Telos PRIMO PIANO SCALA C

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Strato of Lampsacus, so what? It was he, an Aristotle's pupil, who in the third century B.C. noted that *water pouring from a spout breaks into separate droplets* and realised that when falling a body initially starts to accelerate. So what are we talking about here, physics or philosophy? When Aristotle was alive they were one and the same thing, and even today revolutionary knowledge and philosophy are closely bound.
We don't have to cite Popper and Kuhn to remember that: they have both emphasised how fracture, the shift between an old and a new theory, requires a radical revision of patterns of thought. This doesn't mean denying the logical and historical relationship between the previous theory and the new one: it's wrong to deny the cumulative effect of knowledge. And this is where the magnificent work of a young scientist comes in: the Neapolitan physicist Giovanni Amelino-Camelia. Rather than being daunted by the idea of working on theories of the great legendary masters of the past, he works to improve rather than demolish them.
He works to unearth the details needed to improve the theories of the great physicists who came before him, without forgetting or rebelling against them, but accepting them with an open mind, learning from them and then building on the difference. Before illustrating his field of interest and research (incomprehensible to most people, but easily understood thanks to his crystal-clear explanation), the Professor tells us about his life as a researcher abroad; it's almost a medieval, or at the very least a Renaissance-style story of a search for knowledge that required endless journeys to places we now call *places of excellence.*
The ultimate goal was to return home with an immense baggage of knowledge. And so Amelino-Camelia did. But his return is an exception. His tale reaches new heights of enthusiasm when he talks about his field of research and the kind of questions he tries to answer, trifles such as the origin of the universe. He speaks with a disarmingly light tone, without any sensationalism. Space-time is his daily bread; his doubly-special relativity theory is now considered as the best solution to one of the great problems of contemporary physics: how to make the two great paradigms of physics - relativity and quantum physics - work together. Many people consider this union as the creation of a *theory of everything* that would allow us to fully comprehend Nature. Amelino-Camelia doesn't agree, but he is firmly convinced in that idea of Science capable of opening new windows onto Nature. Yes, it's time for a new scientific revolution, *made in Naples.*

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AMELINO-CAMELIA

WATER POURING FROM A SPOUT BREAKS INTO SEPARATE DROPLETS

> *It's clear to me that current studies are paving the way for an extraordinary scientific revolution and obviously it would be hilarious if I was the physicist who reviewed this exploratory stage and indicated the way forward.*

Telos: You graduated in Naples, obtained a PhD in Boston, a post doctorate at the MIT, then worked in Oxford, Neuchâtel and the CERN in Geneva. In 2000 you came back to Italy to teach quantum gravity at Sapienza University. You're the exception that confirms the rule of brain drain or is the tide turning?

Giovanni Amelino-Camelia: There's an increased focus on *brain gain* (although I don't think much is being done, at least it's become an issue), but back in 2000 very few people knew what it was. When I came back to Italy I was one of the very few exceptions, and I hadn't even planned it: it's very hard for anyone who has lived abroad for over ten years to win a standard competition in Italy. There's a sort of very strong *home country advantage*… but nevertheless I thought I'd try and participate in a few competitions. After three or four competitions that ended the way I expected them to end, winning the Sapienza competition was an unexpected surprise. I knew that the interest sparked by several of my studies would have earned me international financial backing for my research - in fact it did - and this made me less vulnerable vis-à-vis the problems I'd have to face because of the inadequate funds available for research in Italy. Nevertheless, returning home wasn't easy: I was used to a different academic world with an Anglo-Saxon approach, and I had to make a huge effort to get used to some of the oddities of the Italian academic world. I still wouldn't advise an independent researcher to come back to Italy, someone who wants to develop his own research rather than falling in with the research programmes of the old, powerful research groups. With one exception: if they can attract foreign investments or are tough cookies and have a *thick skin.*

"I owe so much to my excellent education and training at the University of Naples. In America it gave me a head start compared to many of my fellow students." What can we envy about the academic systems of the Countries where you've studied?

As far as education is concerned, at least in physics, Italy is second to none. On the contrary, Italy is the best choice physics students can make, at least when they start out. Then they begin to feel the pinch either when no resources are available (a problem from outside the Academia, created by the government) or their *talent* and expertise is not rewarded (this is an in-house problem, a malpractice). Recently things have improved, even for postgraduates, but instead of improving in leaps and bounds change takes place at a snail's pace. Other Countries realise that research is a crucial ingredient of economy recovery and they invest resources not only to train young researchers, but also to recruit young, trained researchers. Italy simply doesn't take part in this *head-hunting*; instead we export our best brains, something we should be ashamed of. It's not a question of brain gain, but of head-hunting the best people available, naturally even foreigners. If this is to happen then we have to make research attractive here in Italy. Above all, we have to dedicate more financial resources and establish a system whereby these resources are allotted

Giovanni Amelino-Camelia was born in Naples and in 1989 graduated in physics at the University of Naples Federico II. He studied for his research doctorate at Boston University and began his career as a researcher at the MIT (Boston), later moving to Oxford, the University Neuchâtel and the CERN. In 2000 he came back to Italy and has since lectured and performed research at Rome Sapienza University where, among other things, he directs the Quantum Gravity research group. Now aged 49, he continues to be increasingly successful; his research has recently earned him more and more financial support from international institutes and his theoretical proposals have recently won numerous awards including an award by the Accademia dei Lincei (2012) and two prizes awarded by the Gravity Research Foundation (2011 and 2015). He is a member of the Accademia Pontaniana of Naples and the Foundational Questions Institute founded by Max Tegmark. He says that since the birth of his two children - Camilla (eleven) and Edoardo (nine) – he no longer works fourteen hours a day, but that his two little treasures give him the boost he needs to achieve even more results in the shorter space of time he dedicates to research. Apart from his obvious *heroes* - Einstein, Fermi and (above all) Heisenberg - he lists Diego Armando Maradona, Marek Hamsik, Lorenzo Insigne and Gonzalo Higuain. A fan of the *donkey* (Naples football team)? Who knows?

equitably so the money doesn't go to powerful academic groups, but is assigned based only on the quality and innovative nature of the research projects that apply for funding.

You grabbed international headlines for having formulated the doubly-special relativity theory. Although most people don't understand these subjects and concepts, they can truly revolutionise the world of physics. What's so innovative about your work and how can you explain it to people, like us, who know so little about physics?

My innovative research programme focuses on finding experimental study strategies for phenomena involving quantum mechanics as well as relativity and gravity ones. This challenge is, today, the outermost frontier of fundamental physics. The physical phenomena we have so far successfully described and foreseen make use of either one or the other of these two theories. However, to find the answer to several fundamental questions, especially about the origins of the universe, we need to understand how the two theories cooperate when they are both involved. It appears that Nature has skilfully hidden the answer to these crucial questions. In the macroscopic world, for example observing the motions of the planets, the implications of Einstein's description of gravity are significant while the effects of quantum mechanics are quite small in size and we need to be very accurate to identify them; this accuracy is nearly always beyond our reach. Likewise, in the microscopic world, for example the collision between microscopic particles studied at the CERN, where quantum physics reigns supreme, the effects on relativity and gravity are extremely small and beyond our reach. A mere fifteen years ago people believed it was impossible to perform experiments involving these situations, but now there's lots of active research with input by numerous international research groups focusing on these issues - tangible proof that it is feasible. Roughly fifteen years ago I wrote about the idea that sparked this line of research in some of my articles. In short it involves using the universe as a sort of laboratory. Several new effects that might feasibly characterise the coexistence between quantum mechanics and gravity can be observed only when the particles travel over great distances, distances that are not experimentally available on earth, but are typical of the journeys some particles make when they travel across the cosmos before they reach our telescopes. The maximum amount of energy we can inject into particles in a laboratory (at the CERN) is 10 million times smaller than the energy of certain particles produced by the cosmos, especially high energy cosmic rays. My doubly-special relativity has played an important role in this new field of research: it's a special scenario to see how the relativity properties of Einstein's theory will have to adapt to new contexts in which quantum mechanics plays an important role, perhaps even in the description of space and time. We might be able to observe its effects when we study the properties of the particles our telescopes see after they've travelled billions of years.

You've been nicknamed Einstein's Neapolitan heir; in 2006, Discovery Magazine listed you as one of the six possible heirs. How does all this make you feel?

It's anachronistic to look for a new Einstein now. For example, Einstein was not a *new Newton,* he was different to Newton, he was a child of his time, just like Newton was a child of his time. So if taken literally, these characterisations are ridiculous. But obviously, they do somehow make you feel good. They should be considered as signs of admiration… rather clumsy, but nevertheless appreciated; it encourages me to continue my studies. It's nice to know that my ideas resonate internationally, it makes me feel I've made a significant input into fundamental physics and where it's going today. It's clear to me that current studies are paving the way for an extraordinary scientific revolution and obviously it would be hilarious if I was the physicist who reviewed this exploratory stage and indicated the way forward. But first and foremost I'd like to be able to experience that revolution. As a physicist I was born and bred in another theoretical age created by great physicists like Einstein, Heisenberg and Fermi; a theoretical age which, on the one hand, continues to be successful, but on the other we know to be incomplete. I want to know what's beyond that theoretical age and I'm trying to find the right way forward, but in actual fact it doesn't matter who finds it, simply that someone does find it.

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