# Alessandro Bile

*Curriculum vitæ*

# Summary

## Part I – GENERAL INFORMATION

| | |
|---|---|
| **Full Name** | Alessandro Bile |
| **Spoken Languages** | Italian (native), English (C2 written and spoken), French (B1 written, B2 spoken) |
| **Personal WebPage** | https://alessandrobile.site.uniroma1.it/ |

## Part II – Education
### II A – Formation

| TYPE | YEAR | INSTITUTION | NOTES |
|---|---|---|---|
| **under-graduate** | 2013 | Liceo Classico Terenzio Mamiani | **Maturità Classica – Classical Bachelor Licence (100/100)** |
| **Bachelor degree** | 2013-2016 | Università degli Studi di Roma La Sapienza | **Bachelor's degree in Physics (110/110).** Thesis: "BNCT: boron neutron capture therapy". |
| **Bachelor degree** | 2014-2017 | Conservatorio di Roma Santa Cecilia | **Bachelor's degree in Electronic Music (110/110).** Thesis: "Gravitational Music". |
| **Master degree** | 2016-2018 | Università degli Studi di Roma La Sapienza | **Master's degree in Physics (110/110 cum Laude).** Thesis: "Objects detection and tracking". |
| **Post-laurea training** | 2019 | Experis Academy di Bergamo (ITA) | Data Science Certification |
| **24 CFU Post-laurea training** | 2020-2021 | Sapienza | 24 CFU Teaching Certification |
| **Post-laurea training** | 2021 | CNR | Certification in Technological Translator, organized by the Mathematical Office for Innovation and Businesses of the CNR |
| **Dottorato-PhD** | 2019-2022 | Università degli Studi di Roma La Sapienza | **PhD in Electromagnetism.** Thesis:" Solitonic Neural Network: Development of an innovative photonic neural network based on solitonic plastic interconnections". Special **Mention Doctor Europaeus** awarded by Sapienza University of Rom. |
| **Master degree** | 2021-2023 | Conservatorio di Roma Santa Cecilia | **Master's degree** in Electronic Music. |

### II B – Languages

| Language | Understanding | Spoken Skills | Written Production |
|---|---|---|---|
| Italian | Native | Native | Native |
| English | C2 | C2 | C2 |
| French | B2 | B1 | B1 |
| Spanish | A2 | A1 | A1 |

### II C – Digital Competences

| Programming Language | Level |
|---|---|
| Matlab | Professional |

| | |
|---|---|
| COMSOL | Professional |
| Python | Good Knowledge |
| C | Good Knowledge |
| Fortran | Good Knowledge |
| Octave | Professional |
| R | Good Knowledge |
| Max-MSP, PureData | Good Knowledge |
| Scratch | Good Knowledge |
| Perl | Basic |
| Blender | Basic |

- Professional skills of didactic tools for remote lessons, tutoring and exams. Professional knowledge of Exam.net, Safe Exam Browser (SEB), Google Meet, Zoom and Microsoft Teams.
- Professional knowledge of the Office package.

## Part III – Appointments

### III A – Academic Appointments

| START | END | INSTITUTION | POSITION |
|---|---|---|---|
| **2022** | **2023** | Sapienza Università di Roma (Italy) | **Research fellowship** related to the research project "Development of materials, metamaterials and polar metasurfaces for manipulating mid-infrared emission", the Department of Basic and Applied Sciences for Engineering of the University of Rome "Sapienza", with scientific director Prof. Maria Cristina Larciprete. |
| **2022** | **2023** | Università di Torino (Italy) | **Research fellowship** related to the research project "Study pilot demonstration for the preparation and dissemination of forecast biophysical supports to the application of integrated and organic production", at the Physics Department of the University of Torino, with scientific director Prof. Claudio Cassardo. |
| **2022** | **2022** | Femto-ST Institut (FR) | **Research fellowship from BGF** related to the experimental demonstration of "Solitonic X-Junction in Lithium Niobate On Insulator". |
| **2021** | **2022** | Sapienza Università di Roma (Italy) | **Research fellowship** related to the research project "*Intelligent optical systems for recognition and sanification of pathological micro- and nano-* |

| | | | |
|---|---|---|---|
| | | | *organisms*" at the Department of Basic and Applied Sciences for Engineering of the University of Rome "Sapienza", with scientific director Prof. Eugenio Fazio. |
| **2022** | **2022** | Sapienza Università di Roma (Italy) | **Physics and Mathematics Professor** at "Liceo Ginnasio Statale Visconti", High School in Rome. |
| **2019** | **2021** | Sapienza Università di Roma (Italy) | **Research fellowship** related to the research project "*Optical and optoelectronic systems for signal processing and monitoring of cultural heritage*" at the Department of Basic and Applied Sciences for Engineering of the University of Rome "Sapienza", with scientific director Prof. Eugenio Fazio. https://www.collectioncare.eu/about- us / |
| **2021** | **2022** | Sapienza Università di Roma | *Lecturer* (**Professore a Contratto**) of Elements of Mathematical Analysis, Technical Professions for Construction and the Territory (Civil and Industrial Engineering). |
| **2021** | **2022** | Digital Education Lab | **Principal Investigator** on Education Research methods. |
| **2019** | **2022** | Sapienza Università di Roma | **Tutor** of Physics 1 (FIS/01) for the course in Civil Engineering. |
| **2019** | **2022** | Sapienza Università di Roma | **Tutor** of Mathematical Analysis (MAT/05) for the course in Civil Engineering. |
| **2019** | **2021** | Camplus College di Roma | **Mentor** for the courses of Physics 1, Physics 2, Mathematical Analysis, Programming. |
| **2020** | **2021** | Camplus College di Bologna | **Mentor** for the courses of Physics 1, Physics 2, Mathematical Analysis, Programming. |
| **2020** | **2022** | Digital Education Lab | **Mentor and Founder** of the course Music and Code. |
| **2012** | **2018** | Sapienza Università di Roma | Representative of the PhD Students at the Collegium of *Electromagnetism, Nanoscience and Mathematical Models for Engineering* |

## III B – Visiting Researcher and Visiting Professor Appointments

***FEMTO-ST Institute, Université de Franche Comté, Besançon (France)***

24/01/2022 – 24/04/2022    Visiting Researcher at the *Institute d'Optique*.

### III C - Editorial Appointments

| START | END | ROLE |
|---|---|---|
| 2022 | NOW | **Editor** for the International Journal of Information Security and Software Engineering. |
| 2022 | 2022 | **Member of the Scientific Committee** of the CMPmeet 2022, Munich, Germany. |
| 2022 | 2022 | **Member of the Program Committee** of the International Conference on Neural Computing for Advance Applications (NCAA), Jian, China. |

### III D - Referee for the following scientific journals:

| START | END | JOURNAL |
|---|---|---|
| **2023** | **2023** | **AIP Advances** |
| **2023** | **2023** | **Science & Education (Springer)** |
| **2020** | **2023** | **Cognitive Neurodynamics (Springer)** |
| **2021** | **2023** | **Technology, Knowledge and Learning (Springer)** |
| **2022** | **2023** | **HardwareX (Elsevier)** |
| **2022** | **2023** | **Modern Intelligent Times** |

https://www.innovationforever.com/aboutjournal/MIT/PeerReviewers

### III E – Music Composer at the following Concerts:

| Date | Place | Concert |
|---|---|---|
| June-2017 | New York | Participation in the "Fuse" Concert as Film Artist at Di Menna Center |
| June-2018 | New York | Participation in the "Many Lands" Concert as Film Artist at Symphony Space Theatre. |
| July-2018 | Rome | Participation in the "Opus" Concert as a Film Artist at the Roman Philharmonic Academy. |

## Part V – Teaching experience as Professor

### V A – Laurea courses

| Academic Years | Institution | Lecture/Course |
|---|---|---|
| **2022-2023** | Sapienza Università di Roma | **Fundamentals of mechanics – physics (FIS/07)** for the Medicine and Psychology - Medical and Surgical Sciences and Translational Medicine Orthopedic Techniques - Rome Azienda Ospedaliera Sant'Andrea. |
| **2022-2023** | Sapienza Università di Roma | **Complementary Mathematics (MAT / 04)** for Techniques of prevention in the environment and in the workplace (Bachelor's |

| | | Degree) (health profession of prevention technician in the environment and in the workplace) |
|---|---|---|
| **2023** | Sapienza Università di Roma | **Orientamento in Rete - Physics (FIS/01),** Faculty of Medicine and Psychology, Sapienza University of Rome. |
| **2021-2022** | Sapienza Università di Roma | **Mathematical Analysis (MAT/05)** for Technical Professions for Construction and the Territory course (Bachelor's Degree) (CIVIL AND ENVIRONMENTAL ENG.) |

## V B – High School Courses

| Academic Years | Institution | Lecture/Course |
|---|---|---|
| **2022** | Liceo Classico Visconti di Roma | Mathematics and Physics |

## V C – Students graduated under the AB's supervision

AY 2019-2020 **Francesca Moratti** (Electronic Eng. – laurea magistrale): *study of neuromorphic photonic circuits based on solitonic waveguides*

AY 2019-2020 **Riccardo Pepino** (Nanotech Eng. – laurea magistrale): *Study of a Magnetic switch for surface plasmon polariton circuits.*

AY 2019-2020 **Romolo D'Amico** (Computer and Automatic Eng. – laurea triennale): *Development of a machine learning system through LSTM networks for the analysis and predictions of historical data series.*

AY 2020-2021 **Federico Camponeschi** (Electronic Engineering – laurea magistrale): *Hybrid photonic Nano-interconnection plasmon-soliton* – laurea cum laude + special mention of the Jury Committee.

# Part VI - Awards and Honors

24/01/2022-24/04/2022 Research grant awarded by the French government (BGF) to conduct three months of research activities in France – Budget 5112 €. https://www.institutfrancais.it/ italy / bags-of-the-French-government-0

21/02/2010 to now **A. Bile** was awarded by the Communic-action! contest as the best communication strategy of scientific results through the work entitled "Sonification for the threshold comparison of real and predicted data through neural networks", the 4th congress of AISAM - Italian Association of Atmospheric Sciences and Meteorology, University of Milano, Italy. http://congresso.aisam.eu/comunic-azione-.html

# Part VII - Funding Information [grants as PI-principal investigator or I-investigator]

2022-2023 **PI-principal investigator**. Research Grant: start of research, funding for young researchers. Project title: Realization of psychomemories using soliton neural networks based on the photorefractive plasticity of nonlinear crystals. Funded by Sapienza University of Rome -- Budget 2000,00 €.

Reference: AR2221814D17193B

**2022-2023**    **I-investigator.** Sapienza University research projects. Project title: Study and implementation of a dense optical neural network capable of recognising recurring characteristics in data sets (images) Study and implementation of a dense optical neural network capable of recognising recurring characteristics in data sets (images). Funded by Sapienza University of Rome – Budget 3000,00 €.

Reference: RP12218166ECCD89

**2021-2022**    **PI-principal investigator**. Research Grant: start of research, funding for young researchers. Project title: Study of complex photonic neural networks built through the use of soliton guides. Funded by Sapienza University of Rome -- Budget 1000,00 €.

Reference: AR12117A814F8BCA

**2020-2021**    **PI-principal investigator**. Research Grant: start of research, funding for young researchers. Project title: Photonic implementation of elementary units of artificial intelligence based on soliton guides. Funded by the "Sapienza" University of Rome – Budget 1000,00 €.

Reference: AR120172B7152382

# Part VIII - Research Activities

## VIII A – Summary of all research activities

*Main Research Activity: Photonic Hardware Artificial Intelligence*

My main research work is focused on photonic hardware for the implementation of intelligent systems. The technological means used is the spatial soliton. Soliton waveguides exhibit a plastic behavior by their nature, that is, a modifiable behavior. The refractive index contrast of a soliton guide depends on the intensity of the light used to write it: therefore, by modulating the intensity of the light sent, it is possible to increase or decrease this contrast, giving neuroplasticity to the system. For this reason, the natural evolution of soliton integrated systems is in learning networks or neural networks. This process is typical of biological neural systems. Like them, soliton neural networks (SNNs), made by the interconnection of fundamental structures that are X-junction neurons, are able to learn information and store it in specific neural pathways through changes in the refractive index.

*Software Artificial Intelligence for Microclimate prediction in Museums*

At the same time, I use software neural networks, Machine Learning and Deep Learning, for the creation of devices capable of predicting microclimatic fluctuations inside museums. The models used can be used to safeguard the works of art and to improve the quality of visitors' well-being as well as lower maintenance and management costs*.*

*Educational Models for learning transversal skills*

In recent years I have been interested in the cognitive processes through which the learning of complex concepts that allow the interconnection between cognitive areas takes place. Observing how the playful dimension plays a decisive role, I approached the analysis of educational models based on game-learning, observing how children who learn in this way are able to obtain a faster and more effective learning, even of abstract concepts.

# Part IX – scientific metric indicators

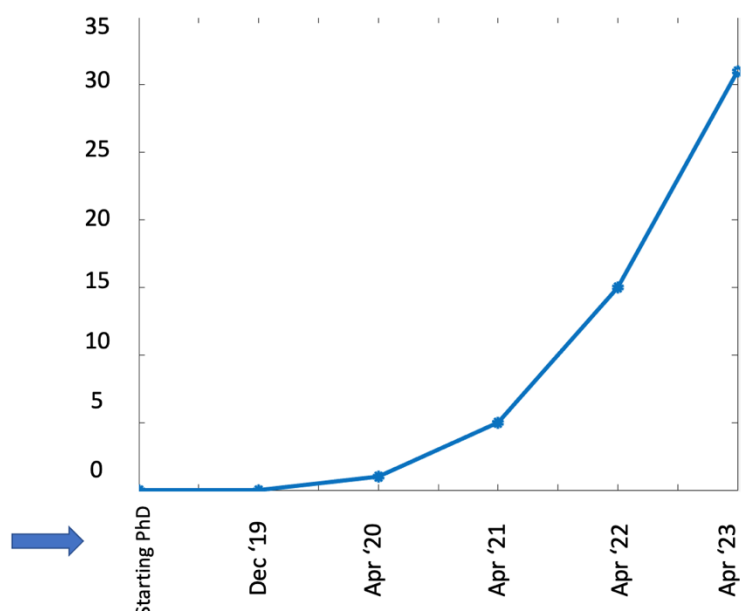|  |  | total (2020-2023) |
|---|---|---|
| Scopus | H-index: | 4 |
|  | Total records: | 12 |
|  | Total international papers (Proceeding excluded): | 12 |
|  | Total Citations: | 31 |
|  | Average citations/paper: | 2.81 |
| Google Scholar | H-index: 4 | |
|  | I10-index: 4 | |
|  | Citations: 31 | |



Fig. Citations over time

## Part X – Publications and conferences

### X A – Papers

- **A. Bile,** R. Santoboni, S. Frasca and P. Astone, *Gravitational Music: a mathematical-musical model for the popularization of gravitational waves*, submitted.
- **A. Bile**, M. Chauvet, H. Tari and E. Fazio, All-Optical erasing of photorefractive solitonic channels in Lithium Niobate thin films, submitted.
- H. Tari, **A. Bile**, A. Nabizade, M. Iodice and E. Fazio, *Addressable hybrid Plasmonic-Solitonic interconnection*, submitted.

- **A. Bile**, G. Bile, G. Nicita, *Report Analysis of the transversal skills acquired though the game-programming Minecraft Education*, submitted.

1)  **A. Bile**, G. Bile, R. Pepino, H. Tari, *Innovative and non-invasive method for the diagnosis of dyschromatopsia and the re-education of the eyes*, Res. Biomed. Eng (2023). https://doi.org/10.1007/s42600-023-00263-1

2)  F. Frasca, E. Verticchio, A. Peiró-Vitoria, A. Grinde, **A. Bile**, C. Chimenti, C. Conati Barbaro, G. Favero, E. Fazio, F. Garcia-Diego, A.M. Siani, *Strategies for the use of microclimate sensors in spaces housing collections*, Heritage Science (2022), *Herit Sci* **10**, 200 (2022). https://doi.org/10.1186/s40494-022-00831-1.

3)  **A. Bile**, H. Tari, A. Grinde, F. Frasca, A.M Siani, E. Fazio, *Novel model based on artificial neural networks to predict short-term temperature evolution in museum enviroment*, Sensors 22, 615 (2022) https://doi.org/10.3390/s22020615.

4)  **A. Bile**, M. Chauvet, H. Tari and E. Fazio Supervised Learning of soliton X-junctions in Lithium Niobate films On Insulator, Optics Letters 47, 21 (2022), https://doi.org/10.1364/OL.468997.

5)  **A. Bile**, H. Tari, E. Fazio, Episodic Memory and Information Recognition Using Solitonic Neural Networks Based on Photorefractive Plasticity. Appl. Sci. 2022, 12, 5585, https: // doi.org/10.3390/app12115585.

6)  H. Tari, **A. Bile**, F. Moratti, E. Fazio, *Neuromorphic activation function for Surface Plasmon Polariton integrated circuits*, Plasmonics (2022) https://doi.org/10.1007/s11468-021-01553-z

7)  B. Ianero, **A. Bile**, M. Alonzo, E. Fazio, *Stigmergic electronic gates and networks*, in press on J. Computational Electronics **20**, 2614–2621 (2021)

8)  **A. Bile**, F. Moratti, H. Tari**,** E. Fazio, *Supervised and unsupervised learning using a fully-plastic all-optical unit of artificial intelligence based on solitonic waveguides*, Neural Comput. & Applic. (2021). https://doi.org/10.1007/s00521-021-06299-7

9)  **A. Bile**, Development of intellectual and scientific abilities through game- programming in Minecraft. Educ Inf Technol (2022). https://doi.org/10.1007/s10639-022-10894-z

10) **A. Bile**, R. Pepino, E. Fazio, *Study of magnetic switch for surface plasmon-polariton circuits*, AIP Advances 11, 045222 (2021)

11) F. Camponeschi, **A. Bile**, H. Tari, E. Fazio, *Plasmonic-Solitonic coupling structure*, Int. J. Sci. Eng. Appl. Sci. 7 (3), 162-167 (2021)

12) M. Reza Majidi, H. Tari, **A. Bile**, E. Fazio, *Development of sol-gel based carbon ceramic electrode modified by graphene oxide - polypyrrole nanocomposite for simultaneous determination of uric acid and dopamine in presence of ascorbic acid,* Int. J. Sci. Eng. Appl. Sci. 7 (3), 162-167 (2021).

## X B – Book Chapters

1)  E. Fazio, **A. Bile**, H. Tari (2022). Optical Soliton Neural Networks. In (Ed.), Artificial Neural Networks – Recent Advances, New Perspectives and Applications. IntechOpen. https://doi.org/10.5772/intechopen.107927

## X C – Conferences in the period 2020-2022

### *Plenary Speeches*

1)  **A. Bile**, F. Frasca, A.M. Siani, E. Verticchio, E. Fazio, Prediction of the microclimate through NAR and NARX neural networks: application to Rosenborg Castle, museum partner of the CollectionCare project, CollectionCare Conference, Valencia, Spain. Plenary Speaker - December 2021.

### *Invited Speeches*

1)  **A. Bile**, H. Tari, E. Fazio, Development of an episodic neural network model using spatial solitons, CMPMEET2022 International meet on condensed matter physics, Munich (Germany). Invited Speaker – May 2022.


### *Regular speeches and poster*

1.  E. Fazio, **A.Bile**, H. Tari, Neural networking and machine learning based on photorefractive solitonic waveguides: novel all-plastic Photonic Artificial Intelligence, Photorefractive Photonics and Beyond 2022, Monastier di Treviso (Italy), Regular Speech – September 2022.

2.  H. Tari, **A. Bile**, M. Iodice, E. Fazio, Photorefractive soliton synapsis for Surface-Plasmon-Polariton circuits, Photorefractive Photonics and Beyond 2022, Monastier di Treviso (Italy), Regular Speech – September 2022.

3.  **A. Bile**, M. Chauvet, F. Bassignot, L. Gauthier-Manuel, H. Tari, E. Fazio, Addressable and erasable photonic neurons using solitonic X-Junctions in lithium niobite films, Photorefractive Photonics and Beyond 2022, Monastier di Treviso (Italy), Regular Speech – September 2022.

4.  E. Fazio, **A. Bile**, H. Tari, Stigmergic reinforcement learning in photonic neural networks based on solitonic waveguides, AI and Machine Learning, Budapest (Hungary), Regular Speech – August 2022.

5.  M. Chauvet, A. Perin, **A. Bile**, F. Bassignot, L. Gauthier-Manuel, E. Fazio, Films De LiNbO3: a plateforme pour fonctions optiques photo induites, OPTIQUE NICE 2022, Nice (France), Regular Speech – July 2022.

6.  **A. Bile**, H. Tari, E. Fazio, Solitonic neuromorphic hardware for episodic pattern recognition and memorization, ICOP 2022, Trento (Italy), Regular Speech – June 2022.

7.  **A. Bile**, H. Tari, E. Fazio, Solitonic neuromorphic hardware for pattern recognition and episodic memorization, Euro Optics 2022, Rome (Italy), Regular Speech - March 2022.

8.  **A. Bile**, F. Frasca, E. Verticchio, E. Fazio, G. Favero, C. Chimenti ,, A. Grinde, A.M. Siani, Novel approach based on machine learning techniques to predict the microclimate variables inside museums, at the 4th congress of AISAM - Italian Association of Atmospheric Sciences and Meteorology, University of Milano, Italy. Regular Speech – February 2022.

9.  F. Frasca, E. Verticchio, **A. Bile**, E. Fazio, G. Favero, C. Chimenti, A. Vulpiani, A. Grinde, A.M. Siani, Approaches to analyze the indoor climate in historical buildings, at the 4th congress of AISAM - Italian Association of Atmospheric Sciences and Meteorology, University of Milano, Italy. Regular Speech – February 2022.

10. **A. Bile**, G. Nicita, D. De Vito, Analysis of transversal skills acquired through game-learning, Fablearn Italy Conference 2021, INDIRE, Regular Speech – December 2021.

11. F. Frasca, E. Verticchio, **A. Bile**, E. Fazio, G. Favero, C. Chimenti, C. Conati Barbaro, A. Vulpiani, S. Lupi, A. Grinde, B. Escobar Soca, M. Zarzo, P. Merello, F.J. García-Diego, A.M. Siani, Changing track in procedures for deploying microclimate sensor devices in museum environments: application to CollectionCare museums, CollectionCare Conference, Valencia, Spain. Regular Speech – December 2021.

12. E. Fazio, **A. Bile**, H. Tari, Experimenting with optical plasticity in photonic machine learning – towards all-optical Artificial Intelligence, EOSAM 2021, Rome Italy, Regular Speech – September 2021.

13. F Frasca, E. Verticchio, **A. Bile**, E. Fazio, G. Favero, C. Chimenti, A. Vulpiani, A. Grinde, A.M. Siani, Definition of allowable targets from indoor climate observations in exhibition rooms: the case study of the Rosenborg Castle (Denmark) Analysis of the indoor climate trends in exhibition rooms: the case study of the Rosenborg Castle (Denmark), at the 3rd congress of AISAM - Italian Association of Atmospheric Sciences and Meteorology, University of L'Aquila, Italy, Poster - February 2021.

14. **A. Bile**, F. Moratti, E. Fazio, Photonic implementation of an elementary unit of artificial intelligence based on solitonic waveguides, Orale at ICOP2020 Italian Optics and Photonics Conference, University of Parma, Italy. Regular Speech – September 2020.

15. H. Tari, **A. Bile**, F. Moratti, E. Fazio, Implementation of neuromorphic activation function within Surface Plasmon Polariton circuits, at ICOP2020 Italian Optics and Photonics Conference, University of Parma, Italy. Regular Speech – September 2020.

16. H. Tari**, A. Bile**, F. Moratti, E. Fazio, Surface Plasmon Polariton neuromorphic circuit with sigmoid activation function, at 9th EPS- QEOD Europhoton, Czech Technical University, Prague, Czech Republic. Poster – September 2020.