Matteo Caggio

Curriculum Vitae

Institute of Mathematics CAS, Žitná 25, 115 67 Praha 1, Czech Republic
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Personal data

Date and place of birth: Born March 11, 1986, Ferrara, Italy.

Research interests

Mathematical theory of compressible and incompressible Navier-Stokes equations. Turbulence.

Education

2011 **M. Sc. in Physics, University of Ferrara, Italy**, *Thesis title: Turbulence parameterisations in the atmospheric surface layer (supervisor: Prof. Federico Porcù, Department of Physics and Astronomy, University of Bologna, Italy; co-supervisor: Prof. Francesco Tampieri, National Research Council of Italy, Institute of Atmospheric Sciences and Climate (CNR-ISAC) Bologna, Italy)*.

2017 **Ph. D. in Applied Mathematics, Faculty of Applied Sciences, University of West Bohemia, Pilsen, Czech Republic**, *Thesis title: Navier-Stokes equations and related problems (supervisior: RNDr. Šárka Nečasová CSc. DSc., Institute of Mathematics of the Czech Academy of Sciences, Prague, Czech Republic; co-supervisior: doc. RNDr. Zdeněk Skálak CSc., Department of Mathematics, Faculty of Civil Engineering, Czech Technical University, Prague, Czech Republic)*.

Academic experience

May 2023 – current **Institute of Mathematics of the Czech Academy of Science, Prague, Czech Republic (Researcher position)**, *Department: Evolution Differential Equations*.

Apr. 2021 – Apr. 2023 **Institute of Mathematics of the Czech Academy of Science, Prague, Czech Republic (Postdoc position)**, *Department: Evolution Differential Equations*.

Mar. 2020 – Mar. 2021 **Department of Mathematics, Faculty of Science, University of Zagreb, Croatia (Postdoc position)**.

Jan. – Feb. 2020 **Institute of Mathematics of the Czech Academy of Science, Prague, Czech Republic (Postdoc position)**, *Department: Evolution Differential Equations*.

Jan. 2018 – Dec. 2019 **Department of Information Engineering, Computer Science and Mathematics, University of L' Aquila, Italy (Postdoc position)**.

Sept. 2013 – Dec. 2017 **Institute of Mathematics of the Czech Academy of Science, Prague, Czech Republic (Ph.D position)**, *Department: Evolution Differential Equations*.

Funding and projects

Jan. 2022 – current **Czech Grant Agency (GAČR) No. GA22-01591S**, *Mathematical theory and numerical analysis for equations of viscous newtonian compressible fluids; main investigator: RNDr. Šárka Nečasová CSc. DSc. (Department of Evolution Differential Equations, Institute of Mathematics of the Czech Academy of Sciences, Prague, Czech Republic)*.

Jan. 2022 – current **Premium Academiae – ŠN**, *main investigator: RNDr. Šárka Nečasová CSc. DSc. (Department of Evolution Differential Equations, Institute of Mathematics of the Czech Academy of Sciences, Prague, Czech Republic)*.

Apr. 2021 – Dec. 2021 **Czech Grant Agency (GAČR) No. GA19-04243S**, *Partial differential equations in mechanics and thermodynamics of fluids; main investigator: RNDr. Šárka Nečasová CSc. DSc. (Department of Evolution Differential Equations, Institute of Mathematics of the Czech Academy of Sciences, Prague, Czech Republic)*.

Mar. 2020 – Mar. 2021 **Multiscale problems in fluid mechanics - MultiFM, Croatian Science Foundations**, *main investigator: Prof. Igor Pažanin (Department of Mathematics, Faculty of Science, University of Zagreb, Croatia)*.

Jan. 2018 – Dec. 2019 **Singular limits and dimension reduction in fluid mechanics**, *main investigator: Prof. Donatella Donatelli (Department of Information Engineering, Computer Science and Mathematics of University of L'Aquila, Italy)*.

Jan. 2016 – Dec. 2017 **Czech Grant Agency (GAČR) No. GA16-03230S**, *Thermodynamically consistent models for fluid flows: mathematical theory and numerical solution; main investigator: RNDr. Šárka Nečasová CSc. DSc. (Department of Evolution Differential Equations, Institute of Mathematics of the Czech Academy of Sciences, Prague, Czech Republic)*.

Publications/Preprints

article Caggio, Matteo; Donatelli, Donatella, *Relative entropy inequality for capillary fluids with density dependent viscosity and applications,* arXiv:2305.09339.

article Caggio, Matteo; Dell'Oro, Filippo, *Gevrey regularity for the Euler-Bernoulli beam equation with localized structural damping,* arXiv:2212.07110.

article Bisconti, Luca; Caggio, Matteo, *Inviscid limit for the compressible Navier-Stokes equations with density dependent viscosity,* arXiv:2207.12222.

conference paper Caggio, Matteo, *Hidden symmetry in turbulence and analytic study of shell models,* in Proceedings Topical Problems of Fluid Mechanics 2023, Prague, Edited by David Šimurda and Tomáš Bodnár.

article Schiavon, Mario; Tampieri, Francesco; Caggio, Matteo; Mazzola, Mauro; Viola, Angelo Pietro, *The Effect of Submeso Motions on the Budgets of the Mean Turbulent Kinetic Energy and Temperature Variance in the Stable Atmospheric Surface Layer*, accepted for publication in Boundary-Layer Meteorology.

article Caggio, Matteo; Schiavon, Mario; Tampieri, Francesco; Bodnár, Tomáš, *Closure scheme for stably stratified turbulence without critical Richardson number,* SN Applied Sciences 4(8) (2022), 214.

article Caggio, Matteo, *Inviscid incompressible limit for compressible micro-polar fluids,* Nonlinear Anal. 216 (2022), 112-695.

conference paper Uhlíř, Vít; Caggio, Matteo; Bodnár, Tomáš, *Numerical Assessment of Stratification Influence in Simple Algebraic Turbulence Model,* In Proceedings Topical Problems of Fluid Mechanics 2022, Prague, Edited by David Šimurda and Tomáš Bodnár, pp. 159-167.

article Caggio, Matteo; Ducomet, Bernard; Nečasová, Šárka; Tang, Tong, *Low Mach and thin domain limit for the compressible Euler system,* Annali di Matematica Pura ed Applicata (4) 200 (2021), no. 4, 1469–1486.

article Caggio, Matteo; Kreml, Ondřej; Nečasová, Šárka; Roy, Arnab; Tang, Tong, *Measure-Valued Solutions and Weak-Strong Uniqueness for the Incompressible Inviscid Fluid-Rigid Body Interaction,* J. Math. Fluid Mech. 23 (2021), no. 3, Paper No. 50, 24 pp.

conference paper Caggio, Matteo; Schiavon, Mario; Tampieri Francesco; Bodnár, Tomáš, *Second-Order Model for Atmospheric Turbulence without Critical Richardson Number,* In Proceedings Topical Problems of Fluid Mechanics 2021, Prague, Edited by David Šimurda and Tomáš Bodnár, pp. 8-15.

article Caggio, Matteo; Donatelli, Donatella, *High Mach number limit for Korteweg fluids with density dependent viscosity,* J. Differential Equations 277 (2021), 1-37.

article Caggio, Matteo; Kalita, Piotr; Lukaszewicz, Grzegorz; A. Mizerski, Krzysztof, *Vertical heat transport at infinite Prandtl number for micropolar fluid,* Arch. Mech. (Arch. Mech. Stos.) 72 (2020), no. 6, 525-553.

conference paper Schiavon, Mario; Tampieri Francesco; Caggio, Matteo; Bodnár, Tomáš, *The effect of submeso motions on second-order moments budgets in the stable atmospheric boundary layer*, In Proceedings Topical Problems of Fluid Mechanics 2020, Prague, Edited by David Šimurda and Tomáš Bodnár, pp. 192-199.

article Caggio, Matteo; Donatelli, Donatella; Nečasová, Šárka; Sun, Yongzhong, *Low Mach number limit on thin domains.* Nonlinearity 33 (2020) 840-863.

conference paper Caggio, Matteo; Bodnár, Tomáš; Schiavon, Mario, *On the Mechanisms of Dimensional Transition in Stably Stratified Turbulent Fluid Layers*, In Proceedings Topical Problems of Fluid Mechanics 2019, Prague, Edited by David Šimurda and Tomáš Bodnár, pp. 25-30.

conference paper Caggio, Matteo; Nečasová, Šárka, *Note on the Problem of Compressible Non-Newtonian Fluids*, In Proceedings Topical Problems of Fluid Mechanics 2019, Prague, Edited by David Šimurda and Tomáš Bodnár, pp. 31-36.

article Ducomet, Bernard; Caggio, Matteo; Nečasová, Šárka; Pokorný, Milan, *The rotating Navier-Stokes-Fourier-Poisson system on thin domains.* Asymptot. Anal. 109 (2018), no. 3-4, 111–141.

chapter Al Baba, Hind; Caggio, Matteo; Ducomet, Bernard; Nečasová, Šárka, *Relative entropy inequality for dissipative measure-valued solutions of compressible Non-Newtonian system.* Fourteenth International Conference Zaragoza-Pau on Mathematics and its Applications, 11–20, Monogr. Mat. García Galdeano, 41, Prensas Univ. Zaragoza, Zaragoza, 2018.

article Caggio, Matteo; Nečasová, Šárka, *Inviscid incompressible limits for rotating fluids.* Nonlinear Anal. 163 (2017), 1-18.

conference paper Caggio, Matteo; Bodnár, Tomáš, *Analysis of the Turbulence Parameterisations for the Atmospheric Surface Layer*, In Proceedings Topical Problems of Fluid Mechanics 2018, Prague, Edited by David Šimurda and Tomáš Bodnár, pp. 31-38.

conference paper Al Baba, Hind; Caggio, Matteo; Ducomet, Bernard; Nečasová, Šárka, *Note on the Problem of Dissipative Measure-Valued Solutions to the Compressible Non-Newtonian System*, In Proceedings Topical Problems of Fluid Mechanics 2017, Prague, Edited by David Šimurda and Tomáš Bodnár, pp. 1-6.

conference paper Caggio, Matteo; Bodnár, Tomáš, *Note on the Use of Camassa-Holm Equations for Simulation of Incompressible Fluid Turbulence*, In Proceedings Topical Problems of Fluid Mechanics 2017, Prague, Edited by David Šimurda and Tomáš Bodnár, pp. 59-64.

article Guo, Zhengguang; Caggio, Matteo; Skalák, Zdeněk, *Regularity criteria for the Navier-Stokes equations based on one component of velocity.* Nonlinear Anal. Real World Appl. 35 (2017), 379–396.

International conferences with contributed talks

31/05 – 04/06/2023 *The 13th AIMS Conference on Dynamical Systems, Differential Equations and Applications*, Wilmington, North Carolina, U.S.A., talk: On the high compressible limit for the Navier-Stokes-Korteweg model with density dependent viscosity.

11 – 15/07/2022 *EQUADIFF 15*, Brno, Czech Republic, talk: Low Mach number flows and dimension reduction in fluid mechanics.

23 – 24/05/2022 *Environmental Fluid Mechanics: Turbulence and Fluid Mixing*, Lille, France, talk: Second-order scheme for stably stratified turbulence without critical Richardson number

8 – 10/07/2021 *Onset of Turbulence and Singular Flows*, Porquerolles, Hyères, France, talk: Closure scheme for stably stratified turbulence without critical Richardson number.

17 – 19/02/2021 *Topical Problems in Fluid Mechanics*, Prague, Czech Republic, talk: Second-Order Model for Atmospheric Turbulence without Critical Richardson Number.

14 – 18/09/2020 *ApplMath18 Tenth Conference on Applied Mathematics and Scientific Computing*, Brijuni, Croatia, talk: Dimension reduction in fluid mechanics.

20 – 22/02/2019 *Topical Problems in Fluid Mechanics*, Prague, Czech Republic, talk: On the Mechanisms of Dimensional Transition in Stably Stratified Turbulent Fluid Layers.

17 – 20/09/2018 *ApplMath18 Ninth Conference on Applied Mathematics and Scientific Computing*, Šibenik, Croatia, talk: Singular limits in fluid mechanics: "thin" and rotating fluids.

21 – 23/02/2018 *Topical Problems in Fluid Mechanics*, Prague, Czech Republic, talk: Analysis of the turbulence parameterisations for the atmospheric surface layer.

24 – 28/07/2017 *Equadiff 2017*, Bratislava, Slovakia, talk: Non-equilibrium diffusion limit for a barotropic radiative flow in a presence of magnetic field.

3 – 6/04/2017 *Modern challenges in continuum mechanics*, Zagreb, Croatia, talk: Regularity criteria for the Navier- Stokes equations based on one component of velocity.

9 – 10/03/2017 *Theory of the incompressible Navier-Stokes system and related topics*, Calais, France, talk: Inviscid incompressible limits for rotating fluids.

15 – 17/02/2017 *Topical Problems in Fluid Mechanics*, Prague, Czech Republic, talk: On the Camassa-Holm equations for fluid turbulence.

26 – 30/09/2016 *First China–Czech Conference in Mathematical Fluid Mechanics*, Beijing, China, talk: Regularity criteria for the Navier-Stokes equations based on one component of velocity.

Attended international conferences and schools

1 – 2/09/2022 *International Workshop on Flow-Induced Blood Damage in Rotating Systems*, University of Rostock, Rostock, Germany.

22 – 26/08/2022 *Mathematical Fluid Mechanics In 2022*, Institute of Mathematics of the Czech Academy of Science, Prague, Czech Republic.

27/06/2022 – 1/07/2022 *Summer school on fluids and turbulence*, Camille Jordan Institute, Lyon, France.

13 – 17/09/2021 *Partial Differential Equations on Mathematical Physics and Applications*, Lake Como School of Advanced Studies, Como, Italy.

23 – 27/08/2021 *Fluids under Control*, Institute of Mathematics, Institute of Mathematics of the Czech Academy of Science, Prague, Czech Republic.

27 – 31/08/2018 *Waves in Flows*, Institute of Mathematics of the Czech Academy of Science, Prague, Czech Republic.

21/05/2018 – 15/06/2018 *Intensive Programs on Fluids and Waves*, Gran Sasso Science Institute, L'Aquila, Italy.

5 – 7/02/2018 *Partial Differential Equations in Fluid Mechanics*, Centro di Ricerca Matematica Ennio De Giorgi, Pisa, Italy.

12/02/2018 – 16/02/2018 *Minicourse in Navier-Stokes equations*, Institute of Mathematics of the Czech Academy of Science, Prague, Czech Republic.

28/05 – 02/06/2017 *Mathematical Aspects of Fluid Flows*, Kacov, Czech Republic.

08 – 12/05/2017 *Vorticity, Rotation and Symmetry (IV) – Complexity, Regularity and Singularities*, CIRM, Luminy/Marseille, France.

28/08/2016 – 02/09/2016 *Fluids Under Pressure*, Institute of Mathematics of the Czech Academy of Science, Prague, Czech Republic.

18 – 22/07/2016 *Wall-Bounded Turbulence*, International Center for Mechanical Sciences (CISM), Udine, Italy.

11 – 15/07/2016 *International Summer School on Evolution Equations*, Faculty of Mathematics and Physics, Charles University in Prague, Czech Republic.

4 – 6/07/2016 *School on Turbulence*, European High–Performance Infrastructures in Turbulence (EuHIT), Warsaw, Poland.

25 – 31/08/2014 *Particles in Flows*, Institute of Mathematics of the Czech Academy of Science, Prague, Czech Republic.

Invited seminars

26/11/2021 *Inviscid incompressible limit for compressible micro-polar fluids*, Research Group on Navier-Stokes Equations and Fluid-Stucture Interaction.

16/01/2020 *On the highly compressible limit for the Navier-Stokes-Korteweg model with density dependent viscosity*, Workshop Berlin-Prague, 15-16 January 2020, Institute of Mathematics of the Czech Academy of Science, Prague, Czech Republic.

12/11/2019 *On the highly compressible limit for the Navier-Stokes-Korteweg model with density dependent viscosity*, Department of Mathematics, Polytechnic University of Milan, Italy.

25/10/2018 *Singular limits in fluid mechanics: low and high Mach number flows*, Department of Mathematics and Computer Science, University of Ferrara, Italy.

5/12/2017 *Inviscid incompressible limits for rotating fluids*, Camille Jordan Institute, Lyon, France.

3/5/2017 *Navier-Stokes equations and turbulence*, University Pierre et Marie Curie, Paris, France.

17/12/2015 *Turbulence in fluids*, University Paris-Est, Créteil, Paris, France.

Referee activity for international journals

Nonlinear Analysis, Real World Applications; Mathematical Methods in the Applied Sciences.

Additional experiences

Feb. – Sep. 2012 Department of Mathematics and Computer Science, University of Ferrara, Italy: *Navier-Stokes equations and turbulence theory* (activity proposal/internship).

Mar. - Sep. 2011 Department of Physics and Earth Science, University of Ferrara, Italy; National Research Council of Italy, Institute of Atmospheric Sciences and Climate (CNR-ISAC), Bologna, Italy: *Analysis of turbulence in the atmospheric surface layer* (master thesis).

May 2011 - few days visiting Deutscher Wetterdienst (DWD), Offenbach, Germany: *Turbulence-schema modifications in the meteorological model COSMO* (activity proposal).

Nov. 2010 – Jan. 2011 ARPA - SIMC Bologna, Italy: *Turbulence in the atmospheric boundary layer* (internship).

Apr. – Jul 2008 ARPA - SIMC Bologna, Italy: *Limited-area ensemble forecasts of windstorms over Northern Europe* (internship/project) Report: Generation of limited-area ensemble system targeted for Northern Europe: a case study of wind gust.

Languages and contacts

languages Italian (mother tongue); English (fluent); Czech (basic level; certificate A2); French (school level).

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