Avinash Chaturvedi

Title

Understanding the mass assembly of the Fornax galaxy cluster

Abstract

The Fornax galaxy cluster provides an unparalleled opportunity of investigating galaxy formation and evolution in a dense environment in great detail. Although the Fornax cluster seems relaxed, various studies have shown that the Fornax cluster still is accreting various sub-groups. Previous photometric studies of the central massive galaxy NGC1399 revealed an excess of globular clusters (GCs), suggesting accretion of GCs from nearby, interacting major galaxies like NGC 1404.

To kinematically characterize the Fornax cluster's intra-cluster population and understand the assembly of the outer halos of cluster galaxies, we have analyzed the VLT/VIMOS spectroscopic survey of the Fornax cluster covering half of the cluster virial radius (~300 kpc). Combined with previous spectroscopic measurements, this leads to the most extensive catalogue of radial velocity measurements with a total of 2341 confirmed GCs in Fornax.

Our analysis of this unprecedented dataset provides the kinematical characterization of the Fornax cluster's intra-cluster component. We found that metal-rich GCs are concentrated around the major galaxies, while metal-poor GCs are kinematically irregular and extensively spread throughout the cluster's core region. About 30% of the GCs contribute to the intra-cluster population. With the final goal to understand the mass assembly of the Fornax cluster and its member galaxies, in this talk, I will present the kinematics of GCs in the core of the cluster, and ongoing dynamical mass-modelling results obtained from this dataset. I will discuss possible kinematical interaction signatures between NGC1399 and the major galaxies of the Fornax cluster.

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Education

	Ph.D, **European Southern Observatory (ESO), Garching**
09/2019-Present	Ludwig Maximilians University, Munich, Germany
	Thesis Title: A dynamical mass map of the Fornax galaxy cluster
	Advisors: Dr. Michael Hilker, Prof. Dr. Glenn Van de Ven, Dr. Mariya Lyubenova
2016-2018	**Master in Astrophysics**, **Laboratorie d'Astrophysique de Marseille (LAM), "Mention Bien (top 2-5%)"**
	Aix Marseille University, France
	Thesis: Understanding Galaxy 'ESO325 -G004' Using SINFONI and MUSE Spectroscopy,
March-June 2018	**Max Planck Institute for Extraterrestrial Physics (MPE), Garching, Germany**
	Advisors: Dr. Roberto Saglia and Dr. Jens Thomas
2015-2016	**Master of Science** (3rd Sem.), **University of Göttingen, Germany**
	1st and 2nd Semester, University of Lucknow, India (Among Top 5 % in the University)
2011-2014	**Bachelor of Science**, **University of Lucknow, India** (Among Top 5 % in the University)

Academic Achievements/ Scholarships

March, 2022	**Grant for attending winter conference on 'Illuminating Galaxy Formation with Ancient Globular Star Clusters and their Progenitors', Aspen Center for Physics, USA**
Nov, 2021	**Travel grant, Canary Island Winter School of Astrophysics, La Laguna, Tenerife, Spain**
2021-2022	**Remote Pre-Doctoral fellowship and visitor grant, Centre for Computational Astrophysics, Flatiron Institute, New York, USA**
2019-Present	**International Max-Planck Research Scholarship (IMPRS) on Astrophysics, Munich, Germany**
2016-2018	**Amidex Grant for studying Master in Astrophysics at Aix Marseille University, France**
2015-2016	**NAMASTE Erasmus Mundus Scholarship under Master Exchange Program from Georg August Universität Göttingen, Germany.**

Observing proposals as PI

Mar 2021	**"Fornax Cluster VLT Spectroscopic Survey: Merger & formation history with cold stellar streams and outer halo Kinematics", FLAMES at VLT, 60 hours**
Sep 2020	**"Fornax Cluster VLT Spectroscopic Survey: Merger & formation history with cold stellar streams and outer halo Kinematics", FORS2 at VLT, 32.5 hours**

Research Experience

Dec 2021 - Jun 2022	Examining TNG50 simulation galaxy cluster environment against the Meerkat Fornax HI Survey results, Supervisor: Dr. Stephanie Tonnesen and Prof. Greg Bryan, Flatiron Institue, New York, USA
2018 - 2019	Understanding Variability of ESO325-G004 Initial Mass Function, Supervisor: Dr. Roberto Saglia, MPE, Garching, Germany
Mar -Jun 2016 & Jul - Aug 2017	Dark Matter and the Kinematics of Stars in the local Milky Way, Supervisor: Dr. F. V. Hessman, Institute for Astrophysics, University of Goettingen, Germany
Sep-Nov 2017	Standard Model of Cosmology, Supervisor: Dr. Sylvain De La Torre, LAM Marseille, France
Sep-Nov 2016	Luminosity Function and Cosmic Luminosity Density, Supervisor: Dr. Denis Burgarella, LAM Marseille

Sep-Nov 2016   Galaxies in COSMOS, Supervisor: Dr. Olivier Ilbert, LAM, Marseille, France

Computer Skills

Expertise : Python (data analysis, visualisation, Parallelization)
Working knowledge : Mathematica, IRAF, Fortran, C, Matlab
Simulations : IllustrisTNG (data handling and analysis)
Data Reduction : EsoReflex, QFitsView, TOPCAT, DS9
Data Analysis : FLAMES, FORS2, VIMOS, MUSE, SINFONI

Participation in Summer/ Winter Programs (most recent, participated in more than 8 programs)

Nov 2021
- Canary Island Winter School of Astrophysics, Formation and Evolution of Galaxy cluster Across Cosmic Time, La Laguna, Tenerife, Spain.

June 2021
- Summer School in Statistics for Astronomers, Penn State Center for Astrostatistics

Feb 2020
- La Silla Observing Summer School (competitively awarded), ESO Santiago, Chile

Invited Talk

Jul 2022
- "Fornax cluster VLT Spectroscopic Survey", VEGAS meeting, Naples, Italy (scheduled)

Jul 2021
- "Kinematical confirmation of photometric discovered Globular cluster in Fornax Cluster", F3D meeting, Armagh Observatory, Ireland

May 2020
- "Fundamental Answers of Our Existence", Outreach talk at Astronomy delight series, SKY Amateur Astronomy Club, Lucknow, India

Dec 2019
- 'Nobel Prize in Physics 2019', Outreach talk at "15x4", Munich, Germany

Contributed Talk (most recent, delivered more than 10 talks)

May 2022
- "Understanding the mass-assembly of the Fornax cluster", Hypatia Colloquium, ESO (scheduled).

March 2022
- "Globular clusters of the Fornax galaxy clusters", Illuminating galaxy formation with ancient globular star clusters and their progenitors, Aspen Center for Physics, US (scheduled)

Jul 2021
- "Kinematical signatures of interactions between Fornax cluster galaxies", The 15th Hellenic Astronomical Conference, Greece

Jul 2021
- "Understanding the globular cluster system of the Fornax galaxy cluster, as a case study for future extra-galactic GCS surveys", European Astronomical Society Annual Meeting - EAS 2021

Posters (most recent, more than 10 posters)

Jun 2021
- 'Exploring mass assembly of the Fornax Galaxy cluster' ESO GCF-II-2021

Jul 2021
- 'Kinematical confirmation of photometrically discovered globular cluster overdensities in the Fornax' cluster, EAS-2021

Jul 2021
- 'Kinematical signatures of interactions between Fornax cluster galaxies', EAS-2021

Publications (accepted and work in preparation)

1) "The Fornax Cluster VLT Spectroscopic Survey III -Kinematical characterisation of globular clusters across the Fornax galaxy cluster" by **A. Chaturvedi et. al, A&A 657, A93 (2022)**

2) "Dynamical mass-modelling of Fornax cluster out to half virial radii", **by A. Chaturvedi et. al A&A (in preparation).**

3) "TNG50 simulation galaxy cluster environment and Meerkat Fornax HI Survey results", **by A Chaturvedi et. al ApJ (in preparation).**

References

- Dr. Michael Hilker
  mhilker@eso.org
  ESO, Garching Germany

- Prof. Dr. Glenn Van de Ven
  glenn.vandeven@univie.ac.at
  Department of Astrophysics, Uni of Vienna, Austria

- Dr. Christophe Adami
  christophe.adami@lam.fr
  LAM, Marseille, France