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In the context of the Surface Layer investigation at ESO Paranal Observatory, a Surface Layer Slope Detection And Ranging (SL-SLODAR) instrument prototype has been used at Paranal during 2012, while Lunar Scintillometer (LuSci) measurements campaigns are being carried out since 2008. Simultaneous Surface Layer profiling data from the two instruments are analysed in order to compare the two instruments to enforce their reliability and finely characterize the Paranal Surface Layer profile.

BETA is the slope of the turbulence power spectrum delivered by the SL-SLODAR. It is intended purely as a diagnostic tool to indicate whether the Cn2 profile can be trusted. When BETA is significantly less than 3.667 (Kolmogorov law value) this generally indicates that the wind speed is low and the data sets are too short to fully sample the low frequency components of the turbulence. Around the Kolmogorov value, the integrals form the SL-SLODAR and LuSci are pretty much the same. This is valid also in the first 20 m above ground only (SL).

Both instruments agree very well when the wind speed on the Paranal platform is higher than 3 m/s. This last result suggests that wind speed higher than 3 m/s allow to have more reliable turbulence profile measurements from both instruments for further analyses of the Surface Layer. Furthermore, the disagreement of the two instruments in connection with wind speed lower than 3 m/s also suggests that the wind speed is a critical parameter to be taken into account before the treatment of the data.

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SOUTH POL: REVEALING THE POLARIZED SOUTHERN SKY

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SOUTH POL will be a survey of the Southern sky in optical polarized light. It will use a newly designed polarimeter for an 80cm Robotic Telescope. Telescope and polarimeter will be installed at CTIO, Chile. The initial goal is to cover the sky south of declination $-15°$ in about two years of observing time, aiming at a polarimetric accuracy $\leq 0.1\%$ down to V=15, with a camera covering a field of about 2.0 square degrees.

SOUTH POL will impact areas such as Cosmology, Extragalactic Astronomy, Interstellar Medium of the Galaxy and Magellanic Clouds, Star Formation, Stellar Envelopes, Stellar Explosions and Solar System, among others.

The polarimeter is currently being built and its optics and electronics assembled. We will describe the current status of the project.

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IMPROVING INPE′S BALLOON GROUND FACILITIES FOR OPERATION OF THE PROTOMIRAX EXPERIMENT

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The system requirements for reusing the scientific balloon ground facilities available at INPE were a challenge to the ground system engineers involved in the protoMIRAX X-ray astronomy experiment. A significant effort on software updating was required for the balloon ground station. Considering that protoMIRAX is a pathfinder for the MIRAX satellite mission, a ground infrastructure compatible with INPE′s satellite operation approach would be useful and highly recommended to control and monitor the experiment during the balloon flights. This approach will make use of the SATellite Control System (SATCS), a software-based architecture developed at INPE for satellite commanding and monitoring. SATCS complies with particular operational requirements of different satellites by using several customized object-oriented software elements and frameworks. We present the ground solution designed for protoMIRAX operation, the Control and Reception System (CRS). A new server computer, properly configured with Ethernet, has extended the

existing ground station facilities with switch, converters and new software (OPS/SERVER) in order to support the available uplink and downlink channels being mapped to TCP/IP gateways required by SATCS. Currently, the CRS development is customizing the SATCS for the kernel functions of protoMIRAX command and telemetry processing. Design-patterns, component-based libraries and metadata are widely used in the SATCS in order to extend the frameworks to address the Packet Utilization Standard (PUS) for ground-balloon communication, in compliance with the services provided by the data handling computer onboard the protoMIRAX balloon.

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NEW ALGORITHM FOR CENTROIDING IN ELONGATED SPOTS FOR SHACK-HARTMANN WAVEFRONT SENSORS USING ARTIFICIAL NEURAL NETWORKS

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To recover the resolution lost in a ground-based telescopes due to the atmospheric turbulence, it is necessary to use a technique known as Adaptive Optics (AO). The next generation of telescopes will have primary mirrors of more than 30 meter in diameter and will require AO systems from the ground up (Nelson et al. 2006). There are a number of challenges to implement an AO system at these scales. One of these challenges is the accurate measurement of the aberrated wavefronts using a laser guide star and a Shack-Hartmann wavefront sensor. Due to the diameter of the telescope and the use of the sodium layer in the upper atmosphere as photon return for the laser guide stars, the image of the guide star will appear elongated in the wavefront sensor. Typical centroiding algorithms such as Center of Gravity do not perform well under these conditions (Thomas et al. 2008). We present a new technique based on artificial neural networks for measuring the spot position with better accuracy than existing methods. Simulation results confirms that the new algorithm incurs in smaller errors with respect to other centroiding techniques in use.

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COMPUTING DIFFERENTIAL REFRACTION AT ALL HELIOLATITUDES AND ZENITHAL DISTANCES: A HISTORICAL PERSPECTIVE

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Ptolemy (about 150 AC) modeled atmospheric refraction influencing Al Farghani (831), Alhazen (1020), Sacrobosco (1256) and Witelo (1278): the Sun was supposed bigger at horizon like a coin appears under water in a curved bottle. The correct work of Ibn Sahl (984) remained forgotten.

Tycho measured the refraction on the 1572 supernova at various altitudes. Harriot, Kepler, Snell and Descartes found independently the refraction law after 1600. A modern formulation of vertical (0.5" zenithal to 35' at horizon) and horizontal (0.5" at all altitudes) differential refraction of solar diameter appears in Du Séjour (1786). Laplace's formula (1805) computes the vertical deformation of the solar disk, while the horizontal reduction of 0.5" is proportional to the chord's length. Dicke (1967) measured the solar oblateness to determine dynamical constraints to alternative theories of General Relativity. The Astrolabe of Rio de Janeiro measured in 1998-2009 the solar diameter at all heliolatitudes, by timing solar transits across fixed altitude circles: an equatorial excess larger than RHESSI (2008) and SDS (1992-2011) data remains after refraction's corrections. Meridian transits series measured at Rome Campidoglio (1877-1937) and Greenwich (1850-1940) behave as Rio data: the scatters between annual averages were larger than statistical dispersions of each value (Gething, 1955). Anomalous refractions measured with Rio Heliometer (2013) are low frequency seeing (0.01 Hz) acting to scales of the solar diameter (32'): they affect transits measurements with random perturbations hundreds times larger than the expected values calculated from the timing accuracy. These perturbations enlarge the differences between averages values binned either in time or heliolatitude: they are larger than statistical dispersions, suggesting a wider binning. The "adiabatic" approach of Rio Heliometer with high frequency measurements "freezes" the slow seeing image motion component.

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