Gigliola Staffilani Interview

Gigliola Staffilani is Abby Rockefeller Mauze Professor in the Department of Mathematics at Massachusetts Institute of Technology. She is a member of the American Academy of Arts and Sciences and an AMS Fellow. She has published over fifty papers in the area of PDE and is an active member of the Association for Women in Mathematics.

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Diaz-Lopez: *When/how did you know you wanted to be a mathematician?*

Staffilani: I didn't think of math as a profession until college. More than deciding on being a mathematician, I decided to dedicate as much time as possible to learning math and doing research. It turned out that this really meant being a mathematician.

Diaz-Lopez: *Who encouraged or inspired you (mathematically or otherwise)?*

Staffilani: I had a great math teacher in high school. He was assigning hard problems for homework, and I was able to solve them, which made me extremely happy. After arriving in the US, I received great support from the faculty at the University of Chicago. Because I had not taken the TOEFL exam, my paperwork was not in order, but department chair Peter May allowed me to register as a student anyway. Paul Sally, then my registration advisor, gave me a personal check for the equivalent of one monthly stipend, because my first check did not arrive as a consequence of my work permit not being issued in time.

I also received great support from Carlos Kenig, my thesis advisor, who is a master at understanding the personality of each of his students and at implementing a matching mentoring approach that is very effective. I learned a lot from him. Finally, I want to mention Jean Bourgain, my mentor at the Institute for Advanced Study, right after graduate school. His subtle humor and difficult math made for an incredibly effective learning experience.

Diaz-Lopez: *How would you describe your research to a graduate student?*

Staffilani: I work on PDE, more specifically dispersive PDE. These equations come from physics and cannot be explicitly solved. Thus, I invent and use analytic tools to study properties of solutions without having a formula for them. It turns out that often enough some of these equations have a very rich algebraic and geometric structure.

One of the equations I have worked on is the nonlinear Schrödinger equation $i\partial_t u+\Delta u=\pm|u|^{p-1}u$, where $p>1$. The interactions coming from the nonlinearity of the equation are very difficult to understand. Thus, to study the existence, stability, and long-term dynamics of solutions, we have to exploit properties of the equation itself via techniques coming from harmonic analysis, Fourier analy-

sis, and dynamical systems, among others. In the periodic case, for example, ideas from analytic number theory have been used, starting with the work of Jean Bourgain, to estimate oscillatory sums that appear when one writes explicitly the solutions of the linear Schrödinger equation.

Diaz-Lopez: *What theorem are you most proud of and what was the most important idea that led to this breakthrough?*

Staffilani: I am most proud of the work I did with the "I-team,"[1] that is James Colliander, Markus Keel, Hideo Takaoka, and Terry Tao. We were all young, at the early stages of our careers, and that gave us the freedom to investigate certain questions from a completely different point of view. The collaboration started at a very informal lunch we all had at Stanford while Jim Colliander and I were running a small conference. We were talking about the fact that Sobolev norms, except for the H^1 norm involved in the energy, are not as suitable for dispersive equations as they are for elliptic equations. We continued the conversation after lunch, and it was there that we thought about an algorithm that would generate what we called modified energies, more in tune with the equation at hand. Formally, infinitely many energies can be defined in this way, and the challenge is to show that they are well defined. It turned out that, for equations that are integrable systems, such as Korteweg-de Vries and 1-dimensional cubic nonlinear Schrödinger equations, our algorithm recovers the infinitely many conserved integrals for these equations.

Diaz-Lopez: *What advice do you have for graduate students?*

Staffilani: Choosing a field and an advisor that match very well your personality and interests is extremely important. Also it is important that the advisor is active in his/her field and can recommend problems that are approachable as well as considered interesting by the experts in the area.

Diaz-Lopez: *All mathematicians feel discouraged occasionally. How do you deal with discouragement?*

Staffilani: I learned after many years in the profession that, eventually, things get better. I also learned that from failure sometimes comes great progress, so I focus on this. Having a life outside of mathematics—I am also a mother and wife—helps too. It balances other forces that constantly act on me: being a teacher, researcher, mentor, administrator, and so on.

Diaz-Lopez: *You have won several honors and awards. Which one has been the most meaningful and why?*

Staffilani: I think being inducted into the American Academy of Arts and Sciences has been an amazing honor. I felt recognized not just by the math world but by a much larger community of knowledge.

Diaz-Lopez: *If you could recommend one lecture (book, paper, article, etc.) to graduate students, what would it be?*

Staffilani: I loved the book *Partial Differential Equations* by Lawrence C. Evans. It is an amazingly clear book, and every graduate student working on PDE should read it.

Diaz-Lopez: *Any final comments or advice?*

Staffilani: The most important element in this profession is loving the feeling you experience when you solve a problem. Sure there are ups and downs, problems that do not get solved, but as long the research is exciting everything else will follow.

[1] *The name "I-team" comes from the fact that in our proofs we introduced a multiplier operator that we called I.*

Photo Credit

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Alexander Diaz-Lopez, having earned his PhD at the University of Notre Dame, is now visiting assistant professor at Swarthmore College. Diaz-Lopez was the first graduate student member of the *Notices* Editorial Board.