Carlos Alberto Gomez Gonzalez

Junior research chair in Data Science for Earth, Space and Environmental Sciences

I am an astronomer and data scientist working at the interface of direct imaging of extrasolar planetary systems and machine learning. Following my interest in open research practices, I develop open-source scientific computing tools featuring advanced image processing and data analysis algorithms for astronomy. I proposed and validated the use of deep learning for detecting exoplanets through small-angle high-contrast imaging. My aim is to conduct research in cross-disciplinary environments, applying cutting-edge methods and following innovative scientific workflows.

Personal details

Nationality	Colombian
Address	IPAG, Institut de Planetologie et d'Astrophysique de Grenoble
	414 Rue de la Piscine, 38400 Saint-Martin-d'Hères
	GIPSA-lab, Grenoble Images Parole Signal Automatique
	11 Rue des Mathématiques, 38400 Saint-Martin-d'Hères
	Université Grenoble Alpes
E-Mail	carlos.gomez@univ-grenoble-alpes.fr
Website	https://carlgogo.github.io/
Github	https://github.com/carlgogo/

Academic Qualifications

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

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

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

Experience

Visiting researcher   2017-Present
GIPSA-lab, Université Grenoble Alpes

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

Data science consultant   2017
Science to Data Science, Pivigo

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

> Student: Benoit Pairet

Technician in Geographic information systems (ARCGIS) 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

Freelance web developer 2007-2008
Colombia

Observer for the Whole Earth Blazar Telescope (WEBT) 2005-2006
VV Sobolev Astronomical Institute, St. Petersburg State University, Russia

Honors & Awards

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

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

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

Computing

Skills

- Open-source development (Git/Github).
- Python (advanced, 5 years). Experience with scientific and machine learning libraries: Numpy, Scipy, Jupyter, Scikit-learn, Astropy, AstroML, Scikit-image, Matplotlib, Pandas, pymc3, emcee, NLTK, Spacy, OpenCV, Keras, Tensorflow, Blaze/Dask, H2O, cupy.
- Large experience with bash, LaTeX.
- Basic knowledge of SQL, C, Fortran, Java, Octave/Matlab, R and HTML.

Software

- Author of the open-source "Vortex Image Processing" (`VIP`) Python package for high-contrast imaging of exoplanets/disks (see my Github profile).
- Author of the `SODINN` Python package for detection of exoplanets through high-contrast imaging in a machine learning supervised framework (to be released).
- Contributor to the Keck/NIRC2 pre-processing pipeline containing calibration procedures for high-contrast imaging observations (see my Github profile).

Data analysis skills

- Hypothesis testing, Monte Carlo methods (MCMC), data cleansing and feature selection.
- Natural language processing and computer vision.
- Supervised learning (regression and classification). Unsupervised learning (clustering, dimensionality reduction and low-rank modeling). Neural networks (perceptron, MLP, CNN, RNN).

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)

Presentations & Conferences

Talks

- *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 of exoplanets/disks*, 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.

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

- Numediart Deep Learning workshop, May 2017, Mons, Belgium.
- PyData Amsterdam, April 2017, Netherlands (recipient of diversity scholarship).
- PyData Berlin, May 2016, Germany.
- 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] **Gomez Gonzalez, C. A.**, O. Absil, and M. van Droogenbroeck. Supervised detection of exoplanets in high-contrast imaging sequences. *ArXiv e-prints. Accepted for publication in A&A*, December 2017.

[2] 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.

[3] 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.

[4] 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.

[5] **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.

[6] 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.

[7] 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.

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

[9] 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.

[10] 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.

[11] 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.

[12] 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.

[13] **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.

[14] 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.

[15] 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.

[16] 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.