Curriculum Vitae

PERSONAL INFORMATION

Full Name: Llorenç Cremonesi Plaja
Date of birth: 3 April 1990

WORK EXPERIENCE

April 2021 — Technical collaborator
EOS S.r.l., viale Ortles 22/4, I-20139 Milano (Mi), Italy

The collaboration aims at designing specific measurements to assess the capabilities of a custom-built instrument in the recognition of wavelength-sized complex particles.

Dec 2019 – Dec 2020 — Postdoctoral research fellow at EuroCold Lab, University of Milan- Bicocca
"Impact of aerosols and fine dust from the Mediterranean and North African regions on the Alpine Cryosphere (2018-NOECO-0004)
Earth and Environmental Science Department - Piazza della Scienza, 1, 20126 Milan

During the fellowship, I Characterized the optical properties of dust in Alpine and Antarctic samples in a clean room and supported the assembly of an optical instrument based on digital holography.

April 2010 – March 2012 — Technical project assistant
MCE - the Milan Company of Engineering S.r.l. – Via Bassini 53, 20133 Milan
Integrated electrical engineering services

Designing technical plans and layouts with CAD software, drafting bill of quantities and technical reports, translation into English of technical documents.

TEACHING EXPERIENCE:

Lectures and exercise classes including some simple experiments and demonstrations in class, support in drafting and evaluating written and oral exams.

March 2019 – June 2019 — Graduate teaching assistant - Thermodynamics
Physics Department - Università degli Studi di Milano - Via Celoria 16, 20133 Milan
Undergraduate course in Physics

October 2018 – December 2018 — Graduate teaching assistant - Basic Mathematics course
Computer Science Department - Università degli Studi di Milano
Undergraduate degree course in IT Science

March 2018 – July 2018 — Graduate teaching assistant - Physics course
Università degli Studi di Milano – Agricultural Science Department
Undergraduate degree course in Agricultural Science and Technology

Nov 2017 – Dec 2017 — Tutor for the Basic Math Lab course
Department of Mathematics "Federigo Enriques" - Università degli Studi di Milano
Undergraduate degree courses in Geological Science and in Cultural Heritage and Environment

March 2017 – June 2017 — Graduate teaching assistant - Physics course
Università degli Studi di Milano – Agricultural Science Department
Undergraduate degree course in Agricultural Science and Technology

March 2016 – June 2016 — Undergraduate teaching assistant - Physics course
Università degli Studi di Milano – Agricultural Science Department

Undergraduate degree course in Agricultural Science and Technology

EDUCATION AND TRAINING

September 2016 – December 2019

PhD in Experimental Physics

PhD school in Physics, Astrophysics and Applied Physics - Instrumental Optics Laboratory
Università degli Studi di Milano – Physics Department

Thesis title: Light scattering from micrometric mineral dust and aggregate particles: effects of shape and structure applied to paleoclimate studies.

Abstract: The extent of the direct and indirect contribution of aerosols to the radiative energy balance of the Earth has not to date been determined with adequate accuracy. The thesis examines the scattering of visible light from non-spherical particles in the micrometric size range, such as mineral dust and colloidal aggregates, with a focus on the effect of their shape and morphology. This thesis provides an overview of the experimental results from analysing Antarctic and Alpine ice cores using optical techniques with a particle-by-particle approach. Particular attention is also given to the study of colloidal aggregates as a model for complex particles. Specifically, we rely on Single Particle Extinction and Scattering and Near Field Scattering on flowing samples, which give model-independent results. On the theoretical side, an interpretation of scattering data is given in terms of the structure factor of the particles, beyond the spherical approximation. The experimental findings are supported by extensive simulations based on the Discrete Dipole Approximation. By measuring two optical parameters simultaneously, it is possible to distinguish compact particles from aggregates of smaller particles occurring in deep ice cores. While some scattering parameters are correctly predicted by well-established models such as the Rayleigh–Debye–Gans approximation, it is found that particle shape and internal structure have a significant effect on their complex scattering amplitude. Similarly, the discrepancy between the results obtained from two different experimental approaches for particle sizing can be ascribed to particle shape. Moreover, there is evidence that effective medium approximations and Lorenz–Mie scattering cannot be applied to aggregates, as a result of the contribution of correlations.

May 2018 – June 2018

Training course on advanced machining techniques

Università degli Studi di Milano – Mechanical Workshop of the Physics Department

September 2017

Ice Core Analysis Techniques (ICAT)

Centre for Ice and Climate Niels Bohr Institute- Københavns Universitet
Juliane Maries Vej 30, DK-2100 Kbh

New methods developed for the analysis of ice cores with regard to climate research, with dedicated theoretical and laboratory exercise sessions.

April 2014 – July 2016

Master's Degree in Physics

Università degli Studi di Milano – Physics Department

Thesis title: *Zero angle light scattering probes internal structure and correlations of aggregates*
110/110 cum Laude

30th June 2015 – 24th July 2015

Summer School on Atomistic Simulation Techniques

SISSA — CECAM – Democritos - via Bonomea, 265 - 34136 Trieste, Italy

Introduction to Fortran90, AWK, numerical calculus. Theory and implementation of Monte Carlo algorithms, Molecular Dynamics and electronic band structure simulations. Introduction to the Quantum Espresso suite.

October 2009 – April 2014 — **Bachelor's Degree in Physics**
Università degli Studi di Milano – Physics Department
Thesis title: *Object reconstruction by phase retrieval algorithms on measured laser diffraction patterns*
110/110 cum Laude

2002 – 2009 — **Scientific High school degree**
98/100 – L. S. S. Donatelli-Pascal (Milan, Italy)

19th June 2013 – 9th July 2013 — **Applied Mechanics Course**
Università degli Studi di Milano – Mechanical workshop of the Physics Department

PERSONAL SKILLS

Mother tongues: Italian, Spanish, Catalan.

Other languages

	UNDERSTANDING		SPEAKING		WRITING
	Listening	Reading	Spoken interaction	Spoken production	
English	C1	C1	C1	C1	C1
French	B1	B1	A1	A1	A1

Levels: A1/A2: Basic user - B1/B2: Independent user - C1/C2: Proficient user
Common European Framework of Reference for Languages

Digital competence

SELF-ASSESSMENT				
Information processing	Communication	Content creation	Safety	Problem solving
proficient user	proficient user	proficient user	proficient user	proficient user

Levels: Basic user - Independent user - Proficient user

Proficient user of programming languages such as C++, Labview, and Python; good command of LaTeX, image editing software, and office suite.

Job related skills: I have grown a personal interest for languages and developed good cooperation and relational skills acquired during teamworking activities. As a result of my experiences, I am familiar with multidisciplinary exchanges and speaking with ease in public. I deeply appreciate teaching and tutoring and value a positive, constructive interaction with colleagues and students.

ADDITIONAL INFORMATION

Research interests and overview of previous work

I developed my PhD project in Experimental Physics in the Optics Research Laboratory of the Physics Department of the University of Milan. The main goal was the characterization of visible light extinction and scattering by micrometric, non-spherical particles, going beyond the spherical approximation approach. More generally, the fundamental framework of this research is to expand the knowledge about the interaction of aerosols with solar radiation and its contribution to Earth's radiative balance. I applied optical instruments for assessing the physical properties of micrometric solid and liquid particles, among which the recently introduced Single Particle Extinction and Scattering (SPES) method and Near Field Scattering. I gained experience in designing, assembling, and testing simple optical instruments, as well as programming interfaces and software tools. The samples I investigated included Alpine and Antarctic mineral dust, deep ice core mineral aggregates, colloidal fractal aggregates and water droplets. I also had the chance to learn about the exciting properties of ice and glaciers. More recently, I collaborated in applying SPES to aerosols and water droplets.

Until recently, I have been a postdoctoral research fellow at the EuroCold Lab (University of Milan-Bicocca) where I studied dust and solid pollutants in Alpine firn cores, collecting further data from ice cores, and looking deeper into radiative transfer models based on such experimental results. In particular, an ongoing collaboration with the Paul Scherrer Institute (Zurich) and Università Ca' Foscari (Venice) is aimed at characterizing the chemical composition and concentration of pollutants in Alpine samples from the last four years. I also cultivated an interest in the physics of water-related phenomena, which brought me to the CMWS meeting at DESY in Hamburg last February. Recent results suggest it would be promising to apply coherent optics and other techniques to explore the temperature and density fluctuations in water and its interaction with minerals and solid particles in the atmosphere.

Lately, I collaborated in characterizing Antarctic samples from the East Antarctic International Ice Sheet Traverse from a size distribution and concentration standpoint, as well as from an optical properties point of view. The preliminary results obtained with a novel instrument based on digital holography and with a coulter counter instrument suggest the occurrence of some volcanic events that correlate with peculiar extinction properties of the particles as measured with SPES.

I studied the effects of two-point field-field correlations on colloidal fractal aggregates, as a benchmark for assessing the effect of the internal structure of a particle on its radiative properties. The study of the complex field scattered in the forward direction produced strong experimental evidence of the inapplicability of Effective Medium Approximations to fractal structures, and a direct determination of both the fundamental parameters in fractal morphology. Along with the laboratory results, an independent perturbative model was developed, directly linking the particle morphology to its optical properties. I focused on the study of mineral dust from Antarctic and Alpine ice cores. By means of optical techniques it was possible to distinguish compact particles from aggregates of tiny grains formed *in situ* in deep ice cores. Another study dealt with the effect of particle shape on the extinction cross section and optical depth of micrometric particles. I collaborated with the Niels Bohr Institute in characterizing the shape and aspect ratio of the dust particles from Greenlandic RECAP ice cores, as well as their contribution to extinction. A considerable difference in concentration was observed between Holocene and Glacial samples. This study helped explaining a known discrepancy between the results obtained from two widely used commercial instruments for particle sizing, which was found to be due to the orientation of non-isometric particles.

During these years, I generated an extensive database of numerical calculations based on the Discrete Dipole Approximation (DDA) to bolster experimental results, covering the case of various morphologies for both absorbing and dielectric particles suspended in water or in air. I also addressed the calculation of high numerical aperture focusing of infrared and visible laser radiation through dielectric interfaces, in order to give a detailed description of

the wavefronts in a dielectric medium in such conditions. The algorithm describes the amplitude profile near the focal region and the aberrations introduced by the optical interfaces with respect to the ideal gaussian beam model. This was applied to quantify non-linear optical properties in perovskites such as two-photon absorption efficiency in collaboration with the Weitzmann Institute. I implemented a ray-tracing calculation for diffractive optics imaging devices based on stretchable metal-polymer nanocomposites and participated in the realization and testing of an optical tabletop prototype.

The study of morphology-dependent extinction resonances in supercooled water microdroplets predicted by Mie theory and observed experimentally with Raman spectroscopy was the subject of a collaboration with the Institut für Kernphysik. I carried out Mie and DDA calculations for both spherical and non-spherical water droplets and implemented a code based on the Numerov's method to solve the scattering problem, recast in the form of radial Schrodinger equations. This determined the extent to which temperature gradients and slight deviations from the spherical shape contribute to the dampening of the narrow peaks in the extinction cross section.

More recently, I participated in the development of an autonomous and portable instrument based on SPES, designed to characterize aerosols, which hosts a sensor at 0° and two additional sensors at larger angles to characterize the angular dependence of the optical depth and the phase function of aerosols. With this instrument it has been possible to measure the field scattered by single water droplets generated with an atomizer. A preliminary campaign was carried out on a hot air balloon to investigate the lower planetary boundary layer. Some relevant results have been obtained from the study of data collected over several months by two identical instruments in Concordia Research Station in Antarctica and urban sites in Northern Italy.

List of Publications

Llorenç Cremonesi (2021). Probing the morphology of dust particles in deep icecores with light scattering.Il Nuovo Cimento C, (just accepted).

Ceratti, D. R., Cohen, A., Tenne, R., Rakita, Y., Snarski, L., Jasti, N. P., Cremonesi, L., ... & Cahen, D. (2021). *The pursuit of stability in halide perovskites: the monovalent cation and the key for surface and bulk self-healing*. Materials Horizons (2021).

Cremonesi, L., Minnai, C., Ferri, F., Parola, A., Paroli, B., Sanvito, T., & Potenza, M. A. (2020). *Light extinction and scattering from aggregates composed of submicron particles*. Journal of Nanoparticle Research, 22(11), 1-17

Cremonesi, L. *Light scattering from micrometric mineral dust and aggregate particles. Effects of shape and structure applied to paleoclimate studies* (Doctoral Thesis, 2019). Supervisor: M. A. C. Potenza; Director of the School: M. Paris - University of Milan, Physics Department
Springer Theses series, Springer Nature Switzerland (Sep 2020). ISBN 978-3-030-56787-3

Cremonesi, L., Siano, M., Paroli, B., & Potenza, M. A. (2020). *Near field scattering for samples under forced flow*. Review of Scientific Instruments, 91(7), 075108.

Cremonesi L., Passerini A., Tettamanti A., Paroli B., Delmonte B., Albani S., Cavaliere F., Viganò D., Bettega G., Sanvito T., Pullia A. & Potenza M.A.C. (2020) *Multiparametric optical characterization of airborne dust with single particle extinction and scattering*, Aerosol Science and Technology, 54(4), 353.

Minnai, C., Cremonesi, L., Milani, P., & Potenza, M.A.C. (2019). *A very simple scheme for spectrally resolved imaging by means of curved polymeric gratings*. Materials Research Express, 6(6), 065044.

Ceratti, D. R., Rakita, Y., Cremonesi, L., Tenne, R., Kalchenko, V., Elbaum, M., ... & Cahen, D. (2018). *Self-Healing Inside APbBr3 Halide Perovskite Crystals*. Advanced Materials , 30(10): 1706273.

Simonsen, M. F., Cremonesi, L., Baccolo, G., Bosch, S., Delmonte, B., Erhardt, T., ... & Vallelonga, P. (2018). *Particle shape accounts for instrumental discrepancy in ice core dust size distributions*. Climate of the Past, 14(5), 601-608.

Potenza, M. A. C., Cremonesi, L., Delmonte, B., Sanvito, T., Paroli, B., Pullia, A., ... & Maggi, V. (2017). *Single Particle Extinction and Scattering allows detection and characterization of aggregates of aeolian dust grains in ice cores*. ACS Earth and Space Chemistry , 1(5): 261.

Potenza, M. A. C., Nazzari, D., Cremonesi, L., Denti, I., & Milani, P. (2017). *Hyperspectral imaging with deformable gratings fabricated with metal-elastomer nanocomposites*. Review of Scientific Instruments, 88(11), 113105.

Seminars

"Single Particle Extinction and Scattering (SPES) for dust in Antarctica ice cores" - April 2017
Antarctic Research Centre - Victoria University of Wellington, Wellington, New Zealand

Conferences

DESY Water Week 2020 CMWS forum, Hamburg – Germany (24th-28th Feb 2020)

106° Congresso Nazionale della Società Italiana di Fisica (14th-18th Sep 2020) - *"A light scattering pathway for characterizing dust content in ice cores"*

Posters

Department of Physics Congress (28th-29th June 2017): *"Characterization of aeolian dust in Antarctic ice cores"*

2017 GRS Clusters & Nanostructures, Boston- Usa (8th-9th July 2017): *"Characterization of Aeolian Dust Aggregates in Ice Cores by Single-Particle Extinction and Scattering"*

2017 GRC Clusters & Nanostructures, Boston- Usa (9th-14th July 2017): *"Characterization of Aeolian Dust Aggregates in Ice Cores by Single-Particle Extinction and Scattering"*

Polar 2018: Davos – Switzerland (20 June 2018): *"Shape and size constraints on ice core dust optical properties",*

2019 GRC: Clusters and Nanostructures, Les Diablerets – Switzerland (15-21 June 2019): *"Two-point field-field correlations affect light scattering and extinction of submicron particle aggregates"*

2020 European Aerosol Conference 2020, Aachen – Germany (31st Aug-4st Sep 2020): *"Multiparametric optical characterization of urban aerosol with Single Particle Extinction and Scattering"*

24th Alpine Glaciology Meeting (25th - 26th March 2021): Towards an interdisciplinary characterization of the Rutor glacier in Aosta valley.

Awards and accomplishments

Springer Theses series 2019 (PhD thesis)
106th SIF National Congress - best communications

(To whom it may concen)

Le dichiarazioni rese nel presente curriculum sono da ritenersi rilasciate ai sensi degli artt. 46 e 47 del DPR n. 445/2000.

Il presente curriculum, non contiene dati sensibili e dati giudiziari di cui all'art. 4, comma 1, lettere d) ed e) del D.Lgs. 30.6.2003 n. 196.

Luogo e data: Milano, 19 aprile 2021

FIRMA Elorena Cremonesi