Acceptance speech

20 June 2024

Yakov Eliashberg, awardee in the Basic Sciences category (16th edition)

I am extremely honored to receive and accept the BBVA Foundation award in Basic Sciences. I am humbled to share this award with Professor Claire Voisin whose work I greatly admire. Our work belongs to two different branches of geometry: algebraic and symplectic. In the last few decades, thanks to the work of several great mathematicians, notably Mikhail Gromov and Maxim Kontsevich, these two areas had seen a lot of progress, each side contributing to the development of the other. While Professor Voisin's work is on the algebraic side and mine is on the symplectic one, our research contributed to the development of these subjects towards each other.

Symplectic geometry and its cousin contact geometry were brought to life by needs of Classical Mechanics and Geometric Optics, while later deep connections with Quantum Mechanics and Quantum Field Theory were also discovered. At the end of the 19th and the beginning of the 20th centuries Henri Poincaré was the first to realize that many qualitative problems of Celestial Mechanics could be reduced to problems in symplectic geometry. In particular, his so-called "last geometric theorem" (proven by G.D. Birkho already after Poincaré's death) linked a problem about existence of periodic orbits in the 3-body problem to a problem about fixed points of an area preserving transformation of an annulus. One hundred years later the development of symplectic geometry and topology partially realized Poincaré's dreams.

When mathematicians explore mathematical worlds they often encounter problems of two types, which I call flexible and rigid. On the rigidity side, one deals with discovering the "laws of nature" in this world, i.e. constraints which all the constructions in this world have to satisfy. On the flexible side, mathematicians are searching for constructions on the frontier of what is possible. One of my contributions to the development of symplectic geometry and topology was to push the flexible and rigid sides towards the ultimate frontier between them. In particular, I extended Poincaré's last geometric theorem from an annulus to all surfaces, thus proving Arnold's fixed point conjecture in that case. Along with Gromov, I established the first rigidity result in symplectic topology in dimension greater than two. I defined the so-called

tight-overtwisted dichotomy in contact geometry which has driven a lot of research in this area. I am also proud of our joint work with Helmut Hofer and Alexander Givental which introduced a new formalism of Symplectic Field Theory. Symplectic Field Theory has found applications to many geometrically interesting problems on the borderline between symplectic and algebraic geometries, as well as in the theory of integrable systems.

In the course of my mathematical career I benefited a lot from my interactions with several Spanish mathematicians, including Jesús Gonzalo, Francisco Presas Mata, Álvaro del Pino Gomez, Daniel Álvarez-Gavela, Roger Casals, some of whom were my PhD students or postdocs. Hence, it is especially significant for me that I am receiving this Prize from a Spanish Foundation.

I am extremely grateful to all my mathematical teachers, beginning from Nina Mefantievna Mitrofanova, whose "mathematical circle" in Leningrad turned me to Mathematics, my PhD advisor Vladimir Abramovich Rokhlin and my friend and teacher Mikhail Gromov, interactions with whom transformed my view of Mathematics. I was and I am still lucky to be able to collaborate with and learn from many great mathematicians. I am also learning a lot from my Stanford students, 41 of whom already received their PhD and have their own successful careers in Mathematics, science and industry. Finally I want to thank my wife Ada for her love and support throughout our lives together in Leningrad, Syktyvkar and Stanford.