}$	$0^{0.03}$	2.4	0.3	5.1	0.06
774	5	5.7	0.08	$1.07^{1.24}_{0.88}$	$0.54^{0.79}_{0.30}$	7.57	0.2	3.5	0.06
1076	2	10.65	0.15	$1.67^{2.18}_{1.16}$	$0^{0.01}$	11.4	2.7		
1167	3	5.5	0.07	$0.79^{1.03}_{0.55}$	$0^{0.06}$	10.7	0.5	8.8	0.05

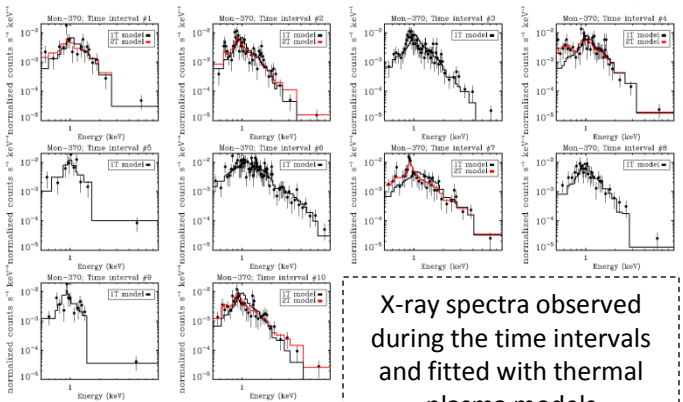


For 7 dips, we calculate NH/Av and infer the composition of the obscuring material, resulting not dust-rich (6/7) and with $FWHM_{dip}/P_{star}$ typical of obscuration from accretion streams *(Stauffer et al. 2015)*

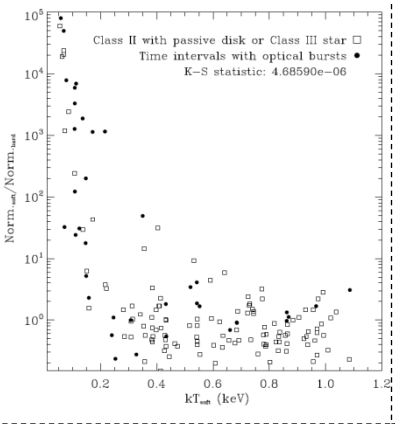
Soft X-ray excess during the optical bursts

In 19% of the stars with optical bursts the X-ray spectrum show excess of soft X-ray emission during the burst





X-ray spectra observed during the time intervals and fitted with thermal plasma models



We fit the spectra of not accreting stars and those observed in time intervals with optical bursts with 2T thermal model (kT_{soft}=0.3 keV, kT_{hard}=1.6 keV, N_H from AV) and analyze the ratio of the soft and hard normalizations

evidence for larger cold plasma emission measure during optical bursts