



Report from the event supported by RadioNet

TITLE *GALAXY INTERACTIONS AND MERGERS ACROSS COSMIC TIME*

DATE: *11TH – 16TH MARCH 2018*

LOCATION: *SEXTEN, ITALY*

MEETING WEBPAGE: *<http://www.sexten-cfa.eu/de/kongresse/2018/details/93-galaxy-interactions-and-mergers-across-cosmic-time.html>*

HOST INSTITUTE: *SEXTEN CENTER FOR ASTROPHYSICS, ITALY*

**RADIONET
BENEFICIARY / NO:** *ESO / 13*

Report:

1. SCIENTIFIC SUMMARY

- *Please provide a scientific summary of the event, including the initial goals and the most relevant results presented. You may also include some figures (with captions), which may be considered the highlights of the event.*
- *Describe clearly the impact of the event for the RadioNet community.*
- *Insert the event webpage*
Please make this part no longer than two pages, plus figures (if it applies to the event).

Event webpage:

<http://www.sexten-cfa.eu/en/conferences/2018/details/93-galaxy-interactions-and-mergers-across-cosmic-time.html>

The main goal of the workshop was to approach the study of galaxy interactions and mergers from complementary perspectives, catalyzing discussions among experts working on different redshifts, techniques and wavelengths, and to foster synergies between observers and theorists. We believe that the workshop helped raising awareness on the importance of combining these perspectives in order to build a complete picture of this fundamental phenomenon, and identifying the most fruitful instrumental avenues to explore in the near future.

We started the workshop studying the impact of mergers on the assembly history of galaxies. This included the important question of identifying merger signatures (both observationally and in simulations), and the delicate issue of their observability. The role of the varying merger timescales as a function of redshift, and its impact on the calculation of merger rates, was thoroughly discussed.

We then moved on to the field of mergers as triggers of star formation. Agreement seems to exist in the local Universe regarding the fact that mergers trigger enhanced star formation at the first pericentre passage, and even more so when coalescence occurs; a similar enhancement of star formation at high redshift has been questioned by simulations, however, provided that the gas content is already very high and some saturation seems to occur. Results using RadioNet facilities such as ALMA and the IRAM 30m telescope were highlighted by several talks in this session; access to observations of cold molecular gas, the fuel for star formation, are crucial in order to disentangle the effect of mergers on star formation, and specifically to identify what properties affect the star formation *efficiency*.

Our workshop also tackled the role of mergers in triggering AGN. While significant efforts have been devoted to this topic, both observationally and from the numerical point of view, it seems particularly hard to find consensus on how strongly mergers can affect nuclear activity. This might be related to the stochasticity of the accretion process, the differences of AGN detectability as a function of wavelength, and the observational difficulty to identify appropriate control samples. While it seems clear that statistically mergers do trigger some enhancement of nuclear activity, it does not seem like a high fraction of active galaxies are necessarily currently interacting or merging.

Finally, we considered the impact of mergers on morphology, dynamics, and chemistry. Recent numerical simulations have demonstrated that major mergers of gas-rich disk galaxies do often result in another disk galaxy (often a spiral), and not necessarily in elliptical galaxies, as traditionally assumed; the disks are initially destroyed but quickly afterwards rebuilt from the gaseous debris of the collision. Access to reliable velocity fields (from HI or CO, via facilities associated with RadioNet) were highlighted as critical to identify the orbital characteristics of mergers via detailed dynamical modelling.

2. AGENDA OF THE EVENT

- *Insert the detailed agenda of the event, including the title of the presentations and speakers (name/institutes/countries).*

Please see attached PDF for the programme.

3. PARTICIPANTS

- *Describe in few sentences the participants, i.e. geographical distribution, presence of young researchers and students, fraction of women, invited experts (especially when they received the RadioNet support).*
- *Insert the conference picture when possible*
- *Insert the attendance list (including name, affiliation and country) – signed by the participants or signed by the organisers (in case of heavy burden with collecting all participant signatures).*

The workshop was attended by 44 participants, with the following breakdown:

- home affiliation in Europe (25/44 or 57%), North America (14/44 or 32%), and others (5/44 or 11%) from Australia, Chile, China and Taiwan.
- 20/44 (45%) are junior researchers including post-doctoral researchers and PhD students, while 24/44 (55%) are senior researchers with permanent positions.
- 15 female (34%) and 29 male (66%), representative of the gender ratio in the field of galaxy evolution.
- All participants were invited to give a talk. Only two senior researchers opted out and led discussions instead.

The conference picture is attached below.

The list of attendance, signed by the chair of the organizers, is attached as a PDF document.



4. RADIONET FINANCIAL CONTRIBUTION

- *Please describe the how the financial support from RadioNet was used and provide a list of the supported participants (including their nationality).*

We have been approved 2000 EUR of financial support from RadioNet for the event, which were allocated to the following participants:

- Annagrazia Puglisi (1). CEA-Saclay, Paris. Italian Female. annagrazia.puglisi@cea.fr . Invited oral presentation. User of the RadioNet facility (ALMA)
- Sugata Kaviraj (1). University of Hertfordshire, UK. British Male. s.kaviraj@herts.ac.uk. Invited oral presentation. User of the RadioNet facility (IRAM 30m telescope and ALMA).
- Antonello Calabro (1). CEA-Saclay, Paris. Italian Male. antonello.calabro@cea.fr. Invited oral presentation. User of the RadioNet facility (ALMA).
- Axel García (2). Spanish National Observatory (OAN), Madrid. Spanish Male. axelga01@ucm.es. Invited oral presentation. User of the RadioNet facility (IRAM 30m telescope and ALMA).
- Vivienne Wild (3). University of St Andrews, UK. British Female. vw8@st-andrews.ac.uk. Invited oral presentation. User of the RadioNet facility (IRAM 30m telescope and ALMA).

Level of support (1): registration fee waiver (€250)

Level of support (2): registration fee waiver plus flight, accommodation in Sexten, and bus transfer between Venice airport and Sexten, with the total sum of up to €1050.

Level of support (3): Subsidy for the cost of babysitter (up to €200).

5. PUBLICATIONS

- *In case of future publication - please provide additional information: place & date. Remember to insert the acknowledgment of the RadioNet support:*

The project leading to this publication has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 730562 [RadioNet]

Noted.

**Programme for "Galaxy interactions and mergers across
cosmic time"**

Sexten Center for Astrophysics, Italy

Sunday 11th March 2018

1800-1900 Welcome reception

Monday 12th March 2018

0830-0900 Registration

0900-0915 Opening remarks by organizers

Assembly history of galaxies

Session chair: Jillian Scudder

0915-0950 Pierre-Alain Duc (Review) - Impact of mergers on the morphology and kinematics of galaxies: an observational perspective

0950-1010 Carlo Nipoti - The second phase of massive galaxy formation

1010-1050 Coffee break

1050-1125 Jeyhan Kartaltepe (Review) - An observational review of how mergers impact the morphology & kinematics of galaxies

1125-1145 Vincente Rodriguez-Gomez - The frequency of galaxy mergers in different environments

1145-1205 Paola Di Matteo - Searching for the building blocks of the Milky Way galaxy: where do we stand?

1205-1600 Free time

1600-1630 Merenda (Italian snacks)

Session chair: Philipp Lang

1630-1650 Jennifer Lotz - Machine Learning Approaches to tracking Galaxy Mergers

1650-1710 Kameswara Bharadwaj Mantha - A Tale of Two Techniques: Empirical and Theoretical Investigation of Close-Pairs and Tidal Features using HST-CANDELS, Semi-Analytic Models and Hydro-Simulations

1710-1730 Carlos Lopez San Juan - Towards a redshift - mass - mass ratio merger function by PDF analysis

1730-1750 Vivienne Wild - Linking post-mergers and post-starbursts

1750- Discussions (facilitated by Allison Man & David Patton)

Tuesday 13th March 2018

Mergers as trigger of star formation (I)

Session chair: George Privon

0900-0935 Florent Renaud (Review) - Star formation in galaxy mergers: a theoretical perspective

0935-0955 Federico Lelli - Galaxy interactions as dwarf-making factories

0955-1015 Miguel Querejeta - Gas and star formation in a Tidal Dwarf Galaxy

1015-1045 Coffee break

1045-1105 Lihwai Lin - Enhanced and Suppressed Star Formation in Mergers

1105-1125 Hsi-An Pan - Molecular Gas Properties in MaNGA Close Pairs

1125-1145 Axel Garcia - Molecular gas and star formation in the colliding Taffy galaxies

1145-1205 Kevin Cong Xu - GBT HI Observations of Close Major-merger Pairs

1205-1600 Free time

1600-1630 Merenda (Italian snacks)

Session chair: Paola di Matteo

1630-1705 Frederic Bournaud (Review) - Mergers as triggers of star formation and nuclear activity — a redshift-dependent process?

1705-1725 Jorge Moreno - Galaxy Mergers on FIRE-2

1725-1745 Sara Ellison - Cold gas reservoirs in galaxy mergers

1745- Discussions (facilitated by Lisa Kewley & Dave Sanders)

Wednesday 14th March 2018

Mergers as trigger of star formation (II)

Session chair: Loreto Barcos-Munoz

0900-0935 Sugata Kaviraj (Review) - Observational connection between mergers & SF

0935-0955 Jérémy Fensch - Star and star cluster formation in $z \sim 2$ major mergers
0955-1015 David Patton - Enhanced Star Formation in Interacting Galaxies in the Illustris and EAGLE Cosmological Simulations

1015-1045 Coffee break

1045-1105 Nick Scoville - ALMA Observations of Arp 220 and ISM at High Redshift
1105-1125 Johan Knapen - What interactions can tell us about 'starbursts'
1125-1145 Jillian Scudder - High redshift pairs are hard to find: searching for FIR-bright pairs with Herschel
1145-1205 Antonello Calabro - Towards an evolutionary sequence of mergers out to $z \sim 1$

1205-1600 Free time

1600-1630 Merenda (Italian snacks)

Session chair: Lihwai Lin

1630-1650 Chris Hayward - Are submillimeter galaxies major mergers?
1650-1710 Carlos Gomez-Guijarro - Starburst to quiescent from HST/ALMA: Stars and dust unveil minor mergers in submillimeter galaxies at $z \sim 4.5$
1710-1730 Philipp Lang - Uncovering stellar mass distributions of distant SMGs at $z \sim 2$
1730-1750 Allison Man - Mergers, gas, and star formation

1750- Discussions (facilitated by Gabriela Canalizo & Jorge Moreno)

2030- Fiaccolata (Night torch walk with drinks)

Thursday 15th March 2018

The role of mergers in triggering AGN

Session chair: Vicente Rodriguez-Gomez

0900-0935 Shobita Satyapal (Review) - Observational Connections between mergers & AGN
0935-0955 Jonny Pierce - Are radio-intermediate AGNs triggered by merger events?
0955-1015 Lisa Steinborn - How (in)significant are mergers for driving AGN activity? (remote)

1015-1045 Coffee break

1045-1120 Marta Volonteri (Review) - Massive black holes and AGN in galaxy mergers
1120-1140 Madalyn Weston - Spectral Energy Distribution Analysis of WISE-Selected Obscured AGNs in Major Mergers from the SDSS

1140-1200 Stuart McAlpine - Galaxy mergers and the triggering of black hole growth

1200-1600 Free time

1600-1630 Merenda (Italian snacks)

Session chair: Hsi-An Pan

1630-1650 Lisa Kewley - Power sources and gas flows in galaxy mergers: near and far

1650-1710 Loreto Barcos-Muñoz - ALMA high angular resolution observations of molecular gas in local mergers

1710-1730 Gabriela Canalizo - The Merging Histories of Quasar Host Galaxies

1730- Discussions (facilitated by Sara Ellison & Johan Knapen)

Conference dinner

Friday 16th March 2018

Morphology, dynamics, and chemistry in mergers

Session chair: Martin Sparre

0900-0935 Lia Athanassoula (Review) - Forming disc galaxies starting with a major merger

0935-0955 Annagrazia Puglisi - The optical properties of high-redshift starbursts

0955-1015 George Privon - Dynamical Modeling of Galaxy Mergers: Dwarfs to (U)LIRGs

1015-1045 Coffee break

1045-1105 Sebastian Bustamente - Merger-Induced Metallicity Dilution in Zoomed Cosmological Galaxy Formation Simulations

1105-1125 Martin Sparre - Cosmological simulations of major mergers

1125- Discussions (facilitated by Albert Bosma & Jennifer Lotz)

(Last updated: 2018/03/08)

Name	Affiliation	Last updated: 2018-03-11
Lia Athanassoula	Aix-Marseille Université & Laboratoire d'Astrophysique de Marseille, France	
Loreto Barcos-Muñoz	Joint ALMA Observatory, Chile	
Albert Bosma	Laboratoire d'Astrophysique de Marseille, France	
Frederic Bournaud	CEA-Saclay, France	
Sebastian Bustamente	Heidelberg Institute for Theoretical Studies, Germany	
Antonello Calabro	CEA-Saclay, France	
Gabriela Canalizo	University of California Riverside, United States	
Paola Di Matteo	Observatoire de Paris, France	
Pierre-Alain Duc	Observatoire Astronomique de Strasbourg, France	
Sara Ellison	University of Victoria, Canada	
Jérémy Fensch	European Southern Observatory, Germany	
Axel Garcia Rodriguez	Spanish National Observatory, Spain	
Carlos Gómez Guijarro	University of Copenhagen, Denmark	
Chris Hayward	Flatiron Institute, United States	
Jeyhan Kartaltepe	Rochester Institute of Technology, United States	
Sugata Kaviraj	University of Hertfordshire, United Kingdom	
Lisa Kewley	Australian National University, Australia	
Johan Knapen	Instituto de Astrofisica de Canarias, Spain	
Philipp Lang	Max Planck Institute for Astronomy, Germany	
Federico Lelli	European Southern Observatory, Germany	
Lin Lihwai	Academia Sinica Institute of Astronomy and Astrophysics, Taiwan	
Carlos López-Sanjuan	Centro de Estudios de Física del Cosmos de Aragon, Spain	
Jennifer Lotz	Space Telescope Science Institute, United States	
Allison Man	European Southern Observatory, Germany	
Kameswara Bharadwaj Mantha	University of Missouri - Kansas City, United States	
Stuart McAlpine	Durham University, United Kingdom	
Jorge Moreno	Pomona College, United States	
Carlo Nipoti	University of Bologna, Italy	
Hsi-An Pan	Academia Sinica Institute of Astronomy and Astrophysics, Taiwan	
David Patton	Trent University, Canada	
Jonny Pierce	University of Sheffield, United Kingdom	
Annagrazia Puglisi	CEA-Saclay, France	
George Privon	University of Florida, United States	
Miguel Querejeta	European Southern Observatory, Germany	
Florent Renaud	Lund Observatory, Sweden	
Vicente Rodriguez-Gomez	Johns Hopkins University, United States	
David Sanders	University of Hawaii, United States	
Nick Scoville	California Institute of Technology, United States	
Jillian Scudder	Oberlin College, United States	
Martin Sparre	Potsdam University, Germany	
Madalyn Weston	University of Missouri - Kansas City, United States	
Vivienne Wild	University of St. Andrews, Scotland	
Marta Volonteri	Institut d'Astrophysique de Paris, France	
Kevin Cong Xu	National Astronomical Observatory of Chinese Academy of Science, China	

Signed by chair of organizers, Allison Man

Allison