This section features conversations with personalities related to science, highlighting the factors and circumstances that guided them in making the career choice to be a scientist.

Striking the Perfect Equilibrium!*

Supurna Sinha talks to Maria Cristina Marchetti

Professor Maria Cristina Marchetti has made significant contributions to research in a variety of areas in Physics. Her research interests range across non-equilibrium statistical physics, condensed matter theory, and biological physics. At the beginning of her career, her work was focussed on non-equilibrium statistical mechanics of complex liquids. Over the years her interest has shifted to biological physics where there is a rich interplay between statistical mechanics of soft condensed matter and biology and she has continued to make significant contributions to this area, building on her years of experience in working in non-equilibrium statistical mechanics. Some of the notable papers (single author and in collaboration) that brings out the vast spectrum of her research work include: Tagged Particle Fluctuations in Uniform Shear Flow (*J. Stat. Phys.*), Flux Line Entanglement in High Temperature Superconductors (*PRB*), Rheology of Active Filament Solutions (*PRL*), Motor-driven Dynamics of Cytoskeletal Filaments in Motility Assays (*PRE*) and more recently, Active Matter: Spontaneous Flows and Self-propelled Drops (*Nature*), Soft Matter: Frictionless Fluids from Bacterial Teamwork (*Nature*), Correlating Cell shape and Cellular Stress in Motile Confluent Tissues (*PNAS*), and her highly cited review article on Hydrodynamics of Soft Active Matter (*RMP*).

She graduated *Laurea cum laude* in physics from the University of Pavia, Italy. and received her PhD in physics from the University of Florida, Gainesville under the guidance of Professor James Dufty. Apart from her distinguished research career, she has also held important administrative positions. She has been the Chair of the Physics Department, Syracuse University, the Associate Director of the Syracuse Biomaterials Institute, the Director of the Syracuse Soft and Living Matter Program, the Chair of the Advisory Board and of the Steering Committee of KITP, Santa Barbara, a Member of Women in Science and Engineering (WISE) at Syracuse University, to name a few. She also has the distinction of being the first woman faculty member at the physics department at Syracuse University. As of July 1, 2018, she is on the

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physics faculty at the University of California, Santa Barbara. She has recently been awarded the prestigious Leo. P. Kadanoff Prize for 2019.

She has been the Principal Investigator and Member of the Board of Directors of the Boulder School for Condensed Matter and Materials Physics (and continues to be one of the four people running the Boulder School), Vice Chair and Chair of the Group of Statistical and Nonlinear Physics (GSNP) of the American Physical Society, Chair of the Group on Soft Matter (GSOFT) of the American Physical Society.

Professor Marchetti is the recipient of several awards and honors including the Membership of the American Academy of Arts and Sciences, Fellowship of the American Physical Society, William R. Kenan Jr. Professorship, the Chancellor's Citation for Academic Achievement from Syracuse University to name a few. She has also received the Rothschild-Mayent Sabbatical Fellowship, Institut Curie and a Simons Fellowship.

In the interview that follows with Professor Supurna Sinha, Professor Marchetti discusses her love for physics and the challenges faced by women researchers while pursuing an academic life.

Supurna Sinha (SS): Cristina, could you tell me about your home environment during your growing up years. To what extent has it shaped your interest in science.

Maria Cristina Marchetti (MCM): My mother was a high school teacher. She taught mathematics and physics. My father was a lawyer. Both were the first and only members of their families to have gone to college and greatly valued education. They encouraged me, my brother and sister, to read and learn on our own. Our house was full of books, and it seemed understood that each of us would pursue an independent career. At the same time, my parents never pushed me in any particular direction, but simply supported my choices. The same was true for my teachers when I was growing up in Italy. In high school, I did well in science and math and was never made to feel that this was unusual for a woman.

SS: Has any particular teacher played a role in your pursuit of science in general and physics, in particular, as a career? Have you had any role model, in particular, a woman scientist in your scientific pursuit?

MCM: My path to physics may seem a little unusual because I attended a high school that specialized in humanities. We studied ancient Greek and Latin, a lot of history, philosophy and

art history, and I loved these subjects. We also had math, physics, and biology, but no calculus. I had excellent math and physics teachers, but I did not seriously think about majoring in physics in college until my last year of high school when I started reading some science books on my own. In fact, I greatly hesitated between physics and ancient languages. I had a passion for philology and physics and philology did not seem that far apart to me back then. Unfortunately, I never had a woman scientist as a role model. In high school one of the physics teachers was a woman (like my mother), and I liked her a lot. But I did not plan to be a teacher, so she was not a role model, although both my teacher and my mother inspired my choices. All the classes I had in college were taught by male faculty. About half of the class were women, although most of the women planned to become high school teachers, while most of the men wanted to be research scientists. In spite of this, I never really felt that it was unusual for a woman to pursue a career in physics until I came to the US for graduate school.

SS: So in Italy, you didn't feel that way?

MCM: That's right, I didn't feel that way. The physics faculty in Italy was mainly male back then. But they were supportive and equally encouraging of women and men students. In fact, several encouraged me to do research and then to apply for a Fulbright Fellowship to come to the US. When I got to graduate school in Florida, it was very different because I was the only woman graduate student, as well as one of the very few non-American students. In addition, the male graduate students tended to be quite conservative and did not make me feel I was part of their group. The combination of being a foreigner and being a woman seemed to make me appear very strange in their eyes. For a while, I found it easier to socialize with the junior faculty who were a more heterogeneous group. It took me nearly six months before I managed to get accepted by the other students as a peer. It was in graduate school that I realized that it was odd for a woman to pursue a career as a research physicist. On the other hand, my advisor was a very supportive and wonderful person.

SS: Over the years you have addressed a variety of problems in equilibrium and non-equilibrium statistical mechanics, condensed matter physics and biological physics. Could you tell us briefly about your motivation behind addressing these problems?

MCM: I have certainly worked in a number of different areas, although always with an underlying theme of nonequilibrium systems. As a student, I chose the mentor more than the problem. Once I started my independent research career, the directions I took were dictated by my own interest, but also influenced by collaborators or simply by big questions that were in the air at the time. As an undergraduate in Italy, I had worked on magnetic systems and I did some experiments – NMR experiments. In fact, the very first paper in my publication list is an experimental paper. Although I went to the US on a Fulbright Fellowship, I went to

the University of Florida through personal contacts to work with Jim Dufty who then became my advisor. I started working on the kinetic theory of hard spheres and the nonlinear rheology of simple fluids. In my first three years of postdoc, I continued in the same general area but then moved to City College with Mel Lax to work on electron transport in semiconductor heterostructures. I enjoyed this work that, unlike my previous one, had many direct connections with experiments. As junior faculty, I first returned to fluids because this was my main area of expertise, but shortly after, the combination of the discovery of high-temperature superconductors and a sabbatical at Harvard led me to start working on fluid and glassy state of vortex lines in high-Tc materials. I worked in this (then very hot) area for a number of years, slowly shifting to more general questions of transport in driven disordered systems. In 2003, while participating in a KITP Program on the mechanics of the cell cytoskeleton, I heard some interesting talks on developing hydrodynamic theories of the suspensions of cytoskeletal filaments and motor proteins. My background seemed ideally suited to attack this problem, and I started to work on it with Tannie Liverpool. From cytoskeleton I moved over the years to more general problems in active matter, hence returning to non-equilibrium fluids. In my experience, one rarely makes the conscious choice of working in a specific field. Ideas and research directions come from reading and from talking to colleagues, students, and collaborators.

SS: Which research work has excited you the most?

MCM: The work on vortex lines was very exciting. Experimentalists were closely involved. At that time, it was felt that high-temperature superconductors would have many technological applications. This gave a big boost to research on the statistical mechanics of flux lines and generally extended interacting systems at finite temperature and in the presence of quenched disorder. Now, something similar has happened with the field of active matter, where there have been exciting developments with implications from biology to engineering. I especially enjoy making connections between different areas or applying ideas from one field to another – I think this is one of my strengths. To this day, I greatly enjoy sitting down to do a concrete calculation with a pencil and paper.

SS: It is quite common among theoretical physicists to be interested in some other areas like art, music, and literature apart from physics. Do you have such passions?

MCM: Having studied Classics, I used to be really interested in poetry and classical literature. I used to know much Italian poetry and some Greek and Latin poetry by heart. I still do, but I haven't really kept it up. I used to like Leopardi and the modern poet Montale, and I still try to read Italian fiction. Unfortunately, having to manage a career and a family (I have two daughters), has taken a toll on keeping up other interests. I like cooking and making up recipes. I am also interested in architecture. In fact, I may have gone into architecture if it had

been offered at the University in my hometown. While most people dread the process of home renovations, I very much enjoyed working with a contractor and a cabinet maker last year to design and renovate the kitchen in our Syracuse home. It was a lot of fun!

SS: I know that you are a very accomplished scientist, in particular, a woman scientist who has been able to strike a perfect balance between being a mother and a professional physicist. Could you tell us more about how you have managed to balance the two ends?

MCM: I am not sure about perfect! But yes, I managed to have a career and a family, but one always has to make compromises. My husband, also a physicist, and I had to both make compromises in our career, and we shared the responsibilities and joys of family life. A key thing to make things work, I think, is to get as much help as possible. Help from friends, relatives, day care centers, babysitters, house cleaners, and more. Of course, you have to find people you can trust, and then be happy if your child becomes very close to her teacher or babysitter. Women tend to feel guilty – more so than men – about leaving their children with others. We need to learn to stop doing this. Our younger daughter very much resented having to go to after-school because none of her friends did. That was hard. But now she is twenty-three, and she tells me "Sorry I did that". She now understands what my career means to me, and I know she is proud of me.

SS: As a woman in science could you comment on the obstacles, if any, you have faced in your scientific pursuit, and how it has shaped your world view.

MCM: I think that women sometimes get treated as if they were invisible at conferences or meetings. Scientists can be quite aggressive, and it can be hard to make yourself heard and listened to if you do not fit that mould. I certainly struggled with this. I think we have all experienced having our remarks at a conference or in a faculty meeting completely ignored, only to hear somebody else – a male – say the same thing a few minutes later, and having people remark that it is really a good idea. In school in Italy, we were not encouraged to ask questions and did not learn to speak up. So I have always had to struggle to make myself heard. Being ignored or unheard takes a toll on your confidence. Now, when I have a woman student, and I find that she is not speaking up, I make sure that I involve her in all the discussions and specifically ask for her opinion. I have certainly struggled with self-confidence and with what is known as the 'imposter syndrome' over the years – I still do. But, I am happy to see more young women today who project strength and confidence with no apologies.

SS: In fact, it is so terrible when you think of a person like Rosalind Franklin who was actively pushed out.

MCM: I don't think I have been actively pushed out. But I did have to struggle to stay in. It

is unpleasant to have people around you think or even remark that your gender is the source of your achievements or recognition. Even more unpleasant is to see that this attitude is still there among young people. I have been on award and grant committees, and I think that in spite of all the lip service paid to gender balance, women end up getting shortchanged when it comes down to selecting. Women are less aggressive and do not push to get nominated for awards. And sometimes we as women forget to support other women. We must all work to remedy this.

SS: What is your advice to future generation women scientists based on your own experiences?

MCM: Be confident. Do not apologize for asking for a break because your child is sick, or that a meeting be moved because it is scheduled after the daycare closing time. These accommodations are due to you. Speak up when you need something. Try to develop a network of women friends of your own career age, meet with them regularly and talk about challenges and successes.

SS: What are the changes you have noticed in society's attitude towards women scientists over the years? Do you think the situation has improved compared to the beginning?

MCM: Unfortunately, I do not see a lot of positive changes in society, although at least most universities have put in place some accommodations, even if minimal, for parental and maternity leave and tenure clock extension. The encouraging change is that young women seem to be more willing to speak up and ask for such accommodations as due to them, and they support each other. Of course, the number of women in grad schools, postdoc or young faculty has increased. But there is still a lot of attrition. Personally, I wish I could have more regular interactions with women scientists of similar career stage to me.

SS: After spending a large fraction of your career at Syracuse, you have now moved to Santa Barbara. How do you feel about it? What are the new challenges you see ahead of you?

MCM: Well, it is both exciting and a bit scary. I have been here only for about ten days. I spent thirty years at Syracuse University, and I knew just about everybody. Now I am in a new place, and I have to start over; a new system, new people. There are also practical issues such as moving and getting a new home. But it is energizing to start something new. A great thing about UCSB is that there are many experimentalists working in areas related to mine. I look forward to getting to know them and build new interactions and collaborations.

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