Tenth anniversary of 51 Peg-b : Status of and prospects for hot Jupiter studies
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Transiting planets and brown dwarfs in star forming regions and young open clusters.

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Abstract. The *Monitor* project[1] is a large scale photometric monitoring survey of a dozen star forming regions and open clusters aged between 1 and 200 Myr using wide-field optical cameras on 2 to 4 m telescopes worldwide. The primary goal of the project is to search for close-in planets and brown dwarfs (BDs) at young ages through the detection of transit events. Such detections would provide unprecedented constraints on planet formation and migration time-scales, as well as on evolutionary models of planets and brown dwarfs in an age range where such constraints are very scarce. Additional science goals include rotation period measurements and the analysis of flares and accretion-related variability.

1. Motivation

Though well over 100 extrasolar planets are known today, the vast majority orbit field stars with poorly determined ages. This is true of all 8 known transiting exoplanets, which are the only cases for which radii are known. The detection of a transiting exoplanet orbiting a star of known

[1]`www.ast.cam.ac.uk/~suz/monitor/monitor.php`

age would thus constitute the first firm anchoring point for evolutionary models of extrasolar planets. Over the last few years, several transit surveys (e.g. Explore OC, von Braun et al. 2004) have been targeting 'middle aged' (≥ 1 Gyr) open clusters, but no confirmed discoveries have been reported to date. We are targeting nearby star forming regions and open clusters in the so far uncharted 1 to 200 Myr age range. In our youngest targets (< 10 Myr), a detection would take added significance, as it would have implications for the disk evolution, planetesimal formation and migration timescales. We are also interested in searching for very low mass short-period eclipsing binaries, with at least one BD or very low mass star (VLMS) component. Evolutionary models in this age and mass range are notoriously uncertain – as highlighted by recent detections of ultra-low mass visual binaries in young associations (Close et al. 2005). The *Monitor* project's high precision, high cadence (in some cases multi-band) photometry of 10000's of low-mass cluster PMS stars will also allow and unprecedented study of angular momentum evolution, flares and accretion-related variability.

2. The Survey

About 10 target clusters were selected on the basis of youth, richness, proximity and compactness, as well as the existence of a known low-mass PMS population. We have observed or are scheduled to observe 8 of those by the end of 2005B (see the *Monitor* webpage for a list), and will apply to survey the remainder over the next few semesters. Sampling times are 3.5–15 min to ensure appropriate sampling of eclipse ingress/egress. 300–1000 frames in i' or (for the ONC and M34) V & i' are obtained for each cluster, with exposure times ensuring SNRs > 30 down to the BD. Standard data reduction steps are done automatically using our in-house pipeline (Irwin & Lewis 2001). We then perform list driven aperture photometry and remove temporal and spatial systematics by fitting and subtracting a 2–D polynomial surface to light curve residuals in each frame. Typical relative precisions reach 2–3 mmag at the bright end, and remain $< 1\,\%$ over ~ 4 magnitudes. We have adapted the calculationd of Gaudi et al. 2005 to estimate the expected number of detections from *Monitor*, using assumptions specific to our young cluster targets. Taking into account cluster (age, distance, size, richness) and obervational (magnitud rang, precision, sampling) characteristics and using suitable assumptions for companion incidence and theoretical mass-radius-luminosity relations, we calculate that *Monitor* as a whole should detect several planets and several tens of VLMSs / BDs that transit their primaries (see the *Monitor* webpage for more details).

3. Preliminary results and prospects

13 eclipse candidates with colours consistent with cluster membership have been identified in the 4 clusters observed so far (see Fig. 1 for examples), using the algorithm of Aigrain & Irwin (2004) plus visual light curve examination. Several have likely primary masses below the BD limit, and half could be planets (no secondary eclipses). We have started follow-up with medium-resolution spectrographs on 4 m telescopes.

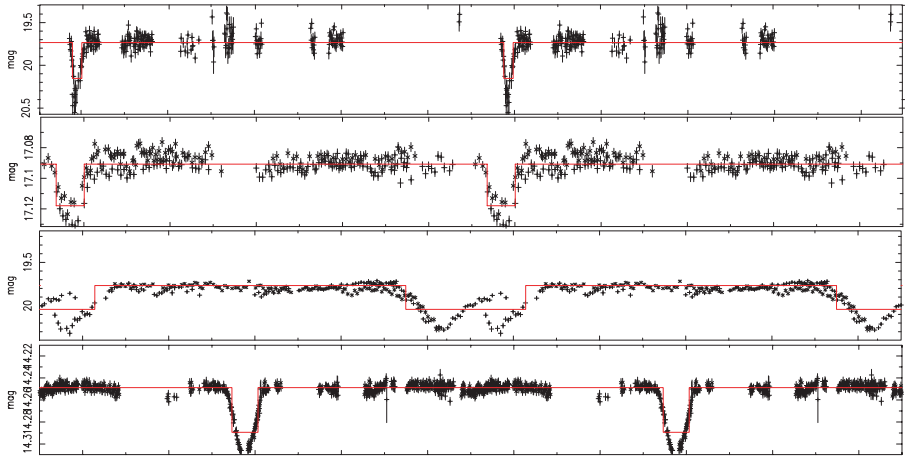

Figure 1.: *Phase-folded light-curves of 4 of our eclipse candidates (M34, M50, NGC 2362 and ONC from top to bottom). Cluster ages are 180, 130, 7 and 1 Myr respecitvely, periods range from 0.5 to 2 d and likely system masses from 0.1 to* $0.8\,M_{\odot}$.

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