**ADELA2016@BOG**

**Universidad de los Andes, Bogotá, Colombia**

**VII DYNAMICAL ASTRONOMY IN LATIN AMERICA**

**VII ASTRONOMÍA DINÁMICA EN LATINOAMÉRICA**

# ORAL CONTRIBUTIONS ABSTRACTS

# Wednesday September 28th

### TITLE: ABSOLUTE ASTROMETRY IN THE NEXT 50 YEARS

**SPEAKER:** ***Erik Høg***

***Niels Bohr Institute, University of Copenhagen, Denmark.***

**ABSTRACT:** With the Gaia astrometric satellite in orbit since December 2013 it is time to look at the future of fundamental astrometry and a time frame of 50 years is needed in this matter. A space mission with Gaia-like astrometric performance is required, but not necessarily a Gaia-like satellite. A dozen science issues for a Gaia successor mission in twenty years, with launch about 2035, are presented and in this context also other possibilities for absolute astrometry with milliarcsecond (mas) or sub-mas accuracies are discussed in my report at http://arxiv.org/abs/1408.2190. In brief, the two Gaia-like missions would provide an astrometric foundation for all branches of astronomy from the solar system and stellar systems, including exoplanet systems, to compact galaxies, quasars and Dark Matter substructures by data which cannot be surpassed in the next 50 years.

**TITLE: THE URAT PROJECT**

**SPEAKER:** ***Norbert Zacharias***
***The United States Naval Observatory.***

**ABSTRACT:** The USNO Robotic Astrometric Telescope performed a northern sky survey between April 2012 and June 2015 and has been operating at CTIO since October 2015. The "redlens" of the UCAC astrograph is used together with a large focal plane (4 CCDs, 111 million pixels each, 28 sq.deg field) in a fixed 680 to 760 nm bandpass. The URAT1 catalog, published in 2015 gives accurate positions of 228 million stars north of about Dec = −15 deg for the R=3.5 to 18.5 mag range based on the first 2 years of operations at the Naval Observatory Flagstaff Station (NOFS). The full 3 years data of the northern observing were used to produce the URAT Parallax Catalog (Finch & Zacharias 2016), the largest catalog of trigonometric parallaxes since Hipparcos. Current URAT observing concentrate on the very bright stars using a neutral density spot in combination with an objective grating.

**TITLE: PROPER MOTIONS AS A TRACER OF THE ORIGIN OF BROWN DWARFS DOWN TO THE 6 $M_{JUP}$ IN SIGMA ORIONIS**

**SPEAKER*: Karla Peña***
***Instituto de Astrofísica, Pontificia Universidad Católica de Chile.***

**ABSTRACT:** The kinematical information encoded in the motions of the least massive population of very young star forming regions and their surroundings would yield key constraints on the substellar formation models since each of them propose different predictions about the kinematics of these type of sources. We have studied the radial distributions of very low mass stars and brown dwarfs down to planetary masses as well as the kinematics of the coldest candidate members of the 3 Myr σ Orionis cluster (∼380 pc). However, in order to obtain a general and robust answer to our fundamental question, it is required to perform a homogeneous kinematical analysis of large samples of low-mass stars and brown dwarfs down to the planetary masses to study their similarities and differences related to their movement dispersions.

By using two epochs of VISTA data imaging with exactly the same instrumental configuration and a large time baseline we estimate the proper motions of low mass stars and brown dwarfs down to planetary mass objects with a precision down to a few mas/yr for the entire σ Orionis cluster sequence. This procedure would give us crucial information about the formation processes that give rise to lowest mass cluster population.

**TITLE: PROPER MOTION SEPARATION OF BE-STARS IN THE MILKY WAY AND THE MAGELLANIC CLOUDS**

**SPEAKER:** ***Khaterine Vieira***

***Centro de Investigaciones de Astronomía – CIDA***

**ABSTRACT:** We present a proper motion investigation of a population of Be stars candidates towards the Large Magellanic Cloud, which has resulted in the identification of two separate populations, the Galactic foreground and the Magellanic background. Be stars are broadly speaking B-type stars that at some point have shown emission lines in their spectra. A narrower definition is that of so-called Classical Be stars, as non-supergiant stars with Balmer emission lines in their spectra, which are theoretically understood as rapidly rotating main sequence B-type stars surrounded by a dust-free gaseous Keplerian disk formed from material ejected by the star. The line emission is formed by re-processing UV stellar light in the aforementioned disk. In this work, we studied a sample of 2446 Be star candidates towards the Large Magellanic Cloud (LMC), taken from the literature. SPM4 proper motions were found for 1480 stars but only 1308 we finally selected based on the quality of the data. OGLE BVI and 2MASS JHK photometry were used with the SPM4 proper motions to discriminate the different populations located towards the LMC. Two populations with distinctive V-I, V-J and J-K colors and noticeable different kinematics were found, the bluer sample is consistent with being in the LMC and the redder one with belonging to the Milky Way (MW) disk. A third population still in study could belong to the MW Halo but its proper motion distribution cannot establish its nature. This is the first of a series of works that aim to improve the identification and characterization of Be stars within the Galaxy and beyond, by using proper motions.

**TITLE: THE OVERTURE TO A NEW ERA IN GALACTIC SCIENCE: GAIA'S FIRST DATA RELEASE**

**SPEAKER:** ***Martin Altmann***

***Heidelberg University, Germany***

**ABSTRACT:** Less than 3 years, after ESA's ambitious astrometric space mission, Gaia, had been launched, the first data release (Gaia DR1) is foreseen to appear in September 2016. The largest part of the Gaia DR1 is a catalogue of positions and broad band photometry for 1+ billion stars - of greater scientific relevance will however be the Tycho Gaia Astrometric Solution (TGAS), which includes significantly improved full 5-parameter astrometry for the 2.5 million Hipparcos and Tycho2 stars. I will report in detail about this release and its potential as well as giving a detailed outlook on the upcoming releases, which will then include all 5 parameters for all Gaia stars and subsequently more and also more refined data.

**TITLE: THE DYNAMICAL EVOLUTION OF THE ORION TRAPEZIUM**

**SPEAKER:** ***Christine Allen***

***Instituto de Astronomía, Universidad Nacional Autónoma de México***

**ABSTRACT:** Based on recent observational data on transverse and radial velocities we study the dynamical evolution of ensembles of multiple systems mimicking the Orion Trapezium. To this end we conduct numerical N-body integrations using the observed planar positions and velocities, the observed radial velocities, and random z-positions for all components. We include perturbations in these quantities compatible with the observational errors. We present results of the integration of 300 ensembles with different values for the mass of the C component, and for values of the crossing times of up to 100. We discuss the dynamical outcome of the evolution of these systems and the properties of the resulting binaries.

**TITLE: INFALL OF ASSOCIATIONS OF DWARF GALAXIES INTO THE MILKY WAY HALO**

**SPEAKER:** ***José Benavides***

***Departamento de Física, Universidad Nacional de Colombia***

**ABSTRACT:** Inside the Local Group, the satellite galaxies of the Milky Way do not have an isotropic distribution, instead most of them lie on a structure almost perpendicular to the plane of the disk of the Galaxy, called VPOS. At present there is not a theoretical model that correctly explains both the abundance and spatial distribution of these objects within the Local Group. This work presents a study, using Newtonian N-body numerical simulations, on the formation of the disk of satellites of the Milky Way (DoS) from accretion of dwarf galaxies that fall into the dark matter halo of the Milky Way following parabolic orbits with initial distances of 4, 2 and 1 Mpc. We analyzed the morphological properties of the dwarfs after 10 Gyr of in fall into the Milky Way halo, the obtained spatial distributions about the plane of the host galaxy and the radial distances at which they are located. We found that, after 10 Gyr of infall, the structures remain compact while keeping their spherical profile. Only associations of dwarf galaxies at distances of 1 Mpc manage to enter the halo of the Galaxy and could be considered as progenitors of the DoS. This is supported by the fact that these closest associations are those that probably had already precipitated into the halo of the Galaxy, and that there are not observed associations of dwarfs at these distances, being the association 14+12 the closest to the Milky Way at 1.37 Mpc.

**TITLE: COULD A COLLISION BETWEEN A GHOST GALAXY AND THE MILKY WAY BE THE ORIGIN OF THE VPOS OR DOS?**

**SPEAKER:** ***Omar Bohórquez***

***Grupo de Astrofísica, Departamento de Física, Universidad Nacional de Colombia***

**ABSTRACT:** The dwarf satellite galaxies of the Milky Way are objects that are distributed around the host in an anisotropic manner in a structure called VPOS or DoS. This structure does not match the predictions made by the cold dark matter model of cosmological formation, which predicts a completely isotropic distribution around the Milky Way. To explain the spatial distribution of satellites several models have been raised, one of them addresses the possibility that these galaxies and their spatial distribution were generated by the collision of two disk galaxies, several billion years ago. In this work a set of Newtonian N-Body simulations using Gadget-2 has been performed in order to investigate if it is possible that this event has occurred in this way. The analysis for different mass ratios between the incident galaxy, called Ghost Galaxy, and the host galaxy or Target Galaxy is made and a clustering analysis on the remnants of the collision is performed to determine their spatial, mass and velocity distributions and to compare these results with those reported by observations and thus determine the feasibility of the model.

**TITLE: BIFURCACIÓN EN LAS CORRIENTES DE MAREA DE SAGITARIO: SIMULACIONES NUMÉRICAS**

**SPEAKER:** ***Yeimi Camargo***

***Universidad de Cundinamarca, Colombia***

**ABSTRACT:** Se realizan simulaciones de N-cuerpos de la galaxia enana Sagitario y la Vía Láctea modeladas como un conjunto de partículas. Las estructuras iniciales son conformadas en GalIC y la interacción gravitacional entre estas galaxias es llevada a cabo en GADGET. Sagitario inicialmente es una galaxia de tipo disco rotante con dos componentes: Halo de materia oscura y disco estelar, y la Vía Láctea como es usual, es una galaxia de disco con tres componentes: halo de materia oscura, disco estelar y esferoide. El objetivo de este trabajo es reproducir las bifurcaciones en sus corrientes de marea y las propiedades físicas de la galaxia enana Sagitario, para ello se simula la interacción del progenitor de esta galaxia enana donde el ángulo entre el momento angular orbital y el momento angular del disco es $180° \leq \theta \leq 0°$ mostrándose que aunque no se reproducen en su totalidad la posición y propiedades físicas del remante de Sagitario, es claro que las bifurcaciones aparecen de modo evidente cuando $180° \leq \theta < 90°$.

**TITLE: STAR TRAIL SEEING MONITOR**

**SPEAKER:** ***Ignacio Ferrín***
***Universidad de Antioquia, Colombia***

**ABSTRACT:** The quality of astrometric measurements depends on the quality of the available image, and in particular on the atmospheric seeing. The smaller the seeing the smaller the photometric and astrometric error of measurement. We describe a Star Trail Seeing Monitor (STSM) and the fundamentals of its operation. In particular we show a way to measure the Greenwood frequency and the resonant frequency of a telescope. Using this technique we made measurements of the atmospheric seeing in Mérida, Venezuela, and Medellin and the Tatacoa desert in Colombia.

**TITLE: AN APPROXIMATION TO THE DISTRIBUTION OF METEOROID IMPACTS AGAINST THE EARTH**

**SPEAKER:** ***Mario Sucerquia***
***FACom, Instituto de Física, FCEN, Universidad de Antioquia, Colombia.***

**ABSTRACT:** The Earth's neighborhood is populated by lots of potential hazardous asteroids that share the Earth's orbital path around the Sun, that could be captured into geocentric orbits, increasing the impact probability against the Earth mainly because the friction with the Earth high atmosphere and the gravitational influence of the Moon. Those objects are called Temporarily Captured Objects (TCO) *or mini-moons*.
Tunguska and Chelyabinsk meteoroid's impact events happened in the same region of the Earth. Even so, "Campos del Cielo" in Argentina and the tektites fields in Chile show hints at a possible link between those impacts. Given that the Near Earth Objects (NEOs) lies close to the Solar System plane, one may think that impacts will be more probable at low latitudes; however, the complex dynamics of the earth-moon system, mainly the Moon's orbital plane inclination, may change this trend. Several authors have studied the distribution of impact and fireballs on the Earth. But, those catalogues must be biased because the recovery and observations require resources and are restricted to continental areas, while most of the impacts may happen in the oceans where they are undetectable. The goal of this work is to assess the problem of calculating the geographical distribution of the probability of meteoroid impact at some given time, and determinate the role of the Moon in these results, in a computationally efficient way. This kind of theoretical approach will be very useful while we develop larger surveillance and tracking systems. Moreover, it could be used to study the distribution of impacts of objects of any size, including the largest ones where few data points are available and also the smallest, which are unobservable.

In doing so, we have adapted some well known techniques used in numerical optics and computational visualization called *ray casting* and a method for sampling distributions with blue noise characteristics. As in the ray casting method, our technique applies the same idea of studying the propagation of meteoroids (photons) from the Earth's surface (object) back to their original sources (a bulb), instead of simulating the propagation in the future from those sources. The distribution of already detected bodies in the Solar System asteroid families as provided by surveys is used as a way to assess the probability that a given meteoroid could impact the Earth. On the other hand blue noise sampling techniques (as Poisson-disk distributions) is used for generating initial conditions (positions and velocities) on the Earth surface in order to get a uniform well-spaced random sampling on those parameters.

The same technique can be applied to study the distribution of impact in other bodies of the solar system, e.g. the Moon, Mars or Jupiter. We are also attempting to apply the technique to assess the probability of capture of TCO for future manned and unmanned missions.

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# ORAL CONTRIBUTIONS ABSTRACTS
# Thursday September 29th

### TITLE: SPECKLE IMAGING WITH DSSI AT GEMINI AND THE DCT

**SPEAKER:** ***Elliott Horch (via Skype)***
***Department of Physics, Southern Connecticut State University, U.S.A.***

**ABSTRACT:** A program of speckle observations at the Discovery Channel Telescope (DCT) and the Gemini North and South Telescopes will be described. It has featured the Differential Speckle Survey Instrument (DSSI), built at Southern Connecticut State University in 2008. DSSI is a dual-port system that records speckle images in two colors simultaneously and produces diffraction limited images to V $\sim$ 16.5 at Gemini and V $\sim$ 14.5 at the DCT. Of the several science projects that are being pursued at these telescopes, two will be highlighted here. The first is a systematic survey of nearby K dwarfs, where the multiplicity fraction will be directly measured and compared to that of G dwarfs, and the second is a study of metal-poor spectroscopic binaries in an attempt to resolve these systems and determine their visual orbits *en route* to making mass determinations. The current status of these projects will be discussed and some representative results will be given.

**TITLE: DISTANT HALO WIDE BINARIES FROM THE SLOAN DIGITAL SKY SURVEY**

**SPEAKER:** ***Julio Chanamé***

***Instituto de Astrofísica, Pontificia Universidad Católica de Chile.***

**ABSTRACT:** Wide binaries, with semi-major axes of hundreds of AU and larger, are objects useful for a variety of applications on many areas, ranging from the determination of fundamental parameters of single field stars (metallicities, ages, etc.) to the study of the clustering properties of dark matter in Galactic and extragalactic environments. In particular, well-characterized populations of wide binaries belonging to the Galactic halo have been used to place meaningful constraints on the mass and density of MACHO-like halo dark matter in a region of parameter space not accessible to the microlensing experiments. The samples of halo wide binaries available for this purposes, however, are very local to the solar neighborhood and suffer from small number statistics. I will describe the recent assembly of a new sample of halo wide binaries that, selected from SDSS, probes regions of the Galactic halo about 10 times more distant than previous ones. Moreover, the availability of the complete phase-space information for the full new sample provides lessons for the future construction of significantly larger catalogs of wide binaries based on data from facilities like Gaia and LSST, where incomplete information (such as lack of radial velocities, for example) risks the inclusion of significant levels of contamination by chance alignments of unassociated stars.

**TITLE: THE BAYESIAN CRAMÉR-RAO LOWER BOUND IN ASTROMETRY**

**SPEAKER:** ***René Mendez***

***Departamento de Astronomía, Universidad de Chile.***

**ABSTRACT:** Astrometry is the foundation of classical astronomy and modern astrophysics, and it remains a cornerstone of the field for the 21$^{st}$ century. Nowadays, astronomers take for granted resources such as the ESA Hipparcos mission, which yielded a catalogue of more than 100,000 stellar positions to an accuracy of 1 milli-arcsecond, and look forward to the results of the ESA Gaia astrometric satellite which will deliver a catalogue of over $10^9$ stars, with accuracies smaller than 10-20 micro-arcseconds for objects brighter than V=15.

A determination of the highest precision that can be achieved in the measurement of the location of a stellar-like object has been a topic of permanent interest by the astrometric community. The so-called (parametric, or non-Bayesian) Cramér-Rao (CR hereafter) bound provides a lower bound for the variance with which one could estimate the position of a point source. In astrometry this CR bound offers meaningful expressions that can be used to analyze the complexity of the inference task in terms of key observational and design parameters such as: source properties, position of the object in the array, pixel resolution of the instrument, background, and so on. Mendez *et al*. (2013, 2014, 2015) have developed closed-form expressions for this bound and have studied its structure and dependency with respect to important observational parameters. Complementing these results, Lobos *et al*. (2015) have studied the conditions under which the CR bound can be achieved by a practical estimator.

In this talk we present a novel analysis (Echeverria *et al*. 2016) of the best precision that can be achieved to determine the location of a point source on a CCD-like detector array in a Bayesian CR setting. A key new element of the Bayesian setting is the introduction of a prior distribution of the object position: We quantify and analyze in a systematic way how much is the gain in astrometric performance from the use of a prior distribution of the object position, not available in the classical parametric setting. We derive new closed-form expressions for the Bayesian CR as well as expressions to estimate the gain in astrometric precision. An insightful corollary of this analysis is that the Bayes setting always offers a better performance than the parametric setting, even in the worse-case prior (i.e., that of a uniform distribution). We evaluate numerically the gain of the Bayes setting with respect to the parametric scenario under realistic experimental conditions: We find that the gain in performance is significant for various observational regimes, particularly in the case of faint objects, or when the observations are taken under poor conditions. We also demonstrate that the performance gains disclosed in our theoretical analysis can be achieved with the minimum mean-square-error estimator, which has a practical implementation. Finally, we present an example of what could be achieved using the Bayesian approach in terms of the astrometric precision of positional measurements with new observations of varying quality, when we incorporate as prior information data from existing (real) catalogues.

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**TITLE: THE FIRST DATA FROM GAIA**

**SPEAKER:** ***Claus Fabricius***

***Institut d'Estudis Espacials de Catalunya, Spain.***

**ABSTRACT:** Gaia astrometric satellite is in its science operational phase since July 2014. At an average rate of about 50 million observations per day, Gaia scans the full sky once every six months. Gaia Data Release 1 (Gaia-DR1), issued in September 2016, contains astrometric and photometric results for more than 1 billion stars brighter than magnitude 21 based on observations acquired during the first 14 months of its operational phase. For more than two million of the brighter stars (down to magnitude 11.5) positions, parallaxes, and proper motions have been obtained to Hipparcos-type precision through a combination with the earlier Hipparcos and Tycho-2 positions. For the remaining stars, positions at epoch J2015.0 have been obtained by essentially neglecting their proper motions and parallaxes. Positions and proper motions are given in a reference frame aligned with the ICRF radio/VLBI frame at epoch J2015.0. We give an overview of the current status of the mission, the astrometric challenges, the Data Processing and Analysis Consortium operations, the validation processes, the contents of Gaia-DR1, and the prospects for the coming releases. We emphasize that although Gaia-DR1 data are based on provisional and incomplete calibrations of the instrument, the results represent a huge improvement in the available fundamental stellar data, and discuss some of the first results.

**TITLE: THE ASTROMETRIC LESSONS OF GAIA-GBOT EXPERIMENT**

**SPEAKER:** ***Sebastien Bouquillon***

***SYRTE, Observatoire de Paris, PSL Research University, CNRS, Sorbonne Universits, UPMC Univ.***

**ABSTRACT:** Since the beginning of the Gaia mission, to ensure the full capabilities of the Gaia's measurements, a programme of daily observations with Earth-based telescopes of the satellite itself - called Ground Based Optical Tracking (GBOT) - was implemented. These observations are carried out mainly with two facilities: the VLT Survey Telescope (ESO's VST) at the Cerro Paranal in Chile and the Liverpool Telescope on the Canary Island of La Palma.

The constraint of 0.02 second of arc on the tracking astrometric quality and the fact that Gaia is a faint and relatively fast moving target (its magnitude in red is around 21 and its apparent speed around 0.04"/s), lead us to rigorously analyze the reachable astrometric precision for CCD observations of this kind of celestial objects.

We present here the main results of this study which uses the Cramér-Rao lower bound to characterize the precision limit for the PSF center when drifting in the CCD-frame. This work extends earlier studies dealing with one-dimensional detectors and stationary sources firstly to the case of standard two-dimensional CCD sensors, and then, to moving sources.

## TITLE: ASTROMETRY WITH LSST: OBJECTIVES AND CHALLENGES

**SPEAKER:** ***Dana Casetti***
***Department of Physics, Southern Connecticut State University, U.S.A.***

**ABSTRACT:** The Large Synoptic Survey Telescope (LSST) is an optical telescope with an effective aperture of 6.7 m, and a field of view of 9.6 square degrees. Thus, LSST will have an étendue larger than any other optical telescope, and therefore will perform wide-field, deep imaging of the sky. There are four broad categories of science objectives: 1) dark-energy and dark matter, 2) transients, 3) the Milky Way and neighbors and, 4) the Solar System. In particular, for the Milky-Way science case, astrometry will have a critical contribution; therefore, particular attention must be devoted to extract the maximum amount of astrometric information from the LSST data. Here, I outline the challenges posed by such a massive survey beginning with the astrometric modelling the telescope and the detector, to absolute calibration (via galaxies and GAIA), and finally to observing strategy. I will also show some current examples of ground-based, wide-field, deep imagers used for astrometry, as precursors of the LSST

## TITLE: DETECTION AND DYNAMIC ANALYSIS OF SPACE DEBRIS IN GEO RING

**SPEAKER:** ***Elvis Lacruz***
***Centro de Investigaciones de Astronomía, CIDA, Venezuela.***

**ABSTRACT:** In the last decade the increase of space debris has been exponential. This growth has been due to the collision between orbiters and satellites that are out of service. Accurate detection and determination of the orbit that crosses each of these orbiters is of great importance for space agencies, in order to execute proper maneuvers.
In this paper we present a study on the detection of space debris located at the geostationary zone.
Orbiters in this area of are mainly affected by the non-uniform distribution of mass of the Earth and solar radiation pressure, which is proportional to the area to mass ratio of the objects.

Through an optical telescope it is feasible to track, detect and determinate the position of debris objects with an error of one second of arc, equivalent to an error of 200 meters at a height of 42164 km. Thus, we have obtained a huge amount of astrometric observations acquired we present the relative motion of two geostationary orbiters nearby of the equilibrium stable and unstable point. Finally, we will comment same issues related to future work.

## TITLE: FIRST ISON OBSERVATIONS FOR CONJUNCTION ANALYSIS IN WESTERN HEMISPHERE

**SPEAKER:** ***Rodolfo Zalles Barrera***

***Observatorio Astronómico Nacional, UAJMS, Tarija, Bolivia***

**ABSTRACT:** The development of observatories collaborating with the ISON project in Western Hemisphere is continuing. In Bolivian national observatory in Tarija second Zeiss-600 telescope is upgraded and putted in operation. With this goal amount of the telescopes was automated and a lens corrector was installed instead of secondary mirror. Also second 25-cm telescope (TAL-250K) on automated mount was installed here. Moreover, the good Internet access was arranged in Tarija and observations may be arranged remotely. This upgrade allows to carry out the observations of pair of approaching space objects in beginning of June together with Mexican observatory of Sinaloa University in Cosala. This is STAR ONE C1 (2007-056A) active satellite in GEO position 65 deg. West and passive satellite LES 6 (1968-081D). The long rows of measurements were obtained on few nights, the precise orbits were reconstructed. LES 6 passive satellite was too faint for 25-cm aperture, also it has rotation with period of 6 s (amplitude is 3 star magnitude). Also 25-cm telescope ORI-25 of Cosala observatory participated in observation campaigns having the goal the providing of safety of Yamal-300K (2012-061B) active satellite in GEO position 183 deg. West.

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# ORAL CONTRIBUTIONS ABSTRACTS

## Friday September 30th

### TITLE: A STUDY GUIDE FOR THE ANALYSIS OF GAIA ASTROMETRIC DATA RELEASES.

**SPEAKER:** ***William F. van Altena (via Skype)***
***Yale University, USA***

**ABSTRACT:** A large fraction of astrometric research in the coming decade will be dominated by results from the European Space Agency's Gaia satellite, which will provide positions, parallaxes and proper motions with accuracies at the tens of microarcseconds level. The first public release of parallaxes and proper motions is projected for the second half of 2017 while the final release is scheduled for 2022. Once a release is made public we can utilize that outstanding database for astrometric investigations that are impossible with our local facilities. A few examples include studies related to the structure and dynamics of the Milky Way, dwarf galaxies, Magellanic Clouds and Local Group of galaxies, as well as the membership and kinematics of star clusters and streams in our Galaxy. Later releases will provide Solar-system results, variable stars and non-single star catalogs. If we are to utilize these data releases when they appear we must already have an understanding of how the data were obtained and the analysis tools needed to optimally process them. It is the goal of this talk to provide an outline of topics needed so that we can optimally utilize the remarkable Gaia datasets.

## TITLE: THE LANDGRAVE IN KASSEL AND TYCHO BRAHE ON HVEN

**SPEAKER:** ***Erik Høg***
***Niels Bohr Institute, University of Copenhagen, Denmark.***

**ABSTRACT:** Tycho Brahe is known as the greatest astronomer of his time and his observations had great significance for the development of science. Tycho received in 1576 the island Hven not far from Copenhagen as a gift from the Danish king Frederik II and he worked there with many collaborators during twenty years. But Tycho must share the credit for renewing astronomy with Landgrave Wilhelm IV in Kassel as has been better recognized recently. About 1566 Wilhelm, achieved much better accuracy of star positions than all astronomers before. Twenty years later, an accuracy about one minute of arc was obtained in Kassel, and soon after also by Tycho Brahe. We shall follow this evolution and the mutual process of learning between Kassel and Hven – which was not without drama.

## TITLE: REVISTA MEXICANA DE ASTRONOMÍA Y ASTROFÍSICA: 42 YEARS OF HISTORY AND PLANS FOR THE FUTURE

**SPEAKER:** ***Christine Allen***
***Instituto de Astronomía, Universidad Nacional Autónoma de México***

**ABSTRACT:** We cast a retrospective view on 42 years of publishing the Revista Mexicana de Astronomía y Astrofísica, founded in 1974. Founding editors were P. Pishmish, E. Mendoza and S. Torres-Peimbert. RMxAA has published original research papers in all areas of astronomy. Until 1994 RMxAA also published the proceedings of astronomical conferences held in México and Latin America. Since 1995 a Series devoted exclusively to such proceedings was founded, RMxAC.

All papers sent to RMxAA are strictly refereed. RMxAA is included in Current Contents, Science Citation Index and other international indexes. Both publications are fully integrated into the ADS. Their contents have always been freely available to the general public. All this ensures a wide international visibility, comparable to that of the best astronomical journals. The impact factor of RMxAA has varied over the years, mostly as a consequence of small number statistics. The average impact factor is about 2.2, far larger than that of all but a few Latin American Journals.

The editorial independence of RMxAA, the fact that there are no page charges for authors and that the printed version has been distributed free of charge to astronomical libraries all over the world motivate us to look forward with optimism to many more years of publication. We share some thoughts about the future of our journal in view of recent developments in the scientific publishing field.

**TITLE: THE VVV SURVEY EXTENSION**

**SPEAKER:** ***Dante Minniti***

***Universidad Andrés Bello, CATA, MAS, Chile.***

**ABSTRACT:** The VISTA Variables of the Via Lactea Survey (VVV) is an ESO public near-IR variability survey that is sampling the Galactic bulge and an adjacent section of the Southern Galactic plane (4th quadrant). The former hosts crucial stellar populations encompassing the Galactic center, whereas the latter features regions of intense star formation around spiral arms. About one billion point sources across an area of 562 sqdeg are being sampled, which includes stellar members of at least 36 (known) globular clusters and 350 open clusters. The survey was conducted over 2000 hours of exposure time via the 4-meter VISTA telescope. The first 5 years with successful operations allow us to plan the observations for the next 3 years. This talk focusses on the scientific mining of the VVV Survey Database, including the exploitation of the photometry, variability and proper motions. The final product of the VVV Survey will be a deep IR multi-epoch and multiband catalog in five passbands (0.9 2.5 m), which will likely exhibit more than a million variable point sources. The survey will enable the construction of a 3-D map using well-characterized distance indicators such as RR Lyrae, classical, and Type II Cepheid variables. Conversely, single-epoch surveys are typically restricted to 2-D maps. Moreover, the VVV survey penetrates 3 to 4 magnitudes fainter than 2MASS for Galactic disk stars, and thereby allows a deeper mapping of the Milky Way via red clump giants, which are employed to delineate the Galaxys bar(s), structure, distance to the Galactic center, and nature of the extinction laws. Furthermore, the observations give crucial photometry for the faintend of the near-infrared spectrum, which permit the characterization of the SEDs of the aforementioned variable sources in the inner Milky Way when combined with data from other surveys (2MASS, DENIS, MACHO, OGLE, EROS, VST, Spitzer, HST, INTEGRAL, WISE, AKARI, Chandra, Fermi LAT, XMM-Newton, and ALMA). The combined variable star catalogs will place important constraints and help guide theoretical investigations of pulsating stars, and extragalactic phenomena such as AGNs, QSOs, and SNe shall likewise be sampled. Data from the survey are made available to the entire community, and will foster studies of the star and cluster evolution history of the Milky Way, and provide a population census of the Galactic bulge and center, in addition to star forming regions throughout the disk. The main variability campaign and proper motions in the Ks-band is taking place, and we anticipate an era of interesting discoveries

**TITLE: LOCAL SYSTEMATIC DIFFERENCES IN 2MASS POSITIONS**

**SPEAKER:** ***Iván Bustos***

***Observatorio Astronómico de Córdoba (OAC), Argentina.***

**ABSTRACT:** We have found that the positions in the 2MASS All- sky Catalog of Point Sources show local systematic differences with characteristic length-scales $\sim$ 5 to $\sim$ 8 arcminutes when compared with several catalogs. We have observed that when 2MASS positions are used in the computation of proper motions, the mentioned systematic differences cause systematic errors in the resulting proper motions. We have developed a method to locally rectify 2MASS with respect to UCAC4 in order to diminish the systematic differences between these catalogs. The 2MASS catalog rectified with the proposed method can be regarded as an extension of UCAC4 for astrometry with accuracy $\sim$ 90mas in their positions, with negligible systematic errors. Also we show that the use of these rectified positions remove the observed systematic pattern in proper motions derived from 2MASS positions.

**TITLE: ORBITAL LIFETIME ANALYSIS FOR NANOSATELLITES AT LEO**

**SPEAKER:** ***Diana Cubillos***

***Grupo de Simulación Análisis y Modelado, Universidad ECCI, Colombia.***

**ABSTRACT:** Nanosatellites at low earth orbits (LEOs) are a low cost option for monitoring atmospheric and environmental conditions around Earth. For instance, data for forecast reports can be obtained periodically with these kind of small satellites. Therefore, to academic institutions, universities, etc., this fact makes nanosatellites a very attractive way for researching with a moderate budget.

In this project we compute lifetimes for hypothetical missions involving nanosatellites at LEO, focusing our attention on exploring regions along the equatorial line. Thus, in the framework of orbital mechanics, we show the viability for these kind of missions in a long and a short term. Applications are projected for countries in northern South America, central Africa and islands/countries in southern Asia.

To compute lifetimes, we take into account three effects: i) gravitational, ii) Earth oblateness and iii) atmospheric density. These effects are included in the motion equation for a nanosatellite around Earth. After solving this equation for initial altitudes in 300-700 km above mean sea level (AMSL), we compute and report flight times to arrive at 150 km AMSL. These results are defined here as lifetimes and they are calculated for different atmospheric density parametrization according to experimental data and estimations. In conclusion, we find lowest and highest lifetimes for hypothetical missions involving small satellites at LEO orbiting along the equatorial line.

## TITLE: PLANES OF SATELLITE GALAXIES: THEIR DYNAMICS AND POSSIBLE ORIGIN

**SPEAKER:** ***Verónica Arias***
***Departamento de Física, Universidad de los Andes, Colombia***

**ABSTRACT:** The anisotropic distribution of satellite galaxies in the Milky Way, Andromeda and Centaurus A cannot be readily explained by current galaxy formation models within the ΛCDM cosmology. The models predict preferential directions for accretion but many observational features, specially for the so-called vast thin plane of Andromeda satellites, are difficult to reproduce. In this work we constrain the unknown proper motions of the satellite galaxies and use dynamical simulations to explore the possible orbits of satellites around Andromeda and reinterpret the observations. We find that 7 out of the 15 satellites in the Andromeda plane could have very similar orbits suggesting that the satellites possibly came from a common accretion event.

## TITLE: CONSTRAINING THE DYNAMICS OF THE ANDROMEDAS SATELLITES

**SPEAKER:** ***David Bernal***
***Departamento de Física, Universidad de los Andes, Colombia***

**ABSTRACT:** Recently Ibata et. Al (2013) proposed the presence of a vast thin plane of corrotating dwarf galaxies orbiting the Andromeda Galaxy. Dynamical simulations of the behavior of this system using observational data have been made in order to propose the time evolution of this structure. In these simulations the tangential velocity of the satellite galaxies had to be supposed, due to unavailable observational data. We propose using large scale Non Linear Programming (NLP) optimization algorithms to determine the values of these tangential velocities. This numerical optimization is implemented by minimizing the difference between different initial conditions and trajectories of the dwarf galaxies and the simulated state of the system, subject to its current observed state. The results of this study indicate the feasibility of the initial conditions and the trajectories proposed and shed light on the possible formation processes and stability of this structure of galaxies in our local cluster.

**TITLE: CONTRIBUCIÓN DEL OAFA AL IERS CON TÉCNICAS SATELITALES CO-LOCALIZADAS**

**SPEAKER*: Ricardo Podestá***

***Observatorio Astronómico Félix Aguilar, Universidad Nacional de San Juan, Argentina.***

**ABSTRACT:** En este trabajo se muestra la estrategia seguida para la co-localización del telescopio Satellite Laser Ranging ILRS 7406 y la antena de la estación permanente GPS, emplazados en el Observatorio Astronómico Félix Aguilar (OAFA) de San Juan. El trabajo de co-localización consistió, en primer lugar, en el diseño, construcción, medición, ajuste y compensación de una red planialtimétrica entre las estaciones SLR y GPS, afianzándose en puntos de apoyo sólidamente monumentados al terreno. En segundo lugar, fue necesario medir la red con equipamiento GPS, para su posterior procesamiento y cálculo. Los centros ópticos o geométricos de los instrumentos, definidos por la intersección de sus ejes de rotación vertical y horizontal, se ubican en el interior del aparato y resultan, por lo tanto, inaccesibles directamente. Resolver matemáticamente la posición de estos centros es una tarea que demanda mucha dedicación además del empleo de los mejores métodos e instrumentales disponibles. Este trabajo permite que las coordenadas de la estación puedan obtenerse combinando los datos de ambas técnicas y con mayor grado de exactitud que los encontrados por cada una de ellas en forma individual. El IERS considera a las estaciones co-localizadas como los puntos más valiosos e importantes para el mantenimiento de los sistemas de referencia terrestres y su vinculación con los celestes.