Artem Aguichine

(He/Him)

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RESEARCH SUMMARY

Tracing volatile compounds: from circumstellar disks to planetary interiors

My research focuses on tracing volatile compounds in solar and extrasolar planetary systems. I aim to bridge theories of planet formation, structure, and evolution with observations through numerical modeling. Ultimately, I seek to identify the conditions necessary for the formation of habitable worlds, which helps developing the field of astrobiology by answering questions of the origin and distribution of life in planetary systems.

Keywords: Planetary formation and evolution, planetary interior structure, numerical models, astrobiology.

RESEARCH EXPERIENCE

2022 – 2025 **Postdoctoral Researcher**
Funded by NASA's Interdisciplinary Consortia for Astrobiology Research (ICAR).
Advisor: Prof. Natalie Batalha
University of California, Santa Cruz, California, USA

2019 – 2022 **PhD in Planetary Science**
at Laboratoire d'Astrophysique de Marseille (LAM)
Advisor: Prof. Olivier Mousis
Aix-Marseille University, Marseille, France

2019 **M. Sc. summer internship in planetary science,** (4 months)
Laboratoire d'Astrophysique de Marseille, Marseille, France

2017 **M. Sc. summer internship in planetary science,** (6 months)
Laboratoire d'Astrophysique de Marseille, Marseille, France

2016 **M. Sc. summer internship in nuclear physics,** (3 months)
Institut de Physique Nucléaire d'Orsay, Orsay, France

2015 **B. Sc. summer internship in cosmology,** (5 weeks)
Centre de Physique des Particules de Marseille, Marseille, France

EDUCATION

2019 – 2022 **PhD in Astronomy and Astrophysics,** at Laboratoire d'Astrophysique de Marseille (LAM)
Aix-Marseille Université, Marseille, France

2019 **M. Sc. in theoretical physics,** at Centre de Physique Théorique
Aix-Marseille Université, Marseille, France

2019 **M. Sc. in Fundamental Physics,** at Ecole Normale Supérieure de Paris-Saclay
Ecole Normale Supérieure de Paris-Saclay, Cachan, France

2018 **Master degree for Education in Higher Education, Laureate of Agrégation de Physique (rank 16/72)**
Ecole Normale Supérieure de Paris-Saclay, Cachan, France

AWARDS AND DISTINCTIONS

2023 **Workshop participation support for Uranus Flagship 2023**
Coverage of participation costs up to $2,500, July 25-27, 2023, in Pasadena, California.

2023 **Thesis Award from the Doctoral School of Physics and Material Sciences (ED352) of Aix-Marseille University**
Award given to the 10% most impactful theses defended in 2022

2018 **Laureate of *Agrégation de Physique* with rank 16/72**

2014 **Study grant (4 years) at *École Normale Supérieure de Paris-Saclay***

FACILITATION OF RESEARCH

2023 – PRES. **Postdoc Representative**, in the Astronomy Department at UCSC

2022 – PRES. **Astrobiology Colloquium Organizer**, in the Astronomy Department at UCSC

2021 – PRES. **Reviewer** for *The Astrophysical Journal*, *A&A Letters*, *Space Science Reviews*, *Earth and Planetary Science Letters*, and *Earth and Planetary Science Letters*

2022 **Press-release** (link) of Aguichine et al. 2022 on the formation of Jupiter

2020 **Press-release** (link) of Aguichine et al. 2020 on rocklines

2020 **Press-release** (link) of Mousis et al. 2020 on highly irradiated ocean worlds

2019 – 2020 **Journal Club Organizer**, in the GSP group at Laboratoire d'Astrophysique de Marseille

TEACHING

2024 **Instructor**
– **Practical Programming for the Sciences (ASTR19)** (5 credits, undergrad) : 32 hours of lectures
University of California, Santa Cruz

2024 – 2025 **Instructor at Project for Inmate Education (PIE)**
– Pre-Algebra and Algebra classes given to inmates of the Santa Cruz County Jail
University of California, Santa Cruz

2019 – 2022 **Teaching Assistant and Instructor,** in B. Sc. (154 h) and M. Sc. (40 h)
– **General Physics** (L1) : 54h tutorials, 12h lab
– **Electromagnetism** (L2) : 24h tutorials, 28h lab
– **Advanced Studies in Physics** (L3) : 36h lectures, 12h lab
– **Preparation for Agrégation** (M2) : 4h lectures, 8h tutorials, 28h lab
Aix-Marseille Université

2018 – 2019 **Examiner for oral exams in preparatory classes (50 h)**
Lycées Thiers and Jean-Perrin, Marseille, France

2016 – 2022 **Private tutoring in math and physics for high school and preparatory classes**
– 1 on 1 tutoring (∼220 h)
– intensive courses (∼200 h)
Groupe Réussite

RESEARCH MENTORING

2024 – PRES **Advisor:**
– Lily Larkins, B. Sc.
– Emerson Tao, B. Sc.
University of California, Santa Cruz

SUM 2024 **co-Advisor with Jonathan Fortney:**
– Sierra Elbert, B. Sc.
University of California, Santa Cruz

W& SPR 2024 **Research project with a group of 5 undergraduate students**
As part of the ASTR9 course (5 credits)
University of California, Santa Cruz

SUM 2023 **co-Advisor with Jonathan Fortney and Nadine Nettelmann:**
– Emma Postolec, M2
University of California, Santa Cruz

SUM 2022 **Advisor:**
– Manon Bertoglio, L1
– Lucas Le Gall, L1
Laboratoire d'Astrophysique de Marseille

SUM 2022 **co-Advisor with Olivier Mousis:**
– Tom Benest, M2
– Udomlerd Srisuchinwong, M2
Laboratoire d'Astrophysique de Marseille

SUM 2021 **Advisor:**
– Clément Caquet, L1
– Solène Four, L1
Laboratoire d'Astrophysique de Marseille

SUM 2021 **co-Advisor with Olivier Mousis:**
– Antoine Schneeberger, M2
– Udomlerd Srisuchinwong, M2
Laboratoire d'Astrophysique de Marseille

SUM 2020 **co-Advisor with Olivier Mousis:**
– Antoine Schneeberger, M2
– Hugo Vivien, M2
Laboratoire d'Astrophysique de Marseille

OUTREACH

2024 – PRES. **Ask An Astronomer**: asking questions sent by email from the general public

2023 – 2024 **Astronomy on Tap Organiser** to promote science and astrophysics to the general public

AUG 2022 **Interview** (link) for the newspaper La Marseillaise

MAY 2022 **Interview** (link) for the online journal The Daily Beast

APR 2022 **Public conference** for the association Observatoire Astronomique du Gros Cerveau

2020 – PRES. **School presentations** to promote science and astrophysics

2019 – PRES. **Participation in public events** to promote science and astrophysics

DEC 2021 **Public conference** for the association Andromède

APR 2021 **Video interview** (link) for the web series CPublié

JUN 2020 **Public conference** (link) on the Twitch channel Tout Se Comprend

SCIENCE COMMUNICATION

JUN 2024 **Contributed talk + Poster** at the Exoplanets 5 Conference
Leiden, Netherlands. Participants : 750.

JUN 2024 **Invited talk** at the Exoplanets 5 mini-Symposium at Kapteyn University.
Kapteyn, Netherlands. Participants : 25.

JUN 2024 **Invited talk** at Imperial College London
London, UK. Participants : 15.

JUN 2024 **Two Contributed talks** at the SF2A Conference.
Marseille, France. Participants : 300.

MAR 2024 **Invited talk** at the Earth and Planetary Laboratory Seminar, in Carnegie Science.
Washington DC, USA. Participants : 20.

AUG 2023 **Contributed talk + Poster** at the International Planetary Probe Workshop 2023
Marseille, France. Participants : 200.

JUL 2023 **Poster** at the Uranus Flagship 2023 Workshop.
Pasadena, USA. Participants : 200.

APR 2023 **Poster** at the Protostars and Planets 7 Conference.
in Kyoto, Japan. Participants : 650.

And 13 other contributed talks, posters, and invited talks.

NOTABLE SCIENTIFIC PRODUCTIONS

1. **mardigras (Mass-Radius DIaGRAm with Sliders)**:

   Aguichine A. (2024), "mardigras: A Visualization Tool of Theoretical Mass–Radius Relations in the Context of Planetary Science", *Research Notes of the American Astronomical Society*, 8, 216, doi:10.3847/2515-5172/ad7506. Github. Zenodo.

SCIENTIFIC PUBLICATIONS

Publications in high-impact peer-reviewed journals (ADS Link):

35. **Aguichine A.**, Owen J. E., Batalha N., Dattilo A. (2025), "Deciphering the nature of sub-Neptunes in the era of Gaia", *The Astrophysical Journal*, **in prep**.
34. **Aguichine A.**, Nimmo F. (2025), "Thermal effects on the bulk density of rocky planets: the Earth-like composition band", *The Astrophysical Journal Letters*, **in prep**.
33. **Aguichine A.**, Batalha N., Fortney J. J., Nettelmann N., Owen J. E., Kempton E. M. -R. (2025), "Evolution of water worlds: energetic aspects", *The Astrophysical Journal*, **accepted with minor revisions**.
32. **Aguichine A.**, Mousis O. (2025), "Saturn's formation at the Carbon Dioxide Iceline",*The Planetary Science Journal*, **accepted with minor revisions**.
31. Alderson L., Moran S. E., Wallack N. L., et al. **(10th author)** (2025), "JWST COMPASS: NIRSpec/G395H Transmission Observations of the Super-Earth TOI-776 b", *The Astronomical Journal*, 169, 142, doi:10.3847/1538-3881/adad64.
30. Balsalobre-Ruza O., Lillo-Box J., Silva A. M., et al. **(14th author)** (2025), "KOBE-1: The first planetary system from the KOBE survey: Two planets likely residing in the sub-Neptune mass regime around a late K-dwarf", *Astronomy and Astrophysics*, 694, A15, doi:10.1051/0004-6361/202452631.
29. Alam M. K., Gao P., Adams Redai J., et al. **(6th author)** (2025), "JWST COMPASS: The First Near- to Mid-infrared Transmission Spectrum of the Hot Super-Earth L 168-9 b", *The Astronomical Journal*, 169, 15, doi:10.3847/1538-3881/ad8eb5.
28. Luu C. N., Yu X., Glein C. R., et al. **(5th author)** (2024), "Volatile-rich Sub-Neptunes as Hydrothermal Worlds: The Case of K2-18 b", *The Astrophysical Journal*, 977, L51, doi:10.3847/2041-8213/ad9eb1.
27. Scarsdale N., Wogan N., Wakeford H. R., et al. **(7th author)** (2024), "JWST COMPASS: The 3–5 μm Transmission Spectrum of the Super-Earth L 98-59 c", *The Astronomical Journal*, 168, 276, doi:10.3847/1538-3881/ad73cf.
26. Benest Couzinou T., Mousis O., Danger G., et al. **(5th author)** (2024), "Journey of complex organic molecules: Formation and transport in protoplanetary disks", *Astronomy and Astrophysics*, 692, A10, doi:10.1051/0004-6361/202449499.
25. Castro-González A., Lillo-Box J., Armstrong D. J., et al. **(5th author)** (2024), "TOI-5005 b: A super-Neptune in the savanna near the ridge", *Astronomy and Astrophysics*, 691, A233, doi:10.1051/0004-6361/202451656.
24. Mousis O., Schneeberger A., Cavalié T., et al. **(5th author)** (2024), "Insights on the Formation Conditions of Uranus and Neptune from Their Deep Elemental Compositions", *The Planetary Science Journal*, 5, 173, doi:10.3847/PSJ/ad58d8.
23. Wallack N. L., Batalha N. E., Alderson L., et al. **(6th author)** (2024), "JWST COMPASS: A NIRSpec/G395H Transmission Spectrum of the Sub-Neptune TOI-836c", *The Astronomical Journal*, 168, 77, doi:10.3847/1538-3881/ad3917.
22. Sulis S., Crossfield I. J. M., Santerne A., et al. **(7th author)** (2024), "A low-mass sub-Neptune planet transiting the bright active star HD 73344", *Astronomy and Astrophysics*, 688, A14, doi:10.1051/0004-6361/202449559.
21. Mousis O., Cavalié T., Lunine J. I., et al. **(6th author)** (2024), "Recipes for Forming a Carbon-Rich Giant Planet", *Space Science Reviews*, 220, 44, doi:10.1007/s11214-024-01071-4.
20. Alderson L., Batalha N. E., Wakeford H. R., et al. **(5th author)** (2024), "JWST COMPASS: NIRSpec/G395H Transmission Observations of the Super-Earth TOI-836b", *The Astronomical Journal*, 167, 216, doi:10.3847/1538-3881/ad32c9.
19. Castro-González A., Demangeon O. D. S., Lillo-Box J., et al. **(9th author)** (2023), "An unusually low-density super-Earth transiting the bright early-type M-dwarf GJ 1018 (TOI-244)", *Astronomy and Astrophysics*, 675, A52, doi:10.1051/0004-6361/202346550.
18. Georgieva I. Y., Persson C. M., Goffo E., Acuña L., **Aguichine A.**, et al. (2023), "TOI-733 b: A planet in the small-planet radius valley orbiting a Sun-like star", *Astronomy and Astrophysics*, 674, A117, doi:10.1051/0004-6361/202345961.
17. Schneeberger A., Mousis O., **Aguichine A.**, et al. (2023), "Evolution of the reservoirs of volatiles in the protosolar nebula", *Astronomy and Astrophysics*, 670, A28, doi:10.1051/0004-6361/202244670.
16. Lillo-Box J., Gandolfi D., Armstrong D. J., et al. **(18th author)** (2023), "TOI-969: a late-K dwarf with a hot mini-Neptune in the desert and an eccentric cold Jupiter", *Astronomy and Astrophysics*, 669, A109, doi:10.1051/0004-6361/202243879.
15. Persson C. M., Georgieva I. Y., Gandolfi D., Acuna L., **Aguichine A.**, et al. (2022), "TOI-2196 b: Rare planet in the hot Neptune desert transiting a G-type star", *Astronomy and Astrophysics*, 666, A184, doi:10.1051/0004-6361/202244118.
14. **Aguichine A.**, Mousis O., Lunine J. I., (2022), "The Possible Formation of Jupiter from Supersolar Gas", *The Planetary Science Journal*, 3, 141, doi:10.3847/PSJ/ac6bf1.

13. Vivien H., **Aguichine A.**, Mousis O., Deleuil M., Marcq E., (2022), "On the Stability of Low-mass Planets with Supercritical Hydrospheres", *The Astrophysical Journal*, 931, 143, doi:10.3847/1538-4357/ac66e2.

12. Acuña L., Lopez T. A., Morel T., et al. **(6th author)** (2022), "Water content trends in K2-138 and other low-mass multi-planetary systems", *Astronomy and Astrophysics*, 660, A102, doi:10.1051/0004-6361/202142374.

11. Mousis O., Lunine J. I., **Aguichine A.** (2021), "The Nature and Composition of Jupiter's Building Blocks Derived from the Water Abundance Measurements by the Juno Spacecraft", *The Astrophysical Journal*, 918, L23, doi:10.3847/2041-8213/ac1d50.

10. Hoyer S., Gandolfi D., Armstrong D. J., Deleuil M., et al. **(20th author)** (2021), "TOI-220 b: a warm sub-Neptune discovered by TESS", *Monthly Notices of the Royal Astronomical Society*, 505, 3361, doi:10.1093/mnras/stab1427.

9. **Aguichine A.**, Mousis O., Deleuil M., Marcq E. (2021), "Mass-Radius Relationships for Irradiated Ocean Planets", *The Astrophysical Journal*, 914, 84, doi:10.3847/1538-4357/abfa99.

8. Mousis O., **Aguichine A.**, Bouquet A., Lunine J. I., Danger G., Mandt K. E., Luspay-Kuti A. (2021), "Cold Traps of Hypervolatiles in the Protosolar Nebula at the Origin of the Peculiar Composition of Comet C/2016 R2 (PanSTARRS)", *The Planetary Science Journal*, 2, 72, doi:10.3847/PSJ/abeaa7.

7. Acuña L., Deleuil M., Mousis O., Marcq E., Levesque M., **Aguichine A.** (2021), "Characterisation of the hydrospheres of TRAPPIST-1 planets", *Astronomy and Astrophysics*, 647, A53, doi:10.1051/0004-6361/202039885.

6. Mousis O., **Aguichine A.**, Helled R., Irwin P. G. J., Lunine J. I. (2020), "The role of ice lines in the formation of Uranus and Neptune", *Philosophical Transactions of the Royal Society of London Series A*, 378, 20200107, doi:10.1098/rsta.2020.0107.

5. **Aguichine A.**, Mousis O., Devouard B., Ronnet T. (2020), "Rocklines as Cradles for Refractory Solids in the Protosolar Nebula", *The Astrophysical Journal*, 901, 97, doi:10.3847/1538-4357/abaf47.

4. Mandt K. E., Mousis O., Lunine J., Marty B., Smith T., Luspay-Kuti A., **Aguichine A.** (2020), "Tracing the Origins of the Ice Giants Through Noble Gas Isotopic Composition", *Space Science Reviews*, 216, 99, doi:10.1007/s11214-020-00723-5.

3. Mousis O., **Aguichine A.**, Atkinson D. H., Atreya S. K., Cavalié T., Lunine J. I., Mandt K. E., Ronnet T. (2020), "Key Atmospheric Signatures for Identifying the Source Reservoirs of Volatiles in Uranus and Neptune", *Space Science Reviews*, 216, 77, doi:10.1007/s11214-020-00681-y.

2. Mousis O., Deleuil M., **Aguichine A.**, Marcq E., Naar J., Aguirre L. A., Brugger B., Gonçalves T. (2020), "Irradiated Ocean Planets Bridge Super-Earth and Sub-Neptune Populations", *The Astrophysical Journal*, 896, L22, doi:10.3847/2041-8213/ab9530.

1. Santerne A., Brugger B., Armstrong D. J., Adibekyan V., Lillo-Box J., Gosselin H., **Aguichine A.**, Almenara J.-M., et al. (2018), "An Earth-sized exoplanet with a Mercury-like composition", *Nature Astronomy*, 2, 393, doi:10.1038/s41550-018-0420-5.