CURRICULUM VITAE

Surname and Name	: Morelli Lorenzo
Date and Place of Birth	: 15/02/1973, Venezia (Italy)
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◯ Education

1993 — High-school degree in scientific studies at the "Liceo G. Benedetti" in Venice.

29/06/2001 — Degree (Laurea) in Astronomy at the University of Padua (Italy). Thesis title: "Stellar disks with scale length smaller than 50 pc in the nucleus of spiral galaxies" (supervisors Prof. F. Bertola and Dr. A. Pizzella).

2002-2004 — Ph.D student at the European Southern Observatory in Santiago, Chile

18/03/2005 — Ph.D. in Astronomy at the University of Padova (Italy). Thesis title "Stellar Populations in Nuclear Disks and in Spiral Bulges (supervisors Dr. A. Pizzella and Dr. E. Pompei).

◯ Observational experience

May 2000 — February 2001 — *Undergraduate student* at the Asiago Astrophysical Observatory (University of Padova (Italy)). In this period I had the opportunity of using the 122 cm telescope equipped with a Boller and Chivens B&C spectrograph for several nights. I also made observations at the 1.8 m telescope equipped with AFOSC (Asiago Faint Objects Spectrograph Camera)

April 2002 — April 2005

- A run in La Silla using the 1.54 m Danish telescope equipped with DFOSC (Danish Faint Objects Spectrograph Camera) and the 1.52 m ESO telescope equipped with (B&C) spectrograph.
- Two runs in La Silla using the 3.6 m ESO telescope equipped with EFOSC2 (Eso Faint Objects Spectrograph Camera).
- A run in La Silla using 3.5 m NTT telescope equipped with EMMI spectrograph
- Two runs at Roque de los Muchachos using 3.5 m TNG (Telescopio Nazionale Galileo) telescope equipped with NICS (Near Infrared Camera Spectrometer).

January 2003 — January 2004

Five shifts at La Silla for duty working in the NTT-team on the atlas of echelle wavelength calibration at the 3.5 m NTT (New Technology Telescope) telescope equipped with EMMI (ESO Multi Mode Instrument) spectrograph.

◯ Publications

- in referred journals

Nuclear stellar discs in low-luminosity elliptical galaxies: NGC 4458 and NGC 4478
Morelli, L., Halliday, C., Corsini, E. M., Pizzella, A., Thomas, D., Saglia, R. P., Davies, R. L., Bender, R., Birkinshaw, M. & Bertola, F., *2004 MNRAS, 354, 753M*

Minor-axis velocity gradient in disk galaxies
Coccato, L., Corsini, E. M., Pizzella, A., **Morelli**, L., Funes, J. G. & Bertola, F., *2004 A&A, 416, 507C.*

Nuclear stellar disks in spiral galaxies.
Pizzella, A., Corsini, E. M., **Morelli**, L., Sarzi, M., Scarlata, C., Stiavelli, M., & Bertola, F., *2002 ApJ 573 131P.*

- in preparation

Stellar Populations of Bulges in Cluster Spirals.
Morelli, L., Pompei, E., Pizzella, A., Corsini, E. M., Saglia, R., & Bertola, F. *in preparation*

The Color of the Nuclear Stellar Disks
Morelli, L., E., Pizzella, A., Cesetti, M., Corsini, E. M., & Bertola, F.

- in conference proceedings

Chemical evolution of bulges of spiral galaxies: environmental and morphological influence
Morelli, L., Pompei, E., Pizzella, A., Corsini, E. M. & Bertola, F.
Poster presented at "Stellar populations", 2003 Garching, Germany.

Chemical evolution of bulges of spiral galaxies: environmental and morphological influence
Morelli, L., Pompei, E., Pizzella, A., Corsini, E. M. & Bertola, F.
Poster presented at "Multiwavelength Mapping of galaxy formation and evolution", ESO Workshop, Venice 2003. *Proceedings in press.*

Nuclear stellar disks in spiral galaxies.
Pizzella, A., Corsini, E. M., **Morelli**, L., Sarzi, M., Scarlata, C., Stiavelli, M., & Bertola, F.
Poster presented at "Precision cosmology", Giambiagi school, Buenos Aires, 2003.

Nuclear stellar disks in spiral galaxies.
Pizzella, A., Corsini, E. M., **Morelli**, L., Sarzi, M., Scarlata, C., Stiavelli, M., & Bertola, F.
Poster presented at "National Meeting of the European Astronomical Society", JENAM, 2001

Nuclear stellar disks in spiral galaxies.
Pizzella, A., Corsini, E. M., **Morelli**, L., Sarzi, M., Scarlata, C., Stiavelli, M., & Bertola, F.
Poster presented at "The Mass of Galaxies at Low and High Redshift", ESO Workshop, Venice, 2001. *The Mass of Galaxies at Low and High Redshift, 219*

◯ Meetings

April 2001	"National Meeting of the Italian Astronomy Society" (Bologna, Italy)

October 2001	" The Mass of Galaxies at Low and High Redshift" ESO Workshop, (Venice, Italy)
October 2002	" Structure Evolution and Cosmology" ESO Workshop, (Santiago, Chile)
December 2002	ESO science days; Santiago, Chile. Talk: "Nuclear Disks in Galaxies"
October 2003	" Stellar populations 2003" (Garching, Germany)
October 2003	" Workshop on Multiwavelength Mapping of Galaxy Formation and Evolution"ESO Workshop, (Venice, Italy)

◯ Schools

September 2000	Scuola Nazionale di Astrofisica "Formazione di galassie - Nuclei Galattici Attivi"; Asiago, Padova, Italy.
June 2002	Scuola Nazionale di Astrofisica "Turbolenza nei Plasmi Spaziali Galassie e Sistemi di Galassie"; Cetraro, Cosenza Italy.
September 2002	Scuola Nazionale di Astrofisica "Cosmology - Relativistic astrofisic"; Asiago, Padova Italy.
May 2003	Scuola Nazionale di Astrofisica "Le galassie del Gruppo Locale - I telescopi di nuova generazione"; Marciana Marina, Livorno, Italy.
August 2003	Giambiagi school, "Precision cosmology"; Buenos Aires, Argentina.

◯ Computer Skills

I work mainly with IRAF, IDL and MIDAS in a Linux or Unix environment. In addiction I use Latex and SuperMongo. I have experience with analysis of kinematical data by means of the Fourier Correlation Quotient and with the analysis of the line strength measurement for the Lick indices. I created my personal Homepage in HTML and I know well to use Windows and Windows office environment.

◯ Teaching experience

2004-2005 "Corso Esercitazioni di Astrofisica". Exercises and theory (25 hours) of astrophysics for the under-graduated student at the Astronomy Department of Padova University

2005-2006 Co-supervisor of the laurea (degree) thesis of Mary Cesetti. Thesis title: The color of the nuclear stellar disks.

◯ Languages

Italian (home language); English (good); Spanish (very good).

RESEARCH ACTIVITY

During the period of my Ph.D. I worked on the stellar populations in the spheroids of galaxies. The problem has been tackled from two different points of view:

- 1. I performed a very detailed study of the photometrical, kinematical and chemical properties of the very central regions of spirals and ellipticals hosting a nuclear stellar disk in their center;
- 2. following a completely different strategy, I performed a more statistical analysis of the photometrical, kinematical and chemical properties of a number of bulges of spiral galaxies in cluster with the aim of characterize their age, metallicity and α-enhancement.

The information obtained with these different approaches gave interesting hints in understanding the formation and evolution of galaxies.

1. THE NUCLEAR STELLAR DISKS

In recent years, the sub-arcsec resolution of the *Hubble Space Telescope* has allowed the study of galactic nuclei, unveiling the presence of distinct components such as small stellar disks of few tens pc scale-length.

The presence of nuclear stellar disks (NSD hereafter) raises the question about the epoch (i.e. coeval or not with that of the host) and mechanism (i.e. external or internal origin) of their formation. The blue color of some already known nuclear disks (*e.g.*, NGC 4342; van den Bosch et al. 1998) suggests they are made of younger stars with respect to the bulk of their host galaxy. In the framework of galaxy formation via hierarchical merging acquired gas may end up forming some of these NSDs. On the other hand, they could be built up from gas transported toward the galaxy center during the secular evolution of a bar as in the case of NGC 4594 (Emsellem et al. 1996). In order to investigate their formation, we selected 38 galaxies out of

a bigger sample of spiral galaxies as they appear free from dust. We applied the photometric decomposition method of Scorza & Bender to this qualified sample finding 3 galaxies hosting a NSD. We derived the photometrical parameters (I_0, r_d, b/a) of these disks finding that they are characterized by high central surface brightness and very small scale-length (Pizzella, Corsini, Morelli et al. 2004). We also performed the photometric decomposition of the NSD hosted in two elliptical galaxies (NGC 4458 and NGC 4478) and developed a criterium to derive the uncertainties of their photometrical parameters (Morelli et al. 2004).

The discovery of these 5 NSDs in spiral and elliptical galaxies doubles the sample of the known NSDs rising their number to 9 and suggests the continuity of the disk properties, with a smooth variation of scale parameters and central surface brightness from spirals to disky ellipticals along a sequence of decreasing disk-to-bulge ratio.

To better address the question of their formation we took into account kinematical data of our objects. The presence of decoupled kinematics on the radial scales of the NSDs we found in the Sa NGC 4698 and in the ellipticals NGC 4458 and NGC 4478 suggests that second events indeed represent a viable mechanism to build a NSD in the center of disk galaxies. For the latter galaxies we also combine photometric and spectroscopic results to assess age, metallicity and overabundances of stellar populations of the two NSDs and surrounding spheroids. For NGC 4458 the inner disk and the main body of the galaxy appear to have the same stellar populations, with a weak metallicity gradient for the main body of the galaxy and has overall low metal content and overabundance. For NGC 4478 instead the central regions are younger, more metal rich and less overabundant than the outer regions, on both the minor and the major axis. The absence of gradients in the stellar population of NGC 4458 indicates that the formation of the inner cold structure happened at the same time as the main body of the galaxy while the younger age and low overabundance of the central structure of NGC 4478 is indicative of a prolonged star formation history, typical of an

undisturbed disk-like, gas-rich structure.

Recently I have started to compare the different properties of the known NSDs to see if they are related with the properties of the hosting galaxy. Up to now the photometric parameters I_0, r_d and b/a are available for 9 objects but it would be interesting to increase the number of the known NSDs with a systematic search for NSDs in all the galaxies presents in the HST archive, to have a more significative sample. Then to improve our knowledge on the formation and evolution processes of NSDs and their hosting galaxies it would be very interesting to extend the study of the stellar populations to all the known NSDs.

This can be done with a photometric analysis of the central region of the galaxies using high resolution (ACS@HST, WFPC2@HST) images with different filters and using high spatial resolution spectra to derive, as done for NGC 4478 and NGC 4458, detailed spectroscopical information of the stellar population of the very central region of the galaxy.

2. AGE AND METALLICITY IN SPIRAL BULGES

Even if great progress has been done in tracing and modeling the galaxy formation and evolution, this topic still defied a general accepted explanation. Consequently similar uncertainties are still present about the formation and evolution process for the galaxy spheroids (ellipticals or bulges).

Currently, the favorite models to explain the formation and evolution for galaxies are hierarchical merging and monolithic collapse. In the hierarchical merging, according to the prescription of the Λ Cold Dark Matter model, the structures present in our actual universe are the result of a continuous merging of small galaxy systems to form larger galaxies. In this picture ellipticals would be formed from recent merging of spirals (Barnes & Hernquist 1996) and bulges would grow up predominantly trough fast and violent merging process, even if also in this scenario long timescale evolution for the bulges is allowed (Kormendy & Kennicut 2004; Combes et al. 1990).

However, others found evidence for a constant comoving density of elliptical up to $z \sim 2$ (Scodeggio & Silva 2000) which would instead favor the monolithic collapse in which the point of view is completely different. In this scenario, spheroids would lead a quiet life, having assembled their baryonic mass at early time in a gaseous form: after a single dominant episode of star formation, they would passively evolve until today. Main S0 and spiral disks are successively formed by acquired material.

A way to discriminate between the above scenarios is to observe very deep in our nearby universe, to understand what kind of signature the stellar population has inherited from the galaxy formation mechanism. All this information can be hide in different photometrical, kinematical and chemical properties of the galaxy itself.
In order to investigate this aspect we observed 17 cluster and 4 field disk galaxies using EFOSC@ESO3.6 telescope. We have measured the kinematic (v, σ, $h3$, $h4$) and the line-strength radial profiles of the Lick indices (Mg_2, Mg_b, $\langle\mathrm{Fe}\rangle$, H_β) along the major axis of the sample galaxies, up to a distance of 1-2 R_e

We found that Mg_2 and $\langle\mathrm{Fe}\rangle$ and therefore metallicity show always their highest value in the center of the galaxy. Then their gradient displays two different behaviors. In some galaxies it is decreasing suggesting that the star formation lasted in the center more than in the outskirts of the galaxies. On the other hand, some galaxies show a very small gradient of Mg_2 and $\langle\mathrm{Fe}\rangle$. This generally occurs for galaxies with a very small bulge, and where the disk contribution is important also in their central regions. For these objects it will be very interesting to measure the Lick indices radial profiles along the minor axis, where projection effects make the disk contribution less important. Disentangling the stellar population of bulge and disk will allow to better interpret the absence of gradients.

Furthermore, we derived the Lick indices and the velocity dispersion in the central regions of the bulges, finding a well defined relation of $\langle\mathrm{Fe}\rangle$, Mg_2 and H_β versus σ. This correlation is expected if the formation process of

the spheroids occurred via dissipative collapse.

Another important result is that we do not find clear gradient in the α/Fe profiles. The constant and supersolar (α/Fe= 0.3) values of the α-enhancement ratio along radius suggests that the formation of the bulk of the stars in spiral bulges occurred with the same short (less than 1 Gyr) timescale as found in elliptical and S0 galaxies.

Therefore the α/Fe radial profiles, disfavor strong inside-out or outside-in scenarios and are in conflict with the pure monolithic collapse, where a positive gradient in the α-enhancement is expected (Martinelli et al. 1998; Thomas et al. 1999). On the other hand the globally α/Fe enhanced stellar population (Thomas & Kauffmann 1999) is not expected in the hierarchical merging scenario where the star formation is triggered by the merger event (Barnes 1992; Bender & Surma 1992) and could give higher central values of α/Fe which decrease outwards (Thomas 1999).

I'm going to compare the results obtained for the sample of cluster galaxies with a similar sample of galaxies in low (field) and high (group) density environment to asses if the environment plays a fundamental role in the chemical composition of bulges.