Coordinated Synoptic Investigation of 2264 (CSI 2264)

Data Delivery

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1. Introduction

The Coordinated Synoptic Investigation of NGC 2264 (CSI 2264) photometrically monitored the star-forming region NGC 2264 for 30+ days starting in December 2011. It constitutes a unique cooperative effort including 15 ground- and space-based telescopes. It was conceived of in the process of executing the Young Stellar Object Variability (YSOVAR) project (Morales-Calderón et al. 2011; L. Rebull 2014, submitted), and involves many of the same people and processing approach. These projects are exploring the variability properties of young stars in several young clusters at an unprecedented combination of cadence, photometric precision, and wavelength coverage, particularly in the infrared.

The CSI 2264 project performed photometric monitoring of young NGC 2264 cluster members using the Spitzer Infrared Array Camera (IRAC; Fazio et al. 2004) and the Convection, Rotation and Planetary Transits satellite (CoRoT; Baglin et al. 2006) simultaneously. Thirteen other telescopes monitored the region at different times concurrently with (or closely in time to) the primary Spitzer and CoRoT joint campaign.

The CSI 2264 project is described in detail in Cody et al. (2014). That paper includes a detailed description of the data reduction methodologies, sample selection, etc. Therefore, we do not repeat very much of that information in the present delivery document.

The delivery described here includes the following:

- Table of objects, one line per object, of several single-valued quantities (e.g., where there is one number per object).
- Table of the CoRoT light curves for the NGC 2264 members.
- Table of the Spitzer light curves for the NGC 2264 members.

In each case, "no data" in numerical columns is indicated by "99.999."

2. Table 1: Table of Objects

Table 1 contains one line per object, and covers all of the objects in the greater NGC 2264 region, not just those that have light curves or are members. As these objects are in the Monoceros region, we have adopted the prefix CSIMon (note that the space between CSI and Mon, as included in Cody et al. 2014, is now omitted).

There are 38 columns in this table, described below. Each of these values included in this table have a single value per object, such as RA or Dec.

Light curve morphologies (columns 37-38) are only provided if published by Cody et al. (2014). This omits most stars lacking infrared excesses. Morphologies include the following codes: S, stochastic; U, unclassifiable variable type; QPS, quasi-periodic symmetric; QPD, quasi-periodic dipper; QPB, quasi-periodic burster; L, long-timescale variable; N, non-variable; B, burster; D, dipper; EB, eclipsing binary; P, periodic; MP, multi-periodic.

Column number	Column name	Description
1	CSIMON_ID	Identification number from the Coordinated Synoptic Investigation of NGC 2264 (Cody et al. 2014)
2	ra	Right ascension (J2000; 2MASS system)
3	dec	Declination (J2000; 2MASS system)
4	TWOMASS	2MASS catalog id
5	ALTID	alternative id(s), if any
6	COROT01	Identification number from the first CoRoT short run ("SRa01")
7	COROT05	Identification number from the fifth CoRoT short run ("SRa05")
8	MAG_U	SDSS u-band magnitude from Venuti et al. (2014)
9	ERR_U	Uncertainty on u-band magnitude
10	MAG_G	SDSS g-band magnitude from Venuti et al. (2014)
11	ERR_G	Uncertainty on g-band magnitude
12	MAG_R	SDSS r-band magnitude from Venuti et al. (2014)
13	ERR_R	Uncertainty on r-band magnitude
14	MAG_I	SDSS i-band magnitude from Venuti et al. (2014)
15	ERR_I	Uncertainty on i-band magnitude. These values are estimated from instrumental errors (i.e., photon noise and background), and hence are severe underestimates.
16	MAG_J	J-band magnitude from the 2MASS point source catalog
17	ERR_J	Uncertainty on J-band magnitude
18	MAG_H	H-band magnitude from the 2MASS point source catalog
19	ERR_H	Uncertainty on H-band magnitude
20	MAG_K	Ks-band magnitude from the 2MASS point source catalog
21	ERR_K	Uncertainty on Ks-band magnitude

22	MAG_36	Spitzer/IRAC channel 1 band (3.6 microns) magnitude from Cody et al. (2014)
23	ERR_36	Uncertainty on [3.6]-band magnitude
24	MAG_45	Spitzer/IRAC channel 2 band (4.5 microns) magnitude from Cody et al. (2014)
25	ERR_45	Uncertainty on [4.5]-band magnitude
26	MAG_58	Spitzer/IRAC channel 3 band (5.8 microns) magnitude from Cody et al. (2014)
27	ERR_58	Uncertainty on [5.8]-band magnitude
28	MAG_80	Spitzer/IRAC channel 4 band (8.0 microns) magnitude from Cody et al. (2014)
29	ERR_80	Uncertainty on [8.0]-band magnitude
30	MAG_24	Spitzer/MIPS 24 micron band magnitude from Cody et al. (2014)
31	ERR_24	Uncertainty on [24]-band magnitude
32	SPT	Spectral type, if available
33	SPTREF	Spectral type reference: mak04=Makidon et al. (2004); dahm05=Dahm & Simon (2005); W56=Walker 1956
34	MEM	Membership flag: -1=likely field object; 0=no membership information; 1=very likely NGC 2264 member; 2=possible NGC 2264 member
35	BINARY	Binarity flag: 0: not a known binary; 1: visual binary (as noted by Sung et al. 2009), eclipsing, or spectroscopic binary, as noted in CSI 2264 project dataset
36	IR_EXCESS	Infrared excess flag: N=no infrared excess; Y=infrared excess, as determined by Cody et al. (2014)
37	LCTYPE_COROT	CoRoT light curve morphology during 2011-12 monitoring, if available and as listed in Cody et al. (2014) table 4.
38	LCTYPE_SPITZER	Spitzer light curve morphology during 2011-12 monitoring, if available and as listed in Cody et al. (2014) table 4.

3. Table 2: CoRoT Light Curves

Table 2 consists of CoRoT light curves. Note that this table only contains light curves for objects that are very likely NGC 2264 members (using the criteria described in Cody et al. 2014).

There are many rows for each object, because each object has many epochs of data. There are 9 columns in this table, as follows. Columns 7, 8, and 9 (the IRAC excess

flag and the light curve types) are duplications of information found in our first table, but are repeated here to make it easy for users to, e.g., pull out all of the light curves of a specific type.

Column number	Column name	Description
1	CSIMON_ID	Identification number from the Coordinated Synoptic Investigation of NGC 2264 (Cody et al. 2014)
2	ra	Right ascension (J2000; 2MASS system)
3	dec	Declination (J2000; 2MASS system)
4	HMJD	Heliocentric modified Julian date
5	MAG_R	CoRoT magnitude, calibrated to the R band
6	ERR	Uncertainty on the CoRoT magnitude. The value is the same for all light curve points, as it was estimated based on the RMS values of non-variable star light curves, as described in Cody et al. (2014).
7	IR_EXCESS	Infrared excess flag: N=no infrared excess; Y=infrared excess, as determined by Cody et al. (2014)
8	LCTYPE_COROT	CoRoT light curve morphology during 2011-12 monitoring, if available and as listed in Cody et al. (2014) table 4.
9	LCTYPE_SPITZER	Spitzer light curve morphology during 2011-12 monitoring, if available and as listed in Cody et al. (2014) table 4.

All light curves have been binned to 512 second cadence, and datapoints flagged as bad by the CoRoT pipeline have been removed.

Data from the SRa01 campaign in 2008 are derived from CoRoT pipeline version 0.8. SRa05 data (2011-12) are from CoRoT pipeline version 3.0. This involves the following corrections. The first step addresses

- the substraction of the offset and background signals to the light-curves;
- the cross-talk perturbations;
- exposure time variations; and
- the jitter effect (Auvergne et al. 2009).
- outliers are detected and flagged.

The second step addresses

- change of the temperature of the CCD;
- loss of overall efficiency of the detectors;
- detection of jumps, but only notification and no correction
- correction of the background, using the median of the background as an estimate for the whole CCD (Drummond et al. 2008)

Notes on individual objects:

The following light curves may be contaminated by light from bright neighboring stars:

- CSI Mon-000227 - CoRoT magnitude does not equal published broad band photometry due to bright star nearby; data deleted due to erroneous magnitude and quality issues.

- CSI Mon-000272 - CoRoT magnitude does not equal published broad band photometry due to bright star nearby. The light curve does show a spotted star signal whose period is in agreement with that of the IRAC light curve.

- CSI Mon-000365 - CoRoT magnitude does not equal broad band photometry - light curve is probably instead dominated by brighter star CSI Mon-000685 (8" east); data deleted.

- CSI Mon-000387 - CoRoT magnitude does not equal broad band photometry - light curve is probably instead dominated by brighter star to the west.

- CSI Mon-000758 - may be contaminated by flux from neighboring star.

- CSI Mon-000920 - light curve is probably contaminated by flux from CSI Mon-011567, 10" to the northwest.

- CSI Mon-001448 - light curve is dominated by light from a companion 12" southwest; data deleted.

A number of other light curves have been deleted due to poor data quality (i.e., systematic effects) in 2011. From the 2011 campaign, these include: CSI Mon-000003, CSI Mon-000006, CSI Mon-000022, CSI Mon-000024, CSI Mon-000060, CSI Mon-000184, CSI Mon-000192, CSI Mon-000216, CSI Mon-000219, CSI Mon-000247, CSI Mon-000253, CSI Mon-000305, CSI Mon-000319, CSI Mon-000484, CSI Mon-000499, CSI Mon-000586, CSI Mon-000593, CSI Mon-000609, CSI Mon-000614, CSI Mon-000714, CSI Mon-000723, CSI Mon-000794, CSI Mon-000805, CSI Mon-000843, CSI Mon-000878, CSI Mon-000931, CSI Mon-000944, CSI Mon-000946, CSI Mon-000967, CSI Mon-000976, CSI Mon-000990, CSI Mon-001056, CSI Mon-001074, CSI Mon-001101, CSI Mon-001271, CSI Mon-000505, CSI Mon-000761, CSI Mon-000836, CSI Mon-000924, CSI Mon-001416, CSI Mon-001416, CSI Mon-001603, and CSI Mon-000227.

4. Table 3: Spitzer Light Curves

Table 3 consists of Spitzer light curves. Note that this table only contains light curves for objects that are very likely NGC 2264 members (using the criteria described in Cody et al. 2014), and that have at least 15 good data points in one of the IRAC bands. Only data from Warm Spitzer cycle 8 program 80040 (Dec. 2011-Jan. 2012) are provided.

There are many rows for each object, because each object has many epochs of data. There are 13 columns in this table, as follows. Columns 11, 12, and 13 (the IRAC excess flag and the light curve types) are duplications of information found in our first table, but are repeated here to make it easy for users to, e.g., pull out all of the light curves of a specific type.

Column number	Column name	Description
1	CSIMON_ID	Identification number from the Coordinated Synoptic Investigation of NGC 2264 (Cody et al. 2014)
2	ra	Right ascension (J2000; 2MASS system)
3	dec	Declination (J2000; 2MASS system)
4	HMJD	Heliocentric modified Julian date
5	MAG_I1	Magnitude in the IRAC 3.6-micron band
6	ERR_I1	Uncertainty on the 3.6-micron band magnitude. The value is estimated from photon noise and sky background.
7	FLAG_I1	Flag on the 3.6-micron band magnitude. 0=potentially bad datapoint due to saturation, bad pixels, or other artifacts; 1=good datapoint
8	MAG_I2	Magnitude in the IRAC 4.5-micron band
9	ERR_I2	Uncertainty on the 4.5-micron band magnitude. The value is estimated from photon noise and sky background.
10	FLAG_I2	Flag on the 4.5-micron band magnitude. Defined as for 3.6 microns.
11	IR_EXCESS	Infrared excess flag: N=no infrared excess; Y=infrared excess, as determined by Cody et al. (2014)
12	LCTYPE_COROT	CoRoT light curve morphology during 2011-12 monitoring, if available and as listed in Cody et al. (2014) table 4.
13	LCTYPE_SPITZER	Spitzer light curve morphology during 2011-12 monitoring, if available and as listed in Cody et al. (2014) table 4.

5. Light Curve JPGs

We also have delivered visualizations of the light curves in the form of JPG images.

CoRoT light curves: We plot the CoRoT magnitudes (calibrated to R band as in the data table) separately for the SRa01 run in 2008 and the SRa05 run in 2011. Error bars are not included, but the size of the typical photometric uncertainty is illustrated at the bottom of the plot.

Spitzer light curves: We plot the Spitzer/IRAC magnitudes for both the 3.6 micron band (blue circles) and the 4.5 micron band (open circles). To display both light curves on the same plot, we have shifted the median of the 3.6 micron data to match that of the 4.5 micron band data. When there are no 4.5 micron data available, then 3.6 micron points are plotted alone and unshifted. Points that are flagged for possibly bad data appear as "x" symbols, while good data appears as dots. Error bars are not included, but the size of the typical photometric uncertainty is illustrated at the bottom of the plot.

6. References

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