# Young eclipsing binaries in NGC2264

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**Abstract:**

In March 2008, CoRoT observed the 3 Myr old star forming region NGC 2264 for 24 days continuously (run SRa01, see Fig.1). This represents a totally unprecedented database of photometric monitoring of a young star cluster, in terms of both sampling and precision. The search for eclipsing binaries (EBs) in the cluster, which can be used as calibrators of evolutionary models for pre-main sequence stars, was one of 4 key motivations for this observation. In this poster we report on the identification of 103 eclipsing systems in SRa01, and detail the criteria for selecting a sub-sample of 12 candidate intermediate to low mass (total mass 0.6-8 $M_{Sun}$) cluster member EBs for immediate follow-up.

For a global overview of the NGC2264 observation and highlights to date, see talk O-XII-64 by F. Favata. We are also using the same data to study accretion and disks around young stars (see talk O-XII-65 by S. Alencar), pre-main sequence pulsations (see talk O-IV-20 by K. Zwintz), and stellar rotation and activity (see poster P-XII-113 by G. Micela).

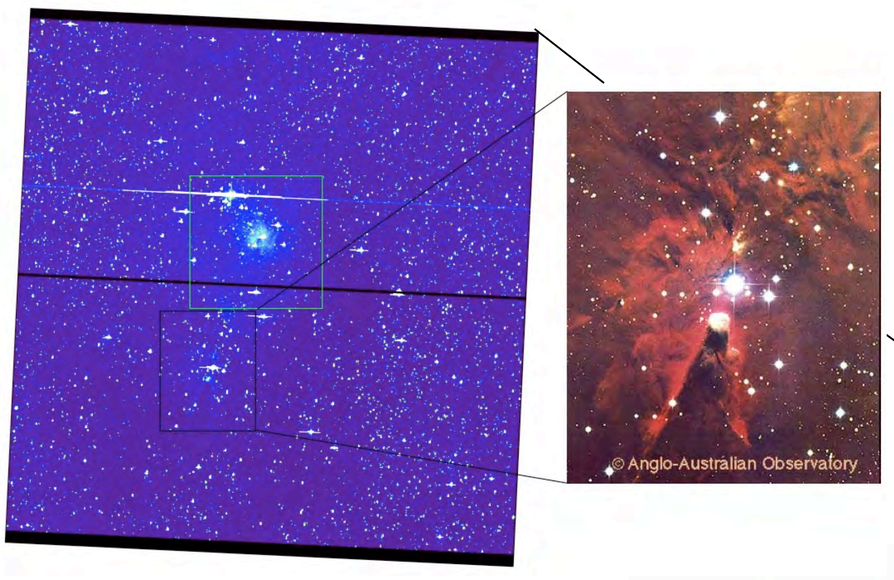


**Figure 1: CoRoT image of NGC2264.** The cluster, which is approximately 1 degree in diameter, was observed on CCD 1 of the planet-finding channel (left, actual CoRoT image). Part of the same field was simultaneously observed with Chandra. The well-known Cone nebula (right) also falls within the observed field.

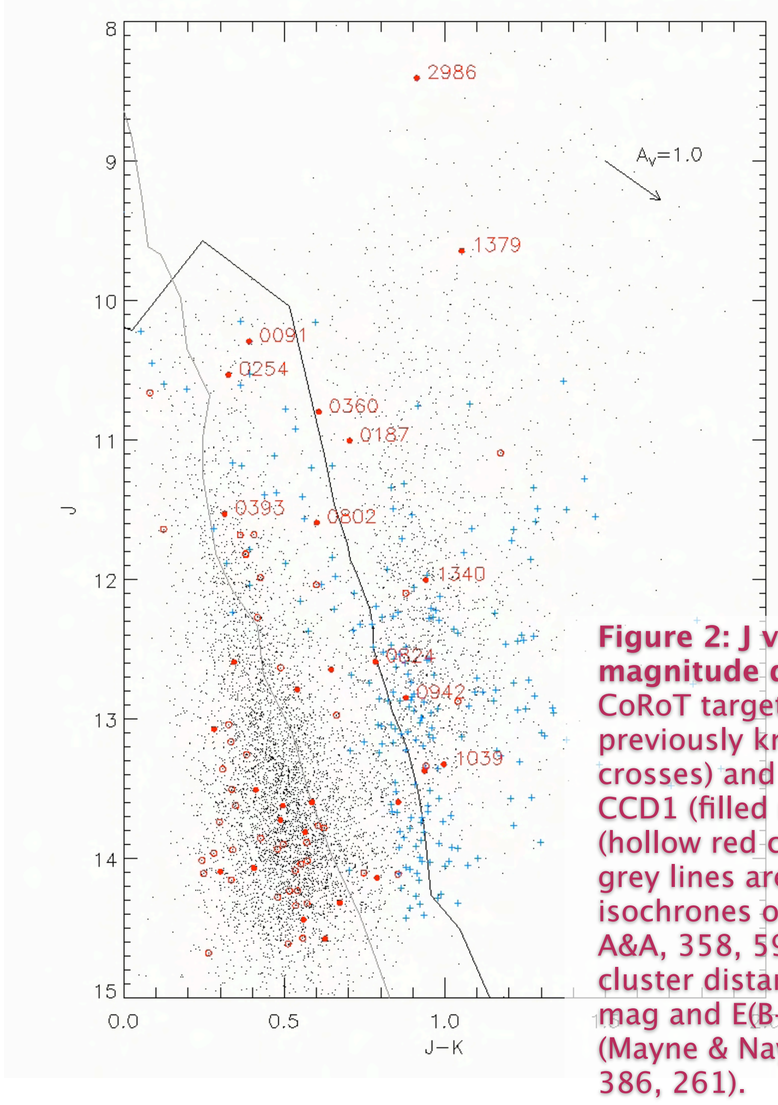


**Figure 2: J vs J-K colour-magnitude diagram** (CMD) of the CoRoT targets (black points) with previously known members (blue crosses) and the EBs detected in CCD1 (filled red circles) and CCD2 (hollow red circles). The black and grey lines are the 3 Myr and 1 Gyr isochrones of Seiss et al. (2000, A&A, 358, 593), shifted to the cluster distance modulus of 9.4 mag and E(B-V) of 0.06 mag (Mayne & Naylor 2008, MNRAS, 386, 261).

**Eclipsing binary identification:**
After pre-processing the N2 data, using a short-baseline running median filter to exclude outlying data points and a 1-d baseline iterative non-linear filter (see Aigrain & Irwin 2004, MNRAS, 350, 331) to remove long-term variations such as stellar activity, we performed an automated search for trapezoidal eclipses in the light curves of all 8150 CoRoT targets in run SRa01. Visual examination of all candidates with an eclipse signal-to-noise ratio above 30 (below which light curves are generally not useful for eclipsing binary characterisation) yielded 103 eclipsing systems. We discarded single eclipses (for which the period is unknown) and, where available, used the 3 colour channels to identify and discard spurious detections induced by hot pixels (which typically affect a single channel).

**Candidate selection:**
We cross-matched the CoRoT target list with 2MASS and with a number of published surveys of NGC2264, including some X-ray, spectroscopic and proper motion surveys (references in table below). From the 2MASS information we constructed a J vs J-K colour-magnitude diagram (Fig.2) which we used, in conjunction with the membership information where available, the spatial distribution of the targets (Fig.3), and a magnitude limit of R=15.5, to select 12 promising systems for immediate follow-up, whose light curves are shown in Fig.4.

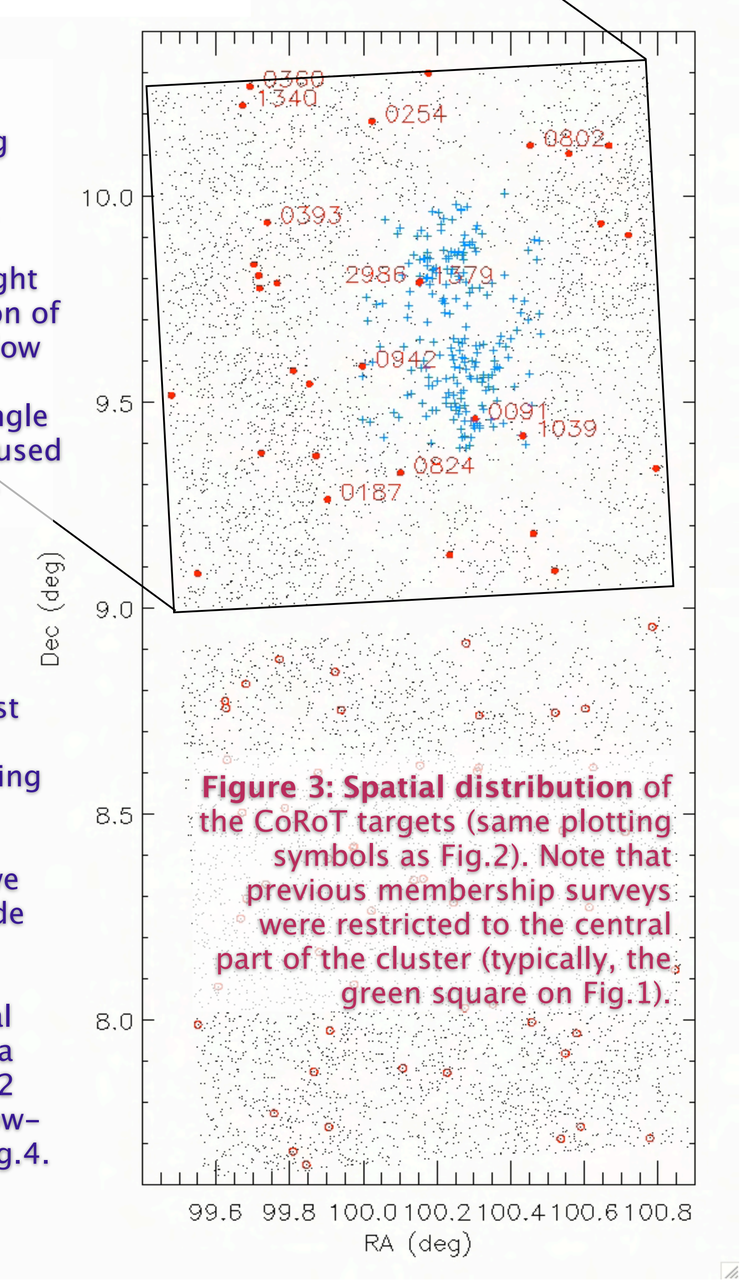


**Figure 3: Spatial distribution** of the CoRoT targets (same plotting symbols as Fig.2). Note that previous membership surveys were restricted to the central part of the cluster (typically, the green square on Fig.1).

**Figure 4: CoRoT white light curves of the selected objects** (Left: original, right: folded on the orbital period)


| LC comments | Literature comments |
|---|---|
| active regions with period ~ 3.5d | X-ray source [1]; proper motion member [2] |
| long eclipses. ellipsoidal variability | |
| long eclipses. ellipsoidal variability | |
| synchronised spot | |
| quasi-periodic brightenings??? | |
| 2 EBs in one mask... | |
| eccentric | |
| sinusoidal variation at P/4 | SpT: M1, Av: 0.22 mag, $EW_{H\alpha}$: 3.32 Å, M: 0.46 $M_{Sun}$ [3]; $P_{rot}$: 2.98 d [4] |
| evolving active regions with same period as binary | |
| sawtooth pattern with period ~ 10d | |
| diluted eclipses? | X-ray source [5,6]; $P_{rot}$: 4.12 d [7]; proper motion member [2] |
| diluted eclipses? | X-ray source [5,6]; SpT: B2, proper motion member, Av: 3.88 mag [2] |

**Future work**
In Feb. 2009, we will obtain multi-epoch echelle spectra of the objects whose light curves are shown in Fig.4 using SARG on the Telescopio Nazionale Galileo (TNG). We will use these to measure radial velocities and effective temperatures for the primaries and, where possible, the secondaries. We will then analyse the radial velocity and light curves jointly to solve for the component masses, luminosities and radii, which we will then compare to the predictions of evolutionary models for the age of NGC 2264.

**Literature sources:**

[1] Flaccomio et al. A&A, 455, 903
[2] Walker et al. 1956, ApJS, 2, 365
[3] Rebull et al. 2002, AJ, 123, 1538
[4] Makidon et al. 2004, AJ, 127, 2228
[5] Flaccomio et al. 1997, MmSAI, 68, 1073
[6] Ramirez et al. 2004, AJ, 127, 2659
[7] Lamm et al. 2004, A&A, 417, 557