Impact and Novelty

- **Formulation of NHQM:**several concepts become common of knowledge such as c-product and self-orthogonality; novel applications to autoionization in atomic, molecular, mesoscopic systems and to predissociation, photo-ionization, photo-dissociation and predesorption 1978-2011. Author of the first book ever written on Non-Hermitian Quantum Mechanics published in 2011 by Cambridge University Press.

- **Formulation of analytical expression for time evolution operator for time dependent (not necessarily periodic) Hamiltonians** with a PhD student Uri Peskin (the (t, t') method, J. Chem. Phys., **99**, 4590- 4596 (1993)); and **time-independent Scattering Theory for Time-Periodic Hamiltonians: Formulation and Complex Scaling Calculations of Above-Threshold-Ionization Spectra**, Phys. Rev. A, bf 49, 3712 (1994).

- **Time-Independent Scattering Theory for General Time-Dependent Hamiltonians**, Comments At. Mol. Phys., **31**, 87-107 (1995).

- The amazingly sharp structure observed in the measurements of **cross sections of electron scattering from molecules** (see our explanations based on exceptional points **(EP)** published together with a PhD student Ed Narevicius published in Phys. Rev. Lett., **81**, 2221 (1998); **84**, 1681 (2000)).

- **The development of an optical switch** as described in "Electromagnetic realization of orders-of-magnitude tunneling enhancement in a double well system." Phys. Rev. Lett., **90**, 176806 (2003). On the basis of this knowledge a multiplexer was invented which is a key component in many of OpTun Incs optical devices (NeoPhotonics acquired OpTun in May 2006).

- **Demonstrating the fingerprints of classical chaos in quantum dynamics** [Phys. Rev. A [**72**, 033603 (2005)]]; In [Phys. Rev. Lett., 89, 253201 (2002)] we have shown that in cold atom setup as of Phillips and Raisen it is possible to get either dramatic enhancement of the dynamical tunneling or a complete suppression.

- **The discovery of nonlinear self-trapped leaking modes and term this novel phenomenon as "soleakons"** [Phys. Rev A **80**, 041801 (rapid communication) (2009) with Oren Cohen and Moti Segev and their PhD students (came out as an output of a course to graduate students based on Moiseyev book on NHQM)].

- **The first prediction of the "Interatomic Coulombic decay" (ICD) phenomena in Neon dimer** [Phys. Rev. Lett., **85**, 4490 (2000) and J. Chem. Phys. **114**, 7351 (2001), with L. S. Cederbaum and his PhD students] that LATER was confirmed in experiments by Dörner and his co-workers [Phys. Rev. Lett., **93**, 163401 (2004)]

- The contribution together with a PhD student Shachar Klaiman and Uwe Gunther from Dresden to the**opening of a new field in optics where PT symmetry has been observed on the basis of our predictions** [Phys. Rev. Lett., **101**, 080402 (2008)]. The topics of PT in quantum optics was mentioned recently as one of the most important new ten subjects of research in a cartoon advertised by Nature Physics.

- **The discovery of light induced conical intersection phenomenon** together with a post doctoral fellow from Haifa, Milan Sindelka and Lenz S. Cederbaum from University of Heidelberg ["Laser-induced conical intersections (LICI) in molecular optical lattices." J. Phys. B **41**,

221001 (2008); "Strong impact of light-induced conical intersections (LICI) on the spectrum of diatomic molecules", *ibid* **44**, 045603 (2011)]. On March 2016 the first experimental results based on our theory of LICI was accepted for publication in Phys. Rev . Lett. "Observation of Quantum Interferences via Light Induced Conical Intersections in Diatomic Molecules", by Adi Natan from Stanford PULSE Institute, SLAC National Accelerator Laboratory and his co-authors.

- **Laying the foundation to the use of DFT calculations of negative electron affinities** [extension of the Hohenberg-Kohn theorem that provides the foundation of ground-state density functional theory (DFT) together with Adam Wasserman, Phys. Rev. Lett., **98**, 093003 (2007)]

- Foundation of the field of **"Chemistry in high-frequency strong laser fields"**. Starting with Sabre Kais from Purdue University on stabilization of negative ions of rare gas atoms and continue with a post doctoral fellow P. Balaranyan, "Strong chemical bond of stable He_2 in strong linearly polarized laser fields", Phys. Rev. A **85**, 032516 (2012) and "Chemistry in high-frequency strong laser fields: the story of HeS molecule" in Mol. Phys. (2013), and "Linear Stark Effect for a Sulfur Atom in Strong High-Frequency Laser Fields", Phys. Rev. Lett. **110**, 253001 (2013).

- Development of new theoretical method and computational algorithm that enable the calculations of **shape and Feshbach atomic and molecular autoionization resonances by using the standard (hermitian) quantum chemistry codes**. The first paper that introduces this method was published in J. Phys. Chem. vol. 19 on December 2015 together with current or previous members of Moiseyev's group at the Technion, Arik Landau, Idan Haritan and Petra Ruth Karpolova.

- **The discovery of atomic, molecular, and optical asymmetric switches**. Theory: J. Phys. A **44**, 43530 (2011) together with Raam Uzdin (a PhD student at that time) and Alexei Mailybaev from Brazil. Realization to molecular systems was first given together with Ido Gilary from our group and Alexei Mailybaev [Phys. Rev. A 88, 010102(R) (2013)]. The first experimental evidence for our finding was published in Nature at 2016 [J. Doppler, A. A. Mailybaev, J. Böhm, U. Kuhl, A. Girschik, F. Libisch, T. J. Milburn, P. Rabl, N. Moiseyev, and S. Rotter, "Dynamically encircling an exceptional point for asymmetric mode switching". Nature, 537(7618), 76-79 (2016)].

- **The discovery of the phenomenon Light stops at exceptional points** together with Tami Goldzak (PhD student) and Alexei Mailybaev (PRL 2017). We show that the exceptional point is the only possible way to achieve the fully stopped light in a waveguide, irrespectively of the underlined physical mechanism of wave propagation. This provides the true hallmark of exceptional points in the new area of physics.