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1 Texts from my old time friends D. Christodoulou and O. Liess

1.1 D. Christodoulou

Sergiu and I had a long collaboration lasting from late 1984 to early 1991 on the stability of Minkowski spacetime, a period which was transformative for both of us. After intensive work on mathematical problems we used to take long walks, in the downtown area while in New York and in the woods, where sometimes we got lost, while at Princeton. In these walks our discussions started with mathematical issues and proceeded to more philosophical questions, like the relationship between mathematics and physics and even to more genuinely philosophical issues. In the after dinner walks we became euphoric and talked about some crazy ideas that some physicists were entertaining at that time, like that of the universe of all universes which was boiling off and some of the universes here being detached from reality and getting into the realm of imagination. In one of these walks, in New York, after a dinner in Little Italy, we were talking about the physicists' obsession with quantization and were entertaining ourselves with the thought that, as an approach to the problem of the stability of Minkowski, one could first quantize the theory and then take the classical limit. At this point Sergiu spotted on the pavement a 5 dollar bill, picked it up, turned to me and exclaimed: This is a sign from heaven! We must go to 5 spacetime dimensions!

While the technical problems we faced at that time may appear easy from today's perspective, what was most difficult for us was that we had to change way of thinking, and perhaps the philosophical walks helped us in this regard.

Concluding, I would like to wish Sergiu many more years of excellent health and continued mathematical creativity.

All the best,

Demetri

1.2   Text from Otto Liess

I know Sergiu from around 1972, almost certainly longer than most other participants in this conference. At the time, he was a student at the University of Bucharest and I worked at the mathematical research institute of the Romanian Academy. At that department, we had no teaching duties: what a life that was!, but we had no direct access to students at the University. Sometimes however, we could attract students to attend introductory seminars on arguments for which there were no teachers at the University.

I was lucky enough that when I offered a seminar for undergraduate students on pseudodifferential operators ("pseudos" henceforth), I could "secure" Sergiu as a participant.

As I will explain in a moment, this turned out more beneficial for me, than for him, since when he emigrated, he turned to a completely different kind of arguments.

My first "story" is about some summer schools which our department organized in collaboration with the Romanian mathematical society, one per year, in 1971, 1972, 1973. The first school was on differential topology, the second on operator theory and when I was asked in 1972 if I had a suggestion for a school for the summer 1973, I incautiously, proposed one on pseudos and Fourier integral operators ("FIO"' from now on).

Pseudos were a hot topic in 1973 and in Bucharest many people were interested to learn something about them. The schools were scheduled over a two weeks period with 4 hours of lectures per day. There was enough time for social activities, or for walks in the lovely hills near the location of the schools in the northern parts of Romania, and the mathematical society always organized a touristic excursion at the end of the first week.

No surprise then, that after some elapse of time, 4 participants in the school of 1973 were married among themselves.

Before I had proposed the school, I had had some preliminary discussions about it with my colleagues in the pde group in my department (and with mathematicians in the town of Iassy, too) and it seemed to me that there was enough man power for a school on

pseudos. The department accepted the proposal, but when it came down to technicalities to organize a meaningful plan of lectures, problems appeared. I could indeed muster the support of a handful of colleagues to give single lectures on selected arguments (wave front sets, Sobolev spaces), but with the exception of Paul Mustata (to be read as Mustazză in "latex"), the head of the pde section in the department, nobody agreed to give a longer series of lectures. The school could have turned into a complete disaster. Fortunately Sergiu, who was just finishing his undergraduate studies at the University, took on the task to give a series of 10 one-hour lectures on the calculus of pseudos.

Paul Mustata gave (to mark a contrast to the distributional point of view, which otherwise was dominant) a similar number of classes concerning the analytic wave front set and related regularity results (with no analytic pseudos, which were out of reach of our capacities in 1973), I gave lectures on canonical transformations, phase functions and elementary FIO's, and the school was saved. Needless to say, the most useful part of the school were Sergiu's lectures on pseudos. His lectures were a complete success and it may please him to know that some 45 years later his lectures were mentioned (as I was told) in a seminar in Bucharest by an algebraic geometer as the reason of why the mathematician in question had some technical knowledge about pseudos.

A second occasion when Sergiu had some impact on my mathematical life occurred much later in Darmstadt. I was working by then in second microlocalization and when Sergiu asked me one morning, if I had an example in which second microlocalization could be relevant, I mentioned crystal optics for cubic crystals. I remember his comment till now, so many years later: he told me that the system of crystal optics was the "last case" of a classical system discussed in Courant-Hilbert, for which nobody had studied long time existence of solutions for (small) nonlinear perturbations. I took up his suggestion and had a very happy time studying the argument. Thank you very much indeed, Sergiu for this suggestion!

There is a short anecdotal story about crystal optics in the Courant-Hilbert book about which I became aware some years later. I once asked Fritz John if he knew from where the information about Fresnel's surface for cubic crystal's in Courant-Hilbert came. John was mildly amused by my question and said that of all people around Courant he should know the answer best, since he himself had written the part in Courant-Hilbert about crystal optics. However, while he thought that he could have learned things directly from Courant, he did not remember details.

Let me also mention an occasion when Sergiu and I met, around 1986, in Bonn. Sergiu arrived there directly from a visit to the Mittag-Leffler institute and he had just understood in Sweden how his method of commuting vector fields could be applied to obtain estimates. I never saw him more enthusiastic about his own insights and he explained to

me that many nonlinear problems could now be attacked.

I wish him many more years of further achievements!

2 My response

To start, I want to thank Jérémie, Mark, and Elena for organizing this wonderful conference, and all of you for taking the trouble to travel here from wherever you come from — some from as far away as China or the United States, and others, the locals, for having the patience to ride the RER B in order to arrive on time to the lectures. I am grateful to both Demetri and Otto for their warm and generous e-mails. They both played an essential role in my scientific and personal life. Otto is the one who convinced me to study PDEs and, though he may have forgotten, he mentioned general relativity to me as a subject of interest, the first time when we met in his office at the mathematics Institute in Bucharest, sometime in 1982. Demetri was, of course, a fantastic collaborator and, as he describes in his e-mail, a wonderful partner of conversations during our interminable walks in New York and Princeton. Thank you Jeremie, for your incredibly emotional and moving speech. Our long and fruitful collaboration and continuing friendship means the world to me. I was similarly touched by the warmth of all the other speeches, including the one of Mark, who is particularly good at finding the right anecdotes to describe my funny idiosyncrasies. Thank you all for your friendship.

2.1 Anca's role

Concerning the idea of having this conference in the first place, I strongly suspect that Anca had something to do with it, given that she seemed to know about it long before I did. She may simply have gotten tired of hearing me complain about how isolated I feel, nowadays, at Princeton and thought such a conference may help lift up my spirits.

In any case the fact that she knew about the conference before me is not really a surprise. She is often better informed than I am about what is going on in the lives of my students, former students, postdocs, and collaborators. By the time I learned that An had a baby, for example, she was already sending him birthday congratulations and urging me to do the same. By the way she is not only better informed about my mathematical social connections; she also keeps in close contact with former friends of mine, even people I introduced her to five years ago at my 50 years school reunion. She recently traveled to India with my first serious high-school girlfriend, whom she met at that occasion.

2.2 The role of luck

As expected, given the list of speakers, the conference has been a great success. Nothing makes me more proud than the fact that at least some of you believe that I have played a role in the development of the theory of nonlinear hyperbolic equations and in what we now call mathematical GR. It may be that part of whatever successes I have had are due to my own efforts and maybe some talent. But it is incontrovertible that a great deal of it is due to luck.

I was first lucky to be introduced to PDEs by Otto Liess, who as I remember, at our first meeting mentioned the Einstein equations as a PDE of possible interest. Otto's infectious enthusiasm for the subject allowed me and other undergraduates (including Peter Constantin, my present colleague at Princeton) to get through the arid books and articles of Hörmander. At least, even as we failed to understand the underlying motivation, we learned not to be afraid of long calculations and difficult, complex, arguments.

I was lucky to leave Romania while still young, at the age of twenty-five, and even luckier to pursue my graduate education at the Courant Institute, which at that time was home to giants such as Fritz John, Louis Nirenberg, Cathleen Morawetz, Jürgen Moser, and Peter Lax. My first-year graduate studies with Fritz John were transformative. His way of presenting mathematics allowed me to understand the motivation behind results, not just their technical details. This manner of presenting mathematics "from above," insisting on motivation, intuition, and vision — so typical of the Courant Institute at that time— cultivated my taste for partial differential equations and shaped the way I have practiced mathematics ever since. For many of you this may sound obvious, but for me, educated as I was in the highly isolated environment of communist Romania, this was a genuine revelation.

I was also lucky to have Nirenberg as my advisor and lucky to have him pass to me a problem posed by Fritz John about longtime existence to quasilinear wave equations, problem that led to my thesis. I was lucky again, during the first year at my postdoc at Berkeley, to have S.T. Yau point to me that my thesis work may have something to do with the problem of the stability of the Minkowski space, about which I knew nothing at the time. I was once more lucky to meet Christodoulou, at about the same time, who just happened to be interested in the same problem. Finally, and most importantly, Berkeley is also the place where I met Anca. All who know her know how lucky I was, especially since my first moves to woo her were met with repeated rejections.

After that it became lot easier to get lucky, being professor at Courant and then Princeton it was not difficult to get great students, postdocs and collaborators. I had three more long term great collaborators, Machedon, Szeftel and Ionescu, besides Christodoulou. I had

many other wonderful shorter time collaborations with A. Majda, T. Sideris, F. Nicolo, Daniel Tataru, G. Staffilani, J. Luk, E. Giorgi and more recently X. Chen, D. Shen, J. Wan and L. He. My deepest, and longest collaboration was, and I hope will continue, with Jeremie.

Jeremie was my postdoc at Princeton for a few years, starting with 2004 when he came to Princeton from France, as a fresh PhD. We worked together on the bounded L^2 curvature theorem and then the global nonlinear stability of the Schwarzschild black hole, which culminated in an Annals of Mathematical Studies 2020 book, and finally the recent series of works on the Kerr stability problem. It was a truly great, highly interactive, collaboration in which we struggled together and encouraged each other during the many difficult times when we were stuck, the many times when we encountered obstacles which seemed insurmountable. There was great chemistry between us. By magic, whenever one of us felt discouraged, depressed by the lack of progress, the other one would compensate with a fresh burst of energy. The most difficult period was at the beginning when we were struggling to find the right strategy, constantly finding serious gaps in whatever we were trying. That is often how a major project begins. At first, one envisions a certain program, but after a year or two of hard work, it often becomes clear that the entire framework does not work. The argument collapses, and the only way forward is to start again from a fresh perspective. I think we had at least 3 such times, during our work on Kerr stability, when we had to change our strategy.

2.3 Energy and stimulation

Some people at this conference have told me that they are impressed by the energy I still seem to have at my very advanced age of seventy-five. This always surprises me, because I have never thought of myself as a high-energy person. My brother Aurel got most of the energy in our family. Anca, as everybody can see, has far more energy than I have. Just last month, as an example, we had three of our grandchildren at our home in Princeton for two weeks. I was completely exhausted after the first day, while she, of course, was thriving, regretting only that the visit was too short.

Two days ago I had a conversation with Elena in which she observed that extroverts get their energy from the people they interact with, while introverts get it from within. She claimed that I am an extrovert. I am not entirely convinced — but I think she is at least half right. Although I can work reasonably well on my own, I am deeply influenced by the people I interact with. Many of my best mathematical ideas were born in conversations. Some of you have probably noticed that I can become very animated when talking with people, especially when they disagree with me. I love to argue. The reverse is also true: I

can become easily discouraged in dull intellectual environments, or in situations where I feel unappreciated, unloved or, even worse, ignored. Yes indeed, as Mark observed, vanity and competitiveness my real defects So, in any case, if I appeared more energetic than usual at this conference, it is because I extracted energy from you, the people in this room.