Carlos Alberto Gomez Gonzalez

Research chair in Data Science for Earth, Space and Environmental Sciences

Personal details

Citizenship	Colombian
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Education

PhD in Astrophysics and Computer Vision 2013-2017
STAR and Montefiore Institutes, Université de Liège, Belgium

Supervisors: Jean Surdej, Marc Van Droogenbroeck, Olivier Absil

Thesis Title: Advanced data processing for high-contrast imaging – pushing exoplanet direct detection limits with Machine Learning

MSc in Astrophysics 2012-2013
Universidad Autoónoma de Madrid and Universidad Complutense, Spain

Specialization in Software Development 2011-2012
Universidad del Magdalena, Colombia

BSc: Astronomy, Specialization in Astrophysics 2002-2007
VV Sobolev Astronomical Institute, St. Petersburg State University, Russia

Experience

Research chair in Data Science 2017-Present
Grenoble Alpes Data Institute, Université Grenoble Alpes

Data science consultant 2017
Science to Data Science, Pivigo

Technician in Geographic Information Systems 2011-2012
IGAC – Agustín Codazzi Geographical Institute, Santa Marta, Colombia

Scientific assistant at Planetarium of Medelliín 2009-2010
Planetarium "Jesus Emilio Ramírez González", Medellín, Colombia

Young Researcher in Astronomy, Teacher of introductory Physics 2009-2010
Technological University ITM, Medellín, Colombia

Summer intern, observations for the Whole Earth Blazar Telescope 2005-2006
VV Sobolev Astronomical Institute, St. Petersburg State University, Russia

Mentoring

Co-supervisor of master thesis 2018-Present
Institut de Planétologie et d'Astrophysique de Grenoble, Université Grenoble Alpes

Student: Ralf Farkas

Co-supervisor of master thesis 2014-2015
Institute of Information and Communication Technologies, Catholic University of Louvain
Student: Benoit Pairet

Outreach and Service

2018	Mentor for a Software Carpentry workshop at the Université Grenoble Alpes
2018	Co-organizer of the Python for science and data analysis in Grenoble group
2018	Co-organizer of the Data Club at the Université Grenoble Alpes
2009	Public outreach at the Planetarium of Medellín, Colombia

Honors & Awards

Grant for project "Exoplanet direct imaging meets AI", 14,000 € 2018-2019
Grenoble Alpes Data Institute

1st Prize with the team Amigrow at the Phi-week startup bootcamp November 2018
ESA/Phi-Lab

PyData Amsterdam - diversity scholarship April 2017
Numfocus

PhD Scholarship under ARC grant for Concerted Research Action 2013-2017
Université de Liège

Scholarship for master studies in Astrophysics 2012-2013
Universidad Autónoma de Madrid & CSIC International Campus of Excellence

Scholarship for studies in Astronomy 2001-2007
ICETEX (Colombia) & Government of the Russian Federation

Computing skills

- Extensive experience with `Python` (more than 5 years).
- Experience in open-source development and version control with Git (GitHub, BitBucket, GitLab) in a team/distributed environment.
- Experience documenting software with Sphinx, readthedocs and Jupyter notebooks.
- Experience with Travis CI and and testing (pytest).
- Experience with `Python` scientific libraries such as Numpy, Scipy, Jupyter, Astropy, AstroML, Scikit-image, OpenCV, Pandas, emcee and Dask.
- Experience with machine and deep learning libraries such as Scikit-learn, H2O, Keras, Tensorflow, Pytorch and Cupy.
- Experience with NLP libraries such as NLTK and Spacy.
- Experience with plotting libraries such as Matplotlib, Bokeh and Seaborn.
- Experience with bash (Unix-based systems) and LaTeX.
- Experience with ArcGIS and QGIS.
- Basic knowledge of `SQL`, `C`, `Fortran`, `Java`, `Octave/Matlab`, `R` and `HTML`.

Software

- Author and lead developer of the open-source "Vortex Image Processing" (`VIP`) Python package for high-contrast imaging of exoplanets/disks. GitHub repository.

- Author of the `SODINN` Python package for detection of exoplanets through high-contrast imaging in a machine learning supervised framework. GitHub repository.
- Contributor to the `PyAstrOFit` package dedicated to planet orbit fitting using MCMC. GitHub repository.
- Contributor to the Keck/NIRC2 pre-processing pipeline containing calibration procedures for high-contrast imaging observations. GitHub repository.

Data analysis skills

- Hypothesis testing, Monte Carlo methods (MCMC), data cleansing and feature selection.
- Computer vision and natural language processing.
- Deep learning and neural networks. Supervised learning (regression and classification). Unsupervised learning (clustering, dimensionality reduction and low-rank modeling).

Languages

Spanish	Native
English	Advanced reading (C1) and speaking (C1), upper-intermediate writing (B2)
Russian	Advanced reading (C1), intermediate speaking (B1) and writing (B1)
French	Intermediate reading (B1), basic speaking (A2) and writing (A2)

Conferences, workshops and summer schools

Talks

- *Deep (learning) dive on SPHERE/IRDIS image processing*, October 2018, Centrum Wiskunde & Informatica, Amsterdam, Netherlands.
- *A la caza de exoplanetas por imagen directa con Python: De la ciencia de datos, la exoplanetologiía y otros demonios*, October 2018, PyconES, Málaga, Spain.
- *Supervised detection of exoplanets with deep neural networks*, August 2018, Université de Liège - Colonster castle, Liège, Belgium.
- *Review of mainstream post-processing techniques for high-contrast imaging*, August 2018, Université de Liège - Colonster castle, Liège, Belgium.
- *Exoplanet direct imaging meets data science*, June 2018, NASA ARC Space Science and Astrobiology Division Seminar Series, Silicon Valley, US.
- *Exoplanet direct imaging meets data science*, June 2018, Kavli Institute for Particle Astrophysics and Cosmology, Stanford, US.
- *Exoplanet direct imaging data challenge*, April 2018, Paris-Saclay center for data science, Palaiseau, France.
- *Data science for direct imaging of exoplanets. Machine learning applied to high-contrast imaging*, April 2018, European Week of Astronomy and Space Science, Liverpool, UK.
- *Data science in astronomical image processing: looking for exoplanets using supervised machine learning*, March 2018, Data Science in the Alps, Grenoble, France.
- *Chasing exoplanets with Python and Machine Learning*, March 2018, PySciDataGre launch event, Grenoble, France.
- *Academic Data Science: conducting research at the interface of different disciplines*, February 2018, Data club seminar, Université Grenoble Alpes, France.
- *High-contrast imaging post-processing methods for exoplanet detection and characterization*, February 2018, Seminar Thoth team, INRIA Grenoble - Rhône-Alpes, France.

- *Supervised detection of exoplanets through high-contrast imaging*, August 2017, Workshop on Image processing for high-contrast imaging, Université de Liège, Belgium.
- *Deep machine learning for astronomical image processing and signal detection*, July 2017, Seminar IPAG, Université Grenoble Alpes, France.
- *Image-processing for high-contrast imaging. Beyond the black-box*, January 2017, Seminar, ETH Zurich, Switzerland.
- *Post-processing for high-contrast imaging*, August 2016, Keck Institute for Space Studies (KISS) workshop on Direct Imaging of exoplanets, Caltech, US.
- *Angular and reference star differential imaging post-processing with* `VIP`, August 2016, First Vortex international workshop, Caltech, US.
- *Applications of PCA and low-rank plus sparse decompositions in high-contrast Exoplanet imaging*, February 2016, Seminar ICTEAM, Catholic University of Louvain, Belgium.
- *Beyond PCA, Low-rank plus Sparse decomposition of high-contrast ADI image sequences for exoplanet detection*, June 2015, In the Spirit of Lyot conference, Montreal, Canada.
- *Vortex Image Processing package tutorial*, May 2015, Adaptive optics data processing workshop, Laboratoire d'Astrophysique de Marseille (LAM), France.

Lightning talks

- `VIP & SODINN` – *Image/data processing for exoplanets direct imaging*, June 2018, SPHERE upgrades workshop, Grenoble, France.
- `VIP & SODINN` – *Image/data processing for exoplanets direct imaging*, May 2018, Python in Astronomy, New York, US.
- *Post-processing for high-contrast imaging*, August 2016, Keck Institute for Space Studies (KISS) workshop on direct imaging of exoplanets, Caltech, US.

Posters

- `VIP` – *Vortex Image Processing package*, October 2016, Astroinformatics IAU symposium, Sorrento, Italy.
- `VIP` – *Vortex Image Processing package*, May 2016, Resolving planet formation in the era of ALMA and extreme adaptive optics, ESO, Chile.
- *Python based pipeline for post-processing in astronomical high-contrast imaging*, July 2014, SciPy Conference 2014, Austin, US.

Attended

- ESA Earth observation Phi-week, November 2018, Frascati, Italy.
- PRAIRIE Artificial Intelligence Summer School, July 2018, Grenoble, France.
- Combining high-resolution spectroscopy and high-contrast imaging for exoplanet characterization, June 2018, Pasadena, US.
- NUMEDIART Deep Learning workshop, May 2017, Mons, Belgium.
- PyData Amsterdam, April 2017, Netherlands.
- PyData Berlin, May 2016, Germany.
- ONERA high-contrast imaging workshop, January 2015, Chatillon, France.
- Sagan Exoplanet Summer Workshop, July 2014, Pasadena, US.
- 5th Subaru International Conference – Exoplanets and disks: Formation and Diversity, December 2013, Hawaii, US.

Publications

Refereed

[1] B. Pairet, F. Cantalloube, C. A. Gomez Gonzalez, O. Absil, and L. Jacques. STIM map: detection map for exoplanets imaging beyond asymptotic Gaussian residual speckle noise. *ArXiv e-prints*, October 2018.

[2] D. Mawet, L. Hirsch, E. J. Lee, et al. Deep exploration of ϵ Eridani with Keck Ms-band vortex coronagraphy and radial velocities: mass and orbital parameters of the giant exoplanet. *ArXiv e-prints*, October 2018.

[3] W. J. Xuan, D. Mawet, H. Ngo, et al. Characterizing the performance of the NIRC2 vortex coronagraph at W.M. Keck Observatory. *ArXiv e-prints*, August 2018.

[4] V. Christiaens, S. Casassus, O. Absil, et al. Characterization of low-mass companion HD 142527 B. *ArXiv e-prints*, June 2018.

[5] **Gomez Gonzalez, C. A.**, O. Absil, and M. van Droogenbroeck. Supervised detection of exoplanets in high-contrast imaging sequences. *A&A*, 613:A71, May 2018.

[6] M. Reggiani, V. Christiaens, O. Absil, et al. Discovery of a point-like source and a third spiral arm in the transition disk around the Herbig Ae star MWC 758. *ArXiv e-prints*, October 2017.

[7] G. Ruane, D. Mawet, J. Kastner, et al. Deep Imaging Search for Planets Forming in the TW Hya Protoplanetary Disk with the Keck/NIRC2 Vortex Coronagraph. *Astronomical Journal*, 154:73, August 2017.

[8] R. Jensen-Clem, D. Mawet, **Gomez Gonzalez, C. A.**, et al. A New Standard for Assessing the Performance of High Contrast Imaging Systems. *ArXiv e-prints*, November 2017.

[9] **Gomez Gonzalez, C. A.**, O. Wertz, O. Absil, et al. VIP: Vortex Image Processing Package for High-contrast Direct Imaging. *Astronomical Journal*, 154:7, July 2017.

[10] Z. Wahhaj, J. Milli, G. Kennedy, et al. The SHARDDS survey: First resolved image of the HD 114082 debris disk in the Lower Centaurus Crux with SPHERE. *Astronomy and Astrophysics*, 596:L4, November 2016.

[11] É. Choquet, J. Milli, Z. Wahhaj, et al. First Scattered-light Images of the Gas-rich Debris Disk around 49 Ceti. *Astrophysical Journal, Letters*, 834:L12, January 2017.

[12] V. Christiaens, S. Casassus, O. Absil, et al. Characterization of the low-mass companion HD 142527 B. *Under review, submitted to A&A*.

[13] J. Milli, P. Hibon, V. Christiaens, et al. Discovery of a low-mass companion inside the debris ring surrounding the F5V star HD 206893. *Astronomy and Astrophysics*, 597:L2, January 2017.

[14] E. Serabyn, E. Huby, K. Matthews, et al. The W. M. Keck Observatory Infrared Vortex Coronagraph and a First Image of HIP 79124 B. *Astronomical Journal*, 153:43, January 2017.

[15] D. Mawet, É. Choquet, O. Absil, et al. Characterization of the Inner Disk around HD 141569 A from Keck/NIRC2 L-Band Vortex Coronagraphy. *Astronomical Journal*, 153:44, January 2017.

[16] O. Wertz, O. Absil, **Gómez González, C. A.**, et al. VLT/SPHERE robust astrometry of the HR8799 planets at milliarcsecond-level accuracy. Orbital architecture analysis with PyAstrOFit. *Astronomy and Astrophysics*, 598:A83, February 2017.

[17] **Gomez Gonzalez, C. A.**, O. Absil, P.-A. Absil, et al. Low-rank plus sparse decomposition for exoplanet detection in direct-imaging ADI sequences. The LLSG algorithm. *Astronomy and Astrophysics*, 589:A54, April 2016.

[18] F. Cantalloube, D. Mouillet, L. M. Mugnier, et al. Direct exoplanet detection and characterization using the ANDROMEDA method: Performance on VLT/NaCo data. *Astronomy and Astrophysics*, 582:A89, October 2015.

[19] V. A. Hagen-Thorn, N. V. Efimova, V. M. Larionov, et al. Color variations of the blazar 3C 454.3 in 2004-2006. *Astronomy Reports*, 53:510–518, June 2009.

[20] C. M. Raiteri, M. Villata, V. M. Larionov, et al. WEBT and XMM-Newton observations of 3C 454.3 during the post-outburst phase. Detection of the little and big blue bumps. *Astronomy and Astrophysics*, 473:819–827, October 2007.

Non Refereed

[1] O. Absil, D. Mawet, M. Karlsson, et al. Three years of harvest with the vector vortex coronagraph in the thermal infrared, in *Ground-based and Airborne Instrumentation for Astronomy VI, vol. 9908 of Proceedings of the International Society for Optical Engineering*, Aug. 2016, p. 99080Q.

[2] B. Femenía Castellá, E. Serabyn, D. Mawet, et al. Commissioning and first light results of an L'-band vortex coronagraph with the Keck II adaptive optics NIRC2 science instrument, *Adaptive Optics Systems V*, 2016.

[3] B. Pairet, L. Jacques, **C. A. Gomez Gonzalez**, et al. Low Rank and Group-Average Sparsity Driven Convex Optimization for Direct Exoplanets Imaging, in *Third international Traveling Workshop on Interactions between Sparse models and Technology*, 2016.

[4] D. Defrère, O. Absil, P. Hinz, et al. L'-band AGPM vector vortex coronagraph's first light on LBTI/LMIRCam, in *Adaptive Optics Systems IV, vol. 9148 of Proceedings of the International Society for Optical Engineering, July 2014, p. 91483X.*