Curriculum Vitae
Fabio Fontanot

First name: Fabio
Last name: Fontanot
e-mail: fontanot@oats.inaf.it
Position: Post-doc
Place of birth: Palmanova (UD, Italy)
Date of birth: April 02, 1977
Citizenship: Italian
Marital status: Married
Addresses: Home: Via G. Ellero, 4, 33050, Castions di Strada, Udine
Office: INAF Osservatorio Astronomico di Trieste - via Tiepolo 11, 34143, Trieste (Italy)
Telephone: Office: 0039 040 3199235 – Home: 0039 0432 827612

Employment History

Post-doctoral position at the Max Planck Institute for Astronomy,
MPIA Heidelberg (Germany) *May 2006 - May 2009*

Post-doctoral position at the Italian National Institute for Astrophysics,
Observatory of Trieste (Italy) *May 2009 - Present*

Membership of international scientific collaborations

GOODS (The Great Observatories Origins Deep Survey). *2003 - 2007*
PanSTARRs (Panoramic Survey Telescope & Rapid Response System). *2007 - 2009*

Education

Laurea Degree in Physics, University of Trieste (Italy) *Oct. 1996 - Mar. 2002*
Dissertation (March 26, 2002): *Studio delle fluttuazioni primordiali dell'Universo Locale a partire da cataloghi di galassie ottici ed infrarossi* Supervisor: Dr. P. Monaco
PhD course in Astrophysics, University of Trieste (Italy) *Jan. 2003 - Dec. 2005*
Dissertation (March 29, 2006): *Multiwavelength Approach to joint Formation of Galaxies and AGNs*
Supervisor: Dr. P. Monaco
Winner of the 2007 "Pietro Tacchini" Award of the Italian Astronomical Society

National school of Astrophysics, Trieste, Italy
Chemical evolution of galaxies - High resolution spectroscopy *15-19 Sept. 2001*
National school of Astrophysics, Marciana Marina (LI), Italy
Local Group Galaxies - New Generation Telescopes *11-17 May 2003*
International Astrophysics school, Allahabad, Uttar Pradesh, India
Advanced School on the Physics of Galaxy Formation *16-28 Dec. 2003*
National school of Astrophysics, Asiago (VI), Italy
Cosmological Parameters - Extrasolar Planets *5-11 Sept. 2004*
International Astrophysics school, Novigrad, Istria, (HR)
The Dark and the Luminous Sides of the Formation of Structures *05-17 Sep. 2005*

Selected contributed talks

Sixth Italian Conference on Active Galactic Nuclei Volterra (PI), Italy
La Natura composita dei Nuclei Galattici Attivi *25-28 May 2004*
International Conference Novigrad, Croatia
Baryons in Dark Matter Halos *5-9 Oct. 2004*
Seventh Italian Conference on Active Galactic Nuclei Montagnana (PD), Italy
Fenomenologia degli AGN, evoluzione e processi di formazione delle galassie. *23-26 May 2006*
International Conference Sintra, Portugal
Deep06 - At the Edge of the Universe *9-13 Oct. 2006*
MPIA Workshop Ringberg Castle, Bavaria
The Impact of AGN Feedback on Galaxy Formation. *21-25 May 2007*
International Conference Rhodos, Greece
Evolution of Accretion, Star Formation and the Large Scale Structure. *2-6 July 2007*
Eigth Italian Conference on Active Galactic Nuclei Torino, Italy
AGN8 *19-22 May 2008*
KITP Workshop Santa Barbara, CA, USA
Building the Milky Way *6 Oct.-14 Nov. 2008*
VII International Conference Marseille, France
Harvesting the desert: the Universe between redshift 1 and 3. *29 June - 3 July 2009*
VII International Conference Malta
Hunting for the Dark: The Hidden Side of Galaxy Formation. *19 - 23 Oct. 2009*
Ninth Italian Conference on Active Galactic Nuclei Ferrara, Italy
Black Holes and Revelations *24-27 May 2010*

Membership in Local Organizing Committees.

International Astrophysics school Novigrad, Croatia
The Dark And The Luminous Sides Of The Formation Of Structures *05-17 Sept. 2005*
MPIA Workshop Ringberg Castle, Bavaria
The Impact of AGN Feedback on Galaxy Formation *21-25 May 2007*

Programming Language and Data analysis techniques

Program Languages: Pascal, FORTRAN 77, FORTRAN 90
Operating Systems: Unix, Linux, Windows
Specific software: MIDAS, Supermongo, Matlab, Mathematica, IDL, Latex, Openoffice

Languages

1. Italian (native).
2. English good (reading, writing, speaking).
3. German fair (reading, speaking).

Research Interest

My research interest are mainly focused on galaxy formation and evolution. My key expertise lies in the quantitative comparison of theoretical models and observational results.

Joint evolution of galaxies and AGNs.

My main interest is trying to eviscerate the different aspects of the so-called "downsizing" trend of galaxies and AGNs. In Fontanot et al., (2009b), we analyze the downsizing in mass assembly (more massive galaxies being assembled faster and at higher redshift then their low-massive counterparts, see e.g., Fontana et al. 2006), in the specific star formation rate (the mass of the typical star-forming galaxy declines with decreasing redshift, see e.g., Drory & Alvarez 2008) and in the age of stellar populations (more massive galaxies host the older stars, see e.g. Gallazzi et al 2006). We conclude that the evolution of massive galaxies is very sensitive to the errors in the mass estimate of these objects and present estimates are not able to strongly constrain theoretical models. On the other hand, the redshift evolution of the low- to intermediate-mass galaxies shows the bigger discrepancies with the model predictions: they form too early and too efficiently. I will deepen the analysis by considering two complementary aspects of the problem.

(A) *Estimate of the physical properties of galaxies from multi-wavelength observations.* In Fontanot et al. (2009b), we demonstrate that the accurate estimate of masses and star formation rates is crucial in order to provide meaningful constrain to models of galaxy formation. I propose to test quantitatively the performances of model for "SED fitting" and "SED mining" (i.e. algorithms that recover the physical properties of galaxies from their observed multi-wavelength photometry and/or spectra; see e.g. Fontana et al. 2004, Panter et al. 2007) against simulated galaxy catalogues extracted from semi-analytical models. Model galaxies are characterized by a variety of random star formation histories (which depend on the detailed evolution of each object), which differ in many aspects from the analytical approximations these algorithms are often calibrated on. I already started a comprehensive analysis of the effect on including different modeling for dust attenuation in theoretical models. In a first paper (Fontanot et al. 2009a), we discuss in detail the difference between an analytical approach and the prediction of a full radiative transfer solver, focusing on optical wavelenghts. A twin paper on infra-red emission is currently under preparation. Moreover, I also consider the effect of a different stellar evolutionary phases in simple stellar population libraries. In particular, in Fontanot & Monaco (2010) we discuss the impact of a different modeling for the TP-AGB phase on the photometric properties (i.e. SEDs) of $1 < z < 3$ sources, with emphasis on the ERO population. I plan to deepen this analysis on a wider redshift range and on the whole galaxy population. The overall effort would result in a better comprehension of the intrinsic errors in the estimate of masses and star formation rates, and a study of the dependence of the estimate on the physical conditions of the galaxy. A second phase of the project will involve the application of the improved algorithm and star formation libraries to multi-wavelength source catalogues.

(B) *Other aspects of Downsizing* In our previous work we did not consider some aspects of downsizing, namely those connected with the chemical properties of galaxies as a function of their mass and with the building up of the AGN population. The main reason for this choice was the lack of proper modeling of these aspects in the semi-analytical models we consider. An embryonal discussion of downsizing in the AGN population in MORGANA was presented in Fontanot et al. (2006): in that paper we demonstrate that the coupling between stellar and AGN feedback is a fundamental step to reproduce the observed evolution of the AGN space density as a function of redshift and bolometric luminosity. However, at that stage we do not attempt to study the connection between AGN and galactic downsizing (either in mass and/or in star formation). Moreover, alternative approaches to include BH grow and AGN feedback in a semi-analytical framework have been presented in the literature by other groups (e.g. Somerville et al., 2008). We are then in the best position to compare these different theoretical predictions with observational constraints. At the same time, in Fontanot et al. (2009b) we do not consider one of the first evidences for downsizing: e.g. the chemical patterns and abundances as a function of redshift and stellar mass. This choice was mainly due to the crude modeling of chemical enrichment in many semi-analytical models. I therefore plan to interface MORGANA (but it should be possible to implement the same strategy in any other semi-analytical framework) with a detailed chemical model, following the evolution of the abundances of the most relevant elements (such as iron, oxygen, silicon, carbon, magnesium and zinc) and comparing the prediction with available observations of the redshift evolution of the mass-metalicity relation (see e.g. Maiolino et al., 2008).

Properties of low-z galaxies.

Several relevant discrepancies have been pointed out in the literature between the properties of local galaxies and the prediction of theoretical models. Given my expertise I plan to concentrate on the following complementary aspects of the problem.

(A) *Cooling Flows, AGN feedback and the colors of massive galaxies* It has been demonstrated (Bower et al. 2006, Croton et al. 2006) that AGN feedback is a necessary ingredient to explain the colors and properties of local massive galaxies. However, we are still lacking a proper, self consistent description for the mechanism responsible for the loss of angular momentum and subsequent gas accretion onto Super-Massive Black Holes. The semi-analytical code MORGANA has been an improvement in that direction, being the first attempt to include AGN feedback in a self consistent way. Unfortunately, the present implementation is not able to quench star formation activity rapidly enough to preserve the observed colors of massive galaxies (Fontanot et al. 2007, Kimm et al., 2009). At the same time, GALEX observations showed that massive red galaxies are not "red and dead" objects, but they host star formation episodes (Kaviraj et al., 2007; Schawinski et al., 2007). Forthcoming deep observations at UV wavelengths using GALEX and HST/WFC3 will likely complement the available optical information on local early type galaxies, while LBC on LBT will provide deep and wide observations in the U-band (see Grazian et al., 2009). Comparing these multi-wavelength observations and the prediction of theoretical models I plan to characterize where star formation occurs in the galaxy and, eventually, to link the level of star formation to the AGN activity and to the environment. All these information will then be used as constraints to the new generation of theoretical models.

(B) *Central vs Satellite galaxy properties.* The direct comparison of model predictions with galactic properties as a function of their hierarchy (i.e. central and satellite) is a fundamental information to shade light on the physical mechanisms acting at different halo masses and their interplay. In recent years, a number of statistical tools (see i.e. Yang et al., 2007) made possible to estimate the central/satellite hierarchy of local galaxies, with high confidence. This advance is of fundamental relevance in the field, since it allows a more straightforward comparison between observations and the predictions of theoretical models. I am already involved in a number of related projects (see e.g. Kimm et al., 2009; Pasquali et al., 2010), and I am currently leading a project aimed at studying the properties of central/satellite galaxies in terms of star formation and AGN activity, with the aim of constraining the different approaches for black hole accretion and AGN feedback proposed in the literature.

(C) *Star formation in low-mass (satellite) galaxies* Comparing the Galaxy Group Catalogue of Yang et al. (2007) to the prediction of theoretical models, van den Bosch et al. (2008) demonstrate that the fraction of red satellite galaxies in the model is larger than observed. They relate this problem to the extreme "strangulation" (i.e. removal of hot gas reservoir, when a dark matter halo became a substructure of a bigger halo) that galaxies suffer when they became satellites. In Fontanot et al., (2009b), we suggest that this discrepancy could be the result of the overprediction of the number of low- to intermediate-mass galaxies in semi-analytical models and to the poor modeling of star formation activity in $\sim 10^{12} M_{\odot}$ dark matter halos (see also Wilman et al. 2008). This scenario implies that the red colors of satellites are the result of physical processes acting on these galaxies when they are still the central galaxies of their parent halos.I plan to compare the two scenarios and to quantify their relative importance on the colors of satellite galaxies in the semi-analytical framework.

The highest redshift Universe.

Constraints on the early growth of super-massive black-hole and the formation of the first structures on galactic scales would likely disentangle between different theoretical models of joint galaxy and AGN formation (e.g. Salvaterra, Haardt, Volonteri 2007, Rhook & Haehnelt 2008, see also Fontanot, Somerville, Jester 2007). I propose to study the properties of samples of high-z objects, mostly selected by their optical-to-infrared fluxes and colors, and use them to estimate the luminosity functions of high-z galaxies and AGNs, using methods similar to those I developed in Fontanot et al. (2007a) to study the $3.5 < z < 5.2$ QSO-LF. In particular, optical-to-near-infrared observations are the preferential tool to select $z > 6$ objects using drop-out techniques (see also Bouwens et al. 2007), given the strong IGM absorption at shorter wavelengths, while X-ray observations help distinguish candidates with relevant nuclear activity. For the brightest objects spectroscopic confirmation will be feasible. I then plan to compare number counts and LFs of galaxies and AGN to the predictions of analytical theoretical models and semi-analytical codes, in order to constrain and characterize both the physics of gas cooling and infall and the processes responsible for the star formation and gas accretion at the early stages of structure formation. The multi-wavelength catalogues produced in the framework of the GOODS legacy are the optimal starting point for this project, and for the calibration of the technique (at the moment tested only on the QSO/AGN LF). Deeper photometric and spectroscopic observations of promising candidates will be highly desirable. In the near future, the wide spectral coverage and the large surveyed area of the forthcoming PannSTARRs survey will provide even stronger constraints on the properties and evolution of both galaxy and QSO LFs, up to $z \sim 7.5$. To probe higher redshifts, deeper surveys on smaller fields are probably required (like JWST and EUCLID, see also Fontanot, Somerville & Jester 2007). At the same time, the next generation of X-ray satellites (such as Constellation-X and XEUS) will provide the deep observations needed to select candidate AGNs.