

Biophysicist in Profile

Antonio Costa-Filho

"After all these years, I would say I am a molecular biophysicist who likes electron magnetic resonance a lot, but who does not run away from other techniques," says Antonio Costa-Filho, Associate Professor in the Physics Department at the University of São Paulo in Ribeirão Preto, Brazil. His group works at the molecular level with enzymes that have vast implications on the macromolecular level: these enzymes play roles in research related to developing drugs against tropical diseases, fighting pollution, and identifying the early stages of cancer. "My group is focused on understanding the molecular mechanisms of protein function," he says. "To do so, we use a multidisciplinary and multi-technique approach, which includes experimental methods such as electron spin resonance, differential scanning calorimetry, circular dichroism, and fluorescence."

> "As a scientist working in a developing country, I believe we have always to be committed with two things: doing good science and educating people."
>
> —Antonio Costa-Filho

As if this handful of methods weren't enough, his multifaceted group is also picking up skills in the cell biology area, learning techniques helpful for work on a project one of Costa-Filho's PhD students has taken on. "I believe that understanding how a macromolecule works at a molecular level can help, at some point, people who are in the other edge of the field developing applications that will be used for biotech or medical purposes," says Costa-Filho.

If his family's choice of profession is any indicator, Costa-Filho should have been a lawyer like his parents and siblings. However, his high school experience at the Military School of Fortaleza in Ceará, Brazil, nudged him toward science. He was inspired and motivated by his biology teacher, who recognized in him not only an aptitude for biology but also an inclination toward physics, and took him to visit a physics lab at the University of São Paulo. This visit decided the course of his undergraduate studies, which he undertook at that very university, majoring in physics. When he discovered the Molecular Biophysics group at the Physics Institute of São Carlos (IFSC) at the end of his freshman year, he was delighted. "I could then work on biology-related problems but from a physics perspective," he says.

Otaciro Nascimento became his supervisor on his first magnetic resonance project: studying magnetic properties of single crystals of copper-peptide complexes that served as model systems for biologically-relevant interactions in biomolecules. The method became the basis for Costa-Filho's future work, which today incorporates a variety of techniques. "Nowadays, my research focuses on understanding molecular aspects of biomolecular interactions, especially lipid-protein interactions, using a combination of spectroscopic techniques," he says. Some of these techniques Costa-Filho learned under *Jack Freed* during his PhD in the Electron Spin Resonance (ESR) lab at Cornell University. "He joined my laboratory already well-trained in traditional ESR methods," Freed recalls. "At Cornell, he mastered the new and advanced technique of two-dimensional Fourier Transform (2D-FT) ESR, in particular 2D-ELDOR. This is both an experimental and theoretical challenge, and Costa-Filho performed a superb job in applying 2D-FT-ESR to important biophysical problems."

In his former lab in São Carlos, and now in Ribeirão Preto, Costa-Filho applies more than scientific skills to his work each day. "While still trying to develop relevant projects, especially with the production of knowledge that can be used to tackle Brazilian and regional

problems, I see in the education of young people a major duty for the future," he says. Teaching happens to be one of Costa-Filho's strengths. "As a teacher Antonio has always been hugely popular with the students and almost every year he is awarded some kind of honor in recognition of the special efforts he puts into teaching," says *Richard Garratt*, one of Costa-Filho's colleagues in the IFSC. "Particularly, he leaves no stone unturned in trying to get physical concepts across to biologists. He will often provide them with hours of extra teaching in order to get them over the hurdles which many face when encountering new ideas involving a little mathematics." Costa-Filho's efforts certainly pay off among his students. "His abilities in teaching are simply outstanding," says *Luis Basso*, a PhD student who has worked under Costa-Filho's supervision since his undergraduate years. "He really cares about the preparation of his classes and always adapts them to the public he is teaching to by taking into account the level and maturity of his students." Costa-Filho himself acknowledges feeling deeply rewarded by the ability to influence students, both in the classroom and in the lab, and to witness the results. "In the classroom, sometimes we are not aware how a good teacher can influence a student's career," he says. "And the reward is almost immediate in this case: we can see the students developing during a course. In the lab, it really makes me happy when I can see that a student is starting to have his or her own ideas as extensions of something I taught him or her. This will certainly lead to nice results in a specific project, which will, in turn, result in good publications, and so on. So everything starts with teaching!"

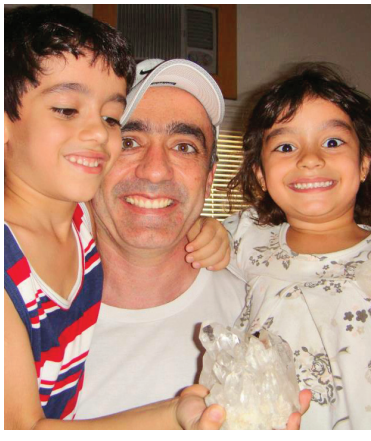
Costa-Filho enjoys being a student, too. He's planning a future sabbatical back in the US to exchange ideas with colleagues and revitalize his research. "This kind of stay abroad is very important to get new inspirations and motivations, especially for people who are most of the time far away from the main research centers in the world, as is the case in Brazil," he says. "I would say that we have enough funds to do good science in Brazil now, but we need to improve the exchange of people both ways." For the time being, Costa-Filho relies on his Biophysical Society membership to fill this role. "Being a member of BPS has helped me to gain a much broader perspective of what biophysics is, not only by means of participating in the Annual Meetings but also by interacting with people I met at those meetings," he says. "One of the consequences has been my participation as a member of the International Relations Committee, which has given me the chance to meet new people from different areas in biophysics and also the chance to work on a team to help improve the quality of science in countries in need."

Recognizing the importance of spending time and energy outside the lab as well as in it, Costa-Filho and his wife, scientist *Cristina Nonato*, also a professor at the University of São Paulo, make it a point to facilitate the precious hours with their two children, Pedro and Rafaela. "Weekdays are really crazy, with so much to do, with not much time to spend together," says Nonato, "so on Saturdays and Sundays I usually prepare a very special breakfast and I like to gather the four of us around our small table in the kitchen. It is a very special moment where we eat and talk together." Costa-Filho is also an avid runner, taking part in three 10K races last year alone. Passionately pursuing activities away from the lab is essential for scientific progress, Costa-Filho maintains. "Science definitely needs constant work, but not obsessive work," he says.

Inside the lab, though, Costa-Filho will continue to foster an environment in which teamwork and an open-minded approach to biological problems are valued. "I believe that biophysics will concentrate more and more on understanding molecular interactions and on building a full picture of biologically-relevant problems by describing and understanding phenomena from molecular biophysics to systems biology," he says. "I believe it is not expected that one person will do it all, but that an orchestrated work to cover such a broad range of interests will emerge."



Antonio Costa-Filho with his wife, Cristina.



Antonio Costa-Filho with his son, Pedro, and his daughter, Rafaela.