clusters of galaxies," which have provided insights on the origin of galaxies and the nature of the Universe. In particular, he has demonstrated a connection between the shape of a galaxy and its environment—that is whether or not it is in a dense cluster of galaxies.

Tremaine, the recipient of the Helen B. Warner Prize, has done extensive theoretical work on disks and rings of matter, which are found in nearby planets and faraway galaxies. His research includes investigations of the shape of the rings of Saturn and Uranus, as well as studies of the physics of disk galaxies. Tremaine received his BSc from McMaster University, and his PhD from Princeton. He has worked at Caltech, Cambridge University, the Institute for Advanced Study, and at MIT, where he is now an associate professor of physics.

German physics prizes

The German Physical Society awarded four prizes in 1983: the Max Planck medal to Nicholas Kemmer (Edinburgh), the Max Born prize to Andrew Keller (Bristol), the Physics prize to Gerd Binnig (IBM, Zurich), and the Walter Schottky prize to Klaus Sattler (Universität Konstanz). In addition, the Physical Society at Berlin awarded the Karl Scheel prize to Manfred Rosenzweig (Technische Universität Berlin).

Kemmer studied physics in Göttingen and Zurich and received his PhD in 1935. He subsequently worked at Imperial College, London, and Cambridge University, among others. In 1953 he was appointed Tait Professor at the University of Edinburgh; he is now professor emeritus there. Kemmer receives the Max Planck medal for his outstanding contributions to the theory of elementary particles. Particularly noteworthy is his recognition, in 1938, that isospin is an internal symmetry of pions. Kemmer was able to show that Yukawa's meson theory of nuclear forces could be made charge-independent, as experimentally observed, if one regards the pions as a triplet state of an internal symmetry. The symmetry thus required a neutral pion as well as charged pions. Kemmer's isospin-invariant formulation of the theory was dramatically confirmed in pion-scattering experiments, once pions became available from accelerators, some 15 years later.

The Max Born prize is awarded jointly by the German Physical Society and the Institute of Physics in commemoration of Born's work in both Germany and the United Kingdom. In alternate years the award goes to British and German physicists.

Keller studied chemistry in Budapest until 1947. In 1948 he joined Imperial Chemical Industries in England to work on polymer crystals, and in 1955 he joined the physics department at the University of Bristol. Since 1969 he has been professor of polymer research there. Keller's contributions have been particularly noteworthy in morphology: for example, his discovery of chain folding, his elucidation of the arrangement of crystal layers in partially crystalline polymers, and his contributions to the understanding of flow-induced crystallization. He has also investigated the elastic behavior of polymers and multi-component polymer systems, including biopolymers. Thus, for example, he has investigated the behavior of collagen in transmitting forces between muscles and bones. His recent research concerns radiation effects on polymers and superconducting polymer crystals.

The Physics prize of the German Physical Society is awarded to Binnig in recognition of his work on vacuum tunneling, which made possible the tunnel microscope and has contributed a powerful new tool for surface science (PHYSICS TODAY, April 1982, page 21). Binnig and his colleagues at the IBM Research Laboratory in Zurich were able to suspend a tungsten needle—only a few angstroms above the surface to be investigated—using a piezoelectric suspension that allowed extremely fine lateral motion. The variation of the rate of tunneling with separation of the needle and plate provides the basis for a scanning microscope that is extremely sensitive to surface irregularities down to the atomic scale. Thus, for example, Binnig was able to demonstrate the 7×7 reconstruction of the silicon (111) surface and determine the positions of the surface atoms.

The Walter Schottky prize for solid-state physics was given to Sattler for his contributions to the study of microclusters of metals, alkali halides and inert gases. Sattler and his colleagues at the University of Constance have been able to produce clusters of atoms bound by metallic, ionic or Van der Waals bonds, reproducibly containing a wide range of numbers of atoms. The existence of the clusters was demonstrated with a time-of-flight mass spectrometer. Such clusters allow one to investigate phenomena that lie at the intersection of atomic, molecular and solid-state physics.

Rosenzweig receives the Karl Scheel prize for his theoretical and experimental work on excitonic polaritons in CdS. He has given a complete description of

the optical properties of the excitonic polaritons and has, for example, shown that the appropriate boundary conditions to use in theoretical interpretations depend on the experimental conditions.

Physicists among 1983 IEEE award winners

Among the 1983 award winners of the Institute of Electrical and Electronic Engineers are Abe Offner, who received the Cledo Brunetti Award, and Erich P. Ippen and Charles V. Shank, who jointly received the Morris E. Leeds award.

Offner is the principal optical scientist for the Perkin–Elmer Corp. in Norwalk, Connecticut. Specializing in the design of optical systems for use in the semiconductor industry, he designed an innovative annular-field all-reflecting optical system that led to the first successful projection wafer-mask aligner used in the manufacturing of integrated circuits. He joined Perkin–Elmer in 1947 and, for the past 35 years, has contributed to many of the company's pioneering optical achievements. The award honors his invention and design of the optics that made possible the projection-lithography system that were crucial to the advance of integrated-circuit manufacture.

Ippen is professor of electrical engineering at MIT. Shank has been with Bell Laboratories in New Jersey since 1969; in 1976, as head of the Quantum Physics and Electronics Department, he worked on extending time-resolved optical spectroscopic techniques into the femtosecond time domain. The award honors both men for their pioneering contributions to extending the techniques of time-domain measurement into the subpicosecond range. (See PHYSICS TODAY, December 1982, page 19.)

Norwegian physicists present Norsk Data and Simrad prizes

Jon Magne Leinaas (University of Oslo) has received the Norsk Data Award in particle physics and Tycho Jaeger (Norwegian Defense Research Establishment) has received the Simrad Prize for electro-optics. The prizes were presented at the annual meeting of the Norwegian Physical Society.

Leinaas is being honored for his work in theoretical physics, in particular for his contributions to understanding the geometrical and topological aspects of gauge theories. Recently he has collaborated with John S. Bell (CERN) in an investigation of the behavior of elec-