Proposal for an ISSI International Team

COSWEB: The Cosmic Web and Galaxy Evolution

Coordinator: Gregory Rudnick

We have assembled the COSWEB team to study the interplay between the cosmic web and galaxy evolution. COSWEB is an outgrowth of a previous ISSI project that focused specifically on how the gas content of galaxies is affected by galaxy clusters. We propose to continue our studies of the gas content of clusters as well as exploit a breakthrough our team has made in characterizing the filamentary structure around clusters.

Starting over thirty years ago, astronomers began to suspect that a galaxy's environment affects its evolution. Compared to the average galaxy, those residing in high density areas have systematically older stellar populations, lower star formation rates (SFR), and different morphologies. In the past decade, large surveys of galaxies with ground-based telescopes have cemented the existence of these environmentally-dependent differences. However, the physical mechanisms by which galaxies are altered as they enter dense environments have not yet been conclusively identified and we do not know where different processes dominate.

Two elements are largely missing from current analyses: 1) information about the gaseous fuel for SF and 2) a proper treatment of dense filamentary environments, rather than a simplistic focus on clusters, groups, and field populations. Our team will address these shortcomings by both characterizing the stellar and gaseous contents of galaxies over a large range in lookback time and by focusing much of our effort on studying galaxies in filaments, the site where many galaxies first encounter a dense environment.

We have assembled a team that can address both of these concerns and bring fresh insights to understanding the environmental dependence of galaxy properties. Our team is composed of 12 individuals from six countries whose research expertise as follows (five new members indicated with a '*'):

- *Molecular tracers of star-forming gas:* F. Combes (F), P. Jablonka (CH), G. Rudnick (USA), A. Noble* (USA), E. van Kampen* (DE), M. Cooper (USA)
- *Ionized tracers of star-forming gas:* B. Weiner (USA), G. Rudnick (USA) R. Finn (USA), Y. Jaffe* (Chile)
- *Dust-obscured star formation:* R. Finn (USA), , G. Rudnick (USA), P. Jablonka (CH)
- *Galaxy environment:* D. Zaritsky (USA), G. Castignani* (F), P. Jablonka (CH), M. Cooper (USA), D. Norman* (USA), Y. Jaffe* (Chile)
- *Very distant clusters:* G. Rudnick (USA), B. Weiner (USA), A. Noble* (USA), E. van Kampen* (DE), G. Castignani* (F)
- *Theoretical modeling:* G. De Lucia (IT), M. Cooper (USA), F. Combes (F), van Kampen* (DE)

These individuals are using the largest ground-based telescopes, the best space facilities, and the largest and newest radio/mm interferometers on the planet. Together they account for much of the data on gas in dense environments, and over a large baseline in cosmic time.

The immediate goals of our team are to:

- Use HST spectroscopic observations at intermediate redshift and Hα narrow-band imaging of the nearby Virgo cluster to determine the response of the ionized gas to the environmental effects.
- Determine how the SFR and dust content are affected by environment through the use of *Spitzer*, WISE, and *Herschel* observations of dust emission in addition to interferometric observations of the molecular gas content in filaments and galaxy clusters spanning 10 Gyr of cosmic time.
- Compare the spatial distribution of the different gas phases to that of the stars to constrain the environmental mechanisms that suppress star formation and change galaxy morphology.
- Initiate new observational programs using JWST and millimeter interferometers to measure the detailed spatial distribution of the ionized and molecular gas of distant filament and cluster galaxies and compare how each phase responds to galaxy environment.
- Constrain models of environmental gas depletion in simulated galaxies that are evolving in a universe characterized by hierarchical structure growth.

The Role of Environment in Galaxy Evolution: our past and future activities

This is an extension proposal for our previous ISSI team "The Effect of Dense Environments on Gas in Galaxies over 10 Billion Years of Cosmic Time" (PI Rudnick) which produced eight papers, 10 accepted telescope proposals, and one accepted NASA funding proposal. In addition to our significant success in gathering new data and funding resources we also started a new research area that grew out of the initial ISSI work. Exploiting these new data, bringing the new research area to fruition, and synthesizing all the results requires support from ISSI in the form of a renewal proposal. Our new team requires the expertise of five new members.

A new focus on how the gas within galaxies is altered within Filaments: Galaxies in dense environments have lower average SF rates than field galaxies out to at least $z \sim 1$ (e.g. Poggianti et al. 1999; Lewis et al. 2002; Gómez et al. 2003; Postman et al. 2005). However, it is still not clear whether the clusters actively alter the gas content of infalling galaxies or whether they are the final resting place of dead galaxies whose gas was depleted before entering the cluster environment.

At low and intermediate redshifts, the suppression of SF starts at large distances from cluster cores, within groups and filaments (Lewis et al. 2002; Gómez et al. 2003; Laigle et al. 2017). This is consistent with simulations that show a boosting of ram pressure within filaments (Bahé et al. 2013), through which the bulk of the mass flows into the cluster (Ramachandra & Shandarin 2015). In contrast, spiral galaxies in the Virgo cluster core show evidence of cold gas stripping and truncated gas disks (Koopmann & Kenney 1998, 2004; Dale et al. 2001; Crowl et al. 2005; Chung et al. 2007). This demonstrates that the cluster environment is actively altering the star-formation properties of at least some of the infalling galaxies.

To conclusively determine the cause for the end of SF in dense environments and where it occurs it is important to **1)** study the fuel of SF itself and **2)** probe a large sample of galaxies in the filaments surrounding clusters, as these galaxies are experiencing environmental effects for the first time. The first goal was the focus of our last ISSI proposal, which we now propose to extend both to synthesize our results and to begin projects with new facilities. The second goal has been largely accomplished by our team, but needs to be folded into our analysis of the gas properties of galaxies.

A revolution in our characterization of filaments: Galaxy environment studies in the past 25 years have focused on a simple trilogy of field, group, and cluster environments. We have moved beyond these categories by characterizing galaxies within filaments out to lookback times of 6 billion years.

The region around the Virgo cluster is ideal because at ~ 16 Mpc, it is near enough to allow spatially resolved studies, and to benefit from existing shallow, wide surveys. Taking advantage of the massive investment of SDSS spectroscopy over $\sim 5000\text{deg}^2$, Kim et al. (2016) have identified seven well-defined filaments around the Virgo cluster (Fig. 1, left panel), which we now target.

We have also made breakthroughs in our understanding of the filaments feeding distant galaxy clusters at $z > 0.4$ thanks to our concerted Spatially Extended ESO Distant Cluster Survey (SEEDisCS) program. These advances have come thanks to the availability of 1 deg^2 field of view imagers on 4-meter telescopes that have enabled distant filaments to be identified via accurate photometric redshifts and subsequently be confirmed with multi-object spectroscopy on 6–8-meter class telescopes (Fig. 1, right panel; Rerat et al. in prep). It has taken years to amass this data but we now have the first ability to study highly pure samples of filament galaxies many virial radii away from clusters, in the regions where they may experience environmental affects for the first time.

Our proposed activities

A revolution in our knowledge of the gas: To understand how SFRs are altered, we require direct probes of the content and spatial distribution of the gas, which, depending on its phase, either traces active sites of SF or its fuel supply (e.g. Kennicutt 1998; Bigiel et al. 2008; Leroy et al. 2008). Fortunately, we are in an age of possibility in our ability to study how gas is affected by dense environments, thanks to

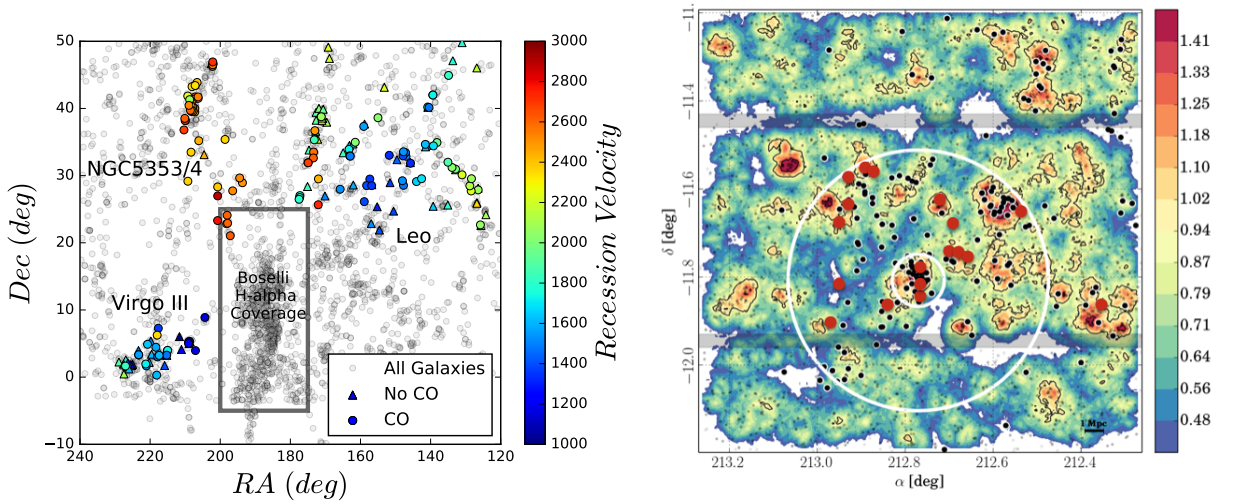

Figure 1: *Left panel* - Our sample of filaments around the Virgo cluster. Galaxies we have already observed in CO are shown color-coded by their velocity and split into sources with (circles) and without (triangles) CO detections. All of these sources have HI observations and will have Hα images taken during the timeframe of our ISSI team through already approved programs. We are also beginning spatially resolved mapping of the CO for a subset of our CO detections. Other galaxies around the Virgo cluster from Kim et al. (2016) are shown in gray. The Leo filaments are made up of multiple distinct filaments. Our data will complement the wealth of data available in the Virgo core (gray rectangle). *Right panel* - Filamentary structure around a well-studied cluster at z=0.52 drawn from the SEEDisCS sample. The color-scale shows the density of sources as measured from photometric redshifts. The black dots are spectroscopically confirmed members and the red dots show sources with ALMA CO observations. *By combining observations of multiple gas phases our ISSI team will gain a unique view of how filaments affect the gas in galaxies over 5 billion years of cosmic time.*

space-based (*Spitzer*, *Herschel*, WISE, HST, JWST) and ground-based (ALMA, IRAM, NOEMA, JVLA, VLT, Nancay) observatories and large observational efforts using these facilities, many of which have been executed by our team members.

We have largely characterized the environments of our galaxies and our immediate work is now to study specific phases of the gas through a set of well-defined programs, described below. Each of our proposed team members is leading 1–2 of these efforts. We will bring together these resources to address the following questions: In what environment moving from the field, into filaments and groups, and into cluster cores is the gas of galaxies first affected? How are the content, distribution, density, and temperature of the gas altered? Over what timescales does the depletion occur? What are the responsible mechanisms for the gas removal and how do they operate in different environments?

Ionized gas: We will determine the effect of environment on the dense ionized gas by combining an HST/WFC3 grism Cycle 20 program (PI: Rudnick) on the infall regions of 4 intermediate redshift clusters with a narrow-band imaging survey of Virgo filament galaxies (PI: Finn). With these programs we will distinguish between different methods of gas depletion by determining relative structure of the star-forming and stellar disks. For example, ram-pressure stripping makes the prediction that the gas disks will be asymmetric (e.g. Quilis et al. 2000; Crowl et al. 2005) with respect to the stars and that the SFRs in the inner parts of the galaxy should be the same as or even enhanced with respect to field galaxies (Koopmann & Kenney 2004; Weinmann et al. 2010). Galaxy-galaxy interactions, however, will result in both the gas and stars being asymmetric. Finally, starvation, which describes a weaker version of ram-pressure stripping (e.g. Larson et al. 1980), may only affect the relative sizes of the gas and stellar disks. Our team will propose with JWST grism spectroscopy to obtain spatially resolved maps of Paα emission ($\lambda = 1.875\mu$m), which provides an extinction-free measure of the instantaneous SF and which is only available through JWST.

Obscured star formation: Infrared observations from *Spitzer*, WISE, and *Herschel* probe the emission by dust grains that have been heated by young stars and can be used to infer the total infrared luminosity L_{IR} and SFR. To isolate the density at which the SFR is first modified in the cosmic web we will use completed

wide-field *Spitzer* 24μm observations around 11 clusters at $0.6 < z < 0.8$ (PI Rudnick) to measure whether there is a location at which the fraction of vigorously star-forming galaxies drops. We will also use our *Spitzer* 24μm observations of 9 local groups and clusters (PI Finn; Finn et al. 2017) and WISE 12 and 22μm observations of Virgo filament galaxies (PI Finn) to compare the spatial distribution of the dust emission in galaxies to that of their stars. Active stripping of the dust, which is usually co-spatial with the cold gas, will result in a spatial offset of the dust emission from the stellar light, while a mere decoupling of the galaxy from its gas supply will result in a lower mean intensity and smaller size of the dust emitting region.

The fuel for star formation. To truly understand the modulation of SF by reduction in the H_2 fuel supply requires that we observe the cold gas, or at least a good tracer like CO. As part of the efforts initiated by our previous ISSI team we have embarked on an ambitious observational campaign to search for stripping by imaging Virgo filament galaxies in CO, both with the IRAM 30m dish and with the NOEMA interferometer. We have also made excellent progress on increasing the number of CO detections in intermediate redshift clusters and their surrounding filaments using NOEMA (Jablonka et al. 2013) and ALMA observations (Jablonka in prep.) and our ISSI team will follow these detections up with spatially resolved observations in future ALMA cycles. We will also apply for JWST observations to measure H_2 directly.

As the result of JVLA and ALMA programs, team members have now detected CO in 13 galaxies that reside in four well studied $z \sim 1.6$ proto-clusters (Rudnick et al. submitted to ApJ; Noble et al. in prep). Taken together with our intermediate redshift measurements, these programs comprise most of the CO detections in dense environments outside the nearby universe. Part of our ISSI program will be to combine these studies to measure how molecular gas and SF relate in dense environments since $z < 2$.

Crucial constraints from observations for theoretical models. Our ISSI team includes experts in both semi-analytic models and hydrodynamic simulations. In nearly all of these models, the gas supply to galaxies is cut off upon their entry to another more massive dark matter halo. Our observations will reveal where the gas supply is cut off, i.e. filaments, the virial radius, cluster core, in groups, and how fast it is shut off. Current attempts result in uncomfortably long quenching timescales, which is how quenching is parameterized in the models (McGee et al. 2011; De Lucia et al. 2012). The fundamental problem is that the models don't properly treat the unknown quenching mechanism. Our spatially-resolved study of gas and stellar disks *in filaments as well as in groups and clusters* will help constrain the relative importance of physical processes such as ram-pressure stripping, starvation, or tidal effects, because their effectiveness varies with the density of the intra-cluster medium, intra-group medium, or intra-filament gas and the velocity of galaxies relative to each other and that gas. We will thus make crucial steps towards understanding the long debated nature of environmental quenching.

Why is our project powerful? Collectively, our team has access to the ideal data to address the questions outlined in our proposal. Our filament sample spans ~ 5 Gyr of cosmic time while our cluster sample spans ~ 10 Gyr and includes the highest redshift cluster with both extremely deep HST grism data (Lee-Brown et al. 2017), along with one of the largest sample of CO detections in distant clusters (Rudnick et al. 2017; Noble et al. in prep.) Importantly, our distant clusters are ideally suited for evolutionary studies as they are all typical progenitors of our local clusters (Milvang-Jensen et al. 2008; Rudnick et al. 2012). At intermediate redshift we probe far enough out in clustercentric radius to identify all of the members that will end up in the cluster at $z = 0$ (Just et al. 2014). At low redshift we use the proximity of Virgo and other local clusters to probe to low stellar masses where environmental quenching is thought to be dominant and we access HI, CO, Ionized gas, dust, and stellar mass in all of our target galaxies.

Our proposed collaboration will also probe nearly all of the phases of the gas that are relevant for SF, from the hot dense gas that traces active SF to the cold molecular gas that is the fuel of SF. We also probe all relevant densities in the cosmic web, from distant filaments to the bottom of deep cluster potential wells. By combining measurements with theoretical models we will gain an improved understanding of how SF is regulated, and eventually quenched, in dense environments. This synergy of the appropriate data and

sample, spanning a large range in redshift, and with accompanying theoretical modeling is unique.

Our proposed team: Our team is composed of 12 experts in various areas of galaxy evolution studies and represents 6 countries (USA, F, CH, IT, Chile, DE). They are playing key roles or are leading projects in one or more of the areas mentioned above. This group has five new members (indicated with a '*'), who bring essential expertise to our collaboration. • *Molecular tracers of star-forming gas:* Combes, Jablonka, Rudnick, Noble*, van Kampen*, Cooper • *Ionized tracers of star-forming gas:* Weiner, Rudnick, Finn, Jaffe* • *Dust-obscured star formation:* Finn, Rudnick, Jablonka • *Galaxy environment:* Zaritsky, Castignani*, Jablonka, Cooper, Norman*, Jaffe* • *Very distant clusters:* Rudnick, Weiner, Noble*, van Kampen*, Castigiani* • *Theoretical modeling:* De Lucia, Cooper, Combes, van Kampen*. In addition to our 12 member team, we also have three experts who are in close contact with our group and will consult with the team on an as-needed basis throughout the ISSI process: V. Desai (USA), C. Papovich (USA), and J. Hodge (NL).

The value of ISSI: Making significant progress on understanding environmental effects requires a concerted and multi-wavelength approach that stretches across large swaths of cosmic time and the full range of densities. This is a highly valued endeavor as understanding the gas in galaxies was highlighted in the Astro2010 Decadal report from the U.S. National Academy of Sciences. It is also a main focus of ALMA, the largest Europe-US-Japan project of the decade and of JWST, the next flagship space telescope.

The funding from ISSI gives us a unique opportunity for extended face-to-face meetings. Our experience has shown that the role of these meetings is crucial. For example, during our first workshop as part of the previous proposal we organically decided on pursuing the Virgo filament studies, which now forms a backbone of this proposal. Based on work done at our meetings we have produced eight papers together, and have 10 accepted telescope proposals and one successful funding proposal[1]. The ISSI funds make these meetings possible as almost none of the collaborators has the necessary funds from other sources. A timely effort in the design of our observing programs is crucial, as JWST has a limited mission lifetime and the first call for proposals is March 2018, right within the timeframe of this proposed team. Likewise, our ISSI team is in a perfect position to propose large programs with ALMA to study the cold gas.

Outcomes: Our collaboration will result in multiple high impact papers. We will also write a paper that combines the different studies above into synthesis of all we know observationally about the gas in galaxies in dense environments. Another paper will combine those observational constraints with our theoretical modeling to constrain the timescales and physical mechanisms for the quenching of SF.

We will submit multiple telescope proposals to ALMA, JVLA, NOEMA, HST, and most importantly JWST, to characterize the gas in much larger samples than is currently possible.

Schedule: We propose to hold an initial full team meeting of five days to kick off the project during the summer of 2017. This would be followed by a final 5 day full team meeting in the summer of 2018.

Financial Support: We request the standard support provided by ISSI of a per diem for the living expenses of Team members while residing in Bern and for the travel expenses of the coordinator (Rudnick). We would also appreciate benefiting from the ISSI Young Scientist scheme for two young researchers.

Required Facilities. We require only meeting facilities and reasonably fast internet access.

Bahé, Y. M. et al. 2013, MNRAS, 430, 3017; Bigiel, F. et al. 2008, AJ, 136, 2846; Chung, A. et al. 2007, ApJ, 659, L115; Crowl, H. H. et al. 2005, AJ, 130, 65; Dale, D. A. et al. 2001, AJ, 121, 1886; De Lucia, G. et al. 2012, MNRAS, 423, 1277; Gómez, P. L. et al. 2003, ApJ, 584, 210; Jablonka, P. et al. 2013, A&A, 557, A103; Kim, S., et al. 2016, ApJ, 833, 207; Kennicutt, Jr., R. C. 1998, ApJ, 498, 541; Koopmann, R. A. et al. 1998, ApJ, 497, L75; —. 2004, ApJ, 613, 866; Laigle, C. et al. 2017, submitted to MNRAS, arXiv:1702.08810 Larson, R. B. et al. 1980, ApJ, 237, 692; Leroy, A. K. et al. 2008, AJ, 136, 2782; Lewis, I. et al. 2002, MNRAS, 334, 673; McGee, S. L. et al. 2011, MNRAS, 413, 996; Poggianti, B. M. et al. 1999, ApJ, 518, 576; Postman, M. et al. 2005, ApJ, 623, 721; Quilis, V. et al. 2000, Science, 288, 1617; Ramachandra, N. & Shandarin, S., 2015, MNRAS, 452, 1643; Rerat, F., Jablonka, P., Rudnick, G., in prep; Weinmann, S. M. et al. 2010, MNRAS, 406, 2249

[1] http://www.issibern.ch/teams/gasingalaxies/

Gregory H. Rudnick, *University of Kansas*

ROLE IN THE PROJECT

Gregory Rudnick is an expert in ionized gas properties of galaxies, dust emission, molecular gas, distant clusters, and the characterization of galaxy environments. His knowledge spans many of the areas of the proposal and he will therefore be able to effectively coordinate the various research activities. He will personally lead investigations into: **1)** the spatial distribution the ionized gas in intermediate redshift filament, group, and cluster galaxies; **2)** the environmental dependence of obscured star formation in the same intermediate redshift galaxies; **3)** and the molecular gas contents of the most distant cluster galaxies. He is involved in most of the research projects proposed by the team and will therefore be an effective nexus of the research activities. He will be one of the lead authors on the synthesis papers that the team lists as its primary goal.

On the administrative side, he will organize and run all the team meetings, maintain the e-mail archive, organize and run regular (∼monthly) team telecons, coordinate the writing of team proposals, and maintain the team wiki and public ISSI web page.

FELLOWSHIPS & APPOINTMENTS

- **current position:** Associate Professor of Astronomy, University of Kansas (2013 - present)
- Recipient of an "Alexander von Humboldt Fellowship" to conduct research at the Max-Planck-Institute for Astronomy in Heidelberg, Germany, for the summers of 2012-2014
- Assistant Professor of Astronomy, University of Kansas (2008 - 2013)

PROFESSIONAL PREPARATION

University of Illinois	Physics	B.S.	1996
University of Arizona	Astronomy	Ph.D.	2001
Max-Planck-Institute for Astrophysics	Astronomy	Postdoc	2001 - 2004
National Optical Astronomy Observatory	Astronomy	Leo Goldberg Fellow	2004 - 2008

RESEARCH EXPERTISE AND INTERESTS

Optical and infrared observational astronomy; The effect of environment on galaxies; The growth of stellar mass in galaxies; Galaxy clusters

HONORS

One of four recipients of 2016 University Scholarly Achievement Award for excellent scholarly achievement at the University of Kansas

RELATED PUBLICATIONS

Determining the Halo Mass Scale where Galaxies Lose Their Gas, **Rudnick, G.**, Jablonka, P, Moustakas, J., Aragón-Salamanca, A., Zaritsky, D., Jaffé, Y. L., De Lucia, G., Desai, V., Halliday, C., Just, D., Milvang-Jensen, B., Poggianti, B., submitted to the Astrophysical Journal

Substantial Molecular Gas Reservoirs from CO(1-0) Observations and Extremely Low Star Formation Efficencies in $z = 1.62$ Cluster Galaxies., **Rudnick, G.**, Hodge, J., Walter, F., Momcheva, I., Tran, K.-V., Papovich, C., da Cunha, E., Decarlo, R., Saintonge, A., Willmer, C., Lotz, J., Lentati, L., submitted to the Astrophysical Journal

Disc colours in field and cluster spiral galaxies at $0.5 < z < 0.8$, Cantale, N., Jablonka, P., Courbin, F., **Rudnick, G.**, Zaritsky, D., Meylan, G., Desai, V., De Lucia, G., Aragón-Salamanca, A., Poggianti, B. M., Finn, R., and Simard, L., 2016, A&A, 589, A82

A Tale of Dwarfs and Giants: Using a $z = 1.62$ Cluster to Understand How the Red Sequence Grew Over the Last 9.5 Billion years, **Rudnick, G.**, Tran, K.-V., Papovich, C., Momcheva, I., and Willmer, C., 2012, ApJ, 755, article id. 14

Dust Obscured Star Formation in Intermediate Redshift Clusters, Finn, R., , Desai, V., **Rudnick, G.**, Poggianti, B., Bell, E., and 6 co-authors, 2010, ApJ, 720, 87

A Spitzer-selected Galaxy Cluster at $z = 1.62$, Papovich, C., Momcheva, I., Willmer, C. N. A., Finkelstein, K. D., Finkelstein, S. L., Tran, K.-V., Brodwin, M., Dunlop, J. S., Farrah, D., Khan, S. A., Lotz, J., McCarthy, P., McLure, R. J., Rieke, M., **Rudnick, G.**, Sivanandam, S., Pacaud, F., & Pierre, M. 2010, ApJ, 716, 1503-1513

The Rest-frame Optical Luminosity Function of Cluster Galaxies at $z < 0.8$ and the Assembly of the Cluster Red Sequence, **Rudnick, G.**, von der Linden, A., Pelló, R., Aragón-Salamanca, A., and 11 co-authors, 2009, ApJ, 700, 1559

Spitzer Mid- to Far-Infrared Flux Densities of Distant Galaxies, Papovich, C., **Rudnick, G.**, Le Floc'h, E., van Dokkum, P. G., and 7 coauthors, 2007, ApJ, 668 45

SYNERGISTIC ACTIVITIES AND COMMITTEES

- Member of Scientific Organizing Committee for "Early stages of Galaxy Cluster Formation: Mergers, Protoclusters, and Star Formation in Overdense Environments ", conference on 17-21, July 2017, in Garching, Germany
- Member of Scientific Organizing Committee and author of chapter in final report for Kavli foundation sponsored workshop: "Maximizing Science in the Era of LSST: A Community-based Study of Needed US OIR Capabilities", workshop 2-6, May 2016, in Tucson, USA
- Member of Scientific Organizing Committee for "In the footsteps of Galaxies", conference on 7-11 September, 2015, in Soverato, Italy
- Director of Graduate Studies, Dept. of Physics and Astronomy, KU, Fall 2013 - Present
- Member, BigBOSS community science working group of the National Optical Astronomy Observatory, Jan. 2013 - August 2013
- Member of Scientific Organizing Committee for "Highly Multiplexed Spectroscopy with BigBOSS on the Mayall Telescope: An NOAO Community Workshop" conference on 13-14 September, 2011, in Tucson
- Member of National Optical Astronomy Observatory time allocation proposal review committee, May 2008, November 2009, May 2010, November 2010, November 2011
- Member of NASA time allocation proposal review committee, September 2009, October 2013, April 2014
- Member of Spitzer Space Telescope proposal review committee, April 2007, March 2009, December 2012

Curriculum Vitae of Françoise COMBES

Prof at College de France (Galaxies & Cosmology)
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Web: http://aramis.obspm.fr/~combes

Studies:
1980: PhD Thesis, Univ. Paris VII: " Dynamics and structure of galaxies "
1975: Agregation of Physics (rank 2nd)
1974-5: Thesis of 3rd cycle, (Paris VII): Conditions of nucleosynthesis in a symmetric universe of matter-antimatter
1971-75: Ecole Normale Supérieure (Rue d'Ulm), PARIS

Role in the project:
Observations of the molecular component in galaxies, at low and high redshift. Estimation of the star formation efficiency, and the influence of environment in the quenching. Dynamical modeling of the quenching processes.

Expertise:
- Formation and evolution of galaxies
- Dynamics of galaxies, Interstellar medium
- High redshift galaxies -- Dark matter in the Universe

Professional Experience:
* 2014-: Professor at College de France: Chair Galaxies & Cosmology
* 2007-2014: Astronomer (Classe Exceptionnelle) at Paris Observatory (CE2 en 2011)
* 1989-2006: Astronomer (2nd, then 1cl) at Paris Observatory
* 1985-1989: Staff-director of the Physics Laboratory in Ecole Normale Supérieure (Ulm), Paris
* 1983-1985: Part-time lecturer in Paris 6 (C4 and DEA)
* 1975-1985: Assistant then Maître-Assistant in Ecole Normale Supérieure, Paris

Committees and Functions:
* 2016-: Chair of Section Universe Sciences of Académie des Sciences
* 2009-2016: President of COFUSI
* 2003-2018: Scientific Editor of A&A (Astronomy & Astrophysics main European Journal)
* 2002-2004: President of SF2A (French National Astrophysical Society)
* 2007-2008: Chair of PanelD Astronet Roadmap
* 2012-2015: President Division J (Galaxies & Cosmology) of IAU
* 2009-2016: Member Committee ERC-Astrophysics (PE9)
* 2010-2012: Chair of Committee ANR-Astrophysics
* 2011-2014: Chair of the ALMA Program Committee * 2012-: Chair of ESO-OPC

Publications: ~ **1000** (**485** in refereed journals), >**20 800** citations (hindex=72) from NASA-ADS

Tremblay, G.R., Oonk, J.B.R., Combes, et al.: 2016, Cold, clumpy accretion onto an active supermassive black hole, Nature 534, 218,
Garcia-Burillo, S., Combes, F., Ramos Almeida, C. et al.:2016, ALMA resolves the torus of NGC 1068: continuum and molecular line emission, ApJL 823, L12
El-Zant, A., Freundlich, J., Combes, F.: 2016, From cusps to cores: a stochastic model, MNRAS 461, 1745
Salome, Q., Salome, P., Combes, F., Hamer, S., Heywood , I.: 2016, Star formation efficiency along the radio jet in Centaurus A, A and A 586, A45
Scharwaechter, J., Combes, F., Salomé, P., Sun, M., Krips, M.: 2016, The over-massive black hole in NGC 1277: New constraints from molecular gas kinematics, MNRAS,457, 4252

Books : * La Matière Noire, clé de l'Univers, 2015, F. Combes, Vuibert
* La Voie Lactée, 2013, F. Combes & J. Lequeux, EdP-Sciences
* Galaxies et Cosmologie (2009), F. Combes, M. Haywood, S. Collin, F. Durret, B. Guiderdoni (Ellipses)
* Mystères de la formation des galaxies (2008), F. Combes (Dunod) | Mysteries .. (2010, Springer)
* Galaxies et Cosmologie (CNRS,1991), -- Galaxies and Cosmology (Springer, 1995), avec P. Boissé, A. Mazure et A. Blanchard, ré-édition en 2002

Dennis Zaritsky
Steward Observatory, University of Arizona, Tucson, AZ, USA

Program Role: Study of low surface brightness galaxies vs. environment. Optical/IR observing expertise.

Current Positions:

2002−Present: Professor/Astronomer, Steward Observatory, Univ. of Arizona
2012−Present: Deputy Director, Steward Observatory, Univ. of Arizona
2014−Present: Associate Editor, Science Advances

Former Positions:

1999−2002: Associate Professor/Associate Astronomer, Steward Observatory, Univ. of Arizona
1997−2000 : Associate Professor/Associate Astronomer, Lick Observatory, UC Santa Cruz
1994−1997 : Assistant Professor/Assistant Astronomer, Lick Observatory, UC Santa Cruz
1991−1994 : Hubble Fellow at the Carnegie Observatories

Education: California Institute of Technology, Pasadena, CA; B.S. in Physics with Honor, 1986; University of Arizona, Tucson, AZ; Ph.D. in Astronomy, 1991

National and International Committees: NOAO DataLab Design Review Committee (2016), NASA Astrophysics Senior Review (2016), DESI Technical Document Red Team Reviewer (2015), NSF/NOAO PRP committee (2015), NSF Gemini Review (2015), Columbia University External Review Committee (2015), Hubble Fellowship Selection Panel (2015), ESO Spectroscopic Survey Review Panel (2013-2015)

Honors: Hubble Fellowship (1991), E.F. Fullam Award (1993), David and Lucile Packard Fellowship (1997), Sloan Fellowship (1998), NSF CAREER award (1998), Newton Lacy Pierce Prize (1999), Guggenheim Fellowship (2006), Galileo Circle Fellowship (2017)

Publications: Currently 216 refereed publications, a total of 17909 citation, and an H-index of 71 (Google Scholar). Examples include:

The Massive Halos of Spiral Galaxies 1994. Zaritsky, D. and White, S.D.M, ApJ, 435, 599
H II Regions and the Abundance Properties of Spiral Galaxies 1994 Zaritsky et al., Ap. J, 420, 87
A Direct Empirical Proof of the Existence of Dark Matter 2006. Clowe, D., Bradac, M., Gonzalez, A.H., Markevitch, M., Randall, S., Jones, C., and Zaritsky, D. Ap. J. Letters 648, 108
A Census of Baryons in Galaxy Clusters and Group, 2007, Gonzalez et al., ApJ, 666, 147
The Star Formation History of the Large Magellanic Cloud 2009. Harris, J. and Zaritsky, D., AJ, 138, 1243

Dr. Yara L. Jaffé - Curriculum Vitae

Personal Details

European Southern Observatory
Alonso de Cordova 3107
Vitacura, Santiago, Chile

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Mobile: +56 9 53304322
Web: `http://www.sc.eso.org/~yjaffe/`

Education

2012: PhD in Astronomy, The University of Nottingham, UK.
2007: BSC in Physics (5-year Undergraduate program), Universidad Simón Bolívar, Venezuela.

Areas of specialization

Galaxy formation and evolutio; Observational and theoretical astronomy; The growth of structure in the Universe.

Current Position

2015-Present: Postdoctoral fellow at the European Southern Observatory (Chile), with duties as support astronomer at the Very Large Telescope, Paranal Observatory.

Appointments held

2012-2015: FONDECYT Fellow, hosted by Universidad de Concepción (UdeC, Chile).
2011-2012: Postdoctoral Fellow at Osservatorio Astronomico di Padova (INAF), Italy.
2008-2009: Visiting postgraduate student at European Southern Observatory (ESO), Germany.
2007-2007: Visiting undergraduate student at Goddard Space Flight Center (NASA), U.S.A.
2006-2007: Visiting undergraduate (thesis) student at Centro de Investigaciones de Astronomia, Venezuela.

Honors and Awards

2010: Second place in the Shell "Very early career woman physicist of the year" award, London, UK.
2008: Three-year Scholarship from the Venezuelan Academy of Science.
2007: Three-year Scholarship from the School of Physics & Astronomy of The University of Nottingham.
2007: Undergaduate degree in Physics awarded ***Cum Laude*** distinction.
2007: Undergraduate thesis awarded ***honorific distinction***

Professional Service

Referee for *The Astrophysical Journal* (ApJ) in several occasions.
Reviewer in European grant reviewing committees.

Selected refereed publications (from 28 articles with 207 citations)

B. M. Poggianti, G. Fasano, A. Omizzolo, M. Gullieuszik, D. Bettoni, A. Moretti, A. Paccagnella, Y. L. Jaffé, B. Vulcani, J. Fritz, W. Couch, M. D'Onofrio, *"Jellyfish galaxy candidates at low redshift"* (2016), AJ, 151, 78.

X. Fernández, (inc. Y. L. Jaffé), et al. *"Highest Redshift Image of Neutral Hydrogen in Emission: A CHILES Detection of a Starbursting Galaxy at $z = 0.376$"* (2016) *ApJ Letters*, 824, 1.

Y. L. Jaffé, M. A. Verheijen, C. P. Haines, R. Cybuslky, M. Montero-Castano, A. Chung, B. Z. Deshev, X. Fernandez, J. van Gorkom, B. M. Poggianti, R. Smith, H. Yoon, et al. *"BUDHIES III: The fate of HI and the quenching of galaxies in evolving environments"* (2016) *MNRAS*, 461, 1202.

Y. L. Jaffé, R. Smith, G. N. Candlish, B. M. Poggianti, Y-K. Sheen, M. Verheijen, *"BUDHIES II: a phase-space view of H I gas stripping and star formation quenching in cluster galaxies"* 2015, MNRAS, 448, 1715.

Y. L. Jaffé, A. Aragon-Salamanca, B. Ziegler, H. Kuntschner, D. Zaritsky, G. Rudnick, B. M. Poggianti, C. Hoyos, C. Halliday, R. Demarco, *"Ionized gas disks in Elliptical and S0 galaxies at $z < 1$"* 2014, MNRAS, 440, 3491.

Y. L. Jaffé, B. M. Poggianti, M. Verheijen, B. Deshev, and J. van Gorkom, *"BUDHIES I: characterizing the environment in and around two clusters at $z{\sim}0.2$"* 2013, MNRAS, 431, 2111

Y. L. Jaffé, B. M. Poggianti, M. Verheijen, B. Deshev, and J. van Gorkom, *"Gas reservoirs and star formation in a forming galaxy cluster at $z \sim 0.2$"* 2012, ApJL, 756, 28.

Y. L. Jaffé, A. Aragón-Salamanca, G. De Lucia, P. Jablonka, G. Rudnick, R. Saglia and D. Zaritsky, *"The colour-magnitude relation of Elliptical and Lenticular galaxies in the ESO Distant Cluster Survey"*, 2011a, MNRAS, 410, 280.

Dara J. Norman

PERSONAL INFORMATION

Tel: 520-318-8361
E-mail: dnorman@noao.edu

Address: National Optical Astronomy Obs.
950 N. Cherry Ave
Tucson, AZ

PROJECT ROLE

My focus is the influence of environment on galaxy evolution. In particular, my interest is in the roles that Active Galactic Nuclei and starformation play in shaping galaxy properties. In this program, I will focus on understanding starformation and AGN activity in galaxies associated with the Virgo cluster and especially along connecting filamentary structures. I will be using arcival data from large multi-wavelenth surveys to characterize galaxy properties and identify AGN, as well as, proposing for additional data to follow-up and fill in gaps in our understanding.

EDUCATION

Ph.D, M.S., Astronomy, University of Washington, 1999, 1994
S.B., Earth, Atmospheric and Planetary Science, Mass. Inst. of Tech., 1989

PROFESSIONAL EMPLOYMENT

Deputy Assoc Dir. for the NOAO Community Sci. & Data Cntr	2016 - current
NOAO Associate Scientist & AURA/NOAO Diversity co-Advocate	2012 - current
NOAO Assistant Scientist & AURA/NOAO Diversity co-Advocate	2009 - 12

RECENT EXTERNAL SERVICE

External Reviewer for Kepler K2 GO Cycle 5 proposals	2017
External Reviewer for Sloan Foundation	2015
Hubble Fellowship Review Panel	2015

AWARDS &HONORS

Howard University ADVANCE-IT Faculty Fellow	2015
AURA Team Award as part of the Dark Energy Camera Team	2013
University of Washington Distinguished Alumni Timeless Award	2012
Nat. Sci. Foundation Astronomy & Astroph. Postdoctoral Fellowship	2001 - 04

SELECTED PUBLICATIONS

Martini, P., Miller, E. D., Brodwin, M., Stanford, S. A., Gonzalez, A.H., Bautz, M., Hickox, R. C., Stern, D., Eisenhardt, P. R., Galametz, A., **Norman, D.**, Jannuzi, B. T., Dey, A., Murray, S., Jones, C., Brown, M. J. I. 2013 'The Cluster and Field Galaxy Active Galactic Nucleus Fraction at z = 1-1.5: Evidence for a Reversal of the Local Anticorrelation between Environment and AGN Fraction', ApJ 768, p14.

Norman, D.J., DePropris, R. and Ross, N. 2009 'The Two-Point Correlation of 2QZ Quasars and 2SLAQ LRGs: From a Quasar Fueling Perspective', ApJ, 695, p1327.

Wittman, D., DellAntonio, I. P., Hughes, J. P., Margoniner, V. E., Tyson, J. A., Cohen, J. G., **Norman, D.** , 2006, 'First Results on Shear-selected Clusters from the Deep Lens Survey: Optical Imaging, Spectroscopy, and X-Ray Follow-up', ApJ, 643, p128.

Norman, D.J. and Impey, C.D., 2001, 'Quasar-Galaxy Correlations: A detection of Magnification Bias', AJ, 121, p2392.

Benjamin J. Weiner *Curriculum Vitae* March 20, 2017

Address: Steward Observatory, Dept. of Astronomy, University of Arizona, 933 N. Cherry St., Tucson, AZ 85721, USA. Telephone: 520.621.4119, email: bjw@as.arizona.edu, web: http://mingus.as.arizona.edu/∼bjw

Role in the Project: Expertise on spatially resolved imaging and spectroscopy with HST and preparation for JWST proposals. Measurement of far-infrared SEDs and star formation rates. Radio and millimeter observations including ALMA. Spatially resolved kinematics.

Current Position:
Associate Astronomer and Staff Scientist, MMT Observatory, University of Arizona, 2017 – present

Previous Positions:
Associate Astronomer, Steward Observatory, University of Arizona, 2013 – present
Assistant Astronomer, Steward Observatory, University of Arizona, 2006 – 2013
Postdoctoral researcher, supervisor S. Veilleux, University of Maryland, 2004 – 2006
Postdoctoral researcher, supervisor S. Faber, University of California at Santa Cruz, 2000 – 2004
Barbara McClintock Postdoctoral Fellow, Carnegie Observatories, 1998 – 2000

Education:
Swarthmore College, Physics and English Literature, B.A. 1989
Rutgers University, Astrophysics, Ph.D. 1998

Commitee Service: Beatrice Tinsley Prize Committee, American Astronomical Society

Selected Publications:

C. Pacifici, S.A. Kassin, B.J. Weiner, et al. 2016,"The Evolution of Star Formation Histories of Quiescent Galaxies," ApJ, 832, 79

J.S. Spilker, R. Bezanson, D.P. Marrone, B.J. Weiner, K.E. Whitaker, C.C. Williams, 2016, "Low Gas Fractions Connect Compact Star-forming Galaxies to Their $z \sim 2$ Quiescent Descendants," ApJ, 832, 19

R.C. Simons, S.A. Kassin, J.R. Trump, B.J. Weiner et al. 2016, "Kinematic Downsizing at $z \sim 2$," ApJ, 830, 14

R.C. Simons, S.A. Kassin, B.J. Weiner et al. 2016, "A transition mass in the local Tully-Fisher relation," MNRAS, 452, 986

A.M. Morris, D.D. Kocevski, J.R. Trump, B.J. Weiner et al. 2015, "A WFC3 Grism Emission Line Redshift Catalog in the GOODS-South Field," AJ, 149, 178

R. Genzel et al. 2015, "Combined CO and Dust Scaling Relations of Depletion Time and Molecular Gas Fractions with Cosmic Time, Specific Star-formation Rate, and Stellar Mass," ApJ, 800, 20

T. Dolley, M.J.I. Brown, B.J. Weiner et al. 2014, "The Clustering and Halo Masses of Star-forming Galaxies at $z < 1$," ApJ, 797, 125

F. Walter et al. 2014, "A Molecular Line Scan in the Hubble Deep Field North: Constraints on the CO Luminosity Function and the Cosmic H_2 Density," ApJ, 782, 79

J.A. Newman et al. 2013, "The DEEP2 Galaxy Redshift Survey: Design, Observations, Data Reduction, and Redshifts," ApJS, 208, 5

C. Pacifici, S.A. Kassin, B.J. Weiner, S. Charlot, J.P. Gardner. 2013, "The Rise and Fall of the Star Formation Histories of Blue Galaxies at Redshifts $0.2 < z < 1.4$," ApJL, 762, L15

W. Rujopakarn, G.H. Rieke, B.J. Weiner, P. Perez-Gonzalez, M. Rex, G.L. Walth, J.S. Kartaltepe. 2013, "Mid-infrared Determination of Total Infrared Luminosity and Star Formation Rates of Local and High-redshift Galaxies," ApJ, 767, 73

L.J. Tacconi et al. 2013, "Phibss: Molecular Gas Content and Scaling Relations in $z \sim 1 - 3$ Massive, Main-sequence Star-forming Galaxies," ApJ, 768, 74

S.A. Kassin, B.J. Weiner, et al. 2012, "The Epoch of Disk Settling: $z \sim 1$ to Now," ApJ, 758, 106

K.H.R. Rubin, B.J. Weiner, et al. 2010, "The Persistence of Cool Galactic Winds in High Stellar Mass Galaxies between $z \sim 1.4$ and 1," ApJ, 719, 1503

B.J. Weiner et al. 2009, "Ubiquitous Outflows in DEEP2 Spectra of Star-Forming Galaxies at $z = 1.4$," ApJ, 692, 187

K.G. Noeske, B.J. Weiner, et al. 2007, "Star Formation in AEGIS Field Galaxies since z=1.1: The Dominance of Gradually Declining Star Formation, and the Main Sequence of Star-forming Galaxies," ApJL, 660, L43

Gianluca Castignani - *Curriculum Vitae*

CONTACT INFORMATION

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LERMA
61 avenue de l'Observatoire
75014 Paris, France

E-mail: gianluca.castignani@obspm.fr
webpage: https://sites.google.com/site/gianlucacastignani/home

ROLE IN THE PROJECT

Based on my experience on AGNs and distant clusters around radio galaxies I will investigate the role of the enviroment on star formation in galaxies belonging to the filaments of Virgo using clustering analysis and targeted observations. I will also potentially contribute to the project on high-z galaxy clusters.

CURRENT POSITION

Postdoc

Observatoire de Paris, LERMA **12/2016 - present**
Laboratoire d'Etudes du Rayonnement et de la Matiére en Astrophysique et Atmosphéres
Collège de France **12/2016 - present**
- Advisor: Françoise Combes

FORMER POSITION

Centre National d'Études Spatiales (CNES) postdoctoral fellow
Laboratorie Lagrange, Observatoire de la Côte d'Azur, Nice, France **12/2014 - 11/2016**

EDUCATION

PhD in Astrophysics, SISSA, Trieste, Italy	**11/2010 - 10/2014**
MSc in Physics, University of Pisa, Italy	**07/2008 - 10/2010**
BSc in Physics, University of Pisa, Italy	**09/2005 - 07/2008**
Student in Physics, Scuola Normale Superiore, Pisa, Italy	**10/2005 - 09/2010**

WORK EXPERIENCE

Laboratorie Lagrange, Observatoire de la Côte d'Azur, Nice, France	**12/2014 - present**
Euclid consortium, Ground Segment Workpackage Clusters of Galaxies	**06/2015 - present**
Dark Energy Survey (DES), DES-Brasil consortium, LIneA node	**10/2016 - present**
altogether 1 year research period at the ***STScI*** (Baltimore, USA)	**2010 - 2014**

FELLOWSHIPS, HONORS, AND AWARDS

CNES postdoctoral fellowship	**11/2014 - 11/2016**
Ph.D. fellowship at SISSA	**11/2010 - 10/2014**
Fondazione Angelo Della Riccia Fellowship (3,500 euro) to work at the STScI	**04/2014 - 06/2014**
Fondazione Angelo Della Riccia Fellowship (1,800 euro) to work at the STScI	**03/2013 - 10/2013**
ISSNAF/INAF internship to work at the STScI	**07/2010 - 09/2010**
Scholarship at the Scuola Normale Superiore, Pisa, Italy	**10/2005 - 09/2010**
Competitor at the Italian Olympiads of Physics for high school students, after qualification	**2005**
Competitor at the Italian Olympiads of Mathematics for high school students, after qualification	**2005**

SELECTED PUBLICATIONS IN REFEREED JOURNALS

G. Castignani, E. Pian, et al. *Multifrequency variability study of the gamma-ray emitting blazar PKS 1510-089*, 2017, arXiv:1612.05281, *A&A* in press • **G. Castignani** & C. Benoist, *A new method to assign galaxy cluster membership using photometric redshifts*, 2016, *A&A*, 595, 111 • **G. Castignani** & G. De Zotti, *AGN torus emission for a homogeneous sample of bright flat spectrum radio quasars*, 2015, *A&A*, 573, 125 • **G. Castignani**, M. Chiaberge, A. Celotti, & C. Norman, *A new method to search for high redshift clusters using photometric redshifts*, 2014, *ApJ*, 792, 113 • **G. Castignani**, M. Chiaberge, A. Celotti, C. Norman, & G. De Zotti, *Cluster candidates around low power radio-galaxies at* $z \sim 1-2$ *in COSMOS*, 2014, *ApJ*, 792, 114 • **G. Castignani**, D. Guetta, E. Pian, L. Amati, S. Puccetti, and S. Dichiara, *Time delays between Fermi-LAT and GBM light curves of gamma-ray bursts*, 2014 , *A&A*, 56, 60 • **G. Castignani**, F. Haardt, A. Lapi, G. De Zotti, A. Celotti, and L. Danese, *Black hole mass estimates for a homogeneous sample of bright flat-spectrum radio quasars*, 2013, *A&A*, 560, 28

Allison G. Noble

CONTACT INFORMATION

Kavli Institute for Astrophysics
Massachusetts Institute of Technology

PROJECT ROLE

Characterizing star formation and gas content of galaxies in high-z clusters and the role of environment through infrared and submillimeter observations

CURRENT POSITION

Postdoctoral Fellow, MIT, USA 2016 – present

- Advisor: Michael McDonald

FORMER EMPLOYMENT

Postdoctoral Fellow, University of Toronto, Canada 2014 – 2016

- Advisor: Howard Yee

EDUCATION

Ph.D. McGill University - Department of Physics awarded 2014

- Thesis: *Dusty Star-Forming Galaxies within High-Redshift Galaxy Clusters*
- Advisor: Tracy Webb

B.Sc. University of Wisconsin - Madison (Graduated with Distinction) awarded 2007

- Majors: Honors in Physics and Astrophysics (Dual Major)

PROFESSIONAL SERVICE

Referee Service

- *The Astrophysical Journal; The Astrophysical Journal Letters; Monthly Notices of the Royal Astronomical Society; Letters, Astronomy & Astrophysics*

Telescope Committees

- *CFHT proposal referee; Chandra TAC*

SELECTED AWARDS

Schulich Graduate Fellowship; Molson and Hilton Hart Fellowship; Provost's Graduate Fellowship; Principal's Graduate Fellowship; McGill Recruitment Excellence Fellowship; Phi Beta Kappa; Chambliss Student Achievement Award at the AAS Meeting

SELECTED PUBLICATIONS

1. **Noble, Allison**; Webb, T. M. A.; Yee, H. K. C.; et al. (2016) *The Phase Space of $z \sim 1.2$ SpARCS Clusters: Using Herschel to probe Dust Temperature as a Function of Environment and Accretion History*. ApJ, 816, 48.
2. Webb, T. M. A.; **Noble, Allison**; DeGroot, A.; et al. (2015) *An Extreme Starburst in the Core of a Rich Galaxy Cluster at $z = 1.7$*. ApJ, 809, 173.
3. **Noble, Allison**; Geach, J. E.; van Engelen, A. J.; et al. (2013) *A submillimetre-bright $z \sim 3$ overdensity behind a $z \sim 1$ supercluster revealed by SCUBA-2 and Herschel*. MNRAS: Letters, 436, L40.
4. **Noble, Allison**; Webb, T. M. A.; Muzzin, A.; et al. (2013) *A Kinematic Approach To Assessing Environmental Effects: Star-Forming Galaxies in a $z \sim 0.9$ SpARCS cluster using Spitzer 24 μm Observations*. ApJ, 768, 118.
5. **Noble, Allison**; Webb, T. M. A.; Ellingson, E.; et al. (2012) *Submillimetre Source Counts in the Fields of High-Redshift Galaxy Clusters*. MNRAS 419, 1983.

Rose A. Finn
Department of Physics & Astronomy, Siena College, Loudonville, NY 12211

Role: Analysis of UV, optical, and infrared star-formation rates, including the spatial distribution of star-formation within galaxies.

Current Position:

Siena College	Professor of Physics	2016−
Siena College	Head of Physics Department	2011−

Former Positions:

Siena College	Associate Professor of Physics	2011−2016
Siena College	Assistant Professor of Physics	2005−2011
University of Massachusetts	NSF Astronomy & Astrophysics Postdoctoral Fellow	2003−2005
Albany Academy for Girls	Science Teacher	1994−1997

Education:

University of Virginia	Astronomy−Physics	B.A. 1992
Dartmouth College	Physics	M.S. 1994
University of Arizona	Astronomy	Ph.D. 2003

National and International Committees:
Board Member of Astronomical Society of New York (2005−present); NSF Astronomy & Astrophysics Postdoctoral Fellowship Selection Panel; NSF Astronomy Division Committee of Visitors (2008)

Honors:
NASA Space Grant Fellowship (1997), NASA Graduate Student Researchers Project Fellowship (2000), NSF Astronomy & Astrophysics Postdoctoral Fellowship (2003), NSF Career Award (2008)

Selected Publications:

Finn, Desai, Rudnick, et al. "*The Local Cluster Survey: Probing Gas Stripping in Nearby Groups and Clusters*", 2017, ApJ, submitted

Odekon, Koopmann, Haynes, **Finn**, and McGowan, Micula, Reed, Giovanelli, Hallenbeck, 2016, "The HI Content of Galaxies in Groups and Clusters as Measured by ALFALFA", 2016, ApJ, 824, 110

Jablonka, Combes, Rines, **Finn**, Welch, "Cold gas in the inner regions of intermediate redshift clusters", 2013, *Astronomy & Astrophysics*, 557, 103

Finn, Desai, Rudnick, Poggianti, Bell, Hinz, Jablonka, Milvang-Jensen, Moustakas, Rines, Zaritsky, "Dust-Obscured Star-Formation in Intermediate Redshift Galaxy Clusters", 2010, *Astrophysical Journal*, 720, 87

Finn, Zaritsky, McCarthy, Poggianti, Rudnick, Halliday, Milvang-Jensen, Pello, & Simard, "Hα-Derived Star-Formation Rates for three $z = 0.75$ EDisCS Galaxy Clusters", 2005, *Astrophysical Journal*, 630, 206

VAN KAMPEN, Eelco

- affiliation:

European Southern Observatory
EASC/ARC
Karl-Schwarzschild-Str. 2
D-85748 Garching bei München
Germany

tel: +49 89 3200 6875
fax: +49 89 3200 6898
e-mail: evkampen@eso.org
www: http://www.eso.org/∼evkampen/

- role in the project:

Properties of cluster galaxies at all redshifts, using cluster samples derived from Spitzer (SWIRE survey and its derivatives) and Hubble observations (Frontier Fields, COSMOS), but also numerical models of galaxy clusters and their galaxy population.

- current position:

Staff Astronomer at the European Southern Observatory

- former positions:

European Community Postdoctoral Research Fellow at the Royal Observatory
Edinburgh, 1 August 1994 - 20 September 1996
Postdoctoral Research Fellow at the Theoretical Astrophysics Center, Copenhagen
1 October 1996 - 30 September 1998
Postdoctoral Research Fellow at the Institute for Astronomy, Edinburgh
1 October 1998 - 1 March 2003
Lecturer at the Institute for Astro- and Particle Physics, Innsbruck
1 March 2003 - 30 October 2008

- education:

Doctoraal (equivalent to *Master of Science*) at Leiden University, 27 June 1989
Doctoraat (equivalent to *Doctor of Philosophy*) at Leiden University, 7 September 1994,
thesis entitled 'Formation and Evolution of Clusters of Galaxies and Voids'

- selected publications:

- Dunlop et al. 2017, A deep ALMA image of the Hubble Ultra Deep Field, MNRAS, 466, 861
- Popping et al. 2017, ALMA reveals starburst-like interstellar medium conditions in a compact star-forming galaxy at z∼2 using [CI] and CO, A&A, in press
- Saulder et al. 2016, The matter distribution in the local universe as derived from galaxy groups in SDSS DR12 and 2MRS, A&A, 596, 14
- Simpson et al. 2015, The SCUBA-2 Cosmology Legacy Survey: ALMA Resolves the Rest-frame Far-infrared Emission of Sub-millimeter Galaxies, ApJ, 799, 81
- Alpaslan et al. 2014, Galaxy And Mass Assembly (GAMA): the large-scale structure of galaxies and comparison to mock universes, MNRAS, 438, 177
- Owers et al. 2013, Galaxy and Mass Assembly (GAMA): Witnessing the Assembly of the Cluster ABELL 1882, ApJ, 772, 104
- van Kampen et al. 2012, Herschel-ATLAS/GAMA: spatial clustering of sub-mm galaxies at low redshifts, MNRAS, 426, 3455

Gabriella De Lucia

Current position: Senior researcher at INAF Astronomical Observatory of Trieste (OATs).

Role in the project: Development of theretical models of galaxy formation in a cosmological context to be used to interpret observational data.

Education: *Laurea in Fisica* at the University "Federico II" of Naples in 2000; *Doctor Rerum Naturalium* (Ph.D.), at the Ludwig-Maximilian Universität of München in 2004.

Positions held: *Research contract* at the Astronomical Observatory of Capodimonte (5 months in 2000); *Graduate student* at the Max-Planck Institute for Astrophysics in Garching bei München from 2001 to 2004; *Long term PostDoctoral Fellowship* at MPA from 2004 to 2009; Primo Ricercatore (fixed term position funded by ERC) at INAF-OATs from February 2009 to January 2014; Researcher (permanent) at INAF-OATs since 2013.

Honors: MERAC Prize for the Best Early Career Researcher in Theoretical Astrophysics (awarded by the European Astronomical Society) in 2013; Order of Merit (Officer) of the Italian Republic (awarded by the President of the Italian Republic) in 2011; ERC Starting Independent Researcher Grant (success rate of the call $\sim 3\%$) in 2008.

Professional Activities (last 5 years): Frequent Peer Reviewer for *Monthly Notices of the Royal Astronomical Society* (main journal and letters), *The Astrophysical Journals* (main journal and letters), *Astronomy & Astrophysics*; Time Allocation Committee for the telescopes TNG/LBT/REM (2014-2016); ESO Observing Programmes Committee (Periods 91 and 92); Expert Reviewer for Physics Discovery Grants for the Natural Science Research Council of Canada (2016), ERC Starting 2015 call, ERC Advanced 2013 call, and the French Research Agency (2012).

Conferences and Seminars: 16 invited reviews at International Conferences; 14 invited talks at International Conferences; 25 invited seminars and colloquia.

Publications: 135 refereed papers in peer-reviewed journals with more than 9700 citations (excluding self-citations). 18 refereed publications as first author and 27 as second author. Selected publications:

- *Galaxy assembly, stellar feedback and metal enrichment: the view from the GAEA model*, M. Hirschmann, **G. De Lucia**, F. Fontanot, 2016, MNRAS, 461, 1760
- *Elemental abundances in Milky Way like galaxies from a hierarchical galaxy formation model*, **G. De Lucia**, L. Tornatore, C.S. Frenk, A. Helmi, J.F. Navarro, S.D.M. White, 2014, MNRAS, 444, 970
- *The environmental history of group and cluster galaxies in a ΛCDM Universe*, **G. De Lucia**, S. Weinmann, B. Poggianti, A. Aragon-Salamanca, D. Zaritsky, 2012, MNRAS, 423, 1277
- *The hierarchical formation of the brightest cluster galaxies*, **Gabriella De Lucia** and Jérémy Blaizot, 2007, MNRAS, 375, 2
- *The Buildup of the Red Sequence in Galaxy Clusters since $z \sim 0.8$*, **G. De Lucia**, B. M. Poggianti, A. Aragón-Salamanca, D. Clowe, C. Halliday, P. Jablonka, B. Milvang-Jensen, R. Pelló, S. Poirier, G. Rudnick, R. Saglia, L. Simard, S. D. M. White, 2004, ApJ Letters, 610, 77

NAME, First Name: JABLONKA, Pascale

Affiliation Ecole Polytechnique Fédérale de Lausanne (EPFL)

Role in the project: Leader of the SEEDisCS programme: optical, NIR observations, identification of filaments around the EDisCS clusters, follow-up with ALMA (Fig 1 of the application). Co-PI with F. Combes of the CO observations of the filaments around the VIRGO cluster.

Current position: Professor. Scientific collaborator at EPFL.

Former Position(s):

- 2012 **Senior scientist at CNRS** *(equivalent to University Professor)*.
- 2009-present **Scientific Collaborator** at EPFL
- 2005-2009 **Research associate**, *Maître assistante*, Université de Genève, Switzerland. 2005-present **On leave of absence from CNRS**, *Observatoire de Paris, GEPI CNRS UMR 8111, France*
- 1993 **Researcher at CNRS**, *Chargée de recherche*, France.
- 1992-1994 **Postdoctoral fellow at ESO**, *European Southern Observatory Headquarters, Munich, Germany*.
- 1991-1992 **Teaching and research associate**, *(Attachée Temporaire d'Enseignement et de Recherche)*, Uni- versity Paris XI.

Services in National and/or International Committees (last ones):

- 2016-2018 Elected member of the EPFL IPHYS (Physics Institute) council. 2016-2020 Appointed member of the Strasbourg observatory's board of directors, *France*.
- 2016-2018 Chair of ALMA review panel, *Scientific Category "Galaxies and galactic nuclei"*, Europe/USA/Asia.
- 2016 European H2020 expert,
- 2012-2016 Appointed member of the CoNRS's board (Comité national du CNRS, Section 17)

Selected Publications:

- Jablonka, P.; Combes, F.; Rines, K.; Finn, R.; Welch, T, 2013, A&A, 57, 103: Cold gas in the inner regions of intermediate redshift clusters
- Cantale, N.; Jablonka, P, 2016, A&A, 589. 82: Disc colours in field and cluster spiral galaxies at $0.5 \lesssim z \lesssim 0.8$
- Nichols, M.; Revaz, Y.; Jablonka, P.: 2015, A&A, 582, 23: The post-infall evolution of a satellite galaxy