larger by about 31%. When we subdivide the AXU clusters in two subsamples, one with significant and the other with little or no substructure, we find that the former shows red-sequence slopes that are significantly flatter than those for the latter. This points to AXU clusters being younger systems than normal clusters, possibly accreting groups of galaxies, individual galaxies and gas.

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PROPERTIES OF TYPE IA SUPERNOVAE INSIDE RICH GALAXY CLUSTERS

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We used the GMBCG galaxy cluster catalogue and SDSS–II supernovae data with redshifts measured by the BOSS project to identify 48 SNe Ia residing in rich galaxy clusters and compare their properties with 1015 SNe Ia in the field. Their light curves were parametrised by the SALT2 model and the significance of the observed differences was assessed by a resampling technique. To test our samples and methods, we first looked for known differences between SNe Ia residing in active and passive galaxies. We confirm that passive galaxies host SNe Ia with smaller stretch, weaker colour–luminosity relation [β of 2.54(22) against 3.35(14)], and that are ~ 0.1 mag more luminous after stretch and colour corrections. We show that only 0.02 per cent of random samples drawn from our set of SNe Ia in active galaxies can reach these values. Reported differences in the Hubble residuals scatter could not be detected, possibly due to the exclusion of outliers. We then show that, while most field and cluster SNe Ia properties are compatible at the current level, their stretch distributions are different ($\sim 3\sigma$): besides having a higher concentration of passive galaxies than the field, the cluster's passive galaxies host SNe Ia with an average stretch even smaller than those in field passive galaxies (at 95 per cent confidence). We argue that the older age of passive galaxies in clusters is responsible for this effect since, as we show, old passive galaxies host SNe Ia with smaller stretch than young passive galaxies ($\sim 4\sigma$).

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INSTRUMENTATION

BOMBOLO: A MULTI-BAND, WIDE-FIELD, NEAR UV/OPTICAL IMAGER FOR THE SOAR 4M TELESCOPE

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BOMBOLO is a new multi-passband visitor instrument for SOAR observatory. The first fully Chilean instrument of its kind, it is a three-arms imager covering the near-UV and optical wavelengths. The three arms work simultaneously and independently, providing synchronized imaging capability for rapid astronomical events. BOMBOLO will be able to address largely unexplored events in the minute-to-second timescales, with the following leading science cases: 1) Simultaneous Multiband Flickering Studies of Accretion Phenomena; 2) Near UV/Optical Diagnostics of Stellar Evolutionary Phases; 3) Exoplanetary Transits and 4) Microlensing Follow-Up. BOMBOLO optical design consists of a wide field collimator feeding two dychroics at 390 and 550 nm. Each arm encompasses a camera, filter wheel and a science CCD230-42, imaging a 7 x 7 arcmin field of view onto a 2k x 2k image. The three CCDs will have different coatings to optimise the efficiencies of each camera. The detector controller to run the three cameras will be Torrent (the NOAO open-source system) and a PanView application will run the instrument and produce the data-cubes. The instrument is at Conceptual Design stage, having been approved by the SOAR Board of Directors as a visitor instrument in 2012 and having been granted full funding from CONICYT, the Chilean State Agency of Research, in 2013. The Design Phase is starting now and will be completed in late 2014, followed by a construction phase in 2015 and 2016A, with expected Commissioning in 2016B and 2017A.

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ATMOSPHERIC TURBULENCE SIMULATIONS WITH SPATIAL LIGHT MODULATORS

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Atmospheric turbulence in the optical path of incoming stellar light transforms a plane wavefront into a distorted wavefront. This leads to loss of resolution achievable in a telescope. The correction of these distortions is the goal of adaptive optics. We are designing an experiment to recreate the effects of turbulence on an optical bench. This experiment aims to reproduce the effects observed in an artificial sodium laser star when viewed by a 30m class telescope. The edge of such large telescopes see the sodium artificial star as an elongated rather than a circle. In the bench experiment the turbulence distortions are achieved by directing the light beam through a glass plate whose surface is etched to imitate the phase distortions caused by the atmosphere, this plate is called a phase screen. Phase screens are made much bigger than the incident beam of light and we move this phase plate to simulate the effect of a changing atmosphere. To test new turbulence patterns one needs several different phase screens, which are expensive and hard to make. Our work involves computing numerical simulations of turbulence and testing algorithms to correct the phase distortion.We would then like to test these algorithms on our bench before testing on the telescope. To make these tests more realistic we would like to apply the same simulated turbulence patterns to our phase screen. This is almost impossible to do with phase screens, therefore we are planning to replace phase screens with spatial phase modulators that can be programmed to introduce a phase shift to the incident light at a time resolution of milliseconds. Integration of spatial phase modulators in optical benches as phase screens will allow for much more flexible experiments permitting a perfect correlation between the numerical simulations and the physical experiments.

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EXTINCTION COEFFICIENTS WITH AN ALLSKY CAMERA

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All sky cameras are a great alternative to the study of atmospheric conditions in an astronomical site. We show how to compute the instantaneous coefficients of atmospheric extinction for various moments in the same night. The images used were obtained by the camera SASCA (SOAR AllSky Camera) located at Cerro Pachon. To estimate the extinction coefficients we developed a method to measure the brightness of several stars at different air masses for the same instant. We developed a Python program that calculates azimuth and altitude for the stars and then converts them to pixel coordinates on the CCD. Comparing the positions calculated for a group of stars with their actual positions on the images, we can determine the distortion caused by the camera. After finding out the distortions we know exactly in which pixel a star falls on any date and time. At this point we created tables of star positions and did the photometry of them all on each image using the IRAF routine PHOT. These photometry tables are subsequently converted into multiple tables with apparent magnitude versus air mass for each star at a given instant. Our results show that the extinction coefficient calculated for different atmospheric moments is within two sigma of the values of the coefficients obtained through the monitoring of a single star at different air masses, demonstrating the feasibility of our approach.

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THE HARD X-RAY TELESCOPES FOR MIRAX AND PROTOMIRAX

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The Monitor e Imageador de Raios X (MIRAX), under development at the National Institute for Space Research (INPE), Brazil, is a hard X-ray astronomy experiment that will be launched in low-Earth orbit (650 km altitude, 15° inclination) on-board the Lattes satellite mission in 2018. MIRAX