

## Carlo Cercignani: In memoriam

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The 21th International Conference on Transport Theory began with a scientific session honoring Carlo Cercignani's seventieth birthday. The opening ceremony was held in the Sala del Consiglio di Facoltà at the Politecnico di Torino, in the morning of July 13th, 2009. Despite the serious illness that was undermining his health, Carlo opened the session with an interesting lecture as always distinguished by the clarity and conciseness of his presentation. This was the last talk that Carlo ever gave, because in the fall his condition worsened, and on January 7th, 2010, Carlo Cercignani passed away in Milan.

The scientific community has lost thereby one of its most eminent mathematical physicists. Carlo Cercignani had graduated first in physics, in 1961 and then in mathematics, in 1963. It was really as an assistant in analysis that Carlo began his academic career, and as time passed his love for mathematics, and especially rigorous mathematics, continued to characterize his work. His extensive research activities ranged widely in the area of mathematical physics and its applications, making him one of Italy's leading mathematical physicists. However among his many interests, which ranged from translating Homer to composing poetry, one inevitably came to realize that his true passion was research on the Boltzmann equation with its many open problems. An example of the breadth of his scholarship, as well as his prime interest, is found in his book "*Ludwig Boltzmann. The man who trusted atoms*" (Oxford University Press, 1988), in which Carlo studies not only Boltzmann's scientific theories, but also his philosophical thought.

In the transport theory community, Carlo Cercignani has been one of the most active participants. I met Carlo Cercignani at the ninth International Conference on Transport Theory, the first in which I participated, in Montecatini Terme, the beautiful resort town near to Firenze, in 1985, when the meeting was, for the first time, held outside of US. Carlo gave a 45 minute lecture entitled "Kinetic theory of dense gas of rough spheres". Those were very auspicious years for kinetic theory and Carlo Cercignani was always found among the most active participants. I recall that between May and June of 1985 there were four meetings on such theories: the "Mathematical Methods in Kinetic Theory" at Oberwolfach, the "Mathematical Methods for the Equations of Gas Kinetics" at the École Normale Supérieure in Paris, the "International Workshop on Mathematical Aspects of Fluid and Plasma Dynamics", also in Paris, the fourth being the Montecatini meeting previously mentioned. Carlo's contributions most notably kept alive the interest of the mathematical community in critical phenomena in general and the Boltzmann equation in particular. In that same year he published his most famous treatise "*The Boltzmann equation and its applications*," which collects numerous results on the Boltzmann equation previously found scattered in hundreds of references throughout the literature.



Carlo Cercignani with the Italian contingent during the 10th International Conference on Transport Theory in the Campus of Virginia Tech (1989).

Coming back to the opening session of our conference. After a short introduction dedicating the session to Carlo Cercignani, the scientific activity began with the lecture given by Carlo entitled “*Transport Theory for MEMS and NEMS*”. Here I do not really want to talk about Carlo’s research, because it is impossible to describe in few pages the significant results he obtained in so many different areas. Even in his research centred upon the Boltzmann equation, his papers were characterized by the diversity of his methods, his broad point of view and his skilful use of mathematics. But one must remember that he also published in many other areas, such as theoretical mechanics, partial differential equations, numerical analysis, semigroup theory, spectral theory, Riemann-Hilbert problems, Fourier analysis, self-similar solutions of the Boltzmann equation, evaporation and condensation, kinetic modeling of granular media, derivation of the Boltzmann equation from microscopic models, and so on.

The last decade of Carlo’s research was mainly devoted to the study of the MEMS, Micro-Electro-Mechanical-Systems, which have applications in several industrial fields, as for example silicon inertial sensors and actuators produced by surface micromachining processes. These consist of a collection of suspended and fixed structures coupled into capacitors and vibrating at low frequencies. The modeling of such structures requires applications from many areas of physics, stemming from the coupling of electrostatics, gas flow and structural dynamics. The problem of evaluation of fluid damping is still an intriguing and partially unresolved topic. Cercignani combined the kinetic methods of the Boltzmann equation with the continuum Reynolds equation, obtaining interesting results. In this field he produced many papers, summarized and presented in the book “*Slow Rarefied Flows. Theory and Application to Micro-Electro-Mechanical Systems*” (Birkhauser, 2006).

The presence of Carlo Cercignani in the mathematical-physics community was always vital and incisive. The void he leaves behind is deep, but he always represented a praiseworthy example of enthusiasm, tenacity, versatility and productivity. His courage and his devotion to scientific research will always remain alive in us, and will be an incentive for everyone, the young and not-so-young alike. We are happy to remember him as in the photo on this page, the leader of the Italian contingent of transport theorists.