Few-Body Syst (2013) 54:2155–2157
DOI 10.1007/s00601-013-0711-4

J. Golak

Laudatio for Professor Henryk Witała

Received: 22 March 2013 / Accepted: 26 March 2013 / Published online: 6 April 2013

Professor Henryk Witała celebrated his 60th birthday on April 11, 2012. On that occasion the present issue of few-body systems has been dedicated to him in recognition of his achievements in the field of few-body physics.

Henryk Witała was born in Leszczyny, Silesia, Poland. When he was 14, he went to technical secondary school in Rybnik, and he graduated from it in 1971. In the same year he started studying physics at the Jagiellonian University in Kraków. He graduated *magna cum laude* in 1976 and for about two years held assistant positions at the Jagiellonian University. In 1978 Witała embarked on his doctoral studies at the Institute of Physics of the Jagiellonian University and in January 1982 obtained his doctor's degree by presenting a thesis titled "The inelastic component in the ^{9}Be and ^{12}C collisions". His thesis advisor was Lucjan Jarczyk. This was a very difficult time in Poland because the authoritarian government of the People's Republic of Poland had just introduced martial law in an attempt to destroy political opposition. Classes in schools and at universities were suspended as well as the whole university life. In fact, the official meeting where Witała's thesis was presented and discussed, was *illegal (!)* based on applicable laws.

In the same year Henryk was offered a position at the Institute of Physics of the Jagiellonian University and he has stayed in Kraków ever since, passing through all successive stages of a university career up to a professorship in 1995.

In his early university years Witała investigated highly excited (unbound) nuclear states and processes involving the so-called light heavy ions. This work was based on experimental results from the Van de Graaff accelerator of the Eidgenössische Technische Hochschule (ETH) in Zürich. Witała's master thesis dealt with selected (d, pn) reactions and proved their two-step mechanism, with intermediate highly excited unstable states. In his doctoral thesis Henryk concentrated on the reaction mechanisms in the ^{9}Be and ^{12}C nuclei collision processes. The ^{9}Be ion beam available at that time at ETH Zürich (second in the world after the Kurchatov Institute in Russia) gave the Kraków-Zürich collaboration the possibility of very detailed measurements. The analysis of the experimental data brought interesting information about fusion reactions and excluded the existence of then often searched for "quasi-molecular states".

Having gained his doctorate, Henryk Witała continued his collaboration with ETH Zürich. In particular he studied the interaction of polarized deuterons with the ^{12}C, ^{197}Au and ^{208}Pb nuclei. In order to describe polarization observables in these reactions, Henryk extended the existing DWBA scheme by including the d-wave component of the deuteron in his calculations.

In 1985 Witała received a Humboldt Research Fellowship for postdoctoral researchers. He selected professor Walter Glöckle and the Ruhr University in Bochum as his academic host and research institution in

Electronic supplementary material The online version of this article (doi:10.1007/s00601-013-0711-4) contains supplementary material, which is available to authorized users.

J. Golak (✉)
M. Smoluchowski Institute of Physics, Jagiellonian University, PL-30059, Cracow, Poland
E-mail: jacek.golak@uj.edu.pl

Germany. Henryk stayed in Bochum from January 1986 till September 1988. That was clearly the turning point in his career and the moment he got captivated by few-nucleon physics. Together with Walter Glöckle he worked very hard, pushing available computer resources to their limits. During this stay in Bochum, for the first time a set of numerical algorithms was developed and subsequently used to obtain numerical solutions of the three-nucleon (3N) continuum Faddeev equations with realistic nucleon-nucleon (NN) forces. This great achievement gave a solid foundation for the theoretical interpretation of experimental data and for studies of various ingredients in the nuclear Hamiltonian, without introducing any uncontrolled approximations. (These important results on the nucleon-deuteron reactions entered in 1991 Henryk's habilitation thesis titled "Study of the three-nucleon continuum with realistic nucleon-nucleon interactions".)

Further theoretical studies of the 3N continuum were carried out within a larger collaboration. Henryk Witała and Walter Glöckle were joined by younger colleagues and students: Th. Cornelius, J. Golak, D. Hüber, H. Kamada, A. Nogga, J. Kuroś and R. Skibiński. In the early 1990s numerical solutions of the 3N Faddeev equations for nucleon-deuteron scattering, both below and above the breakup threshold, with inclusion of three-body forces, became available.

Especially the possibility to study the 3N force not only in the bound but also in the 3N scattering states had great impact on the field of few-nucleon physics and triggered vivid experimental activity which led to Henryk's collaboration with experimentalists from Cracow (Poland), PSI (Switzerland), Bochum, Bonn, Cologne, Erlangen (Germany), University of Tokyo, RIKEN, RCNP, Kyushu (Japan), KVI (The Netherlands) and TUNL, Bloomington (USA). Calculations performed in the Kraków-Bochum group enabled experimentalists to prepare measurements sensitive to specific features of the nuclear Hamiltonian such as the role of particular NN force components, charge independence breaking, the structure of the three-body force. Henryk Witała participated in a number of benchmark calculations, which provided crucial tests of the very complicated numerical calculations. All these efforts and the progress achieved by other theoretical groups, proved for the first time that nuclear physics could be understood as a theory of nucleons interacting with two- and three-body forces arising from meson exchanges. Many important results obtained before the mid-1990s for the 3N system were published in the review paper "The three nucleon continuum: Achievements, challenges and applications" by W. Glöckle, H. Witała, D. Hüber, H. Kamada and J. Golak. This paper constitutes an essential reference for anyone interested in 3N calculations.

Despite open questions in the pure 3N system, it became clear that the methods and computer codes developed by Henryk Witała and collaborators can be applied to various processes, where either the proton and the deuteron or three unbound nucleons interact in the initial or in the final state. Henryk worked together with W. Glöckle, J. Golak, S. Ishikawa, H. Kamada, R. Skibiński on final state interactions in electron and photon induced break-up of ^{3}He and proton-deuteron radiative capture. The key idea there was to build the essential nuclear matrix elements from solutions of the Faddeev-like equation, which had the same kernel as the original one appearing for the nucleon-deuteron scattering reaction. The set of codes for exclusive, semi-exclusive and fully inclusive reactions prepared at that time was based on Witała's expertise and was used to analyse experimental data from NIKHEF (The Netherlands), MIT Bates, Jefferson Lab, TUNL (USA), Mainz (Germany) and Lund (Sweden). The same approach was applied also to muon capture on ^{3}He (with W. Glöckle, R. Skibiński, J. Golak), pion absorption on ^{3}He (with H. Kamada, M.P. Locher, T.-S.H. Lee, J. Golak, V. E. Markushin, W. Glöckle), non-mesonic and mesonic weak decays of the hypertriton (with W. Glöckle, K. Miyagawa, C. Bennhold, J. Golak, H. Kamada and others).

In the late 1990s a new generation of two- and three-nucleon forces was derived. These forces were obtained by E. Epelbaum, U.-G. Meißner, W. Glöckle and others in the framework of chiral effective field theory. The chiral potentials were incorporated by Henryk Witała in 3N continuum Faddeev calculations. Results of these calculations revealed new aspects of the nuclear interactions and helped establish this novel theoretical framework as the modern theory of nuclear physics.

Henryk Witała is interested in very many aspects of few-nucleon systems. Together with W. Glöckle he investigated three-neutron resonances in the framework of configuration-space Faddeev equations, which required a totally new set of computer codes. Being well aware of the limitations of the standard nonrelativistic approach, he has been working on the relativistic 3N problem with inclusion of 3N forces (with W. Glöckle, W. N. Polyzou, H. Kamada, J. Golak, R. Skibiński and others).

He keeps exploring different methods in the few-nucleon calculations. In particular, he developed new ways to treat the Coulomb interaction in the proton-proton and proton-deuteron systems (with W. Glöckle, J. Golak and R. Skibiński). He also applied a complex energy method, well known in atomic physics, to the 3N system in order to better control the scattering boundary conditions (with W. Glöckle, H. Kamada, J. Golak, H. H. Oo, A. M. Phyu and others). Despite the fact that the bulk of the results in the few-nucleon physics can

be obtained using conventional partial-wave decomposition, Henryk Witała has also been working on a new treatment of few-nucleon bound and scattering states (with W. Glöckle, Ch. Elster, I. Fachruddin, J. Golak, A. Nogga, R. Skibiński, K. Topolnicki). In this direct approach, the equations for two- and three-nucleon bound states are written in the form of coupled equations for scalar functions, which depend on momentum vectors only. This formulation has been recently extended to three-nucleon scattering, which is especially important in view of 3N Faddeev calculations for high projectile energies and applications of chiral 3N forces, which could be more easily treated directly in such a three-dimensional framework without any expansion in a partial wave basis. Henryk Witała's most recent published paper deals with the exciting problem of the possible existence of the di-neutron.

Henryk Witała's expertise and scientific position have always been unquestioned. He has been invited to give talks at all major international conferences and workshops in the field of few-body physics. During his scientific career Henryk visited many research institutions to carry out ambitious research projects. He spent altogether several years in Bochum, working with Walter Glöckle on many different projects. This long and extremely fruitful collaboration and friendship lasted till Walter Glöckle's death in August 2012. Apart from the Ruhr University, Henryk has also long and very fruitful collaboration with physicits at TUNL, and visited the Cologne University, the University of Basel, the University of Graz, Duke University and TUNL, IUCF, University of Tokyo, Kyushu University, RIKEN, RCNP, and other research institutions.

This very wide research activity has led to Henryk's impressive number (more than 250 up to now) scientific publications, which also resulted in official recognition of his scientific achievements. In particular, Henryk Witała served as a member of the Editorial Board of Few-Body Systems from 1999 till 2009. Further, in 2007, he was elected Fellow of the American Physical Society "for his ground-breaking work in solving the three-nucleon continuum system using the Faddeev scheme in a numerical accurate manner with realistic nucleon-nucleon and three-nucleon forces". Henryk Witała received several times the Rector's of the Jagiellonian University award for his scientific achievements and twice the Polish Ministry of Science and Higher Education award, recently in 2010. In 2001 he received also Wojciech Rubinowicz Scientific Prize of the Polish Physical Society.

I was the first PhD student of Henryk Witała and it has been my distinct privilege to work with him for more than twenty years. I have learned from him what few-body physics really is and what it takes to be susccessful in this field. I could witness his enthusiasm and hard work as well as his incredible persistence in solving various problems, especially ones inevitably bound with writing complicated computer codes.

Judging by Henryk's present activity, in particular by his quest for the di-neutron, we can look forward to a new stream of inspiring papers as he continues his research work.

Dear Henryk, on behalf of your friends, colleagues and students, I wish you great health, continued success, satisfaction from your achievements, and happiness in years to come !