Editorial: In memoriam - Tito Arecchi (11 December 1933 – 15 February 2021)

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The nonlinear science community experienced a painful loss with the sudden death of our colleague and friend, Professor Tito Arecchi. For many years, Professor Arecchi was a very active and constructive member of the CHAOS Editorial Board and later became an Honorary Editor. Tito Arecchi was a pioneer of nonlinear optics and laser physics as well as nonlinear dynamics. His contributions have been so significant as to constitute milestones in the field of photon statistics and in that of nonlinear dynamics not limited to lasers. To this aim we would like to emphasize the year 1965 as emblematic for his brilliant personality. He published two fundamental contributions: In the first one[1] he gave the first experimental evidence of the statistical difference between a laser and a random field obtained by *photon statistics*. In the second one, in collaboration with his first student Rodolfo Bonifacio, they derived the nonlinear equations which describe an electromagnetic pulse interacting self-consistently with an ensemble of two-level atoms under the assumption of a homogeneously broadened electric-dipole transition with two Bloch relaxation times $T_2(\gamma_\perp = 1/T_2)$ and $T_1(\gamma_\| = 1/T_1)$,and of a linear broadband loss mechanism[2]. These equations are usually referred as the Maxwell-Bloch equations but they should be referred as the Arecchi-Bonifacio equations. In these equations, the Slowly Varying Envelope Approximation (SVEA) for the electromagnetic pulse was introduced for the first time. The Arecchi-Bonifacio equations are universally used to describe the dynamics of a single mode laser. Nowadays it is well known that they are formally equivalent to those of the Lorenz model and therefore chaotic behavior is inherent in a laser[3]. However, we had to wait until 1982 to give an experimental confirmation using a single mode CO_2 laser with sinusoidal modulation of the cavity losses[4]. This is due to the fact that in a large class of lasers, the so-called class B lasers, the macroscopic polarization evolves on fast time scales compared with the other two dynamical variables, i.e. the laser intensity, which is proportional the photon number of the laser field mode, and the population inversion $(\gamma_\perp > k > \gamma_\|)$, where k is the decay rate for the electric field. Few years later, Lorenz type chaos has been demonstrated for class C lasers, where the three decay rates are of the same order of magnitude[5]. The above classification of lasers is another crucial contribution by Tito Arecchi[6]. However, it would be narrow-band to link the scientific activities of Tito only to these aspects. Tito has developed, with other colleagues, other important lines of research in the fields of complex systems both from a theoretical and experimental point of view; among them we recall the optical vortices and their statistics, control and synchronization of chaos, multistability and even applications to neuroscience[7]. It is important to emphasize that Riccardo Meucci et al. have recently revisited the rather simple laser model used in 1982[4]. They have highlighted there new aspects on the relationship between multistability and dissipativity as well as its control[8]. Generalized multistability, another pioneering contribution by Tito, has become a focusing issue in many different fields as the numerous papers published on Chaos demonstrate.

In this latest period, when the pandemic has profoundly changed our lives, Tito´s enthusiasm and passion for physics have not diminished, until few days before his departure, and no one who has interacted with him can forget it. This is the greatest legacy of him to science. He will be greatly missed by his many colleagues, former students and friends.

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