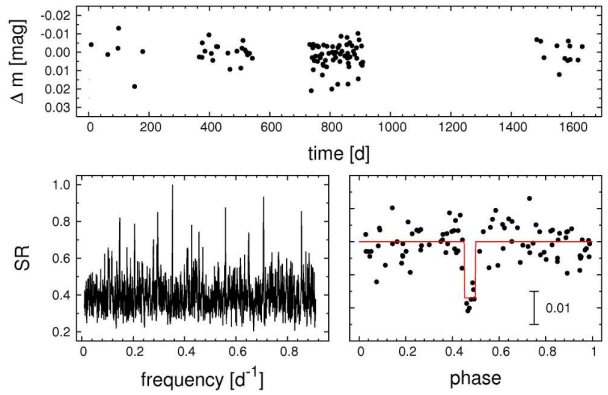

Fig. 3. Simulation of a planetary transit in the VVV five years variability campaign. The planet has a period of $P_{\rm orb}$ = 2.8 days and produces an eclipse depth of 1.7%. The photometric accuracy is the typical shown by a $K_{\rm s}$ = 14.5 mag stars in the Science Verification field (or $K_{\rm s}$ = 16.0 mag in the outer Bulge area, see Figure 2). Top panel: light curve as a function of time, corresponding to the schedule of the $K_{\rm s}$ observations in the Bulge. The bottom-left panel shows the power spectra of the simulated data and the bottom-right panel the phase-folded light curve with the period of the transit.

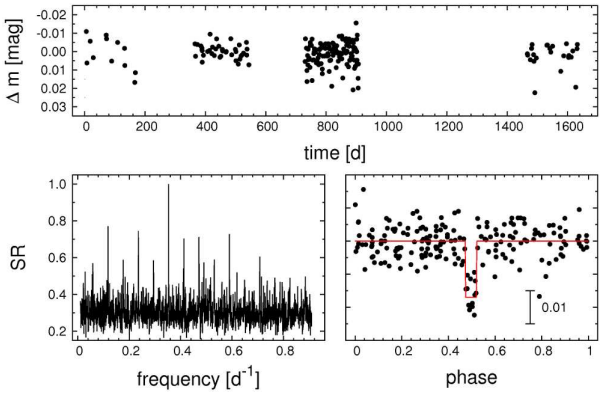

Fig. 4. Simulation of a planetary transit in the VVV five years variability campaign plus the extra observations during the fifth year (see text). The notation is similar to that of Figure 3.

ability campaign plus the extra observations in the fifth year (see § 3).

The typical transiting planets detected to date are "hot Jupiters" orbiting Sun-like stars, showing short orbital periods ($P_{\rm orb} \sim$ 3 days), and eclipses depth $\gtrsim$1.5%. Beside the large area covered by the VVV Survey (520 deg^2), that will allow us to detect a large number of planetary transits; our observations will extend the planetary hunting ground beyond to 1 kpc, while the current searches using small aperture telescopes are, in general, limited to few hundred parsecs. Moreover, a large aperture IR telescope such as VISTA will even allow us to detect planets around faint low-mass stars, including late K- and M-dwarfs.

To demonstrate the high quality of the photometric data, Figure 2 shows the photometric accuracy of the VVV $K_{\rm s}$-band observations as a function of magnitude for the Science Verification area, one of the most crowded fields in the Galactic Bulge (Saito et al. 2010), and for an outer Bulge field observed during the first year of the variability campaign. In order to detect a planetary transit, the signal (difference in brightness) produced by the planet transiting in front the stellar disk must be greater than the accuracy at the given star magnitude.

In Figure 3 we show the in the top panel the simulated light curve as a function of time for a planetary transit of period P = 2.8 days, 1.7% deep, and the typical photometric accuracy of a $K_{\rm s}$ = 14.5 mag star in VVV observations of the inner Bulge (e.g., Science Verification area), or a $K_{\rm s}$ = 16.0 mag star in outer Bulge area (see Figure 2). The data points correspond to the schedule of the VVV observations in the Bulge, taking into account the seasonal change in visibility. The transit signals were simulated with pure Gaussian noise, and a frequency analysis of these signals was performed using the Box-fitting Least-Squares (BLS) method (Kovács et al. 2002), in order to test their detectability. The bottom panels of Figure 3 show the power spectra of the simulated data (bottom-left) and the phase-folded light curve with the period of the transit (bottom-right).

Figure 4 shows the simulation of the same planetary transit shown in Figure 3, but taking into account a double data points coverage, corresponding to the five years variability campaign plus the extra observations during the fifth year. A double coverage is also present on Bulge and Disk areas, in the overlapping regions between the VVV "tiles" (see Minniti et al. 2010a), in a total of $\sim$25 deg^2.

The magnitude and depth used in the simulations would correspond to a Jupiter size planet around a G2-dwarf (e.g., Sun) at the distance of $\sim$1.4 kpc. Interestingly, these parameters would also correspond to a Super-Earth planet around a M6-dwarf at the distance of $\sim$100 pc, showing the potential of the VVV survey in finding rocky planets.

Since the detection limit of the VVV observations is $K_{\rm s} \gtrsim$ 18 mag (single epoch), planets around more distant stars will be detected if the relation planet/star size is greater than that the photomet-