It is a great honour to deliver this *laudatio* for the *laurea honoris causa* in physics of the University of Bologna to Professor Sheldon Glashow.

Sheldon Lee Glashow was born in New York in 1932. He graduated from the Bronx High School of Science in 1950; one of his classmates was Steven Weinberg, with whom Glashow later shared the Nobel Prize. He received his B.A. from Cornell (1954) and Ph.D. from Harvard (1958), under the supervision of Julian Schwinger.

Schwinger conveyed to Glashow his intuition that electromagnetism might be unified with the weak force if the latter, too, could be written in the language of quantum field theory. This view implied that the forces be mediated by vector bosons. Glashow attacked the problem in his PhD thesis, which was in fact titled « The Vector Meson in Elementary particle Decay », and, between 1958 and 1960, while on a post-doctoral fellowship in Europe, studied the possible role of vector bosons in the weak interaction. It was in fact in that period that he made essential progresses toward the definition of what would become the basis of the electroweak theory. In March 1960 he accepted Murray Gall-Mann's invitation to become a research fellow at the California Institute of Technology. There, in 1961, he published a model setting out much of the theory which was to dominate in the 1970s. Glashow's model incorporated a (neutral) singlet and a triplet – in the three states of charge – of vector bosons. The singlet and the neutral member of the triplet mixed – the weak mixing angle has survived in the final version of the theory – in such a way as to produce one very massive particle, which he called B and is now known as Z^0, and one massless particle which could be identified as the photon. The two charged members of the triplet (W^+, W^-) were very massive as well. In Glashow's view, the vector bosons were to be gauge bosons. A gauge group larger than the original SU(2) gauge interaction of Yang and Mills was then necessary, and the gauge group became in fact SU(2) X U(1). By a specific assignment of leptons to representations of SU(2) X U(1) Glashow ensured that the electromagnetic interactions conserved parity, while the weak interactions did not.

Glashow's scheme implied the existence of the so-called neutral currents (no charge exchanged between weakly interacting particles) side by side with the known charged currents. This prediction was to be confirmed in experiments carried out in 1973-74. For the massive vector bosons one had to wait until 1983 and the UA1 and UA2 experiment at CERN.

Two problems were left open by Glashow's original version of the theory, namely gauge boson masses had simply to be put in *ad hoc*, and the renormalizability of the gauge theory had still to be proved. The latter problem was solved in 1971 by Martinus Veltman and Gerard 't Hooft; in 1967, independently, Abdus Salam and Steven Weinberg, had produced an answer to the first problem by proposing the application of the Higgs mechanism to the electroweak interactions.

Glashow, Weinberg and Salam shared the 1979 Nobel Prize in physics “for their contributions to the theory of the unified weak and electromagnetic interaction between elementary particles, including, *inter alia*, the prediction of the weak neutral current”.

In 1964, Glashow, with James Bjorken, had proposed the existence of a fourth quark, that he called charm. The charm created a symmetry between the two fundamental families of elementary particles, leptons and quarks (the scheme was to be subsequently extended to a third family). A naive mixture of electroweak theory and the quark model led to calculations about known decay modes that contradicted observation. A 1970 idea of Glashow, John Iliopoulos, and Luciano Maiani, known as the GIM mechanism, showed that the charmed quark would remove the contradiction. This work led, by the summer of 1974, to theoretical predictions of what a charm/anticharm meson would be like. In 1974, the discovery of the so-called J/psi particle was simultaneously announced from Brookhaven by a group led by Samuel Ting and from Stanford by a group led by Burton Richter. The J/psi was in fact soon interpreted as a charm-anticharm meson.

In the same year, Glashow, in collaboration with Howard Georgi, formulated a specific example of a Grand Unified theory, embracing within a single gauge theory the weak, electromagnetic and strong interactions. The underlying SU(5) symmetry was assumed to be spontaneously broken down to a product of the SU(2) X U(1) symmetry of the electroweak and an SU(3) symmetry of the strong interactions. The theory implied the existence of interactions which do not conserve baryon number, and the experimental lower limit on the proton lifetime appeared to contradict its predictions. However, the elegance of the model has led physicists to use it as the foundation of more complex models which yield longer proton lifetimes.

Professor Glashow, for these outstanding contributions to the physics of fundamental interactions, the University of Bologna is pleased and honoured to confer on you the degree of Doctor of Physics *honoris causa*.