



**IV INTERNATIONAL Pro-Am  
MEETING  
BINARY & MULTIPLE STARS**

**ABSTRACTS**

**COMPILED BY OAG LOCAL COMMITTEE**

*T.Tobal, X.Miret & I.Novalbos*

*September 2015*

**Vilanova i la Geltrú (Barcelona, Catalonia-Spain)**  
**18-19-20 SEPTEMBER 2015**

**ORGANIZATION: [Garraf Astronomical Observatory](#) &  
Campus Universitari de la Mediterrània**

# OPENING ACT

**Tòfol Tobal,**  
**Local Organizing Committee**  
**Garraf Astronomical Observatory (Catalonia-Spain)**

*Welcome major Ms. Neus Lloveras*  
*Welcome president of the 4<sup>th</sup> meeting, Dr. Josefina Ling*  
*Welcome director of the Mediterranean University Campus, Félix Ruiz*

*When a little more than one year ago some of our colleagues present here, sent us the proposal to organize an international meeting of professionals and amateurs specialized in Double and Multiple Star Systems, we embraced it with enthusiasm.*

*The Astronomical Observatory of Garraf is formed by a small team, with limited resources, was founded in 1997. We always have support the collaborative work, and the involvement in joint projects to achieve the best results.*

*The success of the organization of the 4<sup>th</sup> meeting is a good example of the combined efforts of the public and academic institutions of our city, and for each and every one of our colleagues which have provided their works in this year and a half of preparation.*

*In this sense, I would like to thank the major of our city, Neus Lloveras and the municipal team of the Economic Promotion Area for their excellent collaboration with the Organizing Committee. Exactly 15<sup>th</sup> years ago we organized in Castelldefels the 1<sup>st</sup> Meeting (in 2000); the 2<sup>nd</sup> took place in Sabadell (in 2010), the 3<sup>rd</sup> in Rodez (in 2012) and it's about to start the 4<sup>th</sup> in Vilanova I la Geltrú (2015).*

*We will have time to assess and discuss the contents that will be presented starting this afternoon, but I think that in the mind of all of us there is some restrained emotion of satisfaction. Satisfaction for having managed to organize, among all, this new international meeting. For the quantity and quality of the communications presented, I think we will enjoy the next three intense days, which may emerge new projects and complicities among the attendees.*

*I don't want to finish my speech without expressing in name of all of you the gratitude to Dr. Josefina Ling from the University of Santiago de Compostela, on accepting for second time (the first one was in Castelldefels in 2010) the presidency of an international meeting organized jointly by Castelldefels Astronomical Association and Garraf Astronomical Observatory*

*Also from the committee we wish to address a special mention to our colleague Russ Genet for his great work on the diffusion of our 4<sup>th</sup> meeting and for his support since the first day to work in this project. No doubt, his presence here is a union bridge among all the presents.*

*Please forgive me if I don't mention more names; the list would be long and all would deserve to appear on it. Once more time, I want to thank to all who have worked in the organization; to all who have moved from your countries in this 4<sup>th</sup> international meeting making it a reality.*

*Not lengthening my words, I welcome Mr. Félix Ruiz, director of the Mediterranean University Campus thanking him from the Local Organizing Committee his help to arrange this magnificent building Neàpolis for the development of our 4<sup>th</sup> meeting.*

*Thank you.*

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**Josefina Ling**  
**President president of the 4<sup>th</sup> meeting**  
**University of Santiago de Compostela (Galicia-Spain)**

*Ms Major Neus Lloveras,  
Mr. Dear coordinator Tòfol,  
Distinguished colleagues and attendants:*

*Good afternoon. It's for me an honor to preside this 4<sup>th</sup> International Meeting of professional and amateur astronomers that have made the binary and multiple star systems their great passion.*

*It's of justice to start acknowledging the fact that all the merit and work that made possible to be here to enjoy this moments ... is due to the magnificent work carried out by the members of the Local Organizing Committee: Xavier Miret, Ignacio Novalbos, Tòfol Tobal and their collaborators; to whom I wish to thank for offering me the presidency of this event; as well as for all the effort made. I wish also thank the Scientific Advisor Committee for the level and quality of the designed program.*

*I also wish, and I dare to do it in the name of all the participants, to thank the present authorities, for their attendance to the event and for the good reception given by the city of Vilanova I la Geltrú and the spaces of the Neàpolis Building; ratifying the sensibility they express towards the people working in this important area of the Astronomy. The same way I wish to extend my gratitude to all the entities that have sponsored or support this meeting.*

*The binary and multiple stars do not understand of categories nor geographical limits, despite the title of the meeting shows words like "international", "professional" and "amateur". But rather their study serves to scientifically link as brothers the people who share the same madness: the astronomy of the double stars.*

*Unfortunately a frontier exists; made mainly for the difficulty to gain access to the investigation equipment and particularly the big instrumental resources, what mostly and deeply affect the people that has made this science their living way.*

*However the interest, curiosity and the scientific thinking – a world heritage of mankind – with the rise of the close collaborations happening lately, offer us the opportunity to cross it. Is precisely in this discussion spaces like this, where can be promoted the visualization of results fruit of sharing techniques and methods of work in scientific and technological experiences about studies of different types of binary stars, orbital calculus, catalogue and database population, observation techniques treatment, etc; as well as on other of transversal type related with the history of the astronomy, the education or the citizen science. All of it means an important contribution the advance on the investigation and knowledge transmission of our beloved binary stars.*

*I'm sure the development of this 4th international meeting, that we can consider as the firs taking place under the umbrella of the newly born Commission G1 of the IAU "binary and multiple star systems", during the last General Assembly the past August in Hawaii, as was settled by the president A. Prša; will be very fruitful and will serve to let hatch from inside a storm of ideas and cooperation works, as it has happened in the 3 past editions.*

*Thank you.*

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## CLOSING ACT

**Tòfol Tobal,  
Local Organizing Committee  
Garraf Astronomical Observatory (Catalonia-Spain)**

*Dear Councilor Gisela Vargas  
Dear President of the 4th Meeting, Dr. Josefina Ling  
Dear director of C. U. M., Fèlix Ruiz*

*Dear colleagues, the feelings that I'm experimenting right now are multiple, and also contradictories. Let me express my satisfaction for arriving at the end. The intensity we have lived these 3 days couldn't last indefinitely. Probably it would be dangerous... It could lead as to David Bowman in 2001: A space odyssey to say: "My God, is full of stars", or to Buzz Lightyear in Toy Story 1: "To the infinite and beyond", which seem to be two versions of the same concept ...*

*In the next days and weeks we will compile step by step the more significant moments, our formal and informal conversations, ... a richness we will keep as our treasure, waiting a new encounter will mark another phase of this endless activity that is the astronomy. The astronomical observation practice is not only a mechanical activity, devoid of emotions, but all the contrary. A few days before starting this 4th meeting, I received a very special mail, sent by who the enthusiasts consider the promoter of the amateur double stars observation in Spain, Dr. José Luis Comellas. I read his words translation...*

*Dear Tòfol*

*Is for me a very big cause of joy that you could celebrate the 4th meeting in Vilanova with so extraordinary attendance of specialists from all over the world.*

*My most warm-hearted congratulations. I don't know what type of work could I sent at this stage of life, with 87 years, and without possibilities of observation. For me was a delight to dedicate to the double stars with very modest instruments, and enjoy the beauty of so thousands of pairs throughout 60 years.*

*Mine was a prehistoric labor, but I'm happy to see that elemental joy has been shared by so many amateurs, among who you have standed out already among the firsts. I wish this days to be a success, and you know that by heart I'm among you. I hope to see some news.*

*Greetings to all of you and for you a warm-hearted hug.  
José Luis Comellas.*

*The publication of his catalogue in 1975 and his second catalogue in 1982 set the methodological bases of the amateur work until the 90'. The team at OAG worked intensely between 1990 and 2003 on those catalogues, updating measurements, correcting errors of all kinds and adapting them to the proper format to be included in the WDS.2000 of the US Naval Observatory. To do so, it was fundamental the close relationship with Brian Mason and William Hartkopf from the U.S. Naval Observatory in Washington.*

*Thanks to this joint work, more than 5.000 measurements from Dr. José Luis Comellas are listed in this big international file. The extraordinary didactic and dissemination ability, as well as his extraordinary sense of humility, left me a deep mark during my long time hobby. In 1985 I went to visit him in Sevilla, where we talked at length. I remember specially that he gave me a copy of his new catalogue of 1982, in typescript version. So, I was one of the few that could have this document and start the observations.*

*His seed took root with force, and new teams showed up for all Spain and South America. Of that can talk our present colleagues in this room, Rafael Benavides and Edgardo Ruben Masa, drivers of the new computer editions of their observations and the celebration of an important tribute to his leading figure.*

*I want to transmit to you, in the name of all who have taken part of the organization of this 4th meeting, our bigger gratitude for the effort you have done attending, for preparing these magnificent communications, for your collaboration at all levels and for your good humor to endure (resist) with dignity during this 3 intense days. I want to give a special mention to our colleagues of the Astronòmical Observatory of Garraf; also to our support team to dedicate uncountable hours to this event, to the public and private institutions for providing the use of this magnificent space that is Neàpolis. Coordinator of the Mediterranean University Campus, Councilor, President of the 4<sup>th</sup> meeting, ... thank you very much.*

And now, a well-known phrase arises pronounced by the explorer Sir Vivian Fuchs that I have make myself many times: "*even the best projects hang from a thread*". Fortunately, this thread has not broken in this occasion and continues tense and at disposal for a new Congress, may be in USA taking the opportunity of the Sun Total Eclipse of 2017, that will bring the OAG team and many amateurs from all over the world to cross the beautiful natural parks of North America.

Thank you for all.

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**Josefina Ling**  
**President president of the 4<sup>th</sup> meeting**  
**University of Santiago de Compostela (Galícia-Spain)**

*Dear friends, now more than colleagues*

*The 4th Pro-Am International Meeting on Binary and Multiple Star Systems has ended. The quality of the works we had the opportunity to know through the speeches in this room, the posters during the coffee-breaks, or the conversations during our transfers in our Space Shuttle and the delicious meals in the Hotel Cesar, just confirme the good health our binary stars are among the professional astronomers either financially compensated or not.*

*I believe you will agree that the interchange of experiencies has been very fruitful and we have learnt a lot; at least that was my case. For all this I want to thank your participation and the good mood we have enjoyed. We only need to thank the Local Organizing Committee for their magnificent work that has left the standards very high for the organization of the next meeting. Please, an applause.*

*And talking about the next meeting, I give the floor to Russel who has something to say about it.*

Thanks.

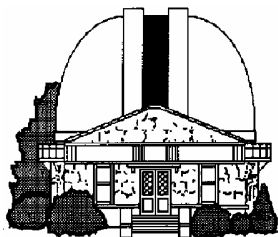
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*T.Tobal, X.Miret & I.Novalbos*

*September 2015*



**United States Naval Observatory Astrometry Department 3450  
Massachusetts Avenue, NW Washington, DC 20392-5420 U.S.A.  
INTERNET: wds@usno.navy.mil 17 September 2015**

*Dear colleagues: As past presidents of Commission 26, Double and Multiple Stars, of the International Astronomical Union we would like to greet and congratulate you on the occasion of your fourth pro-am meeting.*

*Both of us work on a daily basis in the maintenance of the Washington Double Star and other associated catalogs and we witness and can testify to the important contributions made by amateurs in the area of double and multiple star astronomy.*

*When we were making the first double star CD, almost on a lark, we included stars appropriate for our observing list used on the 26 inch refractor in Washington. Since the number of fast moving systems we can access is limited, the observing program was built around what we called "neglected" doubles. These were pairs which were either unconfirmed or had not been observed in a long time. We were both surprised and gratified when this list of neglected doubles were embraced by the community. It seems that people wanted to observe and just wanted someone to tell them what to observe.*

*When we prepared our second double star CD in 2006, the list had changed dramatically. Due to the publication rate and the complications associated with making these lists their generation is infrequent. However, the cadre of observers now know where to go to find pairs and how to filter the WDS on their own for their own Telescope/technique.*

*In addition to the observation of neglected pairs, many people also began finding new pairs. At first, these were found by simple proximity, but later and currently, amateurs are finding many common proper motion systems which are not merely double stars but true binary stars.*

*Since 2006 and the production of our last double star CD, the WDS has added 30,000 new double stars and almost doubled the number of measures. In addition to our  $\Delta m$  and Visual Orbit Catalog, we have added a catalog of linear elements which provides predicted positions for pairs which are close but not physically related. We have also identified systems which are determined to be physical or optical by other means, but even with this, of the 133,134 pairs in the WDS, 20,759 are known to be physical, 4791 are optical and the vast majority (107,584) have their status unknown. There is much still to do!*

*While many astronomy subfields can form a rather strict demarcation between amateur and professional, ever since the times of Baron Dembowski, Reverend Espin and Captain Smyth to name a few, there has been significant involvement by both groups in the study of double stars. They can be very simple systems, and it is possible for a careful and meticulous observer to easily make observations and understand their importance in astrophysics. Indeed, given that most amateurs have access to larger telescopes than were used by the Struve's, coupled with the affordability of CCDs and the availability of data reduction software, the term "amateur" is not accurate enough and we have come to prefer the term, "financially uncompensated professional."*

*Sincerely, Drs. Brian D. Mason & William I. Hartkopf Astronomers, US Naval Observatory*

**EKATERINA AVVAKUMOVA**  
URAL STATE UNIVERSITY  
RUS

### **CATALOGUE OF ECLIPSING VARIABLES CEV**

#### **Abstract**

*A new version of the Catalogue of Eclipsing Variables will be presented. The catalogue contains parameters and morphological types of light curves for some 7200 stars. Spectral classification and recently published information about evolutionary type of about 1300 systems are also given. Our catalogue represents the largest list of eclipsing binaries classified from observations. In the talk we will discuss several problems with the data and some interesting eclipsing binaries, which were found during our work.*

### **INVESTIGATION OF SEVERAL ECLIPSING BINARIES**

#### **Abstract**

*During the work on Catalogue of Eclipsing Variables we compiled an extensive list of binaries with lack of observable parameters or doubtful evolutionary type. In the talk we will present first results of our observational campaign on several northern stars and their investigations.*

**JAVIER ALONSO**  
UNIVERSIDAD DE ALICANTE  
SPA

### **BINARITY IN MASSIVE STARS: LS III +46 11"**

#### **Abstract**

*Massive stars (stars with masses, at least, larger than 8 times that of our Sun) end their lives in luminous explosions as core-collapse supernovae or gamma-ray bursts. Most of these massive stars are born in multiple systems and a large fraction of them are quite close binaries, so we only can detect the companions by studying its spectra. Recently, in this way, we have discovered one of the most massive binary known to date: LS III +46 11*

**RAINER ANTON**  
AMATEUR  
GER

### **ON THE ACCURACY OF DOUBLE STARS MEASUREMENTS FROM LUCKY IMAGES**

#### **Abstract**

*The precision and accuracy of measuring double stars from telescopic images is addressed, in particular for "lucky imaging". Three major contributions to the total error margins are discussed in some detail: the resolving power of the telescope and camera, variations of the seeing, and the image scale. Representative results are compared with literature data.*

**BOB ARGYLE**  
INSTITUTE OF ASTRONOMY UNIVERSITY OF CAMBRIDGE  
UK

### **THE LIFE HISTORY OF A DOUBLE-STAR TELESCOPE**

#### **Abstract**

*W. R. Dawes ordered an 8-inch (20-cm) refractor from Thomas Cooke and Sons which began operation in 1864. More than 150 years later it is still in operation. I describe the history and the travels of the telescope, ending with its current location in Cambridge where a programme of measurement has been in progress for 25 years.*



**KARL LUDWIG BATH**  
INTERNATIONALE AMATEUR STERNWARTE  
GER

### **THE SPECKLE MASKING METHOD -- RECONSTRUCTION OF NARROW BINARY STARS**

**Abstract**

*To get the theoretical telescope resolution there are two methods today. The most modern one is the adaptive optics though unaccessible for us amateurs. The older method reconstructs the Airy disk by reducing the data in the PC. Speckle interferometry can and should be used by us. The first step is the autocorrelation providing already the distance and position angle of a binary star. The refined speckle masking method allows to reconstruct the binary and possibly also its photometry.*

**RAFAEL BENAVIDES & EDGARDO R.MASA**  
OED  
ASOCIACIÓN ASTRONÓMICA DE CÓRDOBA  
SOCIEDAD ASTRONÓMICA SYRMA DE VALLADOLID  
SPA

### **THE "OBSERVADOR DE ESTRELLAS DOBLES" MAGAZINE: A PRO-AM EXPERIENCE**

**Abstract**

*El Observador de Estrellas Dobles (OED) is a Spanish language electronic double-star ournal published twice a year. OED was born in 2009 and during this time has become a reputed magazine distinguished by a marked Pro-Am character. In our communication we will make a statistical overview of the results obtained in these six years: almost 6000 measures of double stars and more than 700 new pairs have been added to the WDS. Likewise, the editorial team his gratefulness to all collaborators, real protagonists of these contributions; we are a mere link for the Pro-Am relationship.*

**DANIEL BONNEAU**  
ASTRONOME HONORAIRE DE L'OCA  
FRA

### **95 YEARS OF INTERFEROMETRIC OBSERVATIONS OF DOUBLE STARS**

**Abstract**

*During the twentieth century, the double stars have become prime targets for astronomical observations using optical interferometry techniques. The use of interference micrometers, the invention of speckle interferometry and the development of stellar interferometers according to principles of Fizeau and Michelson, finally eliminate the boundaries between visual binaries, spectroscopic binaries and photometric binaries. At the beginning of the twenty-first century, a new milestone has been reached with obtaining images revealing the morphology of close binaries by means of the first optical telescopes networks working in aperture synthesis.*

**JOSÉ A. CABALLERO**  
CENTRO DE ASTROBIOLOGIA CSIC-INTA  
SPA

**BINARY SYSTEMS: FROM 0.2 ARCSEC TO 2 DEG (FIVE YEARS LATER)**

**Abstract**

*Five years ago, during the II International Meeting of Double Stars Observers in Sabadell, I gave a talk with a very similar title to this one. It contained astrometric binaries with up to 40 solar masses in young open clusters, pairs of ultracool dwarfs separated by thousands astronomical units in the solar neighbourhood or the most fragile multiple stellar systems at the point of disruption by the Galactic gravitational field. In 2015, I will give another comprehensive and illustrative talk with the latest examples of extreme or benchmark multiple systems at all angular (and physical) separation, masses and ages.*

**JOSEP M. CARRASCO**  
INSTITUT DE CIÈNCIES DEL COSMOS (ICCUB)  
UNIVERSITAT DE BARCELONA  
SPA

**MULTIPLE SYSTEMS WITH GAIA MISSION**

**Abstract**

*Gaia ESA mission (launched in 2013) will obtain positions, parallaxes, proper motions, radial velocities and astrophysical parameters for about one billion objects. Amongst these sources will be numerous multiple systems. The high level of precision of Gaia observations will allow to detect a high number of previously unresolved binaries, trace their orbits in space and improve our knowledge about the ratio of binary stars in our Milky Way. Gaia will also build precise photometric lightcurves during 5 years allowing to discover and study many eclipsing binary systems determining their periods and main characteristics.*

**LAURENT CORP**  
COMMISSION ETOILES DOUBLES SAF  
FRA

**WHY AMATEURS HAVE TO OBSERVE ECLIPSING BINARIES?**

**Abstract**

*Today It's important to observe (the photometry is now a technical common for many amateurs) the Eclipsing Binaries (Ebs) in spite of the data collected by the satellite GAIA. This presentation describe some characteristics of different Ebs and the art to predict the minima as well as the necessity to obtain the complete light curve. Later will follow the analysis of some lights curves and some particularities stars to measure and why. The tool: "Software Astropline" used for determining the minima and the maxima will be showing.*

**HOW TO MEASURE THE MINIMUM OF ECLIPSING BINARIES AND THE MAXIMA OF RR LYRAE**

**Poster**

**MIRIAM CORTÉS**  
UNIVERSIDAD COMPLUTENSE DE MADRID  
SPA

## **MULTIPLICITY OF M DWARFS IN THE CARMENES EXOPLANET SURVEY SAMPLE**

### **Abstract**

*With the help of CARMENCITA, the CARMENES Cool dwarf Information and data Archive, we investigate the multiplicity of M dwarfs in the solar neighbourhood observable from Calar Alto to prepare and characterize the final sample of stars of CARMENES. Our multiplicity study covers a wide range in projected physical separations, from 0.5 to 50000 AU. The inner range is covered with a lucky-imaging survey of 385 M dwarfs with FastCam at the 1.5 m Telescopio Carlos Sánchez (42.3mas/pix), complemented with a literature search. The outer range is covered with a detailed analysis of Washington Double Stars catalogue data and optical images taken by us with TCP and CAMELOT at the 0.8 m IAC80 telescope, and an astrometric study of all-sky public images and catalogues. We review the main results of our searches and derive the multiplicity of M dwarfs at close and wide physical separations.*

**ROSA M<sup>a</sup> DOMÍNGUEZ**  
INSTITUTO DE FÍSICA DE CANTABRIA  
OBSERVATORIO ASTRONÓMICO DE CANTABRIA  
SPA

## **SEARCHING p-MODES IN BINARY STARS**

### **Abstract (Poster)**

*We are looking for stellar oscillations in several binary star systems. Most of them have been obtained by CoRoT satellite during the last years. CoRoT mission had two objectives: to search for extrasolar planets with short orbital periods, particularly those of large terrestrial size, and to perform asteroseismology by measuring solar-like oscillations in stars. During the first six years of its mission, CoRoT has observed about 150 bright stars in the sismo-field and more than 150 000 stars in the exo-field. We have analyzed 62 binaries systems among the exo-field. We show here the results obtained for 12 of these systems. In order to evaluate how difficult is to detect oscillation with terrestrial observation, we also observed some systems with several telescopes. Here we present results for X Tri binary system, that was observed in IAC80 and MERCATOR telescopes.*

**JAKUB JURYSEK**  
INSTITUTE OF PHYSICS OF THE CZECH ACADEMY OF SCIENCES  
CHARLES UNIVERSITY  
CZE

## **THE FRAM TELESCOPE AND PHOTOMETRY OF ECLIPSING BINARIES**

### **Abstract**

*The FRAM (F/(Ph)otometric Robotic Atmospheric Monitor) telescope is a part of the Pierre Auger Observatory (PAO) located near town Malargüe in Argentina. The main task of the FRAM telescope is the continuous night-time monitoring of the atmospheric extinction and its wavelength dependence. The current methodology of the measurement of a atmospheric extinction allows simultaneous observation of other interesting astronomical targets. The current observations of the FRAM telescope are focused mainly on the photometry of eclipsing binaries. In this presentation, we briefly introduce current astronomical observing program including photometry of some triple systems with distant visual companion and preliminary results of the follow up observations of some inclination changing candidates.*

**JOSEFINA F. LING**  
UNIVERSIDADE DE SANTIAGO DE COMPOSTELA  
SPA

### **BINARY STARS IN THE IAU: PAST AND NEW COMMISSIONS**

#### **Abstract**

*We analyze the role that binary stars have played in the International Astronomical Union (IAU) through its two most representative Commissions, Commission 26 "Double and Multiple Stars" and Commission 42 "Close Binary Stars". Next we will justify the reasons for why both commissions have merged into Commission G.C1 (i.e., Commission 1 of Division G) called "Binary and Multiple Stars Systems" --at the XXIX IAU General Assembly, held in Hawaii in August 2015-- as well as their future projects planned.*

**FLORENT LOSSE**  
COMMISSION ETOILES DOUBLES SAF  
FRA

### **REDUC TOOL**

#### **Abstract (Poster)**

*Reduc is a software commonly used by double stars enthusiasts. It provides easy to use tools for reductions. The poster presented at the IVth International Pro-Am Meeting on Binary and Multiple Stars focuses on the main features and on the latest evolutions of the version 5 (Vilanova version!). They include Easy Lucky Imaging and Batch modes features.*

**RUSSELL M. GENET**  
CALIFORNIA POLYTECHNIC STATE UNIVERSITY  
USA

### **SPECKLE INTERFEROMETRY OF CLOSE BINARY STARS**

#### **Abstract**

*A group of professional, amateur, and student astronomers, primarily in the Western United States and Hawaii, has been making speckle interferometric observations of close binary stars. While many of our observations have been on smaller telescopes, 0.1- to 0.5-meters, we have had two week-long runs on a 2.1-meter telescope at Kitt Peak National Observatory. We have developed user-friendly reduction software that incorporates the use of single deconvolution stars, adjustable filters, automatic preprocessing of the data, and semiautomatic operation. High school and undergraduate students in our Astronomy Research Seminars have been reducing and analyzing our speckle interferometry observations. We have several ongoing exploratory developmental programs. These include the development of shaped aperture masks to diffract the bright light of the primary star off in preferred directions to provide discovery zones for faint secondary stars, adding intensifiers to low cost CCD and CMOS cameras as an affordable alternative to EMCCD cameras, and automation of speckle interferometry. Still highly experimental are initial laboratory tests of a very low cost system for positioning mirrors to a fraction of a wavelength for a sparse-aperture speckle interferometry telescope. Our initial laboratory setup is for three 0.25-meter spherical mirrors with focal lengths matched to within a millimeter. Very low cost 2- or 4-meter telescopes are not out of the question.*

**RAFAEL HERNÁNDEZ**  
UNIVERSIDAD POLITÉCNICA DE MADRID, AAM  
SPA

## **THE METHOD OF VIDAL-ABASCAL / KINKERFLUES FOR DETERMINING THE ORBIT OF A BINARY SYSTEM FROM SHORT ARCS**

### **Abstract**

*Generally speaking, this presentation deals with methods of orbit computation of binary stars based mainly on measurements of position angles. Avoiding as much as possible the use of separation data presents advantages, reducing errors and allowing the computation of longer period pairs. We will review the method due to Ernst F. W. Klinkerfues and a variation proposed by Enrique Vidal Abascal. The method of Klinkerfues is based on some geometrical notions that theoretically allow the computation of an orbit from observational data coming from short arcs. Thus, it can be applied to longer period systems or systems observed during a relatively short time. The variation introduced by Vidal Abascal presents some advantages over the original. Firstly some computational improvements, perhaps no longer significant in the era of electronic computation. Secondly and more importantly, certain insensitiveness of the computation with respect to errors or uncertainties in the values of orbital elements such as the orbital inclination, the semiaxis major, the position angle of the ascending node and the argument of periastron. We will finally show progress on the elaboration of a software application for using these methods easily.*

**HUIB HENRICHS &  
MARCELLA WIJNGAARDEN**  
ANTON PANNEKOEK INSTITUTE FOR ASTRONOMY  
(UNIVERSITY OF AMSTERDAM)  
NL

## **WHY WAS THE RECENT ECLIPSE OF THE VISUAL BINARY ALPHA COM (P=26y) MISSED ?**

### **Abstract**

*The orbital inclination of the visual (F5V + F6V) binary Alpha Comae ( $P \sim 26$  y) is very near 90 degrees, which gives a high probability of an eclipse. Observations exist since 1827, but no eclipse has ever been observed. The last possible eclipse was predicted to occur within two weeks around January 25, 2015 (Muterspaugh & Henry (2014), referred to as MH14). We reinvestigated the predicted eclipse date in December 2014. For the special case of a 90 degrees inclined orbit the Thiele-Innes method can be reduced to a straight forward approach to determine five of the seven common orbital elements (Omega and  $i$  not being relevant), which enables a prediction of the epoch of the nearest eclipse. Using the same dataset with the same weights as used by MH14, we found significantly different values for  $a$ ,  $\omega$ ,  $e$ ,  $P$ , and  $T_0$ , resulting in a predicted eclipse date about 2 months earlier than in MH14, and with a 1 sigma uncertainty of 2 weeks. Using the full dataset, we conclude that the eclipse had unfortunately already passed before the predicted day. The origin of the discordance between our and MH14s' prediction was analyzed and attributed to a few erroneous datapoints in MH14, to which our method is not sensitive. The first next opportunity has to wait until 2040.*

**GREGORY JONES**  
ALT-AZ INITIATIVE  
USA

**CHARACTERIZATION OF NON-EMCCD CAMERAS AND OPTIMIZING PROCESSES FOR SPECKLE AND LUCKY IMAGING OF DOUBLE STARS"**

**Abstract**

*While EMCCDs have become the preferred camera for both speckle interferometry and lucky imaging, their high cost makes them impractical for many small institutions and amateurs. The advent of modern industrial and planetary cameras brings viable alternatives to for those wishing to participate on restrictive budgets. A number of inexpensive cameras have been tested and the results presented. Additional information and discussion is presented on optimization strategies to allow performance to be extended situationally.*

**OLGA KIYAEVA & NATALIA SHAKHT**  
PULKOVO ASTRONOMICAL OBSERVATORY  
RUS

**DYNAMICAL AND ASTROMETRICAL INVESTIGATIONS OF BINARY STARS WITH AUTOMATED 26-INCH REFRACTOR IN PULKOVO. RECENT RESULTS**

**Abstract**

*The 26-inch refractor of Pulkovo observatory is automated and observes without observer. Now there are about 18000 CCD and 13000 photographic observations of wide double and multiple stars. To digitize the photographic plates the new device MDD is applied. The AMP method is used for determination of the orbits of slowly moving stars ( $300 < P < 10000$ yr) on the basis of short arc of uniform observations. High precision of relative positions, motions and relative radial velocities is the main condition of these investigations.*

**OLGA KIYAEVA, V.V ORLOV & R.Ya. ZHUCHKOV**  
PULKOVO ASTRONOMICAL OBSERVATORY,  
ST.PETERSBURGS STATE UNIVERSITY,  
KAZAN FEDERAL UNIVERSITY  
RUS

**MULTIPLE STARS INVESTIGATION**

**Abstract (Poster)**

*Dynamical status of 13 visual triple systems with common proper motions of components was investigated. The probabilities of gravitational bounding of the systems and binary subsystems were estimated. We have considered the motions in the plane of sky, using the same values of parallaxes for all components of the system and zero relative radial velocities. So we have found maximal values of energy relation  $\kappa = |U/T|$  (potential to kinetic one). If  $\kappa \geq 1$  then the radial velocities have to be taken into account.*

**JOAN GENEVRIERA**  
TACANDE-LA PALMA  
OBSERVATORY  
SPA

### **DOUBLE STAR SPECTROSCOPY, AN AMATEUR ADVENTURE**

#### **Abstract**

*Investigation of the use of a spectrograph for detection and measure of closed binary systems was conducting using low cost materials. A low resolution optical spectra  $R=5000$ , was taken with a 0.4m-class telescope of Mu-1 Scorpius and Sigma-Aquila, collected along several nights from Tacande Observatory. The observed spectra showsigns of the double star nature. To ensure the stability and repeatability of the spectrometric measurements, the spectrograph calibration system has to be enhanced and/or redesigned.*

**OLEG MALKOV**  
INSTITUTE OF ASTRONOMY OF THE RUS. ACAD. SCI.  
RUS

### **BINARY STAR DATABASE BDB**

#### **Abstract**

*The fully operational version of the world's principal database of binary and multiple systems of all observational types, BDB, is presented. The Binary star DataBase is available at <http://bdb.inasan.ru> and is created as a source joining the comprehensive information on binary stars of all observational and evolutionary types. It provides the user with synthesis of data of large variety of catalogues and databases of binaries of different types: visual, orbital, astrometric, eclipsing, spectroscopic, photometric, etc. The BDB contains all data from catalogues on about 50,000 stellar systems of multiplicity 2 to 22: positional, photometric, spectroscopic, orbital and astrophysical parameters are provided when available. Organization of the information is based on the careful cross-identification of the objects. This allows the user, in particular, to search data on binaries having certain sets of parameters within the complete catalogued data set.*

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### **VISUAL AND ORBITAL BINARIES: PRINCIPAL CATALOGUES, SELECTION EFFECTS AND PARAMETER DISTRIBUTIONS**

#### **Abstract**

*The most complete list of visual binary systems with known orbital elements is compiled. It is based on OARMAC and ORB6 data and contains 3139 orbits for 2278 pairs. A refined subset of high quality orbits with available distance was also compiled. Relations between and distributions along different observational parameters are constructed, and an analysis of selection effects is made. Dynamical, photometric and spectral masses of systems are estimated, and reasons for discrepancies between them are discussed.*

**NÚRIA MIRET**  
GARRAF ASTRONOMICAL OBSERVATORY,  
UNIVERSITAT DE BARCELONA  
SPA

### **CALCULATION OF VISUAL DOUBLE STAR ORBITS USING GEOGEBRA**

#### **Abstract**

*The aim of this paper is to develop the E. Vidal Abascal method for calculating visual double stars' apparent orbits with software GeoGebra and check the accuracy of the method using reference stars with known orbits. The results obtained correlate to the official ones so this enables to consider this method for studying orbital systems without preliminary orbit calculated.*

**DAVID MONTES**  
UNIVERSIDAD COMPLUTENSE DE MADRID  
SPA

### **CALIBRATING THE METALLICITY OF M-DWARFS WITH WIDE VISUAL BINARIES**

#### **Abstract**

*In this contribution we summarise our ongoing project aimed at calibrating the metallicity of M-dwarfs. We have selected a large sample of physical binaries composed of an F-, G- or K-dwarf primary and an M-dwarf secondary. High-resolution spectra of the primary components are being analysed in order to determine, in an uniform way, accurate atmospheric parameters, metallicity and abundance of different elements. Low-resolution spectra of the secondary components allow us to determine good spectral types and metallicity-dependent spectral indices. Using all this information we are improving the current spectroscopic and photometric calibrations of the M-dwarf metallicity and we are testing some new ones. The resulting calibrations will be very useful in the characterisation of the input sample of exoplanets search programs around M-dwarfs like CARMENES (Calar Alto high-Resolution search for M dwarfs with Exoearths with Near-infrared and optical Échelle Spectrographs).*

**NATALIA SHAKHT et al.**  
PULKOVO OBSERVATORY  
RUS

### **THE POSSIBLE HOST STARS OF EXOPLANETS ON THE PULKOVO OBSERVATIONS PROGRAM.**

#### **Abstract (Poster)**

*The Pulkovo programme for many years was dedicated the observations and study of the single and binary stars close to the Sun to determine the parameters of their movement, the orbits of binary stars, masses and to search invisible components. The most part of them are the stars of spectral classes F, G,K,M, and they could be parent stars for exoplanetary systems. We estimated the possible astrometric signals from planets with different masses which could be available with more high technics in the future. Also for some stars we estimated the limits of possible habitable zones (HZ) with the using the new data about stars and with the models by Kasting 1993, Selsis et al., 2007 and Rushby et al., 2013 for HZ.*



**CARLES SCHNABEL**  
AGRUPACIÓ ASTRONÓMICA DE SABADELL  
SPA

## **OCCULTATIONS AS A TOOL TO DETECT BINARY SYSTEMS**

### **Abstract**

*Lunar and asteroidal occultations permit the discovery, confirmation or characterization of double or multiple star systems. The Occult application developed by Dave Herald, allow the computation of occultations of stars catalogued as doubles, and the Occult Watcher application created by Hristo Pavlov, the coordination of observation campaigns. However, there are also many cases in which occultations lead to double stars discoveries within distances in the range of hundredths of an arcsecond. The same Occult, on the one hand, and Tangra from Hristo Pavlov, enable the analysis of recordings and determining the position parameters of a double system. I will show some examples about these topics.*

**J.A.SOLDEVILLA, JOAN GENE BriERA, T.TOBAL**  
OBSERVATORI DE CANYELLES,  
TACANDE-LA PALMA OBSERVATORY  
OAG

## **RUSSIAN MADE OPTICS OF A 200mm F/15 REFRACTOR REBORN IN ALT-AZ TELESCOPE WITH 90° VISION. FROM 3m TO 1,20m TUBE DESING**

### **Abstract (Poster)**

*This joint project of OAG + Universitat de València aims assembly an achromatic doublet of 200mm diameter and F/15 focal lens, built in Russia. With a length of 3 meters tube it is almost impossible to install in a observatory of small dimensions. J.A.Soldevilla and Joan Genebriera designed an option that reduces the tube to 1.20 meters. The telescope will set up a CCD and Double Image Camichel-Lyot micrometer, for visual double stars programs.*

[SEE + INFO ON THIS PROJECT IN OAG WEB SITE PAGE](#)

**EDGARD SOULIÉ &  
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COMMISSION ETOILES DOUBLES SAF  
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**THREE PROMINENT CONTEMPORARY DOUBLE STAR OBSERVERS: PAUL COUTEAU (1923-2014) & JEAN DOMMANGET (1924-2014) & GUY SOULIÉ (- 2015)**

**Abstract**

*Paul Couteau: Né le 31 décembre 1923, passionné par l'astronomie à l'adolescence, Paul Couteau fait de solides études littéraires jusqu'au baccalauréat puis des études scientifiques. Il prépare sa thèse de doctorat sur les naines blanches sous la direction d'Evry Schatzman. En 1951, il devient assistant à l'Observatoire de Nice et Robert Jonckheere lui donne une formation pratique d'observateur d'étoiles doubles (ED)visuelles ; dès lors, il accumule les mesures. En 1961, il passe six mois à l'Observatoire Yerkes avec George Van Biesbroeck. De 1963 à 1969, Paul Couteau dirige la rénovation de la grande lunette de Nice. Il préside la Commission des ED de l'UAI et en 1969, il organise un colloque international sur les ED. Ayant entrepris une prospection du ciel, il accumule les découvertes d'ED. Il est le huitième observateur de l'histoire par le nombre de ses mesures et par celui de ses découvertes. Lauréat du prix Janssen de la SAF, ce savant est aussi un enseignant et un écrivain, qui a publié cinq livres. Son livre intitulé « L'observation des étoiles doubles visuelles » (1978) a stimulé l'intérêt des astronomes amateurs pour les ED. Son livre « Ces astronomes fous du ciel ou l'histoire de l'observation des étoiles doubles » (1988), sans équivalent, est traduit en espagnol. Il décède le 28 août 2014. La Commission des Etoiles Doubles de la S.A.F. perd en lui un conseiller scientifique toujours disponible.*

*Jean Dommanget: naît le 13 Juin 1924, à Bruxelles (Ixelles). En 1947, il travaille à l'Observatoire Royal de Belgique comme aide temporaire dans la section des étoiles doubles dirigée par le Dr Sylvain Arend. En parallèle, il poursuit ses études ; en 1950, il obtient un diplôme universitaire en sciences mathématiques (1950). En 1961, il obtient un doctorat ès sciences et devient membre de la Commission 26 "étoiles doubles" de l'Union Astronomique Internationale (UAI). Il travaille dans divers domaines : l'astrométrie et la dynamique des étoiles doubles visuelles, les occultations stellaires et le profil lunaire, la turbulence atmosphérique, les astéroïdes, les éclipses solaires et lunaires, les outils mathématiques, les propriétés orbitales et l'évolution des étoiles binaires. En 1955-1957, il effectue une mission de prospection en Afrique du Sud à la recherche d'un site approprié à la construction d'un observatoire européen dans l'hémisphère australe (ESO). Plus tard, il est directeur par intérim de l'Observatoire de Boyden à Bloemfontein. De 1967 à 1973, il est vice-président puis président de la Commission 26 de l'UAI. En 1981, il rejoint le consortium du catalogue d'entrée (INCA) de la mission astrométrique Hipparcos de l'Agence spatiale européenne et dirige le sous-groupe "Etoiles Doubles" du Comité exécutif. Auteur de nombreuses publications, il devient chef du Département d'astrométrie et de mécanique céleste. Il participe au comité qui pilote la sélection des étoiles du programme Hipparcos. En 1993, il rejoint le groupe de travail Etoiles Doubles.*

*En 1994, avec l'aide de M. Omer Nys, il publie un "Catalogue des Composantes d'Etoiles Doubles et Multiples" (CCDM), adapté aux besoins du catalogue d'entrée d'Hipparcos (HIC). Il contribue à la publication en 1997 du catalogue Hipparcos, Annexe 1 – Etoiles doubles et multiples (ESA, vol. 6). Membre de la Société Astronomique de France depuis 1954, il devient conseiller scientifique de la Commission des Etoiles doubles au milieu des années 1980 et fait participer la Commission à la vérification des positions des couples HIP pour l'INCA. Il décède le 1er Octobre 2014.*

**GIANLUCA SORDIGLIONI**  
AMATEUR  
ITA

**STELLE DOPPIE: DOUBLE STAR DATABASE SEARCH ENGINE TO THE WDS**

**Abstract**

*Abstract: Finding information on double stars may be very difficult for amateur astronomers. The WDS assign a catalog number for the doubles and cross-references with existing catalogs is a time-consuming operation. StelleDoppie addresses all those problems, providing a clear interface to present information and a power tool to find doubles. Tips and tricks to improve users' searching skills will be presented.*

**TÒFOL TOBAL, XAVIER MIRET & IGNACIO NOVALBOS**  
GARRAF ASTRONOMICAL OBSERVATORY  
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**OAG WIDE PAIRS SURVEY PROJECT (2008-2015) & GWP CATALOGUE OF 3000+ SYSTEMS**

**Abstract**

*OAG Common Proper Motion Wide Pairs Survey (CPMWPS) is a Pro-Am project developed and coordinated by Garraf Astronomical Observatory and professional team (D.Valls, J.A.Caballero, E.Solano et al.) since 2008 to 2015 with the aim of finding new anonymous common proper motions stars pairs, which can form physical systems but which are not yet catalogued. Making use of the Virtual Observatory Tools we have completed a systematic exploration of the Equatorial Zone ( from RA 00h 00m 00s to 23h 59m 59s between Dec +20° 00' 00" and -20° 00' 00" ) taking as a fundamental parameter a common proper motion higher than 50 marcsec/year, without limiting magnitude. We present a catalogue with more than 3000 new pairs detected as well as their influence in a new professional projects.*

**DAVID VALLS**  
CNRS / OBSERVATOIRE DE PARIS-MEUDON  
FRA

**THE ROLE OF BINARY STARS IN THE PLEIADES**

**Abstract**

*Abstract. We review the latest results on the open star cluster M45. New massive surveys have provided us with unprecedented details on proper motions, and new measures of the dynamical mass of the cluster. The evolution of the cluster is also jointly constrained from the colour-magnitude diagram of its members, where unresolved binary systems can be taken into account. We also discuss the problem of its distance, and the results of a pro-am programme aimed at understanding a unique binary system.*

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ARGENTINA

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CHARLES UNIVERSITY  
CZECH REP.

COMMISSION ETOILES DOUBLES  
SOCIÉTÉ ASTRONOMIQUE DE FRANCE  
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