NAUKA 2/2018 • 181–192

Piotr Pierański (1946–2018) Scientist, colleague and friend*

Although no longer with us, Piotr lives in our fond memories and we pleasure the precious time we spent together. He is particularly remembered by his colleagues with whom he shared many passions, not only scientific, and which typically developed in genuine feelings of friendship and mutual respect.

Below are but a few quotes and accounts of his closest friends and colleagues. At the beginning let us quote two excerpts from the recollections sent by Jean-Christophe Géminard and John Finney:

> *...Among the beauties of some human activities, science shares with painting, photography, music, or other forms of art the ability to gather people around common subjects of interest, or even the passion...* (J.-C. Géminard)

> *...Scientists are a privileged group, able to travel the world in the interests of their science, and in doing so meet up with others who have common interests. When people hit it off with each other, these meetings often lead to personal friendships which remain even when they live and work thousands of miles apart, and the common science that brought them together may no longer be a glue. In strong friendships, such glue is not needed. Such was the case between Piotr and me and Ruth, my wife.* (J. Finney)

Both quotes are a perfect example of the relationship which usually built up quickly and grew into a lasting friendship between Piotr and those he met and worked with.

To draw a portrait of Piotr, we collected short testimonies of his friends. Doing this was as Etienne Guyon said,

> *like trying to describe the same Rodin sculpture from isolated pieces of information: views taken at various angles, under different illuminations, or at different scales; put together, they give a unique view of the piece of art, in their case their world of science.*

Piotr's credo

As a researcher and lecturer, Piotr *was fond of basic physics* (G. Dietler). This means that he did not need to use any sophisticated and costly equipment to "characterize" series of samples or make run for days ready-to-use programs on supercomputers. On the contrary, the experiments he made and the computer programs he wrote himself were always as simple as possible, but yet no less effective. They were usualy conceived to tackle an apparently simple issues and yet frequently led to the fundamen-

* Edited by Paweł Pierański – Laboratoire de Physique des Solides, Université Paris-Sud and Andrzej Wójtowicz – Institute of Bioorganic Chemistry of the Polish Academy of Sciences

tal problems of physics. In this matter, Piotr expressed his credo in the introduction to his web pages:

> *How much money do you need to make an experiment, the results of which can be published in a top quality physical journal? I have been asking myself the question since I started my carrier in science. Today, I know the answer: There is no lower limit. You may spend $1 000 000 to produce a paper which will be accepted by the referees. But, if you are clever enough, $10 is more than sufficient. The research in physics, as any other kind of the human activity, displays an enormously wide range of diversity. It can be: costly and serious, costly and funny, cheap and serious, cheap and funny. Physics can be fun. The flying frog experiment is the best example. Its authors, Geim and Berry, enjoy science. I am convinced, this particular piece of physics attracted to the wonderful playground of science more brilliant children than any of the billion dollars experiments. Looking into my own work I find it certainly located within the last two categories. Cheap and serious is what I think I managed to achieve in most cases, but the most precious cheap and funny level I reached no more than twice. It is my aim to show you a few examples from my own and others work. Have a look and think. And remember: cheap cannot mean shabby, funny cannot mean ridiculous. It can be cheap and funny but it must be science.*

Two dimensional systems, a Polish guy with a big smile

by John Finney, The London Centre for Nanotechnology, London, UK

This Polish guy with a big smile on his face and an infectious laugh turned up unannounced at my laboratory in the Crystallography Department of Birkbeck College, London in the mid-1970s. We soon found we had a common interest in problems of space occupation – mine being in three-dimensional non-crystalline packings of spheres, and Piotr's being in structures and structural transitions in two-dimensional systems. So it was natural that we should work together on his problem-of-the-moment, namely structures of a close-packed thin layer of spheres and the transitions between them. So he obtained funding to spend time in London. We also organised reciprocal funding for me to spend some time in his institute in Poznań, where his hospitality was, of course, superb.

Producing the joint paper that resulted was an object lesson in the value of imaginative – but simple – analogue experiments to break a theoretical logjam. Piotr's initial approach to his problem was theoretical, deducing maximum density structures of spheres as a function of the separation of two parallel containing walls. When it came to elucidating the deformations the system would undergo in passing from one maximum density structure to the next as the wall separation changes, the theoretical approach failed for all but the smallest wall separations.

So what to do apart from continuing to scratch his head unproductively? The answer was to set up a very simple analogue experiment in which a set of steel balls was placed on a flat surface, and pressed between two parallel rulers. The results were unexpected and illuminating, revealing higher density transitional structures that theory had been unable to suggest.

Although we did not continue working together scientifically, we met from time-to-time at meetings (during one of which in Leszno he drove out to the meeting and entertained me for a day in his typical fashion), Piotr continued to work on a range of fascinating systems relating to packing, and more generally the occupation of space. I was kept up to date every year at Christmas (with either a complicated image on a Christmas card or a video) on whatever his current scientific obsession was – in particular his fascinating work on knots.

But going back to his work on the hard disc system, Piotr's approach was a classic "string and sealing wax" experiment as favoured by Ernest Rutherford, who was thought by many to have been the undisputed master of the simple experiment. He once said that "theorists play games with their symbols while we discover truths about the universe". Piotr's simple analogue experiment may not have unlocked the truths of the universe. But it stands as a great example of a simple experiment that got round a blockage that theory was unable to unlock. We need more such experiments. And more people like Piotr to imagine them and perform them.

We will miss his infectious laugh and irreverent sense of humour and, of course, his friendship.

Ferroelectric SmC*, this time a French guy with a big smile

by Paweł Pierański in name of Lionel Liébert
Laboratoire de Physique des Solides, Orsay, France

On a cold foggy day of winter 1976, *a French guy with a big smile on his face* arrived at the Institute of Molecular Physics in Poznań. No need to say that his encounter with *the Polish guy with a big smile on his face* was warm and that they were immediately in tune.

The name of the French visitor, my friend, was Lionel Liébert. This warmhearted and always joyful chemist came to the Solid State Physics Laboratory in Orsay in 1970 with Leszek Strzelecki (a chemist too) attracted by Pierre-Gilles de Gennes, the founder and the soul of the Orsay Liquid Crystal Group. Leszek, Lionel and Patrick Keller (their former PhD student) synthetized an impressive number of compounds in which several new mesophases have been discovered. The synthesis of the compound known as DOBAMBC was suggested to Lionel and his colleagues by Bob Meyer, a brilliant young American physicist visiting our lab in 1974. By analogy with similar molecules, DOBAMBC was expected to have a smectic C phase and because of the chiral 2-methylbutyl group this phase should be chiral (labeled SmC*). Indeed, on the basis of his former theoretical work on flexoelectricity Bob understood that the symmetry C_2 of this chiral variant of the smectic C phase (with molecules tilted in liquid layers forming a stack in z direction) allows the existence of a spontaneous polarization P. The vector P should be directed along the twofold axis C_2 of each layer and should turn from layer to layer forming a helix along the z axis. To detect this spontaneous helical polarization, Bob examined the conoscopic figure of the SmC* phase submitted to an electric field. As expected, the electro-optic response of DOBAMBC was linear and due to a deformation of the polarization helix by the electric field.

An alternative demonstration of the helical polarization of the SmC* phase was made shortly later by detection of the hydro-electric effect: induction of an average polarization by a shear-flow induced deformation of the helix.

One year later, Lionel was invited by Piotr for a visit in IFM in Poznań. Lionel accepted this invitation with a lot of enthusiasm and, as mentioned above, he arrived there in winter 1976. With Wojtek Kuczyński they built a setup tailored for detection of the remaining hydro-optical effect: linear deformation of the conoscopic figure by shear flow. This setup imagined by Piotr, Wojtek and Lionel was remarkable by its inventiveness allowing to perform experiments without spending a penny on buying opto-electronic equipment (anyhow inaccessible in Poland at this time). A shaft connected to a pin on a 33 rpm record-player was used for production of the shear flow. A slowly moving photographic film was recording the motion of the conoscopic figure. The result of experiments was clear: the tilt of the conoscopic figure was proportional to the shear rate. The visit of Lionel in Poznan triggered the interest of W. Kuczyński and his coworkers to ferroelectric liquid crystals. They continued to work in this field after the departure of Lionel and their achievements are today worldwide known.

Last but not least I have to say a few words about Lionel's involvement in the creation and activities of a committee founded at the University in Orsay in December 1981 with the aim to help internees and their families. The involvement of Lionel was spontaneous, efficient and joyful in spite of the gravity of the situation. After his premature passing by, Lionel remained in our hearts forever. Piotr and Lionel would be happy that I recall their friendship here.

Gravity's rainbow or conformal crystals

by François Rothen, Lausanne University, Switzerland

Today is a very sad day to recall the wonderful times I spent working with Piotr. I think of his family and especially of his brother Paweł, through whom, I had the privilege to know Piotr. I particularly remember, one day, as I was working with Paweł in Orsay, I saw a beautiful picture on his desk. He proudly told me that it was taken by Piotr, in Poznań, and that it was the result of his current research.

The picture showed a large number of small spheres, piled up, but without any of them touching each other. The image of the pile of spheres was remarkable. First of all, all the spheres were confined inside a plane. Secondly, they formed a beautiful curved lattice. Piotr gave this strange pile of spheres the name “gravity’s Rainbow” (after the title of a novel of Thomas Pynchon?). To produce this lattice, he put a large number of steel spheres between two large glass plates. The plates were parallel to each other and were near enough to allow a unique layer of spheres between them. The plates were somewhat slanted, so that the space between them was filled by the spheres from the bottom up. Finally, he applied a magnetic field, perpendicular to the plates, so that the steel spheres were magnetized and repelled each other. The beautiful picture produced that w ay was the result of the competition between the gravity – as it tends to push all the spheres towards the bottom – and the repulsion between the spheres due to their magnetisation. Interestingly, the lattice was very close to a conformal transformed triangular lattice.

Shortly after, I went to Poznań in order to work with Piotr on the equilibrium state of the spheres we soon called “conformal crystal” because other people found the same structure in different situations.

Concerning my collaboration with Piotr, I want to point out that it was not only a fruitful relationship, but also a very pleasant one. Of course, he carried out all the beautiful experimental work, allying art with science, so that my task was merely to provide some simple equations. It was exactly the same situation I found myself in, working with Paweł in Orsay, on soft matter projects. The similarity between of the gifts of these two brothers was remarkable. Paweł discovered an ordered array of colloid particles he named “colloidal crystal”, whilst in Piotr’s ordered structure, the spherical particles were made out of steel, forming a lattice. Could you imagine a better sign of their brotherhood?

Piotr, knots, braids and friendship

by Arne T. Skjetorp, Institute for Energy Technology, Norway

I met Piotr for the first time in Kraków in the summer of 1984. It was prof. Jerzy Janik at the Henryk Niewodniczański Institute of Nuclear Physics who brought us together. As Jerzy told me later: “I had a feeling that you and Piotr could find the tone" – and we certainly did.

Piotr and I started to collaborate after that and in 1987 he came for an extended visit to our research group in the Physics Department at IFE (Institute for Energy Technology) at Kjeller. I had at that time been working with ferrofluids and so-called magnetic holes for a few years. Piotr started with great enthusiasm and fresh new ideas to work with me and my colleague Geir Helgesen on magnetic holes. He was both a master in the lab as well with computer modeling. This collaboration, lasting on and off for about 20 years, led to five joint publications on complex particle dynamics using knot and braid mathematics and symbolic dynamics. This has recently led to new directions in so-called active matter systems in the development of biologically inspired systems.

I visited Piotr at the Institute of Molecular Physics in Poznań for about two weeks in the fall of 1988. At the end of my stay, Piotr took me home to meet his mother and sister. I could only communicate with his mother through smiles and gestures. There and then I understood from whom Piotr had received his warmth and good spirit.

Since 1971 the Physics Department at IFE has arranged a series of interdisciplinary graduate science schools known as "The Geilo Schools". In March 1989 a new School was scheduled with the theme "Phase Transitions in Soft Condensed Matter", the 10th in a row every two years since 1971. Piotr and Paweł were invited lecturers to this School and they both gave a series of fascinating lectures. It became a great School, not the least due to the presence of Piotr and Paweł.

The last time I saw Piotr was in May 2011, when he came to the "surprise" celebration of my 70th year birthday. Geir Helgesen was in charge of this and had invited 10 prominent researchers and friends to present talks at a one day seminar in the Norwegian Academy of Letters in Oslo and Piotr was one of them. His talk was a most memorable, warm hearted and spirited tour de force on our scientific collaboration with interludes of art in the form of paintings and tender music from Grieg and Chopin. All attendees were both moved and impressed by Piotr's performance. I still meet persons who were there and mention Piotr's talk as a highlight.

In March 2017 the 23rd Geilo School was scheduled to take place with the theme "Physics Inspired by Living Matter". I saw this School as a golden opportunity to have both Piotr and Paweł back as invited lecturers like in 1989. They both accepted. In February 2017 Piotr informed that he was unable to come due to health reasons. He had a solution: "I am not leaving you alone with the problem. I have already called my Swiss friend Giovanni Dietler from EPFL asking him, if he would be willing to replace me as the lecturer in Geilo. He agreed". Fortunately, Paweł was able to attend. Both he and Giovanni gave superb tutorial lectures in Geilo.

The last email I got from Piotr was on the 3rd of February 2018 with his lecture on "Snapping shrimps". Fascinating – and demonstrating Piotr's never ending curiosity about life and phenomena around us. All of us who knew Piotr will miss him a lot.

From Geilo school to Rydzyna meeting

By Joseph L. McCauley, University of Houston, USA

My first meeting with Piotr was in July 1987, at IFE (Institute for Energy Technology/Institutt for Energiteknikk) at Kjeller, Norway. We were living in an IFE apartment at Odalsgate 2 and were not due to leave for another week. The same apartment had been booked for Piotr but no one had worried about the overlap. Piotr took it in stride and slept in his car along the bank or the Nitelv (Nit river). I never saw Piotr in anything but a good mood and I liked him from the start.

His visits evolved into a fruitful collaboration with Arne Skjeltorp. I was more like The Lone Ranger; I did not succeed in collaborating with anyone in the IFE Physics Dept. Of course, Piotr and I were at Geilo (The Geilo NATO-ASI) many times together and enjoyed conversation during the evenings, which were always a big social affair. One time Paweł was there too. But my second big encounter with Piotr was at Schloss Rydzyna where he had organized Dynamics Days in June, 1993. I arrived by train from Augsburg, Germany, and walked from the stop 3–5 miles to the Schloss wearing Bundhosen (my Frau and I spent as much time as possible on foot in the Alps and on the Hardangervidda in those days) and carrying my big mountain backpack as if I were on a Wanderung. Piotr greeted me heartedly but his German co-organizer (from the flat part of Germany) looked askance at my choice of dress! I gave a terrible talk about turbulence but Piotr said, “Don't worry, it was fine!” I didn't believe him but I was glad to hear that anyway!

I used to drive race boats, and at one point I was writing a book on high speed planing boats and surface piercing propellers in 2015. I needed a drawing of both a helix and a helicoid. The helix that I found on the internet was drawn by Piotr and a collaborator. On Feb. 1, 2018 I wrote Piotr to ask permission to use his helix drawing. On Feb. 3 he responded by sending me his entire “Snapping Turtle” file so I used his helix and one more drawing. Thanks, Piotr!

Breaking of spaghetti knots

by Giovanni Dietler, Lausanne University, Switzerland

“Parole, parole,...” in Italian it means “words, words,...”. This is a famous Italian song about a man passionately speaking to the woman of his dreams and she replies singing “Parole, parole, ...”. Piotr was loving Italian songs and he was a good musician playing the guitar, singing and also composing: this is how I would like to remember him, a romantic scientist singing Italian love songs to the science of his dreams! But not only music, also art interested him. If it happens to you to visit his personal webpage you will discover a man interested in combining science and art with a distinctive sense of esthetics. He represented his peers in famous paintings involving often some types of knots or he would simply put beautiful knots in beautiful paintings.

Similarly, with the same romantic spirit Piotr would study problems from basic physics and enchant his interlocutor with remarks, questions and genuinely inventive ideas. He was fond of basic physics.

All this short introduction is useful to understand how it came that we collaborated on the spaghetti knot experiments. I do not know anymore the exact course of the discussion we had, but it was during one of our encounters when we would discuss about everything that interested us. And so, we came to discuss the question why a knot under tension breaks at the knot site. He was doing numerical simulations on the tightening of knots, I was pulling on nylon strings to understand why they break at the knot site. Finally, high speed camera movies were not able to capture the rupture instant and see the details of the whole process: to fast even for a camera recording 1000 images per second. At the same moment that we discussed this and the reasons for the fast rupture process, he came with the simple solution: namely the use of soft materials that will slow down the rupture and therefore cooked spaghetti became the natural material to do the experiments. Together with his numerical simulations and the high-speed movies we understood that the bending at the entrance of the knot was responsible of the breakage at the knot site. It must be noted that since the ancient times it was known that strings with a knot break at the knot site and that the maximum tension supported by the string is almost halved if a knot is present on the string, but no explanation was ever put forward. We did it thanks to the resourceful Piotr. This experiment also joins his interest in three penny physics experiments (see his webpage). His attitude toward experiments in physics, simple but profound, is similar to the one of my particle physics teacher who has preconized (30 years ago!) that in a not so far future, a table top experiment might be able to unravel one of the big mysteries of nature.

And now Piotr is gone like the music that he loved so much, like a sound wave he went somewhere and we remain here with beautiful memories but sad.

Dynamics of lines and chains, the beauty of science

by Jean-Christophe Géminard, Ecole Normale Supérieure, Lyon, France

Sometimes, the choice of a research subject imposes itself by local, economic, political, or personal interests. The origin of my collaboration with Piotr is of a drastically different nature. In my early career of researcher, more than 25 years ago already, I had the privilege to be in contact with Paweł, his twin brother. Paweł has been to me a very impacting person. For years, we have been sharing at times thinkings, not only on scientific problems. Naturally, invited to Warsaw about 15 years ago, pushed by curiosity, I could not resist to travel to Poznań and meet Piotr. The event was beyond my expectations.

In his office of the Poznań University of Technology, Piotr presented spontaneously to me and Andrzej Żywociński who had travelled from Warsaw with me, three physical systems that were appealing to him at that time; the ”levitron”, the ball chain and the bouncing ball. He was amazed that the problem of the stability of a spinning top floating above a magnet had been solved so recently. The presentation he made of the two other systems impacted my research up to now.

He was studying numerically with his student, Waldek Tomaszewski, the dynamics of the falling chain. The problem is commonly used to introduce the mechanics of open systems. A chain, held by its to ends initially forms a closed U. The question is to describe at best the dynamics of one of the ends when released. The problem can be approached analytically in the limit of a closed chain (the two ends are initially at the same point) and the system is non-dissipative. Piotr was proposing to tackle on with the problem for any initial spacing between the ends, and to take the dissipation into account. I immediately offered to complement the numerical study with laboratory experiments. We published together the next year (2005).

The bouncing ball exhibits the transition to chaos by period doubling. The contribution of Piotr in this field is enormous. Depending on the vibration, and on the initial conditions, a ball bouncing above a vibrated surface exhibits periodic or chaotic motion. I was surprised to hear Piotr's questions, 20 years after his first studies of the system. We did not directly collaborate of this subject, but exchanged ideas. His impact has been such that I got convinced of the interest of such a system and considered it, with a different point of view, that of the out-of-equilibrium statistical mechanics. Years later, Jean-Yonnel Chastaing defended a thesis reporting a study that would not have been done without the initial impulse given by Piotr.

Lively person, Piotr also liked art, played with knots in Polish paintings, shared nice photographs, and I had the pleasure and honor to receive lately recordings of his songs, him singing and playing the piano. We will miss him.

Horse whip, or popularisation of physics

by Łukasz A. Turski, Center for Theoretical Physics, Warsaw, Poland

On a sunny day thousands of people were watching a person on the stage in Warsaw Old Town, exercising his ability not only to use an old fashioned horse whip but also explaining, in plain words, how come that the tip of the whip can move with such an incredible speed and create such a loudly noise. With this performance Piotr Pierański had stolen the show during one of our Science Picnics, the largest European open air science fair.

A few years later, in the lecture room of the Center for Theoretical Physics attending Piotr seminar researchers, PhD students and visitors form other Warsaw labs were watching his lecture on the physical properties of knots and admiring the computer generated presentations of the knots behavior when pulled over the ropes.

Piotr was then the member of the Science Council of the Center and we had the real pleasure to see him in our lab on various occasions.

When his term on the Council expired and we grew a bit older our meetings moved to the space of the social media. For years I had exchanged with Piotr, only Facebook and Cambridge Analytica know how many, comments, posts, and bits of information on interesting scientific, political and general interest events. I shall never forget his mail when I was bedridden and as a result my restricted walking abilities: "if you still can do partial integration then things are not so bad".

Piotr was one of those scientists who, unfortunately, become more and more rare with the explosive growth of science and radical changes of our civilization, one who understood that it is science which through its many spin-offs has created the complex edifice of our technical civilization, but that what makes our living in this structure worthwhile is the culture. He loved music, poetry, literature, art.

With his departure from our side of the Universe we have lost not only a distinguished scientist and accomplished educator but a dear friend who loved people and worked for a better world for all of us.

It will be very hard, if possible, to fill the void he left.

Scientific elegance

by Etienne Guyon, École supérieure de physique et de chimie industrielles, Paris, France

I never worked with Piotr nor lived close to him. Although all our encounters were rich of sharing science and enthusiasm for life we did not have many opportunities to meet. The situation is radically the opposite of that with his twin brother Paweł with whom I have shared beautiful years in science and also in friendship. However, thanks to the so close connection (permeation) between science and life between both of them, I have learned through Paweł to know and appreciate Piotr.

Making a distinction between Paweł and Piotr's interest in physical science is like trying to describe the same Rodin sculpture from isolated pieces of information: views taken at various angles, under different illuminations, or at different scales; put together, they give a unique view of the piece of art, in their case their world of science.

The microscopic descriptions of organized matter given by Paweł responds to macroscopic everyday observations and analyses of Piotr: the geometry and mechanics of a simple knot, the noise of a whip, the delicate tendril of a growing pea respond to the colors, the geometries and textures of flowing liquid crystals or of the colloidal world of Paweł.

Their curiosities are similar: they take the same care in looking for the sources of their research; they present lively portraits of scientists who inspired them. They have had a similar quest for simplicity in their experimental procedures and analyses, in the recourse of analogies which are so useful to communicate, and finally in the artistic qualities of their presentations. I have a full admiration for this type of approach which is nowadays not so common in public research.

To summarize, an expression comes to my mind: it is that of scientific elegance. We have lost Piotr too early, leaving to his scientist friends and to Paweł the care to keep alive this memory of Piotr's style.

A short anthology of relevant articles

Two dimensional systems

Piotr Pierański and John Finney, *A hard-disc system: structures of a close-packed thin layer*, Acta Cryst. A **35** (1979) 194–196.

Alain Bonissent, Pi. Pieranski and Pa. Pieranski, *Solid-solid phase transitions in a low-dimensionality system*, Philosophical Magazine A, **50** (1984) 57–64.

B. Pansu, Piotr Pieranski and Paweł Pieranski, *Structures of thin layers of hard spheres: high pressure limit*, J. de Physique **45** (1984) 331-339.

Ferroelectric SmC*

R.B. Meyer, *Piezoelectric effects in liquid crystals*, PRL **22**, 918–921 (1969).

R.B. Meyer, L. Liébert, L. Strzelecki and P. Keller, *Ferroelectric liquid crystals*, J. de Phys. 36 L-69 (1975).

Paweł Pieranski, E. Guyon and P. Keller, *Shear flow induced polarization in ferroelectric smectics C*, J. de Phys. **36** 1005 (1975).

Paweł Pieranski, E. Guyon, P. Keller, L. Liébert, W. Kuczynski and Piotr Pieranski, *Optical study of a chiral smectic C under shear,* Mol. Cryst. Liq. Cryst. **38** 275 (1977).

Gravity's rainbow or conformal crystals

P. Pierański, *Gravity's rainbow. Structure of a 2D crystal grown in a strong gravitational field*, Proceedings of the NATO Advanced Study Institute, Geilo, 1989.

F. Rothen, Piotr Pieranski, N. Rivier and A. Joyet, *Cristaux conformes*, Eur. J. Phys. **14**, 27 (1993)

N. Rivier, P. Pieranski and F. Rothen, *Conformal crystals and their defects*, Proceedings of the conference "Aperiodic 94", Les Diablerets, 17–21, September 1994.

F. Rothen, P. Pierański, *Mechanical equilibrium of conformal crystals*, Phys. Rev., **E 53**, 2828 (1996).

Knots and braids

Geir Helgesen, Piotr Pieranski and Arne T. Skjeltorp, *Nonlinear phenomena in systems of magnetic holes*, Phys. Rev. Letters **64**, 1425 (1990).

G. Helgesen, P. Pieranski and A. Skjeltorp, *Dynamic behavior of simple magnetic holes systems*, Phys. Rev. A 41, 7271 (1990).

P. Pieranski, G. Helgesen, S. Clausen and A. Skjeltorp, *Braids plaited by magnetic holes*, Phys. Rev. Letters **77**, 1620 (1996).

Piotr Pieranski, Justyna Baranska and Arne Skjeltorp, *Tendril perversion – a physical implication of the topological conservation law,* Eur. J. Phys. **25**, 613 (2004).

Breaking of spaghetti knots

Piotr Pieranski, Sandor Kasas, Giovanni Dietler, Jacques Dubochet and Andrzej Stasiak, *Localization of breakage points in knotted strings*, New Journal of Physics, **3** (2001) 10.1–10.13.

Sylwester Przybyl and Piotr Pieranski, *Tightening of the elastic overhand knot*, Phys. Rev. E **79** (2009) 031801.

Piotr Pieranski and Sylwester Przybyl, *In the search of the ideal trefoil knot*, [in:] *Physical Knots: Knotting, Linking and Folding Geometrical Objects in R3*, Contemporary Mathematics **304** (2001) 153. (Proceedings of AMS special session on Physical Knotting and Unknotting, Las Vegas, April 2001, Edited by J.A. Calvo, K.C. Millet, E.J. Rawdon).

Giovanni Dietler, Piotr Pieranski, Sandos Kasas and Andrzej Stasiak, *The rupture of knotted strings under tension*, [in:] *Physical Knots: Knotting, Linking and Folding Geometrical Objects in R3*, Contemporary Mathematics **304** (2001) 153. (Proceedings of AMS special session on Physical Knotting and Unknotting, Las Vegas, April 2001, Edited by J.A. Calvo, K.C. Millet, E.J. Rawdon).

Alexander V. Vologodskii, Nancy J. Crisona, Ben Laurie, Piotr Pieranski, Vsevolod Katritch, Jacques Dubochet, Andrzej Stasiak, *Sedimentation and electrophoretic migration of DNA knots and catenanes*, J. Mol. Biology **278** (1998) 1–3.

Vsevolod Katritch, Wilma K. Olson, Piotr Pieranski, Jacques Dubochet and Andrzej Stasiak, *Properties of ideal composite knots*, Nature **388** (1997) 148–151.

Piotr Pierański, *In search of ideal knots*, Computational Methods in Science and Technology, **4** (1998) 9–23.

Dynamics of lines and chains

W. Tomaszewski, P. Pieranski and J.-C. Géminard, The motion of the freely falling chain tip, arXiv:physics/0510060v1 [physics.comp-ph] 7 Oct 2005.

Piotr Pierański, *Direct evidence for the suppression of period doubling in the bouncing-ball model,* Phys. Rev. A **37**, 1782 (1988).

Zbigniew J. Kowalik, Marek Franaszek and Piotr Pierański, *Self-reanimating chaos in the bouncing-ball system*, Phys. Rev. A **37**, 4016 (1988).

Jean-Yonnel Chastaing, *Mécanique statistique de systemes macroscopiques hors-équilibre*, PhD thesis, https://tel.archives-ouvertes.fr/tel-01359122/

Piotr Pieranski, *Jumping particle model. Period doubling cascade in an experimental system,* J. de Physique **44** (1983) 573.

Piotr Pierański *Fractals. From Geometry to Art* (in Polish), Scientific Publishers OWN, Poznań 1992.

Abstract

Professor Piotr Pierański, an outstanding Polish physicists, excellent researcher and brilliant lecturer, passed away on the 23rd February 2018. The article quotes some recollections of his numerous friends and coworkers wordwide.

Key words: Piotr Pierański, knots, braids, chaos, nonlinear phenomena, conformal crystals, fractals