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Honorary note

Manuel G. Velarde

Manuel Garcia Velarde, was born on September 7th, 1941 in Almeria (SE Spain). In 1963 Manuel graduated in Physics at Universidad Complutense of Madrid (UCM, Spain). On September 13th, 1965, Manuel was married to Maria del Pilar Ibarz-Gil. After spending a couple of years at the Spanish Atomic Center (JEN, in Spanish) Manuel decided to leave Spain in September 1965 to work for his Ph. D. at the School of Ilya Prigogine (Nobel Laureate for Chemistry in 1977) and then at the Universté Libre of Brussels (ULB, Belgium) with research work done on classical kinetic theory at the ULB (assessing the domain of validity of Gibbs' local equilibrium hypothesis, on the basis of Onsager-Prigogine linear thermodynamics of irreversible processes). Manuel got the second Ph. D. from the UCM in November 1968. It was necessary from the administrative point of view in order to apply for any position in the Spanish universities. Another reason was that having the Ph. D. from Brussels made it easier to get the contract at University of Texas at Austin, where Prigogine was the head of a research institute. With another piece of research, this time on quantum transport theory (analyzing aspects of the divergence of density series expansions in transport theory beyond the dilute Boltzmann gas theory — focusing on self-diffusion) he obtained the Ph. D. in Physics from the ULB in January 1970. At that time, a Ph. D. obtained in a foreign university was not legally accepted in the Spanish university system and many others like him were forced to obtain two Ph. D. For his research Manuel received guidance, besides Prof. Prigogine, from Manuel Castans, Gregoire Nicolis, and Pierre Resibois (his ULB Ph. D. supervisor). Later on, Manuel has been awarded with the Honorary Doctorate from the Universite de Provence-Aix-Marseille (France) in 1994 and from the Chernyshevsky Saratov State University (Russia) in 2010.

Manuel's research over four decades covers a wide spectrum of phenomena, problems, and sub-disciplines, with an inter-, trans-, and pluri-disciplinary approach (from Physics, including geophysics — waves in the atmosphere, the sea and straights-, waves in nonlinearly elastic solids-like polysterene rods-, laser dynamics, reaction–diffusion systems, lattice dynamics in active media, quantum electron transport in crystalline solids, … to neurodynamics and model-brains for robots; see web site www.ucm.es/info/fluidos). Below, we focus on Manuel's contributions to hydrodynamics and, in particular, to interfacial phenomena in general. In a sequential way let us identify his research achievements in thermodynamics and statistical mechanics (basic questions including basic aspects of hydrodynamic instabilities), about the role of cross-transport processes in various problems, interfacial instabilities due to surfactants, and surface-tension-gradients (the Marangoni effect); Bénard convection and derivatives, patterned convection and the evolution of pattern defects, interfacial transverse and longitudinal–dilational waves, the onset and growth of solitary waves and solitons in various systems including interfaces, interfacial instabilities, and waves excited by parametric excitation-coupled or not to the Marangoni effect in single and layered structures-, the self-propulsion or the super-drag of active drops due to instabilities triggered by the Marangoni effect, the aspects of wetting and spreading dynamics, and the dynamics of falling liquid films.

Besides the mentioned problems in his doctoral work Manuel's interest, initiated at ULB, on some rather basic questions of (mostly non-equilibrium) thermodynamics and statistical physics continued over decades. We may mention his analysis, several years later, of the domain of the validity of the so-called Boussinesq (and Overbeck) hydrodynamic equations of standard use in the literature of hydrodynamic instabilities. He identified the significant parameters to be used in the first and succesive approximations. He also studied the general lay-out of most hydrodynamic instabilities with particular emphasis on buoyancy-driven (Rayleigh–Benard) instabilities and surface-tension-gradient-driven (Bénard–Marangoni) instabilities. Another related problem was the assessment of the validity of John Ross' nonlinear non-equilibrium thermodynamics. With him he targeted not only the basic understanding of all transport processes and reactive systems but also the purely thermodynamic approach to hydrodynamic instabilities with quite satisfactory experimental verification of predictions. The same spirit is in the work with Victor Starov when dealing with wetting and spreading processes and, to a certain extent, in the work in collaboration with Ramon G. Rubio and colleagues.

From ULB, in September 1969, Manuel moved to the Department of Physics at University of Texas at Austin where Ilya Prigogine was the

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Director of a Research Center at that time. There, continuing under his guidance, he started research in Fluid Physics with Robert S. Schechter. In a two-year postdoc period he dealt with the role of the cross-transport of matter, mass diffusion, under the action of a temperature gradient (the Soret effect) in triggering hydrodynamic instability. This instability leading to convection masked the genuine molecular transport. He elucidated the role that indeed convection played in quite many experimental studies and publications. This research led to three papers, one in Advances in Chemical Physics, which until now are used by researchers. Worth mentioning is that his predictions about the onset of instability and his estimate of the convected fluxes were beautifully verified in new experiments, motivated by his papers, were carried out by H. J. Val Tyrrell.

In fall of 1972, at the invitation of Nicolas Cabrera, Manuel returned from the USA to Spain to participate in the development of the Department of Physics in the recently created Universidad Autonoma of Madrid (UAM). During a decade Manuel was interested in one-to-many aspects of hydrodynamic instability leading to a string of more papers on the role of the Soret effect, and on the influence of geometry, including surface deformation, affecting stability, the role of inertial effects with rotation or varying effective gravity (so-called, albeit misnamed, micro-gravity), the role of anisotropy in liquid crystals, the role of electric fields and charge injection in EHD, the competition and/or cooperation of bulk hydrodynamics and interfacial hydrodynamics (mostly with the Marangoni effect), etc. At UAM Manuel also initiated the exploration of biophysical problems (like the alternating aerobic–anaerobic respiration process of a *Klebsiella Aerogenes* bacterial culture, modeling theory for experiments conducted by Hans Degn at Odense University, or the four-decades periodic damaging outbreak on trees, like balsam fir and white spruce, of *Choristoneura Fumiferana*, a light-emitting budworm), reaction–diffusion systems, and also exploring the role of, e. g., autocatalysis in triggering interfacial instability (an area of research initiated with Albert Sanfeld and Annie Steinchen Sanfeld). Since that time, Manuel has been moving across borders with non-linear dynamics as an "instrument" for dealing with evolutionary problems, thus transferring concepts, and more, from one subfield of science to another (like transferring ideas from fluid physics to laser dynamics: the Q-switch dynamics of a laser with a saturable absorber, like CO_2 with SF_6, was modeled with the equations of the two-component Soret hydrodynamic equations, etc.). It suffices to mention that, as noted above, Manuel started being interested in the role played by varying effective gravities in fluid physics. This led him to accept consultancy with the European Space Agency (ESA) for about a decade. He was member of the ESA-Microgravity Advisory Committee (ESA-MAC) and various other ESA specialist panels. Later on Manuel became the president of the European Low Gravity Research Association (ELGRA). During this period he was appointed, with a five-year contract, CNRS Visiting professor with the University of Provence (Aix-Marseille). His action, in close collaboration with Etienne Guyon led to a spectacular research development. In 1994 the University of Aix-Marseille awarded Manuel an Honorary Doctorate.

In 1981 Manuel moved to the Spanish Open University (acronym in Spanish, UNED) where he created the first Department of Physics. It was a difficult period as until 1987 neither an appropriate building nor laboratory equipment were available. Yet theoretical research went ahead with quite a number of results about the role of surface deformation and the Marangoni effect on instability leading to interfacial transverse and longitudinal–dilational waves. At that time Manuel started being interested in nonlinear waves like solitons. He provided a theory for interfacial instabilities leading to such waves. This was done in collaboration with Hartmut Linde and a Chinese doctoral student, Xiao-Lin Chu, the first Chinese citizen ever to get a Ph. D. in Physics in the history of Spain. Besides research in a variety of problems, Manuel embarked in the adventure of lecturing for the lay audience all over the country in a program called in Spanish "La barraca de la ciencia", hundred of lectures with demonstrations and participation of the audience.

At the end of 1992 Manuel moved to the UCM thanks to a special chair programme (acronym in Spanish, PROPIO) set-up by the Spanish Ministry of Education and Science, quite in the spirit of the Royal Society chairs, giving complete freedom to the chair holder. Manuel was a cofounder of the Instituto Pluridisciplinar (IP-UCM), a research center where he served twice as a Director.

As a follow-up of his previous work, and based on theory and experiments carried out in his laboratory at the IP-UCM, he provided quite a lot of results on hydrodynamic instabilities, with emphasis on interfacial phenomena. He dealt with the problems of patterned convection and the evolution of defects, the onset and growth of interfacial solitary waves and solitons, interfacial instabilities with parametric excitation, coupled or not to the Marangoni effect, in single and layered structures, the self-propulsion of active drops due to instability triggered by the Marangoni effect, the aspects of wetting and spreading dynamics, and the evolution of falling liquid films.

Among the results obtained was his coinage of the concept of "dissipative solitons" as a natural follow-up of a string of papers on "dissipative hydrodynamic oscillators" published in the preceding period while at UNED. Manuel also transfered soliton concepts and methodology from hydrodynamic and interfacial instabilities to active lattice dynamics and, eventually, to electron transport in anharmonic lattices modeling crystalline solids. In doing this he embarked in yet another subfield of science new to him, quantum solid state physics. Worth mentioning is a concept he invented in his theory of soliton-assisted electron transport. It is the "solectron", a new quasiparticle which is the result of the dynamic bound state between an electron and a lattice soliton carrier. His "solectron" is a generalization, to nonlinear Hamiltonians, of the (now text book) "polaron" concept introduced by L. D. Landau and S. I. Pekar and, subsequently, developed by H. Fröhlich, T. Holstein, R. Peierls, and others. This new and recent line of Manuel's research benefits from the collaboration with Werner Ebeling, Alex P. Chetverikov, and several other colleagues – theorists, numerical experts, and experimentalists – from several countries.

As mentioned by his collaborators Christo I. Christov and his former Ph. D. student Andreas Wierschem, with deep theoretical insight he guided the systematic numerical/computational and experimental exploration of all possible features (collisions, wall reflections, and other evolutionary aspects) of solitonic interfacial waves driven by the Marangoni effect. The consequences of the discoveries have proven to be of much value well beyond their interfacial hydrodynamics origin.

Worth noting is that the basic idea Manuel exploited over and again was that for almost any dynamically evolutionary system, like a living system, a drop or an interface, when affected by appropriate external constraints, can be made to act as an "engine" – with its internal dynamics – as it receives energy or potentially reactive matter from outside. Then the initial state, motionless or other, can give way to a new state, steady or otherwise (periodically oscillatory or chaotic), as a consequence of the dynamic balance between the energy input and its internal redistribution and dissipation.

In work with Yuri S. Ryazantsev and Alex Ye. Rednikov, Manuel predicted the possible self-propulsion of "active" drops like those with reaction at their open surfaces or in their interiors leading to variations of its surface tension. It was verified in experiments by several authors.

The flows, inside and outside, were analytically obtained, using matched asymptotic expansions, under various circumstances like reaction at the drop surface in a homogeneous or inhomogeneous surrounding, uniform internal heat generation, time-varying effective gravity, and g-jitter. This permitted to establish the generalization to finite Reynolds number of the classic, any text book, and results due to J. S. Hadamard (1911), W. Rybczynski (1911), and B. G. Levich (1962). A curious result was that also superdrag beyond the Stokes–Hadamard–Rybczynski law could occur to the drop depending on its activation mechanisms. Manuel also explored the role of the simultaneous action of electric and magnetic fields on the deformation of the surface of a drop.

Another line of research followed by Manuel originated in his encounter with Victor M. Starov in 1987, in Sofia, where both had been invited by their colleague and friend Ivan B. Ivanov for the celebration of the centenary of the University of Sofia. However, it was only a decade later that they were able to establish research collaboration. It still continues, thanks to the economic support of the EU under the Marie Curie Networks programme. Ramón G. Rubio and Uwe Thiele have been an instrument in the significant progress along this line of research. It has already produced a long string of papers with a rich variety of theoretical predictions and experimental results, generally providing confirmation of the theory and with technological potential. It has also led to the publication of a joint research frontier monograph. One of their findings is illustrated in Fig. 1. When a drop of lateral extent, L, is deposited on a dry porous solid substrate, under complete wetting conditions (hence the Derjaguin pressure is strictly positive) it penetrates the substrate with an extent, $l(t)$. Then after some time, t_{max}, its base reaches a maximum base value, L_{max}, and so the imbibition size, l_{max}. The spectacular result with porous cellulose wafers is that no matter the value of the porosity density, the porous size, the viscosity of the (silicone oil) liquids, and the duration of the experiments (seconds, minutes, hour), with appropriate scaling, all data fall on two universal curves corresponding, respectively, to the time evolution of the surface and imbibition lengths. The overall process, following L_{max}, involves retraction of the surface extent to zero.

Finally, the evolution and dynamics of a falling liquid film, much common in leasure parks, squares, and gardens, attracted the interest of Manuel. The pioneer in its study was P.L. Kapitza. Kapitza's seminal work, with theory and experiments, attracted applied mathematicians. Among them was Victor Ya. Shkadov whose Ph. D. thesis was devoted to this problem. At IP-UCM, Victor Shkadov and Manuel worked on the role of surfactants and the Marangoni effect on the evolution of the falling film. Subsequently, several other colleagues joined in the collaborative research, thanks to economic support from the EU. They (Serafim Kalliadasis, Christian Ruyer-Quil, Benoit Scheid and Radyadour Kh. Zeytounian) published several joint papers and ended up by publishing a research frontier monograph where the interplay of flow, heat, and the Marangoni effect offers a rich variety of evolution equations and theoretical predictions on wave patterns and solitons in one, two, and three dimensions.

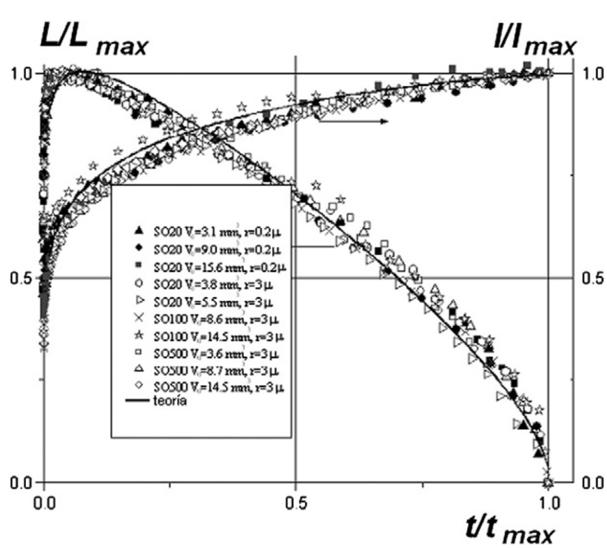

Fig. 1. Time evolution in dimensionless units of the spreading process under complete wetting condition of an oil drop over an originally dry porous substrate (cellulose wafer). First, imbibition starts taking place inside down while spreading over the surface proceeds up to a maximum value at t_{max}. Subsequently, the liquid recedes until the process stops. With $l(t_{max}) = l_{max}$ and $L_{max} = L(t < t_{max})$ we have $L(t_{max}) < L_{max}$ until it goes to zero.

Manuel has published around 330 journal papers, some 130 chapter-contributions to books, and over 130 lay audience papers, co-authored six research frontier monographs, five of which deal with fluid physics and one with lattice dynamics; five other monographs Manuel has produced as scientific coordinator. The full list of Manuel's publications as well as other interesting and useful information can be found on www.ucm.es/info/fluidos. Below 10 Manuel's publications with highest impact are cited.

In 2002 Manuel was elected for three years as a Rector of the International Center for Mechanical Sciences (CISM, Udine, Italy). Since 2005 Manuel is an Honorary Rector and a member of its Scientific Council.

Manuel has been an invited research scientist or an invited professor in a number of universities and institutions like CEN-Saclay, Paris [VI, XI], Marne-La-Vallée, Grenoble, Marseille [I, II, III], CISM-Udine, Pescara, Los Alamos National Laboratory (consultant during a decade in the 1980s), NTH-Trondheim, Cambridge U., Chelsea College, Imperial College, Stanford U., UC Berkeley, UC Santa Barbara, UC Irvine, Academia Sinica-Beijing, HUST-Wuhan, and ECNU-Shanghai.

Manuel has lectured as an invited speaker at a huge variety of international and national scientific events worldwide. Manuel was elected to membership in 1993 with the *Academia Europaea*. Manuel was awarded a number of international/national prices/medals, for example, 1996 he received the RAMMAL Medal of the Societe Française de Physique and the Fondation Ecole Normale Superieure (Paris). In 2003 he was awarded with the *DuPont* Science prize, to mention only a few.

Manuel has served the international community and the profession in several committees like Committee "Liquids", European Physical Society-EPS (co-founder); MAC-European Space Agency-ESA; Commission C3 "Statistical Physics" IUPAP; Scientific Council International Centre Heat & Mass Transfer, Ankara, Turkey; Centre Europeen de Thermodynamique-CERET (co-founder); Panel "Chaos, Order and Patterns: Aspects of Nonlinearity"-NATO; Human Capital & Mobility, Physics panel-EEC; ELGRA, Vicepresident and President; Training and Mobility of Researchers, Panel-EU (Physics: Fellowships & Networks); Conference Committee-IUTAM; Intenational experts committee to evaluate the Physics Department of ULB; European Space Science Committee; LABEX Jury (France, President); IDEX Jury (France); Evaluation Committee for PMMH Laboratory-ESPCI (President), etc.

In 2002 to celebrate Manuel's 60th birthday Gregoire Nicolis coordinated a Special Issue of the *International Journal of Bifurcation and Chaos* 12 (2002) 2305–2653 with the theme "Spatio-Temporal Complexity".

In 2011 to celebrate his 70th birthday a "Week of Science" was organized at the IP-UCM where many of his former collaborators and friends, from quite many countries, delivered contributions covering a vast domain of Science, not just Physics. As a follow-up in 2013 appeared a book with the title "Without Bounds: A Scientific Canvas of Nonlinearity and Complex Dynamics", Springer-Verlag, Berlin, 801 pp., edited by, former and present collaborators and friends, Ramon G. Rubio, Yuri S. Ryazantsev, Victor M. Starov, Guoxiang Huang, Alex P. Chetverikov, Paolo Arena, Alex A. Nepomnyashchy, Alberto Ferrús and Eugene G. Morozov.

Over years Manuel developed a wide range of scientific connections all over the world: Argentina, Belgium, Brazil, Colombia, Chile, China (PR), Cuba, France, Germany, Israel, Italy, Mexico, Morocco, Nigeria, Norway, Peru, Portugal, Russia, U.K., Ukraine, USA and, indeed, Spain.

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Co-Editors of the Special Issue
Reinhard Miller
Ramon G. Rubio
Victor Starov