

# EROS WIDE FIELD PHOTOMETRY FOR A SYSTEMATIC STUDY OF YOUNG STARS

D. MOUILLET<sup>1</sup>, D. STONE<sup>1</sup>, J. BOUVIER<sup>1</sup>, A.-M. LAGRANGE<sup>1</sup>

<sup>1</sup> Laboratoire d'Astrophysique de l'Observatoire de Grenoble, UJF, BP53X, F-38041 Grenoble Cédex

## Abstract

The mechanisms involved in star formation and the subsequent evolution toward the Main Sequence are not fully understood. From the observational point of view, the detection of numerous young stellar objects is necessary to constrain the evolutionary stages and their associated characteristics, and the impact of environmental conditions. Such detections require large scale surveys.

Pointed observations have shown photometric variabilities, associated with their physical properties. We investigate here the scientific interest of wide field photometry of a star forming region. We then show the suitability of EROS-like instrumentation for a systematic study, on the basis of EROS-I observations.

## 1 Interest in wide field photometry of young stellar objects

The observational study of pre-main sequence (PMS) stars is based on various signatures: the Lithium absorption line, some emission lines, X-ray activity, photometric variability.

Pointed observations [4] allow precise investigations on selected targets, but not numerous new detections. Wide field photometry appears very attractive to such studies:

- It allows to monitor at the same time of hundreds or thousands of stars in star-forming regions.
- It is not affected by the same bias as other large scale surveys ( $H_\alpha$  [8], X-ray [5]): both CTTs and WTTs show detectable photometric variabilities. Such an unbiased survey may reveal new kinds of variability, and thus new classes of PMS stars.

- Photometric variability is intrinsically rich in astrophysical information: different kinds of variability are known to indicate various classes of objects and physical processes [6]. Further conclusions require new observations.
- The required precision (a few 0.01 to 0.1 mag) lies within current instrumental capabilities.

## 2 EROS-I observation of a star forming region in $\rho$ Ophiuchus

The instrumentation developed for micro-lensing detection provides the opportunity to monitor the photometry of a very large number of stars. We performed observations over a  $1^\circ \times 1^\circ$  area in the star forming region of the  $\rho$  Ophiuchus cloud, for which various kinds of complementary observations is available [3]. This required a total of less than 2 hours per night over 20 nights in March-April 1995. We used both available filters ( $R_E$  and  $B_E$ ) and in each filter two different exposure times (typically 2 and 6 minutes) in order to observe both the brighter and fainter stars in the field of view.

We used the PEIDA reduction software [1, 7] to extract stellar objects and derive their photometry on regions (11 CCDs out of 30) where the extinction was low enough such that many stars ( $\geq 300$  per CCD) were detected. For the CCDs covering the most extinguished regions, we used IRAF/DAOPHOT-based procedures and took care to reject iteratively any variable stars as reference stars.

We achieved a photometric precision of 0.05 mag (resp 0.1 mag) for stars brighter than magnitude 18.5 (resp 20). This implies the possible detection of T Tauri stars variabilities among hundreds of candidates.

## 3 Results and discussion

### 3.1 Observed photometric variabilities

These observations pointed out about 50 variable stars. The few previously observed variable stars [2] were detected. Also, similar periodic low amplitude variations have been observed as well as less frequent but easier to detect larger sporadic variations. This kind of variations is consistent with previous pointed observations, and their first interpretation in terms of physical processes for young stellar objects [6].

We conclude that this kind of instrumentation is an efficient method to study the photometric variability associated with PMS stars on a very large sample.

### 3.2 Further possible research

This preliminary study suggests complementary pointed observations with the new unbiased selection of interesting targets. Also, possible enhancements are foreseen for this type of observation with, in particular, improved photometric precision (longer exposure times; better photometric capabilities anticipated for EROS-II), and also better temporal sampling (possible with further observations to investigate the photometric behaviour from year to year; irregularly spaced, exposures per night for high frequency variations detectability).

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