# Elena Bachini

## Curriculum Vitae

## Personal Information

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| Name | Elena Bachini |
| Address | Via Trieste 63, 35121, Padova (IT) |
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| ORCID | 0000-0001-8610-9426 |
| Researcher ID | GRJ-1388-2022 |
| SCOPUS | 57219255684 |

## Education

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| 2020 | **Ph.D. in Computational Mathematics.** University of Padua, Italy |
| Sep 2018 - Mar 2019 | *Visiting PhD student.* "Oden Institute for Computational Engineering and Sciences", UT Austin, USA |
| 2016 | **Master's Degree in Mathematics.** University of Padua, Italy |
| Feb-Jul 2015 | *ERASMUS+ Programme.* Instituto Superior Técnico, Lisbon, Portugal |
| 2013 | **Bachelor's Degree in Mathematics.** University of Pisa, Italy |

## Research experience

### Current position

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| from Apr 2023 | **Fixed-term junior assistant professor** <br> Dept. of Mathematics "Tullio Levi-Civita", University of Padua, Italy |

### Previous positions

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| Apr 2021 - Mar 2023 | **Research associate** at the Institute of Scientific Computing, TU Dresden, Germany <br> Research project: "Vector- and Tensor-Valued Surface PDEs" |
| Jul 2020 - Mar 2021 | **Postdoctoral fellow** at the Dept. of Geosciences, University of Padua, Italy <br> Research project: "Development of a numerical model for the solution of strongly anisotropic flow and transport equations in porous media" |
| Apr - Jun 2020 | **Postdoctoral fellow** at the Dept. of Geosciences, University of Padua, Italy <br> Research project: "2D and 3D flow models in porous media with anisotropy" |
| Oct 2016 - Sep 2019 | **Doctoral student** at the Dept. of Mathematics "Tullio Levi-Civita", University of Padua, Italy <br> Thesis title: "Numerical methods for Shallow Water Equations on regular surfaces" |

### International mobility

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| Sep 2018 - Mar 2019 | *Visiting PhD student* at "Oden Institute for Computational Engineering and Sciences". University of Texas at Austin, Austin (TX), USA <br> Working under the supervision of Prof. C. Dawson in the Computational Hydraulics Group |

23 Aug - 10 Sep 2015   *VSRP - Applied Differential Equations Workshop*. KAUST, Saudi Arabia
The workshop included: lectures by KAUST faculty and research scientists, visit to the laboratory facilities, a group research project under the supervision of Prof. D. Gomes and collaborators. The work has been published in a research paper [pub1].

Feb-Jul 2015   *ERASMUS+ Programme*. IST, Lisbon, Portugal.
Courses from Master degree in Mathematics and Applications

## Awards and fellowships

2023-2026   Fixed-term assistant professorship (RTDa) within the *"RETURN - multi-Risk sciEnce for resilienT commUnities undeR a changiNg climate"* project, MUR-PNRR Extended Partnership PE5, funded by EU

2021-2023   Postdoctoral fellowship within the *"Research Unit FOR 3013"*, funded by DFG (German Research Foundation)

2020-2021   Postdoctoral fellowship within the project *"Progetto di Eccellenza CARIPARO 2017"*, funded by Fondazione CARIPARO

2020   Research grant (2 months) at the Dept. of Geosciences, University of Padua, Italy

2020   Nomination from the Doctoral School of Mathematical Sciences (UniPD) to the national prize *"con.Science"*

2018   Grant for a (6 months) period abroad from *"Fondazione Ing. Aldo Gini"*

2016-2019   Doctoral scholarship (3 years), Department of Mathematics, University of Padua, Italy

2014   *ERASMUS+ Programme* scholarship for a (1 semester) period abroad

## Teaching, tutoring and supervision

### Doctoral courses

from a.y. 24/25   *"Modeling and Big Data for Biological Systems"*, doctoral course, University of Padua. Co-organizer and teacher

### Master degree courses

a.y. 22/23   *"Computational Mathematics Project"*, Computational Mathematics (master) curriculum, TU Dresden. Research assistant.

### Bachelor degree courses

from a.y. 23/24   *"Calcolo Numerico"*, first cycle degree in Chemical and Materials Engineering, University of Padua. Teacher with responsibility

a.y. 22/23   *"Calcolo Numerico"*, first cycle degree in Energy/Mechanical Engineering, University of Padua. Teacher (16h)

a.y. 20/21   *"Matematica"*, first cycle degree in Agricultural Sciences and Technology, University of Padua. Didattica integrativa (30h)

a.y. 19/20   *"Calcolo Numerico"*, first cycle degree in Chemical and Materials Engineering, University of Padua. Teacher (48h)

a.y. 19/20   *"Calcolo Numerico"*, first cycle degree in Computer Science, University of Padua. Didattica integrativa (16h)

a.y. 16/17   Tutor for the course *"Analisi Matematica 1"* held by Prof. O. Bernardi, University of Padua

### Thesis supervision

- Supervision of 1 Master's degree thesis in Mathematical Engineering, University of Padua:
  ○ B. Pigato (2025 - ongoing)

- Co-supervision of 1 Master's degree thesis in Civil Engineering, University of Padua:
  ○ M. Zurini (2024). "Modellazione geometricamente intrinseca delle equazioni delle onde lunghe in acque basse e della loro approssimazione diffusiva"

- Co-supervision of 2 Master's degree thesis in Mathematics, University of Padua:
  ○ L. Favero (2022). "Intrinsic FEM for Vector Laplacian equations"
  ○ L. Donà (2020). "Bathymetry reconstruction via a time-dependent intrinsic shallow water model"

### Supervision of postdocs

- Co-supervision of 1 postdoctoral researcher, University of Padua:
  ○ F. Muraro (2025 - ongoing), within the *"RETURN - multi-Risk sciEnce for resilienT commUnities undeR a changiNg climate"* project (supervisor Prof. A. Larese)

## Workshops, schools, conferences, and seminars

### Keynote presentations

26-27 Jun 2024 **AIxtreme Annual Meeting**, Politecnico di Torino, Italy - *Keynote presentation*

### Invited seminars

16 Jan 2024 **Elite Scientific Computing Program seminars**, University of Bayreuth, Germany

11 Jan 2024 **PhD seminar series**, TUM-IAS, Germany

10 Jan 2024 **Research seminar**, University of Duisburg-Essen, Germany

9 Mar 2023 **Numerical Analysis seminar**, KTH, Sweden

18 Jan 2021 **Research seminar**, TU Dresden, Germany (online event)

11 Dec 2020 **Seminar series: "Computational Science and Engineering Seminar"**, School of Computing at the University of Leeds, Leeds, UK (online event)

### Invited speaker in mini-symposium sessions at international conferences

14-17 Oct 2025 (forthcoming) **"SIAM conference - Mathematical and Computational Issues in the Geosciences"**, Baton Rouge, Louisiana, USA

15-19 Jul 2024 **"SciCADE2024 - International Conference on Scientific Computation and Differential Equations"**, Singapore

10-12 Jul 2024 **"GIMC SIMAI YOUNG 2024"**, Napoli, Italy

18-22 Sep 2023 **"YAMC 2023 - Third Conference of Young Applied Mathematicians"**, Siena, Italy

28 Aug - 1 Sep 2023 **"SIMAI congress"**, Matera, Italy

19-22 Jun 2023 **"SIAM conference - Mathematical and Computational Issues in the Geosciences"**, Bergen, Norway

12-14 Dec 2022 **"POEMS2022 - Polytopal Element Methods in Mathematics and Engineering"**, Milan, Italy - invited to the "Lighting Talks" session

25-29 Jul 2022 **"SciCADE2022 - International Conference on Scientific Computation and Differential Equations"**, Reykjavík, Iceland

11-15 Jul 2022 **"EquaDiff15"**, Brno, Czech Republic

21-24 Jun 2021 **"SIAM conference - Mathematical and Computational Issues in the Geosciences"**, Milan, Italy (online event)

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| 11-14 Mar 2019 | "SIAM conference - Mathematical and Computational Issues in the Geosciences", Houston (TX), USA |
| 11-14 Sep 2017 | "SIAM conference - Mathematical and Computational Issues in the Geosciences", Erlangen, Germany |

## Contributed talks and posters

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| 1-5 Sep 2025 (forthcoming) | *"ENUMATH 2025 - European Conference on Numerical Mathematics and Advanced Applications"*, Heidelberg, Germany - co-organizer of a minisymposium session |
| 19-21 Jun 2025 (forthcoming) | *"HIPCOMP - $1^{st}$ Hellenic-Italian Conference on Computational Mechanics, Biomechanics and Mechanics of Materials"*, Rhodes Island, Greece |
| 25-28 May 2025 (forthcoming) | *"COUPLED 2025 - XI International Conference on Coupled Problems in Science and Engineering"*, Villasimius (Sardinia), Italy - co-organizer of a minisymposium session |
| 10-11 Feb 2025 | *"GNCS-SIAM Chapters Meeting 2025"*, Pavia, Italy |
| 29-31 Jan 2025 | *"RETURN - Interspoke Workshop VS1"*, Genova, Italy - poster |
| 27-29 Nov 2024 | *"RETURN - Dissemination Workshop"*, Bologna, Italy - poster |
| 3-7 Jun 2024 | *"ECCOMAS CONGRESS 2024 - $9^{th}$ European Congress on Computational Methods in Applied Sciences and Engineering"*, Lisbon, Portugal - co-organizer of a minisymposium session |
| 1-2 Feb 2024 | *"RETURN - Dissemination Workshop"*, Torino, Italy - poster |
| 18-19 Feb 2024 | *"RETURN - Workshop VS1"*, Padova, Italy - poster |
| 4-8 Sep 2023 | *"ENUMATH 2023 - European Conference on Numerical Mathematics and Advanced Applications"*, Lisbon, Portugal - co-organizer of a minisymposium session |
| 3-5 Jul 2023 | *"INTRUSION 2023 - numerIcal aNalysis, porous media and waTer ResoUrceS: a fruItful cOntamiNation"*, Bari, Italy |
| 5-7 Jun 2023 | *"COUPLED 2023 - X International Conference on Coupled Problems in Science and Engineering"*, Crete, Greece - co-organizer of a minisymposium session |
| 31 May - 1 Jun 2023 | *"CATHY Days - International workshop on coupled surface and subsurface flow in hydrology"*, San Vito di Cadore (BL), Italy |
| 15-17 Sep 2022 | *"Chemnitz Finite Element Symposium 2022 "*, Herrsching am Ammersee, Germany |
| 23-26 May 2022 | *"UMI100-800UniPD"*, Padova, Italy |
| 7-9 Mar 2022 | *"Workshop - PDEs for surfaces and Interfaces"*, Regensburg, Germany |
| 30 Sep - 4 Oct 2019 | *"ENUMATH 2019 - European Conference on Numerical Mathematics and Advanced Applications"*, Egmond aan Zee, The Netherlands - co-organizer of a minisymposium session |
| 22 May 2019 | *Graduate seminars series*, Department of Mathematics, University of Padua, Italy |
| 15-17 May 2019 | *"IperPA2019 - XVIII Italian Meeting on Hyperbolic Equations"*, Palermo, Italy |
| 3-7 Jun 2018 | *"Computational Methods in Water Resources XXII"*, Saint-Malo, France |
| 3-4 May 2018 | *"Seminari Padovani di Analisi Numerica"*, Padova, Italy |
| 4-6 Apr 2018 | *"International Conference on Terrestrial Systems Research"*, Bonn, Germany - poster |
| 6-8 Sep 2017 | *"IperPV2017 - XVII Italian Meeting on Hyperbolic Equations"*, Pavia, Italy |
| 12-14 Jun 2017 | *"Coupled Problems 2017 - VII International Conference on Coupled Problems in Science and Engineering"*, Rhodes Island, Greece |
| 28 May - 02 Jun 2017 | *"NUMHYP17: Numerical Methods for Hyperbolic Problems"*, Monte Verità, Switzerland |

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| 26-27 Jan 2017 | *"CATHY Days - International workshop on coupled surface and subsurface flow in hydrology"* San Vito di Cadore (BL), Italy |

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| 7-11 Oct 2023 | *"PARTICLES 2023 - VIII International Conference on Particle-Based Methods"* (Particle courses and conference), Milan, Italy |
| 11-13 Sep 2016 | *"4<sup>th</sup> Dolomites Workshop on Constructive Approximation and Applications"*, Alba di Canazei (TN), Italy |
| 23 Aug - 10 Sep 2015 | *"VSRP - Applied Differential Equations Workshop"* King Abdullah University of Science and Technology - Thuwal, Saudi Arabia |
| 19-26 Jul 2015 | *"European Consortium for Mathematics in Industry (ECMI) Modelling Week 2015"*, Instituto Superior Técnico - Lisbon, Portugal |

## Organizing activities

- **Member of the Organizing Committee** at:
  ○ *"YAMC 2025 - Fifth Edition of the Young Applied Mathematicians Conference"* (Padua, Italy, 22-26 Sep 2025)
  ○ *"INTRUSION 2025 - numerIcal aNalysis, porous media and waTer ResoUrceS: a fruItful cOntamiNation"* (Bari, Italy, 30 Jun-2 Jul 2025)

- **Member of the Scientific Committee** at:
  ○ *"COUPLED 2025 - XI International Conference on Coupled Problems in Science and Engineering"* (Villasimius (Sardinia), Italy, 25-28 May 2025)

- **Co-organizer of mini-symposium sessions** at:
  ○ SIAM-GS 2025 (Baton Rouge, Louisiana, USA, 14-17 Oct 2025)
  ○ ENUMATH 2025 (Heidelberg, Germany, 1-5 Sep 2025)
  ○ COUPLED 2025 (Villasimius (Sardinia), Italy, 25-28 May 2025)
  ○ ECCOMAS 2024 (Lisbon, Portugal, 3-7 Jun 2024)
  ○ ENUMATH 2023 (Lisbon, Portugal, 4-8 Sep 2023)
  ○ COUPLED 2023 (Crete, Greece, 5-7 Jun 2023)
  ○ ENUMATH 2019 (Egmond aan Zee, The Netherlands, 30 Sep - 4 Oct 2019)

## Publications (* = corresponding author)

### In preparation

[pub7] E. Abreu, E. Bachini, J. Perez, and M. Putti. A Lagrangian-Eulerian Finite Volume scheme for ISWE with localized discontinuous topography. *in preparation*.

[pre6] E. Bachini, C. Janna, A. Larese, G. Scovazzi. Including low-dimensional features in 2D surface models. *in preparation*.

[pre5] E. Bachini, M. Camporese, A. Larese. Shallow water equations versus zero-inertia approximation within a geometrically intrinsic framework. *in preparation*.

[pre4] E. Bachini. Intrinsic shallow water equations on a moving bottom surface. *in preparation*.

[pre3] E. Bachini and A. Voigt. Intrinsic surface finite element method for vector Laplacian on surfaces. *in preparation*.

[pre2] E. Bachini, M.W. Farthing, M. Putti. Intrinsic surface finite element method on a time-dependent surface. *in preparation*.

[pre1] E. Bachini, C. Dawson, M.W. Farthing, M. Putti. Intrinsic Discontinuos Galerkin scheme for SWE on surfaces. *in preparation*.

### Submitted publications with peer-review process

[sub1]  E. Bachini* and M. Putti. Convergence analysis of the intrinsic surface finite element method. *SIAM J. Numer. Anal.*, 2024.

### Publications with peer-review process

[pub9]  E. Bachini, P. Bandner, T. Jankuhn, M. Nestler, S. Praetorius*, A. Reusken, and A. Voigt. Diffusion of tangential tensor fields: numerical issues and influence of geometric properties. *J. Numer. Math.*, 32(1):55-75, 2024.

[pub8]  E. Bachini, V. Krause, I. Nitschke, A. Voigt*. Derivation and simulation of a two-phase fluid deformable surface model. *J. Fluid Mech.*, 977:A41, 2023.

[pub7]  E. Bachini, V. Krause, A. Voigt*. The interplay of geometry and coarsening in multicomponent lipid vesicles under the influence of hydrodynamics. *Phys. Fluids*, 35:042102, 2023.

[pub6]  E. Abreu, E. Bachini*, J. Perez, and M. Putti. A geometrically intrinsic Lagrangian-Eulerian scheme for 2D shallow water equations with variable topography and discontinuous data. *Appl. Math. Comput.*, 443:127776, 2023.

[pub5]  E. Bachini*, E. Bellizia, M. Putti, A. D'Alpaos, and M. Ghinassi. Two-dimensional model of flow and transport in porous media: linking heterogeneous anisotropy with stratal patterns in meandering tidal channel deposits of the Venice lagoon (Italy). *Environ. Modell. Softw.*,157:105535, 2022.

[pub4]  E. Bachini*, G. Manzini, and M. Putti. Arbitrary-order intrinsic virtual element method for elliptic equations on surfaces. *Calcolo*, 58(30), 2021.

[pub3]  E. Bachini*, M. W. Farthing, and M. Putti. Intrinsic finite element method for advection-diffusion-reaction equations on surfaces. *J. Comp. Phys.*, 424, 2021.

[pub2]  E. Bachini and M. Putti*. Geometrically intrinsic modeling of shallow water flows. *ESAIM Math. Model. Num. Anal.*, 54(6):2125–2157, 2020.

[pub1]  D. Gomes* et al. Existence of positive solutions for an approximation of stationary mean-field games. *Involve, a Journal of Mathematics*, 10(3):473–493, 2017.

### Doctoral thesis

[phd]  E. Bachini. *Numerical methods for Shallow Water Equations on regular surfaces*. PhD thesis, University of Padua, 2019.

## Research interests and collaborations

- **Scalar-, Vector- and Tensor-valued surface PDEs:** development of numerical methods adapted to the geometry for PDEs on surfaces (intrinsic finite volumes, discontinuous Galerkin, surface finite element, high-order virtual element methods). Applications to surface fluid flows, including shallow water equations and two-phase flow with curvature effects on stationary and evolving surfaces.
  COLLABORATORS: M. W. Farthing (U.S.Army-ERDC, US), G. Manzini (IMATI-CNR, IT - LANL, US), A. Mazzia (UniPD, IT), M. Nestler (TU Dresden, DE), S. Praetorius (TU Dresden, DE), M. Putti (UniPD, IT), A. Reusken (RWTH Aachen, DE), P. Schwering (RWTH Aachen, DE), A. Voigt (TU Dresden, DE)

- **Intrinsic Shallow Water Equations (ISWE) on fixed and moving surfaces:** modeling and development of numerical methods to solve ISWE (finite volumes with Eulerian and Lagrangian-Eulerian approach, discontinuous Galerkin scheme, continuous Galerkin with entropy-viscosity stabilization).
  COLLABORATORS: E. Abreu (UniCamp, BR), C. Dawson (UT Austin, US), M. W. Farthing (U.S.Army-ERDC, US), J. Pérez (ITM, CO), M. Putti (UniPD, IT)

- **Coupling of 1D, 2D and 3D models:** formulation and numerical solution of geometrically intrinsic models of two-dimensional overland flows for coupled surface-subsurface hydrological applications; numerical modeling of flow and transport equations in porous media with strong anisotropy; development of unfitted methods for embedded low-dimensional features.
  COLLABORATORS: E. Bellizia (UniPD, IT), M. Camporese (UniPD, IT), M. W. Farthing (U.S.Army-ERDC, US), M. Ghinassi (UniPD, IT), A. Larese (UniPD, IT), C. Paniconi (INRS, CA), M. Putti (UniPD, IT), G. Scovazzi (Duke Univ., US)

## Project participations

### International projects

- *"MONUGEO - Modern numerical methods for high-fidelity simulation of geohazards"* project, HORIZON-MSCA-2023-SE-01 - G.A. n. 101182721 01/03/2025-28/02/2029 - 1.269.600 EUR (Head of UniPD Unit A. Larese)

- *"REACT - Digital Twins of Civil StRucturEs And Protection Systems in A ClimAte Change PerspecTive"* project, TUM-IAS, Munich, Germany, 01/10/2021-30/09/2025 - 80.000 EUR (PI A. Larese)

- Research Unit *"Vector- and Tensor-Valued Surface PDEs" (FOR 3013)*, German Research Foundation - DFG (PI A. Voigt)

### Italian projects

- *"Modelli matematici supportati dall'integrazione di dati per agricoltura sostenibile"* project, INdAM-GNCS 2025 - CUP E53C24001950001 - 1700 EUR (Coordinator N. Ferro)

- *"ReLUIS - Rete dei Laboratori Universitari di Ingegneria Sismica e Strutturale"* project, DPC-ReLUIS 2024-2026

- *"RETURN - multi-Risk sciEnce for resilienT commUnities undeR a changiNg climate"* project, MUR-PNRR Extended Partnership PE5 on Natural Risks Next-Generation EU, 01/10/2021-31/03/2026 (Scientific head A. Larese)

- *"NEMESIS - NumErical MEthods for the SImulation of the impact of extreme hazards on Structures and landscape"* project, University of Padua - 39.376,70 EUR (PI A. Larese)

- *"HYDROSEM: Fluvial and tidal meanders of the Venetian-Po plain: from hydrodynamics to stratigraphy"* project, Progetto di Eccellenza CARIPARO 2017 - 250.000 EUR (PI M. Ghinassi)

- UniPD-SID-2016 project *"Approximation and discretization of PDEs on Manifolds for Environmental Modeling"*, University of Padua (PI M. Putti)

## Institutional responsabilities

Feb-Jul 2024    Member of "Commissione Incaricata di definire i bisogni relativi all'emissione di Bandi a Cascata per Start-up, Spin-Off, Piccole Imprese Innovative", within the Spoke Water VS1, MUR-PNRR RETURN project

| from Sep 2023 | Member of the Teaching Board for the first cycle degree in Chemical and Materials Engineering, Dept. of Industrial Engineering, University of Padua |
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| from Apr 2023 | Member of the Department Board, Dept. of Mathematics "Tullio Levi-Civita", University of Padua |
| 2017-2018 | Representative of the PhD students in the Department Board, Dept. of Mathematics "Tullio Levi-Civita", University of Padua |

## Reviewer for

| 2024 | AIMS Mathematics,Communications in Computational Physics, European Journal of Environmental and Civil Engineering |
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| 2023 | Bollettino dell'Unione Matematica Italiana, Computational Geosciences, Journal of Computational Physics |
| 2022 | ESAIM: Mathematical Modelling and Numerical Analysis, Mathematical and Computational Applications, Mathematics and Computers in Simulation |
| 2021 | Applied Mathematics and Computation |

## Scientific societies

| from 2024 | Member of AIMETA, member of SIMAI, member of UMI |
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| from 2022 | Member of "European Women in Mathematics" |
| from 2017 | Member of the "Gruppo Nazionale Calcolo Scientifico" (GNCS) of the Istituto di Alta Matematica (INdAM) |
| 2019-2020 | Member of "SIAM Geosciences" and "SIAM Computational Science and Engineering" |

## Other activities

| 22 Jan 2025 | Engagement and interaction event in a primary school<br>∘ Activity: "Sperimentando con i dadi" |
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| 2023, 2024 | Dissemination event *"Science4All"*, University of Padua<br>∘ 29 Sep 2024, activity: "Asteroids from another space"<br>∘ 30 Sep 2023, activity: "La matematica per comprendere il mondo" |
| 23-24,26-27 Jan 2024 | Training programme (with OpenBadge) "Teaching4Learning@Unipd - New Faculty Course", University of Padua |
| 17 Oct - 28 Nov 2014 | Progetto C.A.M – Crittografia e Aritmetica Modulare.<br>Tutor: assistance to the participants (high-school students) during lectures and laboratories, University of Padua |

## General skills

| Languages | English (Fluent), Italian (Mother tongue) |
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| Software | C++, Fortran (from Fortran 77 to object-oriented Fortran 2018), Matlab, Python, Git, CMake, LaTeX, Unix-based systems |

Padova, April 2025

Elena Bachini