

## Antoine Dumont



### Title

Revealing the origin of the most luminous globular clusters in Centaurus A

### Abstract

During merging, the tidal forces of a giant galaxy can strip away the contents of a smaller one leaving behind the nuclear star cluster to orbit in the halo of the giant galaxy as a stripped galaxy nuclei. These stripped nuclei hide among the most luminous globular clusters (GCs) in the halo of galaxies and can be challenging to distinguish. The collection of massive GCs and stripped galaxy nuclei are often called ultra-compact dwarf galaxies (UCDs). An exciting confirmation of this theory is the detection of overmassive black holes in the centers of some UCDs, which also lead to elevated dynamical mass-to-light ratios compared with regular massive GCs.

Here I present new high-resolution spectroscopic observations of 321 luminous GCs in Centaurus A. Centaurus A is the closest giant elliptical and may have undergone a significant merger event, thus providing a unique comparison framework for substructures with the Local Group, such as stripped galaxy nuclei. This work represents the most complete catalog of dynamical mass measurements of luminous GCs in Centaurus A. Our results show a bi-modality in the dynamical mass-to-light ratio distribution, with a population of "normal" GCs and a second population with elevated mass-to-light ratios. This bi-modal distribution deviates significantly from the GC distribution in the Local Group. I will also show that massive central black holes of 10% of the luminous GC virial mass can explain the observed elevated mass-to-light ratios, suggesting that some of these luminous GCs in Centaurus A are stripped galaxy nuclei.

# ANTOINE DUMONT

## Ph.D. Candidate University of Utah

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- **University of Utah - PhD (Physics)**  
2016 - 2022 GPA: 3.934  
Supervisor: Anil C Seth  
Expected Graduation: Aug-2022
  - **University of Utah - Master of Science (Physics)**  
2016-2020
  - **University of Santiago - Bachelor in Applied Physics (Physics)**  
Mar 2012 - Dec 2015 Ranked 2<sup>nd</sup> in my graduating class

## RESEARCH EXPERIENCE

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### University of Utah

Research graduate - under the supervision of **Prof. Anil C. Seth**  
Jun 2017 to present

- Discrete dynamical modeling of the dark matter halo profile of the giant elliptical galaxy Centaurus A.
- Identified galaxy stripped nuclei in the halo of Centaurus A through dynamical mass measurements of globular clusters (GCs) and ultra-compact dwarf galaxies.
- Investigated the infrared emission from hot dust in low-luminosity active galactic nuclei and its correlation with other AGN tracers.

### University of Santiago

Student intern Dec 2014 - Sep 2015

- Assisted **Prof. Jorge Gamboa** with "Non-commutative quantum mechanics" project

Student intern Mar 2014 - Oct 2014

- Assisted **Prof. Mikhail Plyushchay** with "Super-symmetric Quantum Mechanics" project

## TEACHING EXPERIENCE

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### University of Utah

Substitute Professor Mar 2020

- Taught graduate students in astronomy how to work with SDSS data to obtain the light curve of a supernova observed with the 32-inch telescope at the Willard L. Eccles Observatory (WEO) located in South Utah.

### University of Utah

Teaching assistant Aug 2016 - Apr 2018

- Explaining theory behind different standard classical mechanics problems to 2nd-year undergraduate students.

### University of Santiago

Teaching assistant Mar 2014 - Aug 2015

- Helped small groups of students with Calculus I and Linear Algebra assignments. I also assisted the professor to create lesson plans, and overseeing lesson preparation.

Teaching assistant Aug 2014 - Dec 2014

- Helping to set up lab experiment in areas related to experimental thermodynamics as well as grading lab reports and giving support in theoretical aspects of this matter.

## RESEARCH INTERESTS

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Active galactic nuclei, ultra-compact dwarf galaxies, globular clusters, dynamical modeling of stellar systems, supermassive black holes.

## PROFESSIONAL SKILLS

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### Programming Languages

- **Python:** Advance (Data analysis and visualization)
- **R:** Advance
- **IRAF:** Intermediate
- **SQL:** Intermediate
- **IDL:** Basic
- **Bash:** Basic

### Data analysis

- **Astronomy related:** Astropy, pPXF, Multi-Gaussian Expansion (MGE), Jeans Anisotropic Modelling (JAM), DS9, TopCat.
- **Numerical Methods:** Clustering, Principal Component Analysis, Bootstrapping, Markov-Chain Monte Carlo simulations, Neuronal Networks, Natural Language Processing.

### Data Reduction

- Gemini/NIFS (IFU data)
- HST/STIS
- Michigan/Magellan fiber system (M2FS) (Multi-object)
- Magellan Inamori Kyocera Echelle (MIKE)

### Languages

- **Spanish:** Native speaker
- **English:** Fluent (C2 Toefl certificate)
- **French:** Basic Fluency (B2)

## HONORS/AWARDS

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- **University of Utah Graduate Research Fellowship** For the academic year 2021-2022. \$19500 USD + Tuition 2021
- **Swigart Award for outstanding graduate student** for the academic year 2019-2020 at the University of Utah. \$ 5000 USD 2019
- **Best poster presentation** at the Physics Graduate Physics Symposium at the University of Utah.
- **Scholarship "Puntaje Nacional"** For have achieved the maximum score in the mathematical university entrance exam. By University of Santiago of Chile. \$45000 USD (Tuition) 2012

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## TRAINING & COURSES

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### Schools

- **4th Summer School in Artificial Intelligence for Astronomy**, Institute of Space Science 2021. One week workshop on advance machine learning and artificial intelligence techniques. Included lectures on overview of Machine learning techniques, ScikitLearn, PyTorch, TensorFlow, Clustering, Neuronal Networks and Deep Learning.
- **Summer School in Statistics for Astronomers XVI**, (Virtual) Penn State 2021. One week workshop about different statistical tools for data exploration and inference in astronomy. Lectures covered from theory lectures in statistics to hands-on sessions in R.
- **Summer School in Statistics for Astronomers XIV**, Penn State 2018 . One week workshop about different statistical tools for data exploration and inference in astronomy.

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## TALKS & POSTERS

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### CONFERENCE TALKS

- **Utah Valley University Colloquium Series**  
Invited Colloquium Speaker Utah Valley University November 2021
- **Chandra Data Science Workshop**  
Lightning Talk (Virtual) August 2021
- **The Future of Airborne Infrared/Submm Astronomy**  
Poster & Lightning Talk (Virtual) July 2021
- **Supermassive Black Holes**  
Pre-recorder Talk (Virtual) Pucon, Chile Dec 2020
- **Young Astronomers on Active Galactic Nuclei**  
Talk (Virtual) Niels Bohr Institutet, Denmark Oct 2020

### POSTERS

- **10th VLTI School of Interferometry**  
Poster (Virtual) France June 2021
- **Mapping The Central Regions of Active Galactic Nuclei**  
Poster Guilin, China Sep 2019

### OTHER ATTENDED CONFERENCES

- **Past, Present and Future of Galaxy Evolution**  
Participant (Virtual) ESO Chile Apr 2021
- **Raveling the Milky Way with Gaia**  
Participant (Virtual) Heidelberg Feb 2021

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## COMMUNITY OUTREACH & SERVICES

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- **Peer Mentor**  
Mentor first-year graduate students in Physics Astronomy. 2021
- **Poster Judge, University of Utah**  
Volunteered to judge Undergraduate Symposium posters at the University of Utah. Aug 2020
- **Atmospheric balloon launch**  
Program for under-represented groups to get involved in science. The project was to launch an atmospheric balloon in the Utah dessert. Apr 2019

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## EXPERIENCE

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### PROPOSALS

- **Co-investigator Chandra Cycle 23 Proposal 23620148.**  
“A Chandra survey of low-luminoisty AGN with adaptive optics infrared integral field spectroscopy data” 2021
- **Co-investigator JWST Cycle 1 Proposal 02016.**  
“A Chandra survey of low-luminoisty AGN with adaptive optics infrared integral field spectroscopy data” 2021

### SCIENCE MANAGEMENT

- **Co-advisor for undergrad student.**  
Weekly meetings with an undergraduate student to discuss research project, help with coding problems and science guidance 2021 – Present

### DATA SCIENCE

- **REN**  
Data Scientist  
My work here has been the implementation of machine learning and artificial intelligence techniques to diverse data bases. (Chile)  
May 2021 – Present

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## REFERENCES

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- **Dr. Anil C. Seth**  
Associate Professor. Dept. of Physics and Astronomy the University of Utah. Salt Lake City, UT, 84112, USA  
Tel: (+1) 801-585-5383 aseth@astro.utah.edu
- **Dr. Karina Voggel**  
CNES Fellow. Université de Strasbourg, CNRS, Observatoire astronomique de Strasbourg UMR 7550, F-67000 Strasbourg, France  
Tel: (+33) 036 885 2474  
karina.voggel@astro.unistra.fr
- **Dr. Jay Strader**  
Associate Professor. Department of Physics and Astronomy Michigan State University, Biomedical Physical Sciences. 567 Wilson Rd, Room 3275 East Lansing, MI 48824-2320, USA  
Tel: (+1) 517 884-5605 straderj@msu.edu

- **Motivational talks for pursuing science careers at public schools in Chile**

Volunteered multiple times at the local public school where I graduated to give motivational talks and to donate physics books to distinguished students.

Pitrufulquen, Chile 2012-2014

## PUBLICATIONS

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### FIRST AUTHOR:

- **Dumont, Antoine**; Seth, Anil C.; Strader, Jay; Greene, Jenny E.; Burtscher, Leonard; Neumayer, Nadine *"Surprisingly Strong K-band Emission Found in Low-luminosity Active Galactic Nuclei"*
- **Dumont, Antoine**; Seth, Anil C.; Strader, Jay; Greene, Voggel, Karina T.; Allison K. Hughes, David J. Sand, Mario Mateo, Nelson Caldwell (submitted) *"A population of luminous globular clusters and stripped nuclei with elevated mass to light ratios around Centaurus A"*

### OTHER REFEREED PUBLICATIONS:

- Karina. T. Voggel, Anil C. Seth, Holger Baumgardt, Bernd Husemann, Nadine Neumayer, Michael Hilker, Renuka Pechetti, Steffen Mieske, **Antoine Dumont**, and Iskren Georgiev. *"First direct dynamical detection of a dual super-massive black hole system at sub-kpc separation"*
- Christian H. Hannah, Anil C. Seth, Dieu D. Nguyen, **Dumont, Antoine**, Nikolay Kacharov, Nadine Neumayer, and Mark den Brok. *"Resolving Star Formation Histories of Nuclear Star Clusters to Constrain Formation Mechanisms"*
- Allison K. Hughes, David J. Sand, Jay Strader, Anil Seth, Karina Voggel, **Dumont, Antoine**, Denija Crnojevic, Mario Mateo, Nelson Caldwell, Duncan Forbes, J. Simon, R. GuhaThakurta, and E. Toloba *"Connecting Gaia and Ground: A comprehensive catalog of NGC 5128 globular cluster candidates out to 150 kpc"*
- Nguyen, Dieu D.; Seth, Anil C.; Neumayer, Nadine; Iguchi, Satoru; Cappellari, Michelle; Strader, Jay; Chomiuk, Laura; Tremou, Evangelia; Pacucci, Fabio; Nakanishi, Kouichiro; Bahramian, Arash; Nguyen, Phuong M.; den Brok, Mark; Ahn, Christopher C.; Voggel, Karina T.; Kacharov, Nikolay; Tsukui, Takafumi; Ly, Cuc K.; **Dumont, Antoine**; Pechetti, Renuka *"Improved Dynamical Constraints on the Masses of the Central Black Holes in Nearby Low-mass Early-type Galactic Nuclei and the First Black Hole Determination for NGC 205"*