Sven Gösta Nilsson - 1927-1979

Bohr, Aage; Mottelson, Ben R

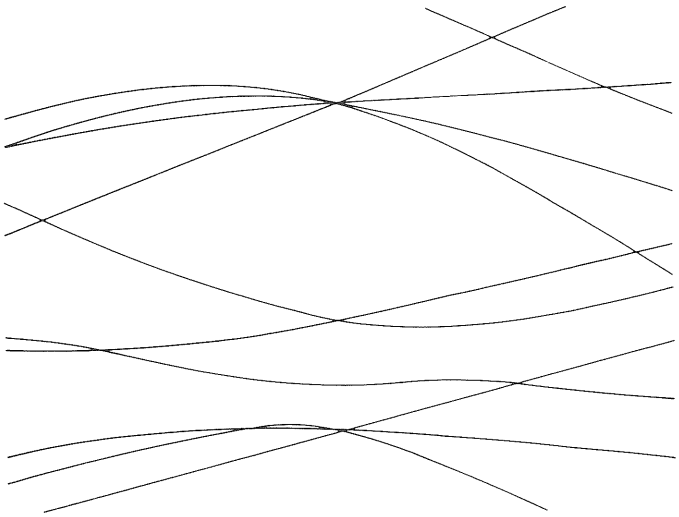
Published in:
Nuclear Physics A

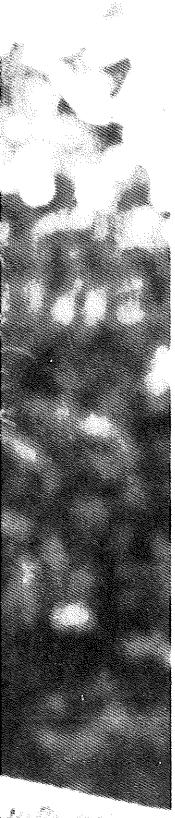
1981

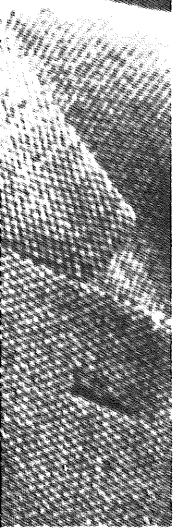
NUCLEAR PHYSICS

SVEN GÖSTA NILSSON

1927–1979







SVEN GÖSTA NILSSON
1927–1979

Sven Gösta Nilsson was a leading figure in the nuclear physics community. His many profound contributions have had a decisive impact on the development of the field. With his warm and enthusiastic personality and his broad insight, he gave inspiration to many colleagues and created at the Technical University of Lund one of the most active centers of theoretical nuclear physics *.

Our group in Copenhagen had the special good fortune to be able to benefit from an intimate scientific collaboration with Sven Gösta Nilsson that extended through his entire scientific career. This collaboration began in 1952 when Sven Gösta came to Copenhagen as a young student starting his work in nuclear physics. He was quickly attracted by the inspiring personality of Tommy Lauritsen who, as a visiting professor at the Institute for Theoretical Physics (later the Niels Bohr Institute), was carrying out elegant experiments on resonance scattering in the $d + {}^4He$ system. Sven Gösta was able to contribute a theoretical analysis of the measured angular distribution that made possible a determination of the spin and parity of the first excited state of ^6Li. Tommy was very enthusiastic about the collaboration and thus Sven Gösta appeared to be on the threshold of a promising career as a theorist of light nuclei. These systems held great attraction because of the simplicities associated with the relatively small number of constituents.

However, at this same time, the experimental study of the spectra of heavy nuclei were presenting challenging problems. In particular, the discovery of rotational spectra revealed the occurrence of a large class of nuclei whose shapes deviated essentially from spherical symmetry. Sven Gösta chose to take up these problems of the heavy nuclei, and he attacked the basic issue of analyzing the orbits and spectra of single-particle motion in nuclei with strongly deformed shapes. The problem involved solving the one-body Schrödinger equation in a non-separable potential; a crucial point was the selection of an appropriate form for the potential that could be readily solved on the rather primitive electronic computers then coming into use, and which at the same time was sufficiently flexible to reproduce the evidence on the level spectra of spherical nuclei. Sven Gösta's analysis of this

* A memorial article, which also describes Sven Gösta Nilsson's childhood and university studies, has been written by Professor Torsten Gustafson, who was his teacher at a decisive stage of his development. Copies of this article can be obtained by writing to The Department of Mathematical Physics at the University of Lund, Box 725, S-220 07 Lund.

problem was to become a classic work in nuclear structure, reflecting his style in its exhaustive working out of the problems, its broad view, and clarity of presentation. Contemporary workers continue to return to this work for insight and valuable information.

Sven Gösta's work opened the way for major progress in the understanding of nuclear spectra. It quickly became possible to establish a detailed correspondence between the calculated spectra and the sequence of lowest states as observed in odd-A rare-earth nuclei. After this first foothold had been gained, there followed more than a decade of extensive effort involving both experimental and theoretical developments, which led to a vast growth of knowledge concerning single-particle motion in nuclei. Among the landmarks on this frontier were the extension of the classification to new regions of the periodic table (actinides, s-d and p shell nuclei), selection rules, effects of higher moments in the nuclear shape, identification of polarization effects in nuclear moments and transitions, and extensive testing of the single-particle wave functions in one-particle transfer and alpha decay. The successful application of the deformed potential in the analysis of the spectra of light nuclei led to the recognition of the connection between the many-body shell-model calculations and the Nilsson wave functions. The firm basis for understanding single-particle motion in deformed nuclei also opened the way to significant developments illuminating the microscopic origins of collective properties such as equilibrium shapes, pair correlations, rotations and vibrations. In these developments, which involved contributions from a large part of the nuclear physics community, Sven Gösta played a major role both through his own central contributions as well as through his extensive personal contacts.

The spirit of this period is well captured by Viki Weisskopf's summary talk at the Kingston conference in 1960: "Another . . . impressive indication of the validity of the independent-particle is the immense success of the Nilsson scheme, ... We know the famous level scheme and the popularity of his paper – I am sure this is the one paper which one finds on the desk of every nuclear physicist – . . .".

In 1963, Sven Gösta Nilsson took up a professorship at the Technical University at Lund and began building up the institute that he was to lead so successfully and to imbue with such a spirit of common participation in a tremendously exciting adventure. His enthusiasm, personal generosity, and outstanding qualities as a teacher attracted a large number of highly gifted and dedicated students, whom he was able to bring into the frontiers of research.

Sven Gösta's group has taken up over the years a wealth of different problems that have been in the foreground of developments in nuclear physics. A major program has involved the study of the effect of single-particle motion on nuclei with very large deformations with a view to illuminate the fission process as well as to study the possibility of metastable nuclei with exotic shapes. This work was in part inspired by the dramatic experimental discovery of the "fission isomers", revealing major shell structure effects in the region of the fission saddle point. The

investigations contributed significantly to the understanding of this phenomenon and also cast light on many other features of the fission process, including the long-standing problem of the origin of the asymmetry observed in the mass distribution of fission fragments.

A second major theme in the work has been the study of stability of nuclei with charge and mass number considerably beyond the presently known species. The expected shell structure effects for masses of about $A \sim 300$ opens the possibility of an "island" of stability (surrounded by the "sea" of very short-lived spontaneously fissioning species), and this prospect has exerted a profound fascination for both the theoretical and experimental community. Sven Gösta's group has played a leading role in the exploration of this field, attacking the problems in the broadest possible manner, including investigations of all the different decay modes as well as of the reactions which might lead to the formation of these elusive species. The possibility of formation of these elements in astrophysical processes has been a special chapter. Extensive experimental efforts in laboratories all over the world have not as yet succeeded in producing traces of the envisaged "superheavy elements", but the basic issue of major new shell structure effects in this region remains unsettled and continues to pose a major challenge.

In the past five years, a new dimension has been added to nuclear studies through the possibility of producing systems with very large values of the angular momentum. Again, the Lund group has been among the pioneers on the new frontier. Indeed, a basic element in this development has been the extension of Sven Gösta's classic work to single-particle motion in rapidly rotating potentials. Among the important results of the work in Lund have been predictions concerning changes of the nuclear shape produced by rotation and the possibility of new types of isomerism.

The above account reflects only a part of Sven Gösta's impact on the development. He travelled extensively and had highly developed personal contacts with almost all the centers contributing to nuclear physics. He shared his broad experience, knowledge, and common sense with an appreciative community both at his own institution, in the Nordic countries and throughout the world. His refined sense of humor, generosity, and the kindness of his personal relations gave special quality to the contacts with him.

At the time of his death, Sven Gösta's group was engaged in far-reaching investigations on all the major problems mentioned above, and the nuclear physics community feels a deep sense of loss in no longer having his inspiring participation in the continuing discussion. The vital group of his colleagues and students represent a legacy whom we all must wish success in their efforts to continue in the spirit that he established.

Aage Bohr Ben R. Mottelson

CURRICULUM VITAE

Sven Gösta Nilsson: born, Kristianstad, Sweden, January 14, 1927; married to Ingrid M. (Peterson), June 10, 1954; children: Bengt O. and David G.; B.Sc., Occidential College, Los Angeles, California, 1949; M.Sc., Royal Institute of Technology, Stockholm, 1950; Ph.L. and Ph.D. University of Lund, Sweden, 1954 and 1955. Teaching Assistant, Royal Institute of Technology, Stockholm, 1949–50, 1951–52; Assistant, University of Lund, 1950–51, 1952–55; Docent (Assistant Professor), University of Lund, 1955–63; Professor, mathematical physics, Lund Institute of Technology, Sweden 1963–; Guest researcher, Institute of Theoretical Physics ("Niels Bohr Institute"), Copenhagen, 1953–55, partly as a CERN theoretical study group fellow; Guest Professor, Nordita, Copenhagen, 1959, 1960, 1962–63; Member research staff Lawrence Berkeley Laboratory, 1956–57, 1960–61, 1967–68, 1972–73; Consultant, Los Alamos Scientific Laboratory, 1973; Scientific Associate, CERN, Geneva, 1977–78; Member of Swedish and Danish Academies of Science.

PUBLICATIONS

1) The motion of electrons in the field of a homogeneously winded toroid, S. G. Nilsson, Ark. Fys. **4** (1952) 347.
2) The motion of electrons in two combined magnetic fields, S. G. Nilsson, Transactions of the Royal Institute of Technology, Stockholm, Sweden, no. 72 (1953), Acta Polytechnica **5**, no 5 (1954).
3) Scattering of deuterons in helium, T. Lauritsen, T. Huus and S. G. Nilsson, Phys. Rev. **92** (1953) 1501.
4) On the magnetic moment and rotational spectrum of Thulium 169, B. R. Mottelson and S. G. Nilsson, Z. Phys. **141** (1955) 217.
5) Binding states of individual nucleons in strongly deformed nuclei, S. G. Nilsson, Mat. Fys. Medd. Dan. Vid. Selsk. **29**, no. 16 (1955).
6) Classification of the nucleonic states in deformed nuclei, B. R. Mottelson and S. G. Nilsson, Phys. Rev. **99** (1955) 1615.
7) On some properties of nuclear states, S. G. Nilsson, Lund 1955, diss.
8) Nuclear-structure dependence of conversion coefficients in electric multipole transitions, S. G. Nilsson, University of California Radiation Laboratory Report UCRL-3803 (1957).
9) On anomalous conversion coefficients of dipole transitions, S. G. Nilsson and J. O. Rasmussen, Nucl. Phys. **5** (1958) 617.
10) The intrinsic states of odd-A nuclei having ellipsoidal equilibrium shape, B. R. Mottelson and S. G. Nilsson, Mat. Fys. Skr. Dan. Vid. Selsk. **1**, no. 8 (1959).
11) The shape of the nuclear photo-resonance in deformed nuclei, B. R. Mottelson and S. G. Nilsson, Nucl. Phys. **13** (1959) 281.
12) The effect of pair correlation on the moment of inertia and the collective gyromagnetic ratio of deformed nuclei, S. G. Nilsson and O. Prior, Mat. Fys. Medd. Dan. Vid. Selsk. **32**, no. 16 (1961).
13) The giant El resonance for deformed nuclei, S. G. Nilsson, J. Sawicki and N. K. Glendenning, Nucl. Phys. **33** (1962) 239.
14) The penetration effect in electric dipole internal conversion, G. Kramer and S. G. Nilsson, Nucl. Phys. **35** (1962) 273.
15) Nuclear magnetic dipole moments and electric quadrupole moments, S. G. Nilsson, Proc. Uppsala Meeting on Extranuclear perturbations in angular correlations, Uppsala, 1963, ed. E. Karlsson, E. Matthias and K. Siegbahn (North-Holland, Amsterdam, 1964) p. 163.
16) The nuclear energy gap and fluctuations in particle number in pairing wave functions, S. G. Nilsson, Nucl. Phys. **55** (1964) 97.
17) Collective nuclear motion and the unified model, O. Nathan and S. G. Nilsson, Alpha- beta- and gamma-ray spectroscopy, ed. K. Siegbahn, vol. 1 (North-Holland, Amsterdam, 1965) p. 601.
18) On a method to correct for particle number fluctuations, J. Bang, J. Krumlinde and S. G. Nilsson, Phys. Lett. **15** (1965) 55.
19) Deformed nuclei: Collective and single-particle aspects, S. G. Nilsson, Lectures in Theoretical Physics, Volume VIII C, University of Colorado Press, Boulder (1966) p. 177.
20) Corrections to the BCS expressions for nuclear matrix elements due to particle number fluctuations, J. Krumlinde and S. G. Nilsson, Phys. Lett. **20** (1966) 661.

21) Nuclear deformabilities in the rare-earth and actinide regions with excursions off the stability line and into the superheavy region, C. Gustafsson, I. L. Lamm, B. Nilsson and S. G. Nilsson, Proc. Int. Symp. on Why and how should we investigate nuclides far off the stability line, Lysekil, Sweden, 1966, ed. W. Forsling, C. J. Herrlander and H. Ryde, Ark. Fys. **36** (1967) 613.

22) Particle number fluctuations, S. G. Nilsson, Proc. 11th Summer Meeting of Nuclear Physicists, Herceg Novi, Jugoslavia 1966, ed. L. Šips, vol. I, p. 253.

23) Nucleonic structure at equilibrium and fission deformations, S. G. Nilsson, Proc. Int. School of Physics Enrico Fermi, course XL, Varenna, 1967, Nuclear structure and nuclear reactions, ed. M. Jean and R. A. Ricci (Academic Press, New York and London, 1969) p. 142.

24) Collective gyromagnetic ratios of deformed nuclei, O. Prior, F. Boehm and S. G. Nilsson, Nucl. Phys. **A110** (1968) 257.

25) Hexadecapole equilibrium distortions of nuclei, P. Möller, B. Nilsson, S. G. Nilsson, A. Sobiczewski, Z. Szymański and S. Wycech, Phys. Lett. **26B** (1968) 418.

26) On the spontaneous fission of nuclei with Z near 114 and N near 184, S. G. Nilsson, J. R. Nix, A. Sobiczewski, Z. Szymański, S. Wycech, C. Gustafsson and P. Möller, Nucl. Phys. **A115** (1968) 545.

27) Hur ser atomens kärna ut?, S. G. Nilsson, Kosmos 1968, Svenska Fysikersamfundet, ed. N. R. Nilsson (Almqvist & Wiksell, Uppsala, 1968) p. 47.

28) Nuclear structure, fission, and superheavy elements, S. G. Nilsson, in Cargèse Lectures in Physics, ed. M. Jean, vol. 3 (Gordon and Breach, New York, London, Paris, 1969) p. 105, and University of California, E. O. Lawrence Radiation Lab. Report, UCRL-18355 (1968).

29) Stability of superheavy nuclei and their possible occurrence in nature, S. G. Nilsson, S. G. Thompson and C. F. Tsang, Phys. Lett. **28B** (1969) 458.

30) On the nuclear structure and stability of heavy and superheavy elements, S. G. Nilsson, C. F. Tsang, A. Sobiczewski, Z. Szymański, S. Wycech, C. Gustafsson, I. L. Lamm, P. Möller and B.-Nilsson, Nucl. Phys. **A131** (1969) 1.

31) Microscopic calculations of the inertial mass parameter for fissioning nuclei, A. Sobiczewski, Z. Szymański, S. Wycech, S. G. Nilsson, J. R. Nix, C. F. Tsang, C. Gustafsson, P. Möller and B. Nilsson, Nucl. Phys. **A131** (1969) 67.

32) Supertunga atomkärnor – finns dom?, S. G. Nilsson, Forskning och Framsteg no. 2 (1969) p. 11.

33) New regions of stability, S. G. Nilsson, Proc. Int. Conf. on properties of nuclear states, Montréal, 1969, ed. M. Harvey, R. Y. Cusson, J. S. Geiger and J. M. Pearson, (Les Presses de l'Université de Montréal, Montréal, 1969) p. 149.

34) Nonperturbative treatment of the P_3 degree of freedom of the nuclear potential at equilibrium and fission distortions, P. Möller, S. G. Nilsson, A. Sobiczewski, Z. Szymański and S. Wycech, Phys. Lett. **30B** (1969) 223.

35) On a new type of fission-isomeric state, S. G. Nilsson, G. Ohlén, C. Gustafsson and P. Möller, Phys. Lett. **30B** (1969) 437.

36) Shape isomeric states in heavy nuclei, C. F. Tsang and S. G. Nilsson, Nucl. Phys. **A140** (1970) 275.

37) Further theoretical results on the stability of superheavy nuclei, C. F. Tsang and S. G. Nilsson, Nucl. Phys. **A140** (1970) 289.

38) A theoretical search for a possible region of superheavy elements, S. G. Nilsson, Proc. of the Robert A. Welch Foundation Conferences on Chemical Research, XIII, The transuranium elements – The Mendeleev Centennial, Houston, Texas, 1969, ed. W. O. Milligan, p. 43 and discussions p. 187.

39) The fission barrier and odd-multipole shape distortions, P. Möller and S. G. Nilsson, Phys. Lett. **31B** (1970) 283.

40) Varför blir fissionsfragmenten inte lika stora?, S. G. Nilsson, Forskning och Framsteg, no. 3 (1970) p. 8.

41) Supertunga grundämnen – än en gång, S. G. Nilsson, Forskning och Framsteg, no. 6 (1970) p. 20.

42) The low-energy spectrum of ^{29}Si and the existence of large oblate distortions associated with certain intrinsic orbitals, I. Ragnarsson and S. G. Nilsson, Nucl. Phys. **A158** (1970) 155.

43) Superheavy islands of nuclear stability, R. Bengtsson, C. Gustafsson, T. Johansson, P. Möller, S. G. Nilsson, G. Ohlén and I. Ragnarsson, Proc. Int. Conf. on the properties of nuclei far from the region of beta-stability, Leysin, 1970 (CERN 70–30, Geneva, 1970) vol. II, p. 645.

44) The microscopic mechanism behind the fission barrier asymmetry, C. Gustafsson, P. Möller and S. G. Nilsson, Phys. Lett. **34B** (1971) 349.

45) Theoretical predictions concerning superheavy elements, T. Johansson, S. G. Nilsson and Z. Szymański, Ann. de Phys. **5** (1970) 377.
46) Gudsbilden i atomåldern, S. G. Nilsson, Inter Medicos, no. 2 (1971) p. 119.
47) Planeten jordens energiresurser, S. G. Nilsson, Sådd och Skörd, no. 6 (1971) p. 206.
48) The nuclear potential energy surface and the odd-particle effect for some nuclei in the region $80 < A < 120$, I. Ragnarsson and S. G. Nilsson, Proc. Colloq. on transitional nuclei, Orsay, 1971 (Inst. de Phys. Nucl. d'Orsay, 1972) p. 112.
49) Fission barriers and the inclusion of axial asymmetry, S. E. Larsson, I. Ragnarsson and S. G. Nilsson, Phys. Lett. **38B** (1972) 269.
50) Naturligt plutonium rubbar planetsystemets tidsskala, S. G. Nilsson, Forskning och Framsteg, no. 1 (1972) p. 25.
51) Nuclear potential-energy surfaces and the half-lives of heavy and superheavy elements, S. G. Nilsson, The impact of computers on physics, Proc. First European Conf. on computational physics, CERN, Geneva, 1972, Computer Physics Comm. **3**, Suppl. (1972) 92.
52) Octupole deformations in the nuclei beyond ^{208}Pb, P. Möller, S. G. Nilsson and R. K. Sheline, Phys. Lett. **40B** (1972) 329.
53) On the termination of the r-process and the synthesis of superheavy elements, R. Boleu, S. G. Nilsson, R. K. Sheline and K. Takahashi, Phys. Lett. **40B** (1972) 517.
54) Shell structure for deformed nuclear shapes, R. K. Sheline, I. Ragnarsson and S. G. Nilsson, Phys. Lett. **41B** (1972) 115.
55) The present status in super-heavy element calculations, S. G. Nilsson and J. Damgaard, Physica Scripta **6** (1972) 81 and Proc. Daresbury Study Weekend No. 5 on open problems in nuclear structure, 1972, ed. J. M. Irvine, G. S. Mani and V. F. E. Pucknell, p. 145.
56) A coupling scheme relevant to high angular momenta and intermediate nuclear deformations, F. S. Stephens, R. M. Diamond and S. G. Nilsson, Lawrence Berkeley Lab. report LBL-1607; Phys. Lett. **44B** (1973) 429.
57) The nuclear skin thickness treated as a Strutinsky variable, H. H. von Groote, W. D. Myers, P. Möller, S. G. Nilsson, J. R. Nix, J. Randrup, W. J. Swiatecki and C. F. Tsang, Lawrence Berkeley Lab., Nucl. Chem. Ann. Rep. 1972, LBL-1666, p. 140.
58) Theoretical predictions of fission half-lives of elements with Z between 92 and 106, J. Randrup, C. F. Tsang, P. Möller, S. G. Nilsson and S. E. Larsson, Nucl. Phys. **A217** (1973) 221.
59) Axial asymmetry and the spectrum of ^{16}O, S. E. Larsson, G. Leander, S. G. Nilsson, I. Ragnarsson and R. K. Sheline, Phys. Lett. **47B** (1973) 422.
60) How much of a bubble is there in ^{184}Hg?, S. G. Nilsson, J. R. Nix, P. Möller and I. Ragnarsson, Nucl. Phys. **A222** (1974) 221.
61) Stephen's and Mottelson's models for rotation-aligned odd-particle motion, S. G. Nilsson, Proc. XII Int. Winter Meeting on Nuclear Physics, Villars, 1974, p. 174.
62) Calculated ground-state properties of heavy nuclei, P. Möller, S. G. Nilsson and J. R. Nix, Nucl. Phys. **A229** (1974) 292.
63) The single-particle mechanism behind the asymmetric distortions, S. E. Larsson, P. Möller and S. G. Nilsson, Proc. Nobel Symp. 27, Super-heavy elements – Theoretical predictions and experimental generation, Ronneby, 1974, ed. S. G. Nilsson and N. R. Nilsson, Physica Scripta **10A** (1974) 53.
64) Shapes and shells, S. G. Nilsson, Proc. Int. School of Physics Enrico Fermi, course LXII, Varenna, 1974, ed. H. Faraggi and R. A. Ricci (North-Holland, Amsterdam, 1976) p. 240.
65) Alternative regions of metastable heavy and superheavy elements directly accessible in heavy-ion reactions, R. Bengtsson, S. E. Larsson, S. G. Nilsson and I. Ragnarsson, Phys. Lett. **55B** (1975) 6.
66) Predicted properties of transuranic elements with Z around 106, S. G. Nilsson, Proc. Int. School-Seminar on reactions of heavy ions with nuclei and synthesis of new elements, Dubna, 1975.
67) Yrast bands and high-spin potential-energy surfaces, R. Bengtsson, S. E. Larsson, G. Leander, P. Möller, S. G. Nilsson, S. Åberg and Z. Szymański, Phys. Lett. **57B** (1975) 301.
68) Nuclei at high angular momentum, S. G. Nilsson, Energy and physics, Proc. 3rd General Conf. of the European Physical Society, Bucharest, 1975 (European Physical Society, Geneva, 1976) p. 309.
69) Spontaneous-fission half-lives for even nuclei with $Z \geqq 92$, J. Randrup, S. E. Larsson, P. Möller, S. G. Nilsson, K. Pomorski and A. Sobiczewski, Phys. Rev. **C13** (1976) 229.

70) Nuclear shell structure at very high angular momentum, G. Andersson, S. E. Larsson, G. Leander, P. Möller, S. G. Nilsson, I. Ragnarsson, S. Åberg, R. Bengtsson, J. Dudek, B. Nerlo-Pomorska, K. Pomorski and Z. Szymański, Nucl. Phys. **A268** (1976) 205.
71) Dynamic calculation of the spontaneous fission half-lives for the heaviest nuclei, A. Baran, K. Pomorski, S. E. Larsson, P. Möller, S. G. Nilsson, J. Randrup and A. Sobiczewski, Proc. 3rd Int. Conf. on nuclei far from stability, Corsica 1976, CERN 76–13 (Geneva 1976) p. 537.
72) Heavy nuclei and super-heavy element, S. G. Nilsson and S. E. Larsson, Europhysics News, European Physical Society, no. 9 (1976) p. 4.
73) Supertunga Grundämnen, S. G. Nilsson and S. E. Larsson, Kosmos 1976, ed. N. R. Nilsson and U. Litzén (Svenska Fysikersamfundet, Liber Förlag/Allmänna Förlaget, Lund, 1977) p. 129.
74) Superheavy elements and variations in the nuclear skin thickness, G. Andersson, S. E. Larsson, G. Leander, S. G. Nilsson, I. Ragnarsson and S. Åberg, Phys. Lett. **65B** (1976) 209.
75) Search for the yrast traps in neutron deficient rare earth nuclei, M. Cerkaski, J. Dudek, Z. Szymański, C. G. Andersson, G. Leander, S. Åberg, S. G. Nilsson and I. Ragnarsson, Phys. Lett. **70B** (1977) 9.
76) Nucleon binding in nuclei at high angular momentum, M. Cerkaski, J. Dudek, Z. Szymański, C. G. Andersson, G. Leander, S. Åberg, S. G. Nilsson and I. Ragnarsson, Phys. Lett. **72B** (1977) 149.
77) Description of the yrast traps at very high angular momenta, M. Ploszajczak, A. Faessler, G. Leander and S. G. Nilsson, Nucl. Phys. **A301** (1978) 477.
78) Shell structure in nuclei, I. Ragnarsson, S. G. Nilsson and R. K. Sheline, Phys. Rep. **45** (1978) 1.
79) Prediction of superheavy element half-lives on the basis of a single-particle potential, S. G. Nilsson, Proc. Int. Symp. on Superheavy Elements, Lubbock, 1978, ed. M. A. K. Lodhi (Pergamon Press, New York, 1979) p. 237.
80) Islands of high-spin yrast isomers, C. G. Andersson, G. Hellström, G. Leander, I. Ragnarsson, S. Åberg, J. Krumlinde, S. G. Nilsson and Z. Szymański, Nucl. Phys. **A309** (1978) 141.
81) Nuclei at very high angular momentum, S. G. Nilsson and S. Åberg, Proc. Conf. on dynamical properties of heavy-ion reactions, Post-Conference School, Johannesburg, 1978, vol. 4,p. 37.
82) Particle-hole structure of nuclear isomers at high angular momenta, M. Cerkaski, J. Dudek, P. Rozmej, Z. Szymański and S. G. Nilsson, Nucl. Phys. **A315** (1979) 269.
83) Properties of yrast states and yrast traps, G. Leander, C. G. Andersson, S. G. Nilsson, I. Ragnarsson, S.Åberg, J. Almberger, T. Døssing and K. Neergård, Proc. Symp. on high-spin phenomena in nuclei, Argonne, 1979, ANL/PHY-79-4, p. 197.
84) Shell structure at high spins, S. Åberg, S. E. Larsson, P. Möller, S. G. Nilsson, G. Leander and I. Ragnarsson, Proc. Int. Symp. on physics and chemistry of fission, Jülich, 1979, vol. I (IAEA, Vienna, 1980) p. 303.
85) Dynamical calculations of spontaneous-fission half-lives, A. Baran, K. Pomorski, S. E. Larsson, P. Möller, S. G. Nilsson, J. Randrup, A. Łukasiak and A. Sobiczewski, Proc. Int. Symp. on physics and chemistry of fission, Jülich, 1979, vol. I (IAEA, Vienna, 1980) p. 143.
86) Muon excitation probabilities in muon-induced fission of uranium nuclei, P. Olanders, S. G. Nilsson and P. Möller, Phys. Lett. **90B** (1980) 193.

BOOK

Shapes and shells in nuclear structure, S. G. Nilsson and I. Ragnarsson, (Wiley, New York, to be published)