Laudatio for Barry Simon

Winner of the Henri Poincare Prize 2012

I am very pleased and honored to give the laudatio for Barry Simon, my former advisor, on his winning the Henri Poincare Prize for 2012.

Barry grew up in Brooklyn, New York, went to school there at James Madison High, obtained his bachelor degree at Harvard, and then his PhD in Physics at Princeton under Arthur Wightman in 1970. He was a faculty member at Princeton for 12 years, and since 1981 he has been the IBM Professor of Mathematics and Theoretical Physics at Caltech.

The 1970's were a very special time for mathematical physics at Princeton. One can read a lively account of those days, written by Barry himself, in the current edition of the Bulletin of the IAMP. The main thrust of the activity was in statistical mechanics, quantum field theory and non-relativistic quantum mechanics. The list of people who participated in Math-Phys at Princeton University in those years, for shorter or longer periods of time, as students, post-docs, junior faculty or senior faculty, or just visitors for a day, reads like a Who's Who of Mathematical Physics. Leading the charge were Arthur Wightman, Elliot Lieb and Barry. But there were also Eugene Wigner, Valentine Bargmann, Ed Nelson and many others, some of whom I see here in the audience today. And across the way at the Institute there was Freeman Dyson, doing wonderful things. Barry was a dynamo, challenging us with open problems, understanding every lecture instantaneously, writing paper after paper, often at the seminars themselves, and all the while supervising 7 or 8 PhD students.

In the early years of his career Barry divided his efforts more or less equally between statistical mechanics, quantum field theory and non-relativistic quantum mechanics, but in the 1980's he started to concentrate on questions of exotic spectra for Schroedinger operators, both continuous and discrete, which then led him to his current focus on orthogonal polynomials, both on the circle and on the line.

Here are just some of Barry's outstanding research accomplishments:

- After more than 30 years, Barry's work with Frohlich and Spencer, and Dyson and Lieb, still provides the only rigorous proofs of non-abelian classical and quantum continuous symmetry breaking

- Simon was the first to give a mathematically precise definition of resonance. He created the rigorous framework for the complex scaling method, which is not only a theoretical tool, but is also used by many computational quantum chemists. He used the method to provide the first rigorous proofs of the convergence of time dependent perturbation theory, and, with Harrell, of the Oppenheimer and Bender-Wu tunneling formulae

- Simon pioneered the use of differential geometric invariants in understanding quantum phenomena. In 1983 he pointed out that the phase found by Berry was the holonomy of a connection on an associated manifold. Berry's phase, which Barry named and which won Berry the Wolff prize, might have remained obscure if not for Simon's influential paper

- Together with Perry and Sigal, Simon gave the first proof of the absence of singular continuous spectrum for general

N-body quantum systems

- Together with Lieb, Simon gave the first rigorous interpretation/proof of Thomas-Fermi theory and Hartree-Fock theory

- Simon established the foundations of the theory of ergodic Schroedinger operators, including Last-Simon results on absolutely continuous spectrum, and discrete Kotani theory

- Together with Tom Wolff, Simon developed the Simon - Wolff criteria for localization in quantum mechanics

- Together with Killip, and Damanik-Killip, Simon characterized L2 perturbations of free and periodic problems

… and the list goes on!

Barry is also famous for his many books. Their influence is quite extraordinary. On Google Scholar, one sees that, as of August 2, Barry's series with Mike Reed on Methods in Modern Mathematical Physics has 12,313 citations, and 3 of his other books have over 1,000 citations! It's a common refrain amongst mathematical physicists that they learned the subject from Barry's books. Barry has an uncanny, and famous, ability to extract the key elements of a proof. This ability is expressed in his books as a signature combination of economy and clarity, which accounts, I believe, for their usefulness and great popularity.

Another way Barry has influenced math-phys is through his knack in naming things in a way which sticks, e.g., hypercontractive semi-groups, Birman-Schwinger bounds, the CLR (Cwickel-Lieb-Rosenblum) inequality, infrared bounds, the almost Mathieu equation, checkerboard estimates, Verblunsky coefficients, CMV matrices, …, and the Wonderland Theorem, which was proved by Simon, and which says roughly the following: If the operators with purely absolutely continuous spectrum form a dense set in a metric space X, and if the operators with purely point spectrum are also dense in X, then generically operators in X have only singular continuous spectrum. Quite a wonder!

There are many Barry-stories and you can find a list of them on Barry's Wiki page. I would like to tell a personal story that goes back to the time when Barry was still living in Edison, New Jersey. One day a number of us went to visit Barry at his home to discuss a joint project on the decay of L2 eigenfunctions. We spent the afternoon discussing various questions and came up with a long list of problems that should be addressed. We left in the late afternoon thinking about the challenging task that lay ahead of us. The next morning Barry came into the office. Not only had he solved all the problems on our list, but he had in his hand the first draft of the paper! We were overwhelmed. For a young person like myself, this was most discouraging. And I was doubly discouraged: Barry was younger than me!

All of us, his many students, his post-docs, his collaborators, and his colleagues, owe Barry a great debt for the extraordinary service he has provided to mathematical physics. I offer Barry my congratulations on his outstanding achievement in winning the

Henri Poincare Prize for 2012!

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Percy Deift
New York City
August, 2012