CV
INMA MARTINEZ-VALPUESTA

Date of Birth: 8/Dec/1977

Place of Birth: Logrono. La Rioja. Spain.

Personal Address:

Urba. Mayber n# 115
38296 La Laguna
TENERIFE
CANARY ISLANDS
SPAIN
Tel. 0034922256147
e-mail address: inmavalpu@yahoo.es

Academic Address:

University of Hertfordshire
Centre for Astrophysical Research
STRI. College Lane
AL10 9AB Hatfield
HERTS.
United Kingdom
e-mail address: martinez@star.herts.ac.uk

EDUCATION:

- 09/1991 - 07/1994 High School. I.B. San Benito. La Laguna. Tenerife. Canary Islands. Spain
- 09/1994 - 07/1995 C.O.U. Pre- University. I.B. San Benito. La Laguna. Tenerife. Canary Islands. Spain.
- 09/1995 - 09/2001 Licenciatura en Matematicas con Orientacion de Astronomia. Universidad de La Laguna. Tenerife. Canary Islands. Spain.
- 09/2000 - 06/2001 Erasmus Student. University of Maynooth. Kildare. Ireland.
- 09/2001 - 03/2002 Postgraduate Course in Teaching. Universidad de La Rioja. La Rioja. Spain.
- 11/2002 - 03/2006 PhD at University of Hertfordshire under the supervision of Prof. Isaac Shlosman and Prof. Johan Knapen. HERTS. United Kingdom. Title of the Thesis: " Evolution, structure and kinematics of galactic bars."
- 01/2003 – 12/2005 Visitor at University of Kentucky as part of my PhD research. Under the supervision of Prof. Isaac Shlosman. Lexington. Kentucky. USA.
- Actually visiting Dr. Evangelia Athanassoula at OAMP, Marseille, France.

OTHER TRAINING:

- PPARC Summer Astronomy School. 6th to 11th of September of 2002. Leeds. UK
- Generic Training at the University of Hertfordshire. 20 hours:
  Communication techniques, Leadership, Time management, Team work
- PPARC Grad School. 28h to 30th of November of 2004. Brighton. UK.

TEACHING EXPERIENCE:

- 1995-2001 Tutorials to high school students in Mathematics.
- Dec. 2001 Teaching Mathematics in a High School, I.E.S. Escultor Daniel. La Rioja. Spain.
- Feb2002-Oct2002 Teaching Operative System Windows, Microsoft Office and Mathematics in a Private Adult Center. Academia Anchieta. La Laguna. Tenerife. Spain.
- Jan2004-May2004 Grader of Astronomy course at University of Kentucky. USA.
- Dec. 2004 Astronomy Labs at University of Hertfordshire. Herts. United Kingdom.

RESEARCH INTERESTS:

The problem of the formation and evolution of galaxies has been at the forefront in astronomy for decades, ever since the original work of Hubble proving the existence of galaxies other than our own. The idea that galaxies evolve has attracted a large number of astronomers to study them, but a compelling theory of galaxy evolution does not exist at present. Meanwhile, the development of cosmology into an observational science, which uses galaxies as building blocks to map the larger scale structure, has shifted the attention to larger issues than only the fate of individual galaxies. Indeed, issues such as dark matter, and now dark energy, about which we know preciously little, except their likely existence, are now inextricably linked with extragalactic astronomy.

Observation of galaxy evolution is hindered by the snapshot nature of the problem (we can see only galaxies at different stages of their evolution at different redshifts). At low redshift, the wealth of data on individual galaxies may hinder the comprehension of the basic phenomena, since we will have to distinguish the forest from the trees. At intermediate or high redshifts, the resolution is limited, and we rarely obtain detailed information about the 2D and 3D structure of the individual objects. Numerical simulations of galaxy evolution can help to bridge the gap between the observations of structural properties of galaxies at various stages, and may even lead to predictions subsequently verified by observations.

For example, the early numerical simulations in the 1970s have been very useful in alerting to the possibility of formation of elliptical galaxies through mergers of disk galaxies, and in outlining the possibility that galaxy stability needs possibly dark matter. Understanding the formation of large-scale structure in the Universe would be immensely more difficult without N-body simulations, and a whole industry has sprung up to model this in detail. Numerical simulation have predicted the appearance of universal density profiles in dark matter halos --- an effect still to be understood theoretically. Yet there is a consensus that the larger scale structure of the Universe is relatively well described by the N-body simulations, and the discrepancy between the theory arrived at in this way and the observations seems to be mainly on the galaxy scale.

My research has been focused on the dynamical, kinematical and morphological aspects of evolution in barred galaxies and its relationship to the peanut/boxy/X-shaped bulges frequently observed in disk galaxies. I was particularly interested in various recurrent dynamical instabilities in stellar bars, and in the role of bars as mediators of angular momentum transfer from the disk to the surrounding massive halo, in other words, in secular evolution of bars.

My personal contribution in this research is the detection, for the first time, of a secondary vertical buckling in the bars and the consequent formation of the X-shaped bulges. I have been also carrying a very detailed and high-resolution study of the stellar orbits in barred galaxies, using novel methods like spectral orbital analysis. This study allowed me to classify the orbits responsible of the different morphological features often detected in modelled and observed galaxies, such as the ansae, peanut/boxy/X-shaped bulges and the rectangular bar shapes.

Stellar bars play the dominant role as an intrinsic factor in disk galaxies evolution. Numerous unresolved issues are related to the galactic bars and those are of a great interest to me. For example, the dynamics of nested bars (i.e., of large-scale bars hosting nuclear bars), the AGN—starburst connection, M_{BH}-sigma relation, the evolution of stellar populations in barred galaxies --- comprises a short list of fundamental topics in galaxy evolution. These issues have been studied extensively both observationally and by means of a numerical modelling. Still, they are largely unsolved. I would like to approach these topics from a combined theoretical and observational point of view.

PUBLICATIONS and CONFERENCES:

- *Why Buckling Stellar Bars Weaken in Disk Galaxies*. Martinez-Valpuesta, I. and Shlosman, I., 2004, ApJL, 613, 29
- *Evolution of Stellar Bars in Live Axisymmetric Halos: Recurrent Buckling and Secular Growth*, Martinez-Valpuesta, I., Shlosman, I. and Heller, C.~H. 2006, ApJ, 237

- Contributing talk: *Secular and dynamical evolution of galactic bars*. Martinez-Valpuesta, I. and Shlosman, I. Conference: The evolution of Starbursts: The 331st Wilhem and Else Heraeus Seminar. Held in Bad Honnef, 2005, AIP Conference Proceedings, 783, 189
- Poster: *Secular Evolution of Stellar bars, vertical instabilities and starburst*. Martinez-Valpuesta, I and Shlosman, I. Conference: Starbursts: From 30 Doradus to Lyman Break Galaxies, Held in Cambridge, UK, ed.: R. de Grijs and R.M. Gonzalez Delgado. ASSL, 2005, 329, Springer, 248.
- Contributing talk: *Secular Evolution of Barred Galaxies*. Martinez-Valpuesta, I. Conference: The Origin of the Hubble Sequence. Held in Vulcano Island. 2005.
- Contributing talk: *Secular evolution of barred galaxies*. National Astronomy Meeting, 2006, Leicester, UK

SCHOLARSHIPS:

- 2000 Erasmus Scholarship, selected by the Universidad de La Laguna. Canary Islands. Spain
- 2002 International PhD Scholarship, selection made by Instituto de Astrofisica de Canarias (IAC). Canary Islands. Spain.

OTHERS:

- Junior Member of the American Astronomical Society.
- Languages spoken and written : Spanish (Mother tongue), English (fluent).

REFERENCES:

- **Prof. Isaac Shlosman.** University of Kentucky. USA. shlosman@pa.uky.edu
- **Prof. Johan Knapen.** University of Hertfordshire. UK. kanpen@star.herts.ac.uk
- **Dr. Evangelia Athanassoula.** OAMP, Marseille, France. lia@oamp.fr

Title: EVOLUTION OF BARRED GALAXIES

Summary
Barred galaxies are ubiquitous in the Universe, Observations are still insufficient to give the whole scenario of galactic evolution, and therefore numerical simulations should be added to the equation. We aim to approach the evolution of galaxies by means of numerical simulations including, stars, gas, star formation and cosmological dark matter halos. The addition of the gas, in a realistic way devoid of numerical caveats, the addition of realistic star formation and the application of new analysis tools will be the breakthrough of this project. Until now most of the numerical simulations have been purely stellar, and those including gas have given contradictory results. Once all the elements are in place, we will compare the results of simulations with the existent observations. In particular, we will focus on angular momentum transfer, morphological characteristics, stellar population and age of bars, bulges and disks.

Research Plan
Galaxies, which are basic building blocks in the Universe, come in two varieties: ellipticals and disk galaxies. The latter are often barred. Indeed, in the local universe around 30% of spiral galaxies are strongly barred and another 40% are weakly barred (Sellwood & Wilkinson, 1993) . At intermediate redshifts, a recent study showed that the fraction of strongly barred disk galaxies remains at about 30% up until redshifts of about 1 (Jogee et al 2004; Elmegreen, et al. 2004; Sheth et al. 2003). Our own Galaxy is a barred galaxy. Hence the study of barred galaxies, and of the way they form and evolve is an important subject of study in galaxy evolution.

Two contradictory scenarios of the dynamical evolution of barred galaxies are currently under discussion: in the first one, bars form early on in the life of a disk galaxy, and remain in existence ever thereafter, while in the second one, bars get frequently destroyed under their own internal evolutionary action, and thus will have to be regenerated from time to time. These two alternative scenarios are both being discussed, and the approach to this problem is mainly theoretical and numerical. The first scenario has been demonstrated in purely stellar numerical simulations of barred galaxies (e.g., Athanassoula and Misiriotis 2002, O'Neil and Dubinski 2003, Martinez-Valpuesta, Shlosman and Heller 2006). The transfer of angular momentum between the bar, the disk and the hosting dark matter halo allows the bar to exist and to grow for a long period of time (Athanassoula 2003). The second scenario could have two alternatives explanations. The first one involves numerical simulations of interacting galaxies, which in principle could destroy, but also generate bars in disk galaxies, depending on the circumstances of the interaction (Athanassoula 1996). The second one combines stellar and gaseous simulations in isolated disk galaxies. The bar in the simulations induces torques on the gas, and a material transfer towards the inner parts, which scatter the main orbits of stars building up the bar, which thus self destroys in this way (Friedli & Bentz, 1993; Bournard, Combes and Semelin 2005). A different bar must form again in the disk, which could self destroys again, and so on (Bournard & Combes 2002).

Among the consequences of evolving bars we can point out the formation of peanut/boxy bulges. They are present in the local universe at similar rates as the bars (Lütticke, Dettmar and Pohlen 2000). This has been shown in observations (see review by Kormendy and Kennicut 2004) and in purely stellar simulations of isolated galaxies (Combes et al. 1990). Again a contradiction among simulations involving gas and stars is found. In one hand, it has been shown in the latter ones, that the inflow of gas towards the galactic centre could wash out the peanut/boxy shaped bulges (Berentzen et al. 1998). However, in the former ones, these types of bulges appear for long periods of time, ~7 Gyr., evolving as the bar evolves.

If we want to continue studying the formation and evolution of barred galaxies, and want to understand the dynamical, kinematical and morphological properties of barred galaxies, either isolated or interacting, these two contradictory scenarios between the different types of simulations should be clarified, and a new scenario should be proposed which gives a more satisfactory explanation of barred galaxy evolution consistent with the observations. This proposal aims to carry out such a study. For this purpose, we will use state-of-the-art numerical simulations with a high number of particles and new visualisation and analysis tools.

The main aims of this project are first to develop more realistic numerical simulations of galaxies, involving gas, stars and dark matter halos which are formed in a manner consistent with current cosmological scenarios. We will perform a large sample of simulations. The host researcher, Dr. E. Athanassoula has the experience and the computer resources to accomplish this task. The cosmological input to the simulations will be provided by the Cosmology group at the LAM (Laboratoire d'Astrophysique de Marseille). We will use an approach starting from cosmological conditions, evolve a galaxy initially consisting of gas and dark matter, and form stars in a natural manner. The evolution of such objects is then followed for roughly a Hubble time. The second aim is to make a detailed study and analysis of the bars and the peanut/boxy bulges formed in such simulations. Here, the exciting next aim is a combined dynamical study of the gas and stellar components to give constraints about the distribution of mass in barred galaxies, the age of the bars and bulges, and the dark matter halo characteristics. This will be done in collaboration with my hosts, Dr. E. Athanassoula and Dr. A. Bosma, whose expertise will be crucial for this project.

Draft Budget.
Due to the excellent computer equipment at the host institution, there is no need to spend part of the budget on such equipment. The fellowship will be distributed in two main parts: travelling and stipend.

Total budget for travelling: $2500

- Tenerife (actual residence)-Marseille (France): $ 500
- Marseille-University of Kentucky: Research collaboration with Isaac Shlosman: $ 800 (trip)+$ 500 (accommodation and other expenses).
- Conference in Tenerife. Good opportunity to develop new connections in the candidate's place of origin. Trip: $ 500 + Registration fee $ 200.

Stipend: $ 35000
The overhead for administration of the stipend is about 15%, this includes payment for health insurance and personal liability. This leaves, with the exchange of 1€=1.20$, about 2065€/month, corresponding to starting salaries at CNRS.

Total: $ 37500.

03 '25 '06