



ALEXANDRE POUSSE, Ph.D
Researcher in Celestial Mechanics and Mathematical Physics
CURRICULUM VITAE

Personal Informations

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Citizenship. French. Born in Blois (Loir-et-Cher, France), April 6th, 1987.

Link. Google Scholar: https://scholar.google.fr/citations?user=VV_aGagAAAAJ&hl=fr
Website: <http://imati.cnr.it/mypage.php?idk=PG-106>

Academic Positions

[Aug. 2020
– today] **Assegnista di Ricerca, IMATI[†]-CNR[‡] di Milano**
†: Istituto di Matematica Applicata e Tecnologie Informatiche “Enrico Magenes”,
‡: Consiglio Nazionale delle Ricerche.
1-year for a post-doctoral research fellowship supervised by Dr. Elisa Maria Alessi.
Website: <http://www.ge.imati.cnr.it/index.php/elisa-maria-alessi>

{ Career break }

[Dec. 2017
– Nov. 2018] **Assegnista di Ricerca, Università degli Studi di Padova,**
Dipartimento di Matematica ed applicazioni “Tullio Levi-Civita”,
1-year for a post-doctoral research fellowship funded by the H2020-ERC Project 677793,
“Stable & Chaotic Motions in the Planetary Problem” led by Dr. Gabriella Pinzari.
Website: <https://ercprojectpinzari.wordpress.com>

[Nov. 2016
– Oct. 2017] **Assegnista di Ricerca, Università degli Studi di Napoli “Federico II”,**
Dipartimento di Matematica ed applicazioni “Renato Caccioppoli”,
1-year for post-doctoral research fellowship funded by the H2020-ERC Project 677793.

[Oct. 2015
– Sep. 2016] **ATER (Temporary Research & Teaching Position), Observatoire de Paris,**
1-year grant for research and teaching activities, affiliated to the ASD-team[†] of IMCCE[‡],
†: Astronomie et Systèmes Dynamiques, led by Prof. Jacques Laskar,
‡: Institut de Mécanique Céleste et de Calcul des Éphémérides.
Website: <https://www.imcce.fr/recherche/equipes/asd/>

[Oct. 2012
– Sep. 2015] **Doctoral fellow, Observatoire de Paris,**
3-years grant for research and teaching activities, affiliated to the ASD-team of IMCCE.

Skills

Languages **French:** native. **Italian:** reading & speaking (advanced), writing (intermediate). **English:** reading & writing (advanced), speaking (intermediate).

Computer Programming in **Fortran, C, bash, Gnuplot, Mathematica, Matlab & TRIP** (computer algebra system dedicated to celestial mechanics, link: <https://www.imcce.fr/Equipes/ASD/trip/trip.php>), Word Processing in **LaTeX**, Graphics edition with **GIMP & Inkscape**
OS: Linux (Ubuntu, Mint), Windows & Mac. Office suite: Microsoft Office & Libreoffice.

Cursus

- [Sep. 2016] **Ph.D.** in Astronomy (*Specialization in Gravitational Dynamical Systems*), PSL University-Observatoire de Paris
title: “*Les quasi-satellites et autres configurations remarquables en résonance co-orbitale*” (“*Around quasi-satellites and remarkable configurations in the co-orbital resonance*”).
- Advisors:
 - Prof. Philippe Robutel, *CNRS Senior scientist* (equiv Prof.), ASD-IMCCE-Observatoire de Paris,
 - Prof. Alain Vienne, Université Lille-1, Pegase-IMCCE-Observatoire de Paris.
 - Ph.D. committee:
 - Prof. Jacques Féjoz, Université Paris-Dauphine, ASD-IMCCE-Observatoire de Paris, *president*,
 - Prof. Antonio Giorgilli, Università degli Studi di Milano, *referee*,
 - Prof. Anne Lemaître, Naxys, Université de Namur, *referee*,
 - Dr. Andrea Venturelli, Université d’Avignon, *examiner*.
 - Link: <https://www.theses.fr/2016PSLEO006>
- (Nota bene: since 2016, honorifics ceased to be used for the completion of a Ph.D.)
- [Jul. 2012] **Research M.Sc.degree** (*Master 2 Recherche*) in Astronomy & Astrophysics (*Specialization in Gravitational Dynamical Systems*), Observatoire de Paris.
– mention “*bien*” (*magna cum laude*)
- [Jun. 2011] **Research M.Sc.year 1 with Maîtrise degree** (*Master 1 Recherche*) in Mathematics (*Specialization in Analysis*), Université “François Rabelais” de Tours.
– mention “*bien*” (*magna cum laude*)
- [Jun. 2010] **Research M.Sc.year 1** (*Master 1 Recherche*) in Astronomy & Astrophysics, Observatoire de Paris.
- [Jun. 2009] **B.Sc.degree** (*Licence*) in Mathematics, Université “François Rabelais” de Tours.
– mention “*bien*” (*magna cum laude*)
- [Jun. 2006] **D.U.T. year 1** (*Diplôme universitaire de technologie*) in Computer Networks and Telecomm., I.U.T. (*University Institute of Technology*) de Blois.
- [Jul. 2005] **H.S.diploma** (*Baccalauréat général*) in Sciences, Lycée “Augustin Thierry” de Blois.
– mention “*assez bien*” (*cum laude*)

On my researches

Sci. Interests.

I work in the framework of **dynamical systems**. More specifically I study the existence of normal forms issued from **Celestial Mechanics** in the purpose of showing the existence and the persistence of certain particular dynamics in finite dimension. In particular, my works focus on the existence and stability of periodic or diophantine quasi-periodic invariant torii in the **N-body problem** (NBP), in order to understand the trajectories of certain particular configurations in the 3BP (**peculiar trajectories of an asteroid** with respect of two main bodies in some resonant regime) or the **dynamics of potential exo-planetary systems**. Mainly through **algebraic computations** (construction of normal forms with computer algebra systems), **rigorous estimations of analytic developments** and with the help of **numerical studies**, I intend to prove theorems of existence and **stability over infinite or finite but large timescale** via KAM & Nekhoroshev theories or – at least – improve the understanding of peculiar type of motion. I’m especially interested by the **co-orbital dynamics** in the 3BP (two bodies in 1:1 mean motion resonance).

Publications

(★): A.P. is the first author. (†) is for alphabetic order and (‡) notifies the first author among my collaborators.

Published in peer-reviewed journals.

4. **"On the co-orbital motion in three-body problem: the existence of quasi-periodic horseshoe-shaped orbits"**, (†) with L.Niederman & P.Robutel (2020), Commun. Math. Phys. (online first)

(Arxiv: <https://arxiv.org/abs/1806.07262>)

3. **"On the co-orbital motion in the planar restricted three-body problem: the quasi-satellite motion revisited"**, (★) with P.Robutel & A.Vienne (2017), Celest. Mech. Dyn. Astron. 128 (4): 383–407.

(Arxiv: <https://arxiv.org/abs/1603.06543>)

2. **"Rigorous treatment of the averaging process for co-orbital motions in the planetary problem"**, with P.Robutel (‡) & L.Niederman (2016), Comp. and Applied Mathematics 35: 675–699.

(Arxiv: <https://arxiv.org/abs/1506.02870>)

1. **"On the co-orbital motion of two planets in quasi-circular orbits"**, with P.Robutel (‡) (2013), Celest. Mech. Dyn. Astron. 117 (1): 17–40.

(Arxiv: <https://arxiv.org/abs/1304.1048>)

In preparation.

1. **"On the quasi-satellite motion in the restricted three-body problem. I. An adapted expansion of the averaged Hamiltonian"**, (★) (2020).

2. **"On the quasi-satellite motion in the restricted three-body problem. II. Hamiltonian adapted expansion extended to the eccentric and spatial cases"**, (★).

Peer-reviewed proceedings.

"The family of quasi-satellite periodic orbits in the circular co-planar restricted three-body problem", (★) with P.Robutel & A.Vienne (2014),

Complex Planet. Syst. Proceedings, IAU Symp. N°310: 172–173, Z. Knezevic & A. Lemaitre, eds.

(Arxiv: <https://arxiv.org/abs/1412.3540>)

Published in a popular science journal or website.

"Janus et Épiméthée: un ballet perpétuel autour de Saturne? De l'observation astronomique à la théorie KAM", (★) with L.Niederman & P.Robutel (2018), Images des Mathématiques, CNRS.

(Link: <https://images.math.cnrs.fr/Janus-et-Epimethee-un-ballet-perpetuel-autour-de-Saturne.html>, Arxiv: <https://arxiv.org/abs/1807.10220>)

Ph.D. Thesis.

"Les quasi-satellites et autres configurations remarquables en résonance co-orbitale", (★) (2016), PSL University-Observatoire de Paris.

(Link: <https://www.theses.fr/2016PSLEO006>)

Teaching experiences

Since October 2012, I have been involved in various teaching activities. During my Doctoral fellow (Oct. 2012 - Sep. 2015) and my ATER (Oct. 2015 - Sep. 2016) at the Paris Observatory, I carried out **4-years of teaching activities** for the Research M.Sc degree (Master Recherche Astronomie & Astrophysique) and some "University degrees" (DU, i.e. Diplôme Universitaire). All in all, **I headed 45 hours of lecture-exercices** ("chargé de cours et des Travaux Dirigés"), **68 hours of exercices** ("chargé des Travaux Dirigés"), and **60 hours of practical works** (night observing sessions). More details are summarized below.

- [Sep. – Dec. 2015] **Teaching assistant: Applied Quantum Physics**, Univ. Pierre & Marie Curie, Paris 6 & Obs. de Paris (M.Sc. level).
32h of exercices (*Lectures given by T.Fouchet & C.Antoine*).
Website: <http://www.lesia.obspm.fr/perso/thierry-fouchet/quantique/>
Basis on quantum physics and applications on the study of the interactions between electromagnetic radiation and matter.
- [Jan. – Apr. 2014,
Jan. – Apr. 2016] **Teaching assistant: Théories Mathématiques pour la Physique**, Observatoire de Paris (*"Mathematical theories for physics"*, M.Sc. level).
36h = 14h (in 2014) + 22h (in 2016) of exercices (*Lectures given by L.Niederman*).
An introduction to the mathematical methods of Classical Mechanics, from variational principle to fundamental notions: Lagrangian, Hamiltonian, integral invariants and symplectic structures.
- [Aug. 2013,
Aug. 2014,
Aug. 2015] **Assistant Astronomer: Night observing sessions at the Haute-Provence Observatory** for the DU "Explorer et Comprendre l'Univers" of the Paris Observatory (*Leading Astronomer: M. Puech*)
Website: <https://www.obspm.fr/du-explorer-et-comprendre-l-univers.html>
60h = 3 × 4-nights sessions (practical work).
Monitoring a group of 5-6 students on a professional telescope (80cm of diameter, non-automatized) in order to teach celestial coordinates, star-pointing, naked eye observation and CDD photography.
- [Jan. 2013,
Jan. 2014,
Jan. 2016] **Lecturer: Théories Mathématiques pour la Physique, Remise à niveau** (*pre-course of "Mathematical theories for physics"*, M.Sc. level), Observatoire de Paris.
45h = 3 × 15h of lectures & exercices.
In this pre-course, recalls on analysis and differential calculus from Licence (B.Sc. level) were given (especially for student with only a background in physics).
- [Oct. 2012
– Sep. 2016] **Tutoring (online) 4 students** participating to the DU "Fenêtre sur l'Univers" (now "Lumières sur l'Univers", distance-learning courses on Astronomy) of the Paris Observatory.
Website: <https://media4.obspm.fr/LU/>
- [Oct. 2012
– Sep. 2013] **Contribution** to the website project "L'Astronomie dans l'Apprentissage des Mathématiques" (Astronomy in the mathematics teaching).
Website: <https://media4.obspm.fr/public/AAM/>
Creation of maths courses and exercices linked to some astronomical problems.

Seminars, Conferences, Workshops & Schools

Communications & Posters.

8. **"On the stability of the Saturn co-orbital moons Janus and Epimetheus in the three-body problem"**, *Perspectives in Hamiltonian Dynamics* (Venezia, Italy), June 2018.
7. **"On the stability of co-orbital motion in the three-body problem: the Saturn-Janus-Epimetheus system"**, *CELMEC VII* (Viterbo, Italy), September 2017.
6. **"Around quasi-satellites and remarkable configurations in the co-orbital resonance"**, *Seminario di Fisica Matematica dell'Università degli Studi di Padova* (Italy), June 2017
5. **"Co-orbital motion in the co-planar restricted three-body problem: family of quasi-satellite periodic orbits"** (poster), *EPSC* (Nantes, France), September 2015.
4. **"The family of quasi-satellite periodic orbits in the co-planar restricted three-body problem"**, *AAS DDA Caltech* (Pasadena, USA), May 2015.
3. **"Co-orbital resonance dynamics: an introduction to quasi-satellite motion"**, *Journées Scientifiques de l'IMCCE* (Paris Observatory, France), January 2015.
2. **"On the co-orbital motion in the coplanar restricted Three-Body problem: Quasi-satellites in the circular case"** (poster), *IAU CPS* (Namur, Belgium), July 2014.
1. **"On the co-orbital motion of two planets in quasi-circular and co-planar orbits focused on the Anti-Lagrange orbits"** (poster), *CELMEC VI* (Viterbo, Italy), September 2013.

Conferences attendances.

11. **"Matematica a misura della Natura"**, workshop in honor of G.Benettin's 70' Birthday, Università di Padova (Italy), September 2018.
10. **"Perspectives in Hamiltonian Dynamics"** conference, Venezia (Italy), June 2018.
9. **"Analysis & Dynamics"**, conference in occasion of Prof. L.Chierchia's 60' Birthday, Marina di San Gregorio, Lecce (Italy), October 2017.
8. **CELMEC VII: Seventh International Meeting in Celestial Mechanics**, San Martino al Cimino, Viterbo (Italy), September 2017.
7. **Workshop on Double resonances in the problem of Arnold diffusion**, Institut Henri Poincaré, Paris (France), December 2016.
6. **EPSC: European Planetary Science Congress**, La Cité des Congrès, Nantes (France), September 2015.
5. **AAS DDA 2015: American Astro. Society Dynamical Division of Astronomy**, Caltech University, Pasadena (USA), May 2015.
4. **"Astronomy & Dynamics"**, workshop in occasion of J. Laskar's 60' Birthday, Institut d'Astrophysique de Paris (France), April 2015.
3. **IAU CPS 2014: International Astro. Union Complex Planetary Systems**, Naxys, Université de Namur (Belgium), July 2014.
2. **CELMEC VI: Sixth International Meeting in Celestial Mechanics**, San Martino al Cimino, Viterbo (Italy), September 2013.
1. **International Workshop in Planet. Motions, Satellites Dyn. & Space Ship Orbits**, Centre de Recherche Mathématique, Montréal (Canada), July 2013.

Summer & Winter Schools.

5. **Summer school "Stable and Chaotic Motions in the Planetary Problem"**, Osservatorio di Asiago (Università di Padova, Italy), June 2018.
4. **Winter school "Recent Advances in Hamiltonian Dynamics and Symplectic Topology"**, Università di Padova (Italy), February 2018.
3. **ETH-ITS Winter school on Conservative Dynamics**, Engelberg (Switzerland), February 2017.
2. **CELMEC Summer school "Satellite Dynamics and Space Missions: Theory and Applications of Celestial Mechanics"**, San Martino al Cimino, Viterbo (Italy), September 2017.
1. **GRGS Summer school, "Localisation précise par moyens spatiaux"**, Yverdon-les-bains (Switzerland), September 2012 .

- Visits.*
3. **Centro de Giorgi, Scuola Normale Superiore di Pisa** (Italy), 1-week in December 2018, invited by Dr. J.E.Masseti.
 2. **Università degli Studi di Padova**, 2-weeks in June 2017, invited by Dr. G.Pinzari.
 1. **IMCCE, Observatoire de Paris**, 2-weeks splitted between Dec. 2016, Apr. 2017 and Jul. 2017, invited by Prof. P.Robutel.

References

- Research activities.*
- **Dr. Elisa Maria Alessi**, IMATI-CNR Milano
(Last postdoc supervisor) em.alessi@mi.imati.cnr.it
 - **Dr. Laurent Niederman**, Université Paris-Saclay & ASD-IMCCE-Observatoire de Paris
(Close collaborator) laurent.niederman@u-psud.fr
 - **Dr. Gabriella Pinzari**, Università degli Studi di Padova
(P.I. of the ERC Project "Stable and Chaotic Motions in the Planet. Pb.") pinzari@math.unipd.it
 - **Prof. Philippe Robutel**, ASD-IMCCE-Observatoire de Paris
(Ph.D. thesis advisor & close collaborator) Philippe.Robutel@obspm.fr
- Teaching activities.*
- **Dr. Charles Antoine**, Université Pierre & Marie Curie, Paris 6
(Senior Lecturer) antoine@lptmc.jussieu.fr
 - **Dr. Laurent Niederman**, Université Paris-Saclay & ASD-IMCCE-Observatoire de Paris
(Senior Lecturer) laurent.niederman@u-psud.fr
 - **Dr. Mathieu Puech**, GEPI-Observatoire de Paris
(Leading Astronomer) mathieu.puech@obspm.fr

Miscellaneous

- Qualifications.*
- Qualification aux fonctions de Maître de Conférences, Section 25-26-34**, February 2017.
French habilitation to apply for Associate Professor position in pure math., applied math. and astronomy.
- Projects.*
- [Nov. 2016 – Nov. 2018]
Team member of the H2020-ERC Project 677793 Starting Grant
"Stable and Chaotic Motions in the Planetary Problem" led by Dr. Gabriella Pinzari, Università degli Studi di Napoli "Federico II" (until 2017) & Università di Padova (since 2017).
Website: <https://ercprojectpinzari.wordpress.com>.
- Administration.*
- [Jun. 2018]
Member of the Local Organizing Committee of the "Stable and Chaotic Motions in the Planetary Problem" summer school and the "Perspectives in Hamiltonian Dynamics" conference, June 2018.
Website of the school: <https://events.math.unipd.it/ercschool/>
Website of the conference: <https://events.math.unipd.it/ercvenice/>
- [Jan. 2014 – Dec. 2015]
Representative of the Ph.D. students in scientific and institute IMCCE concils.
- Peer review contributions.*
- Invitations from: **Advances in Space Research; Celestial Mechanics and Dynamical Astronomy.**

Career Break

[Dec. 2018
– Jul. 2020] Career break in order to approach my professional calling with a renewed motivation and fresh perspectives. Early 2019, I moved to France to be reunited with my family, pursued some scientific works in freelance (*revision and acceptance of Robutel-Pousse-Niederman 2020 on CMP, preparation and conclusion of the preprint Pousse 2020*), practiced sports and walked along the ancient *via Francigena* from Pavia to Roma. Since Autumn 2019, I went back to Italy and continue with my life in Rome. Among others, I was introduced to complex systems (*applied to urbanism; Matières et Systèmes Complexes Laboratory, Univ. Paris Diderot*) and took tour guide courses on the *Ancient and Baroque Rome*.

Other working experiences

- [Oct. 2019] **Corrections of “concorso INdAM”** (Istituto Nazionale di Alte Matematica), Roma
Website : <https://www.altamatematica.it>
- [Sep. 2011] **1-mounth Research Contract**, IMCCE, Observatoire de Paris. Advisor: Dr. F.Deleflie.
Application of genetic algorithms in order to improve space debris orbit determination.
- [Mar. – Jun. 2012] **3-mounthes Research Intership**, IMCCE, Observatoire de Paris. Advisor: Dr. P.Robutel.
Master-2-thesis on the Three-body problem: “Quasi-periodic orbits in the neighborhood of the Lagrange equilateral configurations”.
- [Jun. – Aug. 2011] **2-mounthes Research Intership**, Geoazur laboratory (Grasse, France), Observatoire de la Côte d’Azur. Advisor: Dr. G.Metris.
“Study of the two fixed centers problem (or Vinti problem) for geometric integration algorithms”.
Website : <https://geoazur.oca.eu/fr/acc-geoazur/584-metrologie-spatiale-geoazur>
- [Apr. – Jun. 2010] **2-mounthes Research Intership**, Geoazur laboratory (Grasse, France), Observatoire de la Côte d’Azur. Advisor: Dr. G.Metris.
Master-1-thesis: “Software developpement for Laser telemetry stations: satellites in Earth shadow determination”.
- [Summers 2003
– 2010] **Seasonal worker (2009 and 2010 as supervisor)** during the period of June to August for the seed agricultural compagny *Euralis Semences, Blois* (France). Website : <http://euralis-seeds.com>

Interests, Hobbies & Sports

I am passionate about History, especially the **Italian History** (e.g. Ancient Rome, Venice, Baroque Rome) and **Arts** (between 2012 and 2015, I had a chance to visit each section of the Louvre). Early 2020, I took Rome Guide Tour courses on Ancient and Baroque Rome (*associazione culturale Rome4U - Roma e Lazio per te*) in order to apply for the local tour guide licence.

I am also concerned about **Astronomy** (popularization and night sessions with telescope), **Old maps**, Sociology, Music (electronica, french hip hop, experimental rock and metal) and Calcio. Early 2017, I took a basic course on History of cinema (*circolo "la carrozza d'oro", Roma*).

In the past, I practiced **Table tennis** (*Association Pongiste de La Chapelle Vendômoise, 1997-2008*), **Boxing** (*Club Cenvint Paris 13, 2013*), **Fencing** (*Les Duellistes Club Paris, 2015*). Today I resume Table tennis (I'm currently looking for a local club), practice **Running** (*Trails, 10K, Half-marathons in Rome and France, and maybe a Marathon for 2021*), **Trekking** (e.g. *from Pavia to Roma along the ancient via Francigena, 2019*).

Roma,
October 7, 2020,
Dr. Alexandre Pousse.