PROGRAMME AND ABSTRACTS BOOKLET

V3.0 (7nov17)

XXIX Canary Islands Winter School of Astrophysics

"APPLICATIONS OF RADIATIVE TRANSFER TO STELLAR AND PLANETARY ATMOSPHERES"

Instituto de Astrofísica de Canarias
La Laguna, Tenerife, Spain

13-17 November 2017

INDEX

IMPORTANT INFORMATION

REGISTRATION DESK

On Sunday November 12th, the Winter School registration desk will be open during the Welcome Cocktail at the Hotel Laguna Nivaria (19:00-21:00).

On Monday 13th, the registration desk will be set up at the UNED building, close to the conference room. It will be open from 8:00 to 9:00 am and during the coffee breaks.

SCHOOL VENUE

Standard lecture sessions will take place at the main conference room of the Universidad Nacional de Educación a Distancia (UNED) in La Laguna. The conference room is located on the first floor of the building.
Posters will be located close to the conference room, near where the coffee breaks will take place. There will be free access to internet.

See maps on page 4 showing how to reach the UNED from the Hotel Nivaria and Hotel Aguere.

TUTORIALS

Tutorials will take place at the main conference room of the Instituto de Astrofísica de Canarias (IAC) and the computer room of the Physics Faculty of the University of La Laguna, respectively.

See maps on pages 5 and 6 showing how to reach the IAC and the Physics Faculty from the UNED.

SOCIAL EVENTS

- **Sunday 12th (**19:30 to 20:30**)**: A welcome cocktail will be offered to all the participants at Hotel Laguna Nivaria.
- **Wednesday 15th or Friday 17th (**17:45h – 18:15h**)**: After the tutorial session on cool stars, participants will be invited to visit the IAC Headquarters to see the scientific and technical facilities at this research center. The IAC is a leading astrophysics research center in Spain, distinguished by the Spanish Government as a 'Severo Ochoa Center of Excellence', together with only eight other Spanish scientific institutions.
- **Thursday 16th (19:00)**: Dr. Antonia Varela will give the Public Lecture *La vida de una estrella en un arco iris* in the Museo de la Ciencia y el Cosmos (La Laguna), in front of the IAC.
- **Friday 17th (~20:00)**: Closing Dinner offered by the School's organizers.
- **Saturday 18th**: Visit to the Teide Observatory (Tenerife, 2400 m). Lunch is included. We recommend participants to bring warm clothing. We will departure from the Hotel Laguna Nivaria at ~ 09:00, and will be returning to La Laguna ~ 16:00 (exact departure/arrival hours to be confirmed).
- **Sunday 19th**: Optional trip to the Roque de Los Muchachos Observatory (La Palma, 2400m).

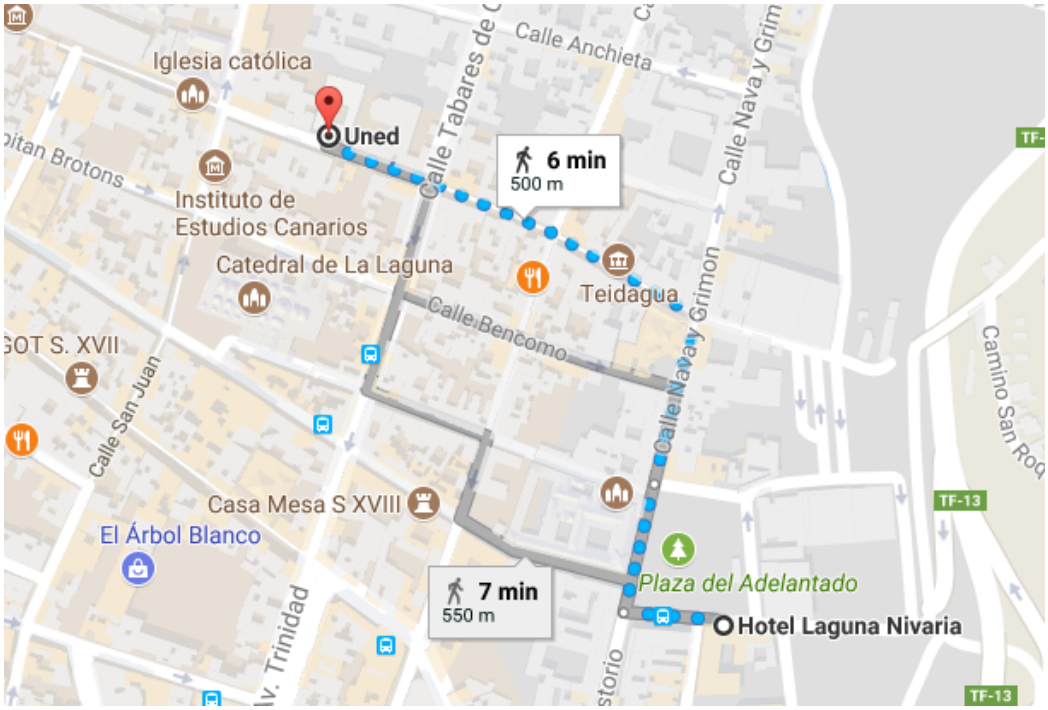
Note: The cost of all the social activities (except for the daily trip to El Roque de los Muchachos observatory) is included in the registration fee.

MAPS

HOW TO REACH THE UNED FROM HOTEL AGUERE AND HOTEL NIVARIA

It is easy to get the UNED from either Hotel Laguna Nivaria or Hotel Aguere. It takes around 5-10 min walking in both cases.

From Hotel Laguna Nivaria to UNED:



From Hotel Aguere to UNED:

HOW TO REACH THE PHYSICS FACULTY AND THE IAC FROM THE UNED

On Wednesday and Friday, after lunch, participants will be divided in two groups to attend the tutorials, either at the IAC or the Physics Faculty of the University of La Laguna. Both are within walking distance (~20-25 min) from the UNED.

From UNED to the Physics Faculty:

HOW TO REACH THE PHYSICS FACULTY AND THE IAC FROM THE UNED (CONT.)

From UNED to the IAC (also valid to reach the Museo de la Ciencia):

OUTLINE OF THE SCHOOL

The radiative transfer (RT) equation is the master key for the determination of the physical parameters and chemical abundances of the stars by means of model atmospheres and the subsequent spectral synthesis. The progress achieved so far in the field of stellar atmospheres is expected to pave the way to new successful applications of RT to planetary atmospheres. The proposed leitmotiv for the XXIX Canary Islands Winter School of Astrophysics is to **discuss the physical and geometrical properties of the stellar and planetary atmospheres in order to ascertain their influence on the radiative transfer equation**, considered as a kinetic (Boltzmann) equation for photons.

Of course, an exhaustive treatment of such a far-reaching subject would largely trespass the limits of time allotted to this Winter School. Two questions have been put forward as a criterion to select among the wide range of possible topics: Which are the problems posed by the physical properties of the different classes of objects (i.e. stellar and planetary atmospheres) considered? How do they shape the mathematical structure of the RT equation?

The **phenomenology of early-type stars, late-type stars and planetary atmospheres** will be examined in order to address the main physical processes inside each individual class of objects and to identify the problems they pose from the standpoint of RT. Among them, departure from Local Thermodynamical Equilibrium (LTE) is an almost ubiquitous phenomenon and will be duly considered. At least a hint upon the effects on line profiles brought about by large velocity fields and shocks propagating through extended atmospheres shall be given as well. Specific problems related to the peculiar physical conditions of planetary atmospheres shall be addressed too.

From the **mathematical and modelling point of view**, specific lectures will be included to indicate how, on the one hand, departures from hydrodynamic equilibrium prevent to introduce in the left hand side of the RT equation the usual simplifying approximations (stationarity, homogeneity, 1-D plane-parallel or spherical geometry) and, on the other hand, departures from LTE must often be taken into account in the right hand side of the equation, which results in the coupling of all the specific RT equations and a consequent severe non-linear and non-local problem.

Distinguished specialists in their field of research have been invited to give **advanced lectures** on the following topics:

- Fundamental physical aspects of radiative transfer
- Mathematical background and computer codes
- Phenomenology and physics of atmospheres of early-type and late-type stars
- Phenomenology and physics of atmospheres of brown dwarfs and extrasolar giant planets
- Near IR high resolution spectroscopy

Lectures will be complemented by **tutorial activity** consisting in the running of standard computer codes to trace the effects of both physical assumptions and a different choice of key parameters on the stellar spectra synthesized in the case of both hot and cool stars.

ORGANIZING COMMITTEE

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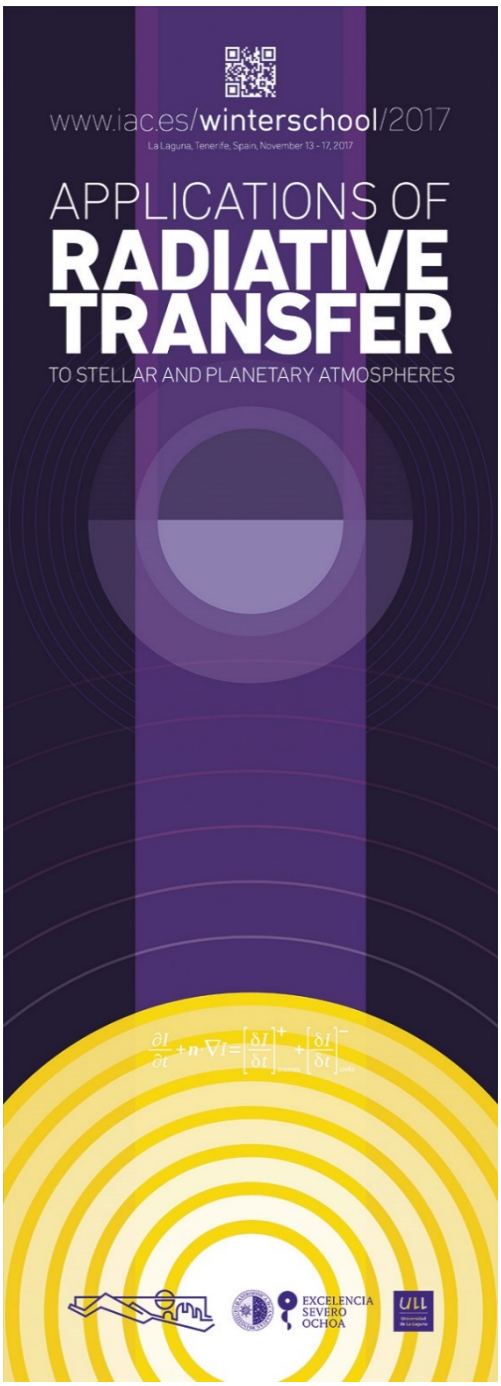

LECTURERS AND SCIENTIFIC PROGRAMME

Introduction to the School

Lucio Crivellari
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Fundamental physical aspects of radiative transfer

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Numerical methods in radiative transfer

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Stellar atmosphere codes

Mats Carlsson
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Phenomenology and physics of late-type stars

Maria Bergemann
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Radiative transfer in the (expanding) atmospheres of early-type stars, and related problems

Joachim Puls
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Modeling the atmospheres of brown dwarfs and extrasolar giant planets

Mark S. Marley
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Near IR high resolution spectroscopy of variable stars

Giuseppe Bono
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Tutorials on the application of radiative transfer codes to the cool and hot star domain

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Sergio Simón Díaz (Hot stars)
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INTRO	MATH	EARLY	PLAT	TUT1 - LATE
L. Crivellari	O. Atanackovic	J. Puls	M. S. Marley	C. Allende-Prieto
FUND	**COD**	**LATE**	**IRs**	**TUT2 - EARLY**
A. Herrero	M. Carlsson	M. Bergemann	G. Bono	S. Simón-Díaz

* Last update: October 10, 2017

	Monday 13	Tuesday 14	Wednesday 15	Thursday 16	Friday 17
09:00-09:15	Welcome				
09:15-10:15	INTRO	FUND (3)	MATH (3)	PLAT (2)	LATE (3)
10:15-10:45			**Coffee**		
10:45-11:45	FUND (1)	EARLY (3)	CODE (3)	PLAT (3)	IRs (2)
11:45-12:00			**Break**		
12:00-13:00	FUND (2)	MATH (1)	PLAT (1)	LATE (1)	IRs (3)
13:00-15:00			**Lunch**		
15:00-16:00	EARLY (1)	MATH (2)	TUTORIALS	LATE (2)	TUTORIALS
16:00-16:30	**Coffee**		(IAC/ULL)	**Coffee**	(ULL/IAC)
16:30-17:30	EARLY (2)	COD (1)		IRs (1)	
17:30-18:30		COD (2)	IAC visit (group 1)		IAC visit (group 2)
				Public talk (19:00)	Closing dinner

LIST OF PARTICIPANTS

1.	**Abdul-Masih, Michael**	KU Leuven	Belgium
2.	**Alam, Munazza**	Harvard University	USA
3.	**Alei, Eleonora**	INAF-OAPD	Italy
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7.	**Blecic, Jasmina**	New York University Abu Dhabi	United Arab Emirates
8.	**Bodensteiner, Julia**	KU Keuven	Belgium
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LIST OF PARTICIPANTS (CONT.)

42.	**Maryeva, Olga**	Astronomical Institute, The Czech Academy of Sciences	Czech Republic
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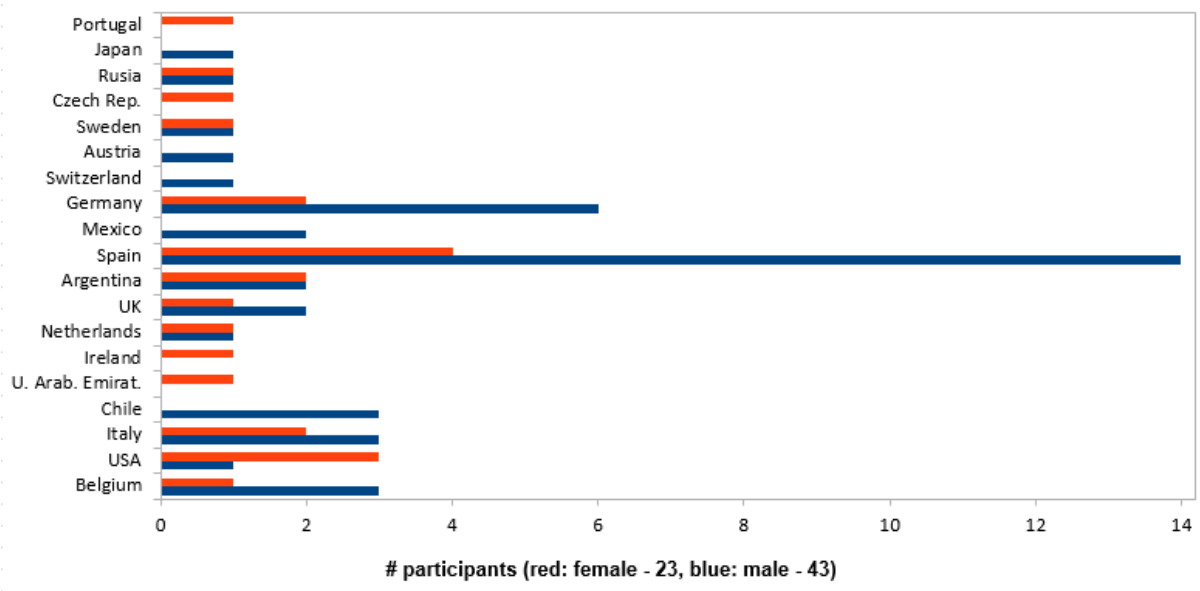

POSTER CONTRIBUTIONS

1. **Is VFTS 352 experiencing Chemically Homogeneous Evolution?**
Abdul-Masih, M.; Sana, H.; Almeida, L.

Nearly a quarter of all massive stars will merge during their lifetimes. The contact phase of massive binaries, preceding coalescence, is poorly understood due to a lack of observational constraints: only 7 O-type overcontact binaries are currently known. Stars in these systems may suffer from enhanced mixing due to rotation and tidal effects. Such enhanced mixing can induce chemically homogeneous evolution, a fundamentally different evolutionary channel where the 2 stars remain compact, preventing them from merging. Such a channel has recently been proposed as a viable way to create close and massive blackhole binaries that can explain the GW150914 gravitational wave event. However, the viability of this GW channel depends on the efficiency of the poorly-understood mixing processes. We use VLT/optical and HST/UV data of a LMC overcontact binary that shows evidence of enhanced mixing: VFTS 352 (O4.5V+O5.5V; P = 1.12d). We present new observational constraints on the physical parameters and surface abundances (He, C, N), compare them with binary evolution models, and discuss our results in the context of the future evolution of the system as a possible GW-progenitor.

2. **A Transmission Spectrum for The Nearest Transiting Super-Earth**
Alam, M; Lopez-Morales, M.

3. **Stability studies of Super Earths atmospheres - Atmosphere in a Test Tube**
Alei E.; Claudi R.; La Rocca N.; Poletto L.; Erculiani S.; Cocola L.

The main purpose of this study is to gather information about the stability of Super Earths atmospheres. Super Earths are likely to exist in a various range of atmospheres; therefore, it is important to understand which ones allow liquid water on the surface and could potentially host Earth-like life forms. In order to do so, a numerical code needs to be developed while trying to include those chemical and physical processes that are believed to be present in a typical atmosphere.
Once determined the best chemical environments for life survival on a Super Earth, these atmospheric conditions (pressure, temperature, and chemical composition) could be reproduced in laboratory. Following the idea proposed by Claudi et al. (2016) within the “Atmosphere in a Test Tube”; experiment, these mixtures could be inserted in a special steel cylinder that contains photosynthetic bacteria: irradiating the chamber, one should be able to study how these species behave and how they effectively change the atmosphere during time – mainly producing oxygen. The setup includes a light source able to reproduce visible and NIR spectra of G, K, and M stars. The experiment is already running with Earth-Sun and Earth-M star simulations, producing many interesting results.
The proposed work is part of a project that aims to define a database of exoplanets’ synthetic spectra in order to understand observational data that will be retrieved from Cheops, PLATO, JWST and ARIEL.

4. **Stellar and wind parameters of massive stars from spectral analysis**
Araya, I; Curé, M.

The only way to deduce information from stars is to decode the radiation it emits in an appropriate way. Spectroscopy can solve this and derive many properties of stars. In this work we seek to derive simultaneously the stellar and wind characteristics of a wide range of massive stars. Our stellar properties encompass the effective temperature, the surface gravity, the stellar radius, the micro-turbulence velocity, the rotational velocity and, finally, the chemical composition. For wind properties we consider the mass-loss rate, the terminal velocity and the line--force parameters (α, κ and δ) obtained from the standard line--driven wind theory. To model the data, we use the radiative transport code FASTWIND considering the newest hydrodynamical solutions derived with HYDWIND code, which needs stellar and line--force parameters to obtain a wind solution. A grid of spectral models of massive stars is created and

together with the observed spectra their physical properties are determined through spectral line fittings. These fittings provide an estimation about the line--force parameters, whose theoretical calculations are extremely complex. Furthermore, we expect to confirm that the hydrodynamical solutions obtained with a value of δ slightly larger than ~0.25, called δ-slow solutions (Curé et al., 2011), describe quite reliable the radiation line-driven winds of A and late B supergiant stars and at the same time explain disagreements between observational data and theoretical models for the Wind--Momentum Luminosity Relationship (WLR).

5. Exploring Cygnus OB2

Berlanas, S.R.; Herrero, A.; Comerón, F.; Pasquali, A.

The Cygnus region is one of the most powerful star forming regions at a close distance (~1.4kpc). Its central OB association Cygnus OB2 is known to harbour many tens of O-type stars and hundreds of OB stars, providing a large homogeneous population of OB stars that can be analysed. Although many studies of its massive population have been developed in the last decades, the total number of OB stars is still incomplete. In this study, we have confirmed 42 new massive OB-type stars in Cygnus OB2 and surroundings, including 11 O-type stars. We have obtained radial velocities and visual extinctions for all of them. We have also derived stellar parameters for the whole sample and built the Hertzsprung-Russel Diagram of the region to study the stellar evolution and discuss the story of star formation.

6. The Effects of Atmospheric 3D Thermal Structure and Cloud Models on 1D Retrieval

Blecic J.; Dobbs-Dixon, I; Cubillos, P.; Baker, A.; Greene, T.

Atmospheric radiative transfer codes are used both to predict planetary spectra and in retrieval to interpret data. We have developed two open-source retrieval frameworks BART (Bayesian Atmospheric Radiative Transfer) and PyratBay (Python Radiative Transfer in a Bayesian Framework) to characterize exoplanetary atmospheres and assess their chemical compositions, thermal profiles and clouds structure. To adequately constrain a physically plausible atmospheric configuration, one must account for the uncertainties coming from our limited knowledge of their chemical and dynamical processes. Combining a retrieval framework (an observation-driven approach that applies a statistically robust treatment of the uncertainties) and theory-driven forward models (that provide a self-consistent insight into physical and chemical processes at play) is a particularly promising way to accurately characterize any planetary atmosphere. We apply these models to investigate the difference between the temperature structure produced with a 3D atmospheric hydrodynamic simulation of a hot-Jupiter planet and the best-fit 1D retrieved model, and present several parametrized cloud models to describe complex aerosol structure of exoplanetary gaseous envelopes and their effect on retrieval.

7. Probing the late stages of massive star evolution with early-time supernovae

Boian,I; Groh, J.

Linking supernovae to their elusive progenitor stars is a challenging task. Recent observations of supernovae taken only a few hours after explosion promise to be a game changer, allowing us to probe with unprecedented detail the last stages of massive star evolution and the interaction between the supernova and the circumstellar material ejected by the star shortly before its death. However, detailed radiative transfer simulations and quantitative spectroscopy are needed in order to completely understand and characterise these events. In this poster, I will present our recent efforts of investigating the nature of explosive eruptive events from massive stars and interacting SNe using the CMFGEN radiative transfer code. Our primary goal is to form a comprehensive understanding of the physical properties of massive stars shortly before explosion and then apply these models towards characterising specific events. I analyse how the spectral morphology of these events changes as a function of progenitor properties such as chemical abundances, mass loss, and wind velocity. Our models indicate a diversity of spectral morphologies and diagnostics, which could in turn be used to infer the nature of the progenitor of observed events. I will present our results for SN 2015bh, showing that an LBV with T_{eff} = 15000K and L=8.5e5 Lsun was the progenitor of the explosive event in which the star lost 1e-3 Msun/yr in an outflow with velocity of 1000 km/s.

8. **Sodium search in exoplanets using high resolution spectroscopy**
Casasayas-Barris, N.; Pallé, E.

Transit spectroscopy is one of the best known methods to characterise the exoplanets atmosphere. Ground-based detections of atomic sodium in the atmospheres of well-known planets, HD189733b (Redfield et al. 2008; Jensen et al. 2011) and HD 209458b (Snellen et al. 2008), were enabled by the use of high-resolution spectrographs (R~50000). Here, we present our results about the sodium search in the atmospheres of HD 189733b and WASP-69b by using HARPS and HARPS-North (R~115000) observations, respectively.

9. **Effects of intense flaring activity on accretion disk of Classical T Tauri Stars**
Colombo, S.; Orlando,S.; Peres,G.; Reale,F.; Ibgui, L; Stehle, Ch.

According to the magnetospheric accretion scenario Classical T Tauri Stars (CTTSs) are surrounded by a disk with which they exchange mass and angular momentum through mass accretion. Despite the accretion process is a crucial aspect of star formation, some issues are still debated, as for example, how the material loses angular momentum and falls into the star. Moreover, CTTSs are characterized by a strong flaring activity. This energetic phenomena may influence the circumstellar environment, and perturb the stability of the disk if a very intense flare occurs in proximity of the disk (Orlando et al. 2011). Starting from these considerations, in this work we investigate the effects on the disk of a train of low intensity flares randomly distributed on the disk surface. In particular we explore the conditions that might induce accretion episodes, through 3D magneto-hydrodynamical modelling. Our model takes into account the most important physical processes (among which thermal conduction and radiative cooling). We find that an intense flaring activity produces a hot extended corona which links the disk to the stellar surface. The flares can also significantly perturb the disk and trigger accretion phenomena leading to accretion rates comparable with those inferred from X-ray observations.

10. **First 3D simulations of pure-helium atmosphere white dwarfs**
Cukanovaite, E.; Tremblay, P-E.

Most stars in the universe will end their lives as white dwarfs, and as such, they are important for studies of stellar evolution, for instance, measuring the ages of stellar populations. To do this, we require the fundamental parameters of white dwarfs themselves, which in turn necessitates a good understanding of their interiors and atmospheres. Synthetic spectra calculated from model atmospheres can be used to directly extract effective temperatures and surface gravities (log$g$) of white dwarfs, and indirectly determine their masses, cooling ages, radii and other useful parameters. Until recently, 1D atmosphere modelling has been used. In this poster, we present the first 3D hydrodynamical models of pure-helium atmosphere (DB) white dwarfs. We discuss our preliminary results, focusing on the so-called 'high-log$g$ problem', where surface gravities derived from 1D spectral models deviate significantly from evolutionary model predictions at low temperatures. It has been suggested that this discrepancy is a consequence of imperfect implementation of line broadening by neutral helium and not due to problems with 1D modelling. However, we have found that this discrepancy can be resolved in part by 3D modelling of DB atmospheres.

11. **The Puzzling P-Cygni Profiles of Massive Magnetic Stars: a Deeper Understanding**
Erba, C.; David-Uraz, A.; Petit, V.; Stanley, O.

Magnetic massive stars comprise approximately 10% of the total OB star population. Modern spectropolarimetry shows these stars host strong, stable, large-scale, often nearly dipolar surface magnetic fields of 1 kG or more. These global magnetic fields trap and deflect outflowing stellar wind material, forming an anisotropic magnetosphere that can be probed with wind-sensitive UV resonance lines. Recent HST UV spectra of magnetic O stars such as HD 191612, CPD-28 2561, and NGC 1624-2 (the most magnetic O star observed to date) show atypically unsaturated P-Cygni profiles in the CIV and SiIV resonant doublets, as well as a distinct variation with rotational phase. We examine the effects of non-

radial, magnetically-channeled wind outflow on P-Cygni line formation, using a Sobolev Exact Integration (SEI) approach for direct comparison with HST UV spectra. We demonstrate that the addition of a magnetic field desaturates the absorption trough of the P-Cygni profiles, but further efforts are needed to fully account for the observed line profile variation. Our study thus provides a first step toward a broader understanding of how strong magnetic fields affect mass loss diagnostics from UV lines.

12. X-rays from Magnetic B-type Stars

Fletcher, C.; Petit, V.; Cohen, D.; Wade, G.; Townsend, R.; Owocki, S.; David-Uraz, A.

Recent surveys have found that ~10% of OB-type stars contain strong, mostly dipolar magnetic fields with strength on the order of a kilogauss. The prominent idea describing the interaction between the stellar winds and the magnetic field is the magnetically confined wind shock (MCWS) model. In this model, the ionized wind material is forced to move along the closed magnetic field loops and collides at the magnetic equator creating a shock ($\Delta v \sim$ 500-800 km/s). As the shocked material cools radiatively it will emit X-rays. Therefore, X-ray spectroscopy is a key tool in detecting the wind material confined by the magnetic fields of these stars. Some of these magnetic B-type stars are found to have very short rotational periods. The effects of the rapid rotation on the X-ray production within the magnetosphere have yet to be explored in detail. The added centrifugal force is predicted to cause faster wind outflows along the field lines, which could lead to higher shock temperatures and harder X-rays. However, this is not observed in all rapidly rotating magnetic B-type stars. In order to address this question from a theoretical point of view, we use the X-ray Analytical Dynamical Magnetosphere (XADM) model, developed for slow rotators and implement the physics of rapid rotation. Using X-ray spectroscopy from ESA's XMM-Newton space telescope, we observed 5 rapidly rotating B-types stars to add to the previous list of observations. Comparing the observed X-ray luminosity and hardness ratio to that predicted by the XADM allows us to determine the role an added centrifugal acceleration plays in the magnetospheres of these stars.

13. Wolf-Rayet Stars in M81

Gómez-González, V. M. A.; Mayya, Y. D.; Rosa-González. D.

We here report the properties of Wolf-Rayet (W-R) stars in the nearby spiral galaxy M81. These were found while analysing the slit spectra of a sample of star-forming complexes, taken using the long-slit and Multi-Object spectroscopic modes of the OSIRIS instrument at the 10.4-m Gran Telescopio Canarias. Colours and magnitudes of the identified point sources in the Hubble Space Telescope images compare well with those of individual W-R stars in the Milky Way**.**

14. The AMBRE project: Formation and evolution of the Milky Way Disk

Grisoni, V; Spitoni, E.; Matteucci, F.; Recio-Blanco, A.; de Laverny, P.; Hayden, M.; Mikolaitis, S. and Worley, C.C.

We study the chemical evolution of the thick and thin discs of the Galaxy by comparing detailed chemical evolution models with recent data from the AMBRE Project. The data suggest that the stars in the thick and thin discs form two distinct sequences with the thick disc stars showing higher [alpha/Fe] ratios. We adopt two different approaches to model the evolution of thick and thin discs. In particular, we adopt: i) a two-infall approach where the thick disc forms fast and before the thin disc and by means of a fast gas accretion episode, whereas the thin disc forms by means of a second accretion episode on a longer timescale; ii) a parallel approach, where the two discs form in parallel but at different rates. By comparing our model results with the observed [Mg/Fe] vs. [Fe/H] and the metallicity distribution functions in the two Galactic components, we conclude that the parallel approach can account for a group of alpha-enhanced metal rich stars present in the data, whereas the two-infall approach cannot explain these stars unless they are the result of stellar migration.

15. The AMBRE Project: r-process element abundances in the Milky Way thin and thick discs
Guiglion, G.; De Laverny , P.; Recio-Blanco, A.

Chemical evolution of r-process elements in the Milky Way disc is still a matter of debate. In the context of the Gaia mission, one needs robust and numerous chemical abundances of r-process elements complementary to this all sky survey. We took advantage of high resolution HARPS spectra from the ESO archive in order to derive precise chemical abundances of 3 r-process elements Eu, Dy & Gd for a sample of 4355 FGK Milky Way stars. The chemical analysis has been performed thanks to the automatic optimization pipeline GAUGUIN. Based on the [alpha/Fe] ratio, we chemically characterized the thin and the thick discs, and present, in this poster, results of these 3 r-process element abundances in both discs, tracing and discussing for the first time their evolution as a function of the metallicity and alpha-enrichement, used as an age proxy.

16. 3D NLTE Radiative Transfer: Continuum and Line Scattering in OB stars
Hennicker, L.; Puls, J; Kee, N.D.; Sundqvist, J.

In order to derive the stellar and wind parameters of observed OB-stars, state of the art spectral analysis compares synthetic spectra, calculated by means of 1D spherically symmetric NLTE atmosphere codes, with observations. Certain atmospheres, however, show strong deviations from spherical symmetry, and have to be analyzed by means of 3D radiative transfer. Typical examples are magnetic winds of OB stars (that also display a variability of UV lines (Marcolino et al. 2013) and of Hα (Sundqvist et al. 2012), which might be qualitatively explained by magneto-hydrodynamical simulations), and rapidly rotating stars (e.g., VFTS102 with v_{rot} = 500-600km/s, Dufton et al. 2011), which are affected by centrifugal forces and gravity darkening.

The aim of this poster is to present a newly developed 3D radiative transfer code, which calculates the radiation field in the winds of hot stars self-consistently for continuum and line-scattering problems. The code is able to handle arbitrary (non-monotonic) velocity fields and density structures. It is based on a finite-volume method (Adam 1990) and incorporates an accelerated Λ-iteration (ALI) by means of a newly developed non-local approximate Λ -operator (ALO). We present the basic assumptions of the code, and provide error estimates by calculating 1D spherically symmetric winds within our framework. As a first application, we present UV resonance line-profiles (based on a two-level-atom approach) for a magnetic wind, which is described by a simplified atmospheric model, the 'analytical dynamical magnetosphere' (Owocki et al. 2016).

17. Modelling the spectra of early-type stars using the ADS approach
Irrgang, A.; Kreuzer, S.; Przybilla, N.; Butler, K.; Heber, U.

To model spectra of early-type stars, the so-called ADS (or hybrid) approach can be employed. It consists of three steps, i.e., codes: ATLAS12, DETAIL, and SURFACE. The underlying idea is that non-local thermodynamic equilibrium (non-LTE) effects are important for the details of radiative transfer but negligible for the atmospheric structure. We will discuss the pros and cons of this approach as well as present recent improvements.

18. Formal Solutions for the Polarized Radiative Transfer Equation
Janett, G.; Steiner, O.; Belluzzi, L.

The task to numerically compute reliable and accurate emergent Stokes profiles is of great relevance in solar physics. Aiming at facilitating the comprehension of the advantages and drawbacks of the different formal solvers, this work presents a reference paradigm for their characterization based on the concepts of order of accuracy, stability, and computational cost.

19. Quantifying the chromospheric activity of M dwarfs from visible and near-infrared CARMENES SPECTRA

D. Montes, F. Labarga, J. Cano, J. A. Caballero, S. V. Jeffers, A. Reiners, P. Schöfer, L. Tal-Or, E. Johnson, M. Zechmeister, D. Shulyak, S. Czesla, K. Froehlich, B. Fuhrmeister, D. Hintz, A. Quirrenbach, S. Reffert, S. Sadegi, I. Ribas, J. C. Morales, E. Herrero, P. J. Amado, and W. Seifert

CARMENES is a brand-new, ultra-stable, double-channel spectrograph at the Spanish-German 3.5 m Calar Alto telescope for radial-velocity surveys of M dwarfs with the aim of detecting Earth-mass planets orbiting in the habitable zones of their host stars (Quirrenbach et al. 2016). The CARMENES survey, which began in January 2016 and will last for at least three years, aims to observe approximately 300 M stars, spread over the complete M spectral range. In this contribution we use the visible and near-infrared CARMENES spectra taken until now to analyse in detail the temporal variability of the chromospheric activity level and quantify the effect of the stellar jitter in the radial velocity determinations.

20. On the spectroscopic properties of hot post Extreme Horizontal Branch stars

Latour, M.; Chayer, P.; Green, E.M.; Irrgang, A; Fontaine, G.

Post-Extreme Horizontal Branch stars (post-EHB) are helium-shell burning objects evolving away from the EHB and contracting directly towards the white dwarf regime. We performed a comprehensive spectroscopic analysis of four such bright stars (of sdO spectral type) including three standard stars used for flux calibration. We used line-blanketed non-LTE TLUSTY model atmospheres in combination with high quality optical and UV spectra to derive the atmospheric parameters and chemical composition of our stars. The four stars have surprisingly similar UV spectra, which is unusual among EHB stars, since these stars are all chemically peculiar. Our sdOs are strongly enriched in iron (25x) and nickel (60x) with respect to the Sun, while the lighter elements are mostly depleted. The fact that the four stars have essentially the same fundamental parameters (T_{eff} ~ 61 000 K and log$g$ ~ 6.0) in addition to their similar chemical composition indicates that diffusion must act in a similar way in their atmosphere. Radiative levitation could be a key mechanism to explain this as its effects are mostly determined by the temperature and gravity.

21. The Belgian Repository of fundamental Atomic data and Stellar Spectra (BRASS)

Laverick, M.; Lobel, A.; Royer, P.; Martayan, C.; Merle, T.

The Belgian Repository of fundamental Atomic data and Stellar Spectra, BRASS, aims to take the first, crucial steps towards removing systematic errors in atomic input data required for quantitative stellar spectroscopy. We will thoroughly assess the quality of fundamental atomic data available in the largest repositories, such as wavelengths and oscillator strengths, by comparing very high-quality observed stellar spectra, taken using the Mercator-HERMES and ESO-VLT-UVES spectrographs, with state-of-the-art theoretical spectra. BRASS will offer both critically-evaluated atomic transition data and high-quality stellar spectra, spanning the entire visible wavelength range for BAFGK spectral types, via an online public interactive interface under development.

To date we have compiled atomic line transition data, for ions of up to 5+ and in the visible wavelength range, from major online repositories including NIST, VALD, and multiple data providers currently in the VAMDC portal. We have cross-matched multiple literature occurrences of atomic transitions for over 75,000 individual lines in preparation for our systematic quality assessment and revealed a significant scatter in literature log(gf) values of up to 2 dex. Almost 3000 unique atomic lines, spanning the BAFGK spectral types, have been selected for quality assessment and quality assessment work is currently underway.

22. Metallicity determination of M dwarfs

Lindgren, S.; Heiter, U.; Edvardsson, B.

M dwarfs make up 70% of all stars in the Galaxy and are today attractive targets in the search for Earth-sized planets and planets within the habitable zone. However, there are few M dwarfs that are well characterized and the determined stellar parameters have a direct influence on the derived planet properties.

Stellar parameters of M dwarfs are difficult to determine with good accuracy. Their low surface temperature results in an optical spectrum dominated by molecular lines, and previous works have mostly relied on empirical calibrations. In our work we instead use the fact that high-resolution spectrographs operating in the infrared have opened up a new window, at wavelength regions that are less affected by molecular lines. We have shown that we can determine the metallicity and effective temperature using synthetic spectral fitting, resulting in more reliable atmospheric parameters.

We are using our sample of around 30 M dwarfs as a basis for a refined photometric metallicity calibration. A photometric calibration gives us the possibility to explore trends in the metallicity between systems with giant planets, multiple planets or no planets for all discovered exoplanets around M dwarfs. This will give key insights on the formation mechanism of planets around M dwarfs as compared to solar-type stars that have more massive proto-planetary disks.

23. Properties of Planets around Young Stars

Lovos, F.; Ahumada, J.A.; Gómez, M.

In this contribution, we present an analysis of planets associated with young T Tauri stars (TTS) belonging to several star-forming regions. The current sample includes 29 planets around 28 TTS and 2 free-floating planets. Most of these planets (25 out of 31) have been detected by direct or coronagraph imaging, and thus spectral types and infrared color indexes are available. This sub-sample is compared with those of L and T type brown dwarfs. The remaining 6 planets are relatively close objects detected by radial velocities or transits, in most cases sharing similar characteristics with the well-known Hot Jupiters orbiting main sequence stars. We analyze dynamical as well as physical properties of the planets. We search for disks around the host stars by means of the corresponding SEDs. We discuss the location of these disks with respect to the semi-axis of the planets and consider the planet-disk interaction. We discuss how these young planets fit within current planetary formation scenarios and highlight the challenges they represent for current models.

24. Atmospheric pollution in white dwarfs

Maldonado, R.F.; Villaver, E.

The metals observed in the atmospheres of cool white dwarfs (Teff ≤ 20,000 K) have shown a new way of revealing planetary material. Since the settlement and diffusion time scales of elements heavier than hydrogen and helium in these stars are shorter that their cooling times, the atmospheric pollution may be explained by two mechanisms: the accretion of interstellar medium and accretion of planetesimals. The first one consists in getting material onto the surface while the white dwarf moves in the gravitational potential of the galaxy. The second, and most accepted scenario to explain the metal pollution in white dwarfs involves the accretion of rocky bodies and planetesimals as they are disrupted by the white dwarf tidal forces. In this work, we link the accreting mechanisms and the evolution of the star by studying observed samples of white dwarfs from different surveys and catalogs to gain insight on the mechanism behind the observed metal pollution.

25. Deriving spectroscopic stellar parameters of cool stars from the visible and near-infrared CARMENES spectra

Montes, D.; Marfil, E; Tabernero, H.; González Hernández, J.I.; Caballero, J.A.; Kaminski, A. et al.

With the aim of using classic spectroscopic methods with high resolution and high signal-to-noise ratio in the NIR spectral window, we made a selection of FGK-type stars observed with CARMENES, the brand-new, ultra-stable, double-channel spectrograph at the Spanish-German 3.5m

Calar Alto telescope. These spectra are part of the CARMENES stellar library of high-resolution spectra. In order to apply the EW method to derive the spectroscopic stellar parameters (T_{eff}, log*g*, [Fe/H], v_{micro}), imposing iron excitation and ionization balance under the assumption of local thermodynamic equilibrium, we used our code StePar (Tabernero et al. 2012) with newly-compiled iron line lists in the VIS and NIR range covered by CARMENES (from 0.5 μm to 1.7 μm). We compiled different line lists for dwarfs and giants, both metal-rich ([Fe/H] > -0.30) and metal-poor (-0.30 < [Fe/H] < -1.50), which allowed us to split the parameter space into four different regions. We tested the stellar parameters thus obtained with some of the Gaia FGK benchmark stars (Jofré et al. 2014, Heiter et al. 2015) included in our sample. We also focused on the differences in the parameter determinations in case only VIS region is taken into consideration. We are also working on line list compilations to derive chemical abundances and extend this analysis to M-type stars.

26. Effective collision strengths improvements on Mg I atomic model for solar and stellar atmospheric models

Peralta, J.I.; Mendez, M.P.A.; Mitnik, D.M.; Vieytes, M.C.

It is studied the improvement of the atmospheric model 1401 (Fontenla, J. M. et al. 2015, ApJ, 809, 15) by improving the atomic model of the Mg I atom. The atomic models are essential to compute the populations in full NLTE. In this case, changes in the Effective Collision Strength (ECS) parameters for electron impact excitation were made to test influence in the synthetic spectra.
Given the relevance of the spectral features formed by Mg I in the stellar spectrum of late type stars, and because there is a need to improve the Mg I atomic model mainly in the NUV range (eg. 283.5 nm inverted line), the populations of the Mg I atom were computed using the Solar-stellar Radiation Physical Modeling (SSRPM) code for 2 new atomic models:
* The atomic model to be improved it has its ECS parameters calculated by the Seaton's formula (for allowed transitions) and the van Regemorter's formula (to forbidden transitions).
* In the atomic model generated by us, the ECS parameters are calculated using Distorted-wave method.
* The second atomic model it uses the ECS calculated by R-matrix method. These calculations are the newest found and were provided by Barklem et al. (2017, A&A 606, A11).
For each one of the three atomic models, an atmospheric model with the same thermal structure it is generated. Then it is computed each synthetic spectrum to identify and compare the most relevant changes in the formation of Mg I spectral lines over the model (1401) and over the observations.

27. Relation of Hot and Cold Gas around Early-type Debris Disc stars

Rebollido, I.; Eiroa, C.; Villaver, E.; Montesinos, B.

Stellar evolution theories predict that as the protoplanetary disc evolves, the gas component disappears as it photoevaporates or is accreted onto the star. Therefore, gas should not be present in stars older than few Myr, leaving a disc composed by dust, planetesimals and maybe, newly-formed planets. But a number of main sequence stars with debris disc have been detected either in far infra-red (FIR) or sub-milimiter (sub-mm) atomic and molecular lines, showing the presence of cold gaseous component in the outskirts of the disc. Since the prevalence of the gas for long periods is very unlikely, a secondary origin has been proposed in most cases, such as major collisions between planetesimals, grain-grain collisions, or exocomet evaporation. We present here the spectroscopic detection of hot gas in cold gas-bearing discs, that seems to be located in the inner parts of the disc and that could reinforce the idea that the gas has secondary origin furthermore providing a physical link for the existence of both components (hot and cold).

28. HERSCHEL-PACS: Constrains for clumping in the intermediate wind regions of OB stars

Rubio-Díez, M.M.; Sundqvist, J.O.; Najarro, F.; Traficante, A.; Puls, J.; Calzolleti, L.

We examine the radial stratification of wind clumping and derive upper limits of mass-loss rates for a sample of 24 Galactic OB-stars, using new far infra-red Herschel/PACS observations together with archival data from near infra-red to radio wavelengths.

We use our density-squared diagnostics to derive $\dot{M} \sqrt f_{cl}^{min}$, where f_{cl}^{min} is the minimum value of the radially dependent clumping factor f_{cl}. Setting $f_{cl}^{min}=1$ thus gives a maximum empirical mass-loss $\dot{M}_{max}$.
We find that for almost all stars in our sample, the clumping in the radio-emitting region is lower than in the infra-red emitting one, i.e. decreasing clumping with increasing radius. Moreover, we find that the maximum mass-loss rate for typically is slightly lower than theoretical values for O-stars, normally included in stellar evolution models (Vink et al. 2001, A&A, 326, 295), but much lower (averaging one order of magnitude) for B-stars.

29. Gaseous disks in white dwarfs
Saker, L.; García, L.; Gómez, M.

In recent years, thanks to Spitzer and WISE, the number of white dwarfs (WDs) with IR excesses attributed to the presence of a debris disk, has increased significantly. Additionally, disks of gas were found in a handful of WDs with debris disks, through detection of emission lines of Ca triplet in 860 nm (distinctive of a gas in a Keplerian stable rotating disk). However, not all WDs with debris disk have a gas disk, which suggests that the production mechanism of the gaseous disks is not universal. At the present time, it still remains unknown why WDs of similar characteristics retain their gas disks and other do not, although several scenarios have been proposed. One manner to infer some constrains or hits to help clarify this issue is to analyze and confront significant groups of both types of objects. In this context, we have obtained GMOS/GEMINI optical spectra for a sample of 9 WDs with IR excess, selected from our sample of 29 debris disks WDs, to find the gas counterpart to the dusty disks. We combined our sample with other objects from the literature and analyze the largest available sample to find key characteristics to better understand gas disks in WDs.

30. NLTE chemical abundances in atmospheres of normal BAF type stars
Sitnova, T.; Sofya, A; Ryabchikova, T.; Mashonkina, L.

Chemical abundances of BAF-type unevolved stars represent abundances of the galactic matter at modern epoch. We treat accurate methods of abundance determination based on the non-local thermodynamic equilibrium (NLTE) line formation for five chemical elements, namely carbon, oxygen, calcium, titanium, and iron. We apply the comprehensive model atoms for C I-II, O I, Ca I-II, Ti I-II described in our previous studies. For iron abundance determination a fairly complete model atom for Fe I-II was used for the first time. Model atom for Fe I-II by Mashonkina et al. (2011) was updated by including measured and predicted high-excitation (> 10 eV) energy levels of Fe II. NLTE leads to weakened Fe I linesand to positive NLTE abundance corrections in agreement with Rentzsch-Holm (1996), however, the magnitude of such corrections is smaller compared to the earlier results. Lines of Fe II are strengthened in NLTE, and the effect grows toward larger line strength. We determine the NLTE abundances of C, O, Ca, Ti, and Fe in ten BAF-type stars with well determined atmospheric parameters using high-resolution and high signal-to-noise ratio spectral observations in wide wavelength range, from UV to IR. It is worth noting, all these elements except O are observed in lines of the two ionisation stages and for each element NLTE leads to consistent abundances from different lines. The C I and Fe II emission lines were detected in the near IR spectrum of late B type subgiant star HD160762. Our NLTE methods reproduce these emission lines with classical hydrostatic model atmosphere. Chemical abundances in the investigated stars show regular behaviour, their element ratios are close to zero as expected.

31. Near infrared spectra and telluric absorption - How to deal with it?
Ulmer-Moll,S. ; Neal, J.; Figueira, P.; Santos, N.

The absorption by the Earth's atmosphere is a major limiting factor for near-infrared spectroscopy. Correcting for this absorption is essential to characterize exoplanet atmospheres and derive precise radial velocity measurements in the near-infrared domain.
As computation of the atmospheric transmission is one of the many applications of the radiative transfer equation, the last few years have seen the development of several codes which produce a synthetic transmission spectra of the Earth's atmosphere at the time of the observations. These codes (Molecfit

from Smette et al. 2015, TelFit from Gullikson et al. 2014 and TAPAS from Bertaux et al. 2014) make obsolete the use of telluric standard stars to correct for the telluric absorption. They are only made possible by the growing completeness of the molecular databases such as HITRAN, the use of radiative transfer code like LBLRTM and the availability of atmospheric profiles.
I will show with CRIRES data how the different codes perform the correction of the tellurics, which are the impact of the correction depending on the molecules and on the level of absorption on the telluric correction.

32. Orbital periods of the B-type binaries in the BBC survey
Villaseñor, J.; Taylor, W.; Evans, C.; Ramírez-Agudelo, O.

The VLT-FLAMES Tarantula Survey (VFTS) has been an incredible productive survey of massive stars with more than 800 stars observed, from which more than half correspond to B-type stars. Recent results proving the importance of binarity in the evolution of the most massive O stars and its high fraction, have raised questions about if this holds for the less massive but more numerous B-type stars, and therefore to the complete supernova progenitor population. The B-star Binary Characterisation (BBC) Survey has obtained 30 epochs of observations of about 90 B-binaries in the 30 Doradus region using FLAMES on the VLT to determine the period distribution of these systems and other properties such as eccentricities and mass ratios. The orbital periods of our sample are presented as the first part of this work.

33. Testing the effect of mass-loss prescriptions on the evolution of hydrogen-free Wolf-Rayet stars.
Viscasillas, C.; Tramper, F., Lennon, D.

To understand the evolution of massive stars and their impact on their surroundings, knowing the effect of the mass loss is critical. In this poster, we present stellar evolution models for Wolf-Rayet (WR) stars developed using the Models for Experiments in Stellar Astrophysics (MESA) code. These models incorporate a new prescription for the WR mass loss rate, which is considerably more accurate than the older prescriptions currently in use. The predictions from these models are compared to those of published models from various groups to assess the impact of the more accurate mass loss rates on, e.g., the lifetimes and final masses. The observed properties of WR stars are compared to those predicted by the new models.

RESTAURANTS IN LA LAGUNA

La Laguna offers a large variety of restaurants, most of them located in the pedestrian center of the city. In general, you can have nice food at good prices in all of them (10-20 € per person). We have created a list of restaurants which local people like.

If you want to have nice Spanish/Mediterranean food:

1. **Restaurante Guaydil**
   Very good Mediterranean kitchen. Usually very crowded after 20:00. Around 15 €.
2. **El huequito andaluz**
   Very good Andalusian food (basically fried fish). Around 15 €.
3. **Labicoca**
   Very good Mediterranean food. Usually crowded at dinner (after 20:00). 15-20 €.
4. **Tasca El Tonique**
   They offer the best *jamón serrano* in town. Food is very good but a bit expensive, around 20-25 €.
5. **La Alhacena**
   Nice food. 15-20 €.
6. **Restaurante Santo Domingo**
   Very good Mediterranean kitchen. Usually crowded at dinner (after 20:00). 15-20 €.

If you want to have good 'tapas':

7. **Tasca La Topa**
   Tapas' place. Very good food and cheap. They serve free 'tapas' when you ask for a drink until 23:00. Also, they have 'happy hour' (see their facebook page). Usually very crowded for dinner and quite noisy. 10-15 €.
8. **Bodegón Tocuyo**
   Cozy typical 'tasca' where they serve wine in bulk and local food, above all tomato salad, 'almogrote' (strong cream cheese with garlic from La Gomera), and cold meat (serrano jam, chorizo, etc.). Not really recommended to vegetarians. Usually is very crowded after 20:00 h. Around 10 €. At Tocuyo, Eduardo Simonneau and Lucio Crivellari developed in the nineties their *Implicit Integral Method to solve Selected Radiative Transfer Problems*.
9. **La Bruma Tapas Bar**
   Good tapas though a bit small and expensive. 20-25 €.
10. **Guachinche Paraiso**
    Tapas' place. (see their facebook page). Around 8-10 €.

If you want to eat some 'Pintxos':

11. **La Venta de la Esquina**
    'Pintxos' and tapas bar. Very good and cheap. Usually very crowded after 20:00 h. 10-15 €.

If you want to have a drink and a sandwich or a snack:

In general, all places in the pedestrian area serve this kind of food and are quite good.

12. **Bar Benidorm**
    They have very good serrano jam and tomato sandwich. Around 5 €.
13. **Los 100 montaditos**
    Only sandwiches. 5-10 €.
14. **La Sureña**
    They offer 5 small beers (200 ml) for 3 €. Usually crowded in the afternoons.

If you want some italian food:

15. **Rucola & Grana**
    Very good Italian food (pizza and pasta). Around 15 €.
16. **Stefano's**
    Pizzas and pasta. Around 15 €.
17. **Da Stefano**
    Pizzas and pasta. Around 15 €.

Other:

18. **Arepera Punto Criollo**
    Very good 'arepas' (typical from Venezuela, kind of sandwich made of fried corn bread). They have arepas filled with soja meat. 5-10 €.
19. **Scooter's**
    American burgers & pizza. 10-15 €.
20. **Natural wok**
    Wok style food.
21. **Sushingourmet**
    Very good but a bit expensive. 15-20 €.

If you want a good beer to enjoy together with something to eat:

22. **Beers**
    Imported beers. They serve 'tapas', snacks, and American style burgers. Slow serving food but they have a lot of very good beers. Quite crowded after 20:00 and very noisy.
23. **Catedral**
    Imported beers and German 1-meter sausages. Close very late in the evening. Cheap.

Coffee, tea, and cakes:

24. **Cafetería Palmelita**
    German style cakes. They serve also sandwiches and salads. Tea and coffee. 5-10 €.
25. **Cafetería Cacao**

    Good cakes and ice creams. They serve also sandwiches and salads. Tea and coffee. Around 5 €.