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WIFSIP: Wide-field Imager for the Robotic Observatory STELLA

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Abstract. STELLA is an observatory on the Spanish island of Tenerife, hosting two robotic 1.2 meter telescopes (STELLA-I and STELLA-II) that operate in fully unattended mode (see Fig. 1). From mid 2007 onwards STELLA-I will host the Wide Field Stella Imaging Photometer (WIFSIP). One of the core science projects for WIFSIP is the time series study of open clusters of different ages. This study is mainly intended for investigating the stellar properties and magnetic activity in open clusters of different ages up to 2 Gyr, but the long photometric time series obtained are also suited for finding planet transits.

STELLA observatory

STELLA is a robotic observatory located at the Teide Observatory in Tenerife with two fully automatic 1.2 meter telescopes (STELLA-I and STELLA-II). Not only the telescopes are automatic but also the entire observatory, no human presence is needed for observing - not even in remote control. In its final configuration STELLA-I feeds a wide-field CCD imaging photometer and STELLA-II supports a high-resolution, fibre-fed and bench-mounted echelle spectrograph.

The STELLA building was finished in spring 2002, and after installing the network and computer system in autumn 2002, it went through a one year test period under realistic conditions. The first of the two STELLA telescopes has been installed in Tenerife in the end of November 2004 and the second telescope, STELLA-II, in December 2005. The spectrograph was delivered to Tenerife in May 2005 and it was assembled there during the next months. WIde-Field STELLA CCD Imaging Photometer (WIFSIP) will be taken to the observatory and commissioned mid 2007.

WIFSIP

WIFSIP is envisioned to provide 1 milli-magnitude photometric accuracy over a field of view of 22x22 arc-minutes with a sampling of 0.3 arc-seconds/pixel. The photometer will be equipped with Strömgren, Hα, Johnson-Bessel and Sloan filters. WIFSIP will use a monolithic 4096x4096 15 μm pixel, back-illuminated, thinned CCD chip from the Steward-Imaging laboratory. The peak quantum efficiency of this chip is >90 %. In Figure. 2 the field-of-view of the science and guider CCD's and the quantum efficiency of the WIFSIP science CCD are given.

Figure 1. STELLA observatory.

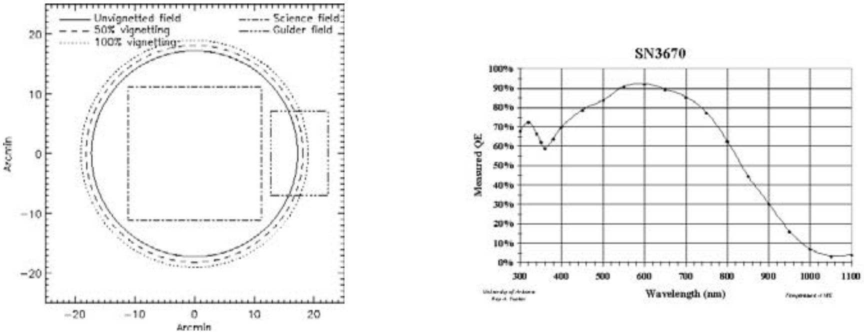

Figure 2. WIFSIP field-of-view (left) and the quantum efficiency of the CCD (right).

To fully take advantage of this robotic observatory, automatic reduction pipeline for high precision photometry is being written. The automatic photometry pipeline for WIFSIP will be split into three modes: imaging, large-field photometry, and single-target photometry. In its current version it employs the GaBoDS image reduction package (Erben et al. 2005) for astrometrically and photometrically calibrated imaging. For photometry we are investigating the possibility of using both the Aarhus University's MOMF package (Kjeldsen & Frandsen 1992) and the ISIS package (Alard 2000).

Science with WIFSIP

The core science project for WIFSIP is the time series study of open clusters with ages between 10 Myr and few Gyr. We will measure rotation periods, spot-filling factors and spot temperatures with the aim of detecting and calibrating rotation-activity-age relations that can be used for determining ages of field stars. The long photometric time series obtained in this study are also very well suited for finding planet transits.

We have selected eight clusters for an initial study (see Table 1). For all our selected clusters we will first do high precision Strömgren photometry to determine the colour-magnitude and colour-colour diagrammes. This also importantly allows us to distinguish the dwarfs from the giants. After the initial Strömgren study of the cluster, we will do a long-term monitoring either using Johnson V or Sloan g' filter. With 30 second exposures in V we would in 10 minutes reach an accuracy of at least 0.01 magnitudes for the stars in the magnitude range of 13–20. This means that we would be able to search for possible planet transits in K dwarfs upto a distance of about 2000 pc. In Figure. 3 the four over-lapping WIFSIP pointings needed to observe NGC 6940 are shown together with the cluster.

Table 1. Possible Open clusters for WIFSIP investigation.

Cluster	Age (Myr)	Dist. (pc)	Redd (mag)	[Fe/H] (solar)	RA	DEC	X-Y size (arcmin)
NGC 1647	145	540	0.37		04 45 55	+19 06 54	30
NGC 2301	165	870	0.028	+0.06	06 51 45	+00 27 36	600
NGC 1039	180	500	0.070	-0.30	02 42 05	+42 45 42	67
NGC 1750	200	630	0.34		05 03 55	+23 39 30	110
NGC 6633	425	376	0.182		18 27 15	+06 30 30	71
NGC 6940	720	770	0.214	+0.01	20 34 26	+28 17 00	50
NGC 6819	1500	2360	0.238	+0.07	19 41 18	+40 11 12	15
NGC 7789	1700	2340	0.21	-0.08	23 57 24	+56 42 30	90

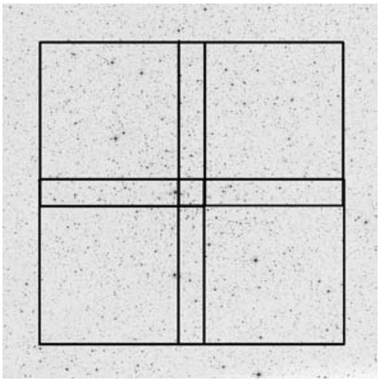

Figure 3. The four WIFSIP pointings needed to cover NGC 6940.

References

Alard, C. 2000, A&AS 144, 363
Erben, T., et al. 2005, AN 326, 432
Kjeldsen, H., & Frandsen, S. 1992, PASP 104, 413