The paper "EXTENSION OF ALGEBRA OF POINCARE GROUP GENERATORS AND VIOLATION OF P INVARIANCE"(1971) .

In the paper [1], Yuri Golfand and his student Evgeny Likhtman pioneered a new concept that later became known as supersymmetry. Supersymmetry is a powerful idea in particle theory, which involves Fermi-Bose symmetry transformation. At the level of quantum mechanics, it employs some quantum operator, let's call it Q, whose action would be to transform bosons into fermions, and vice versa. In operator language this would be written $Q|fermion >= |boson >$, $Q|boson >= |fermion >$. And since this is a symmetry, this operator must commute with the Hamiltonian $[Q, H] = 0$. Such a theory is called a supersymmetric theory, and the operator Q is called the supercharge. Since the supercharge corresponds to an operator that changes a particle with spin one half to a particle with spin one or zero, the supercharge itself must be a spinor that carries one half unit of spin of its own.

Nowadays, supersymmetry is key for particle physics research beyond the Standard Model. Interestingly, however, this is not what the subject of the paper by Golfand and Likhtman was. Rather than trying to add fermions to a bosonic theory, they were exploring the mathematics of space-time with the primary motivation to do something exotic with the group theory of spacetime symmetries.

The usual group of spacetime symmetries in relativistic quantum field theory is called the Poincare' group. This group includes symmetries under spatial rotations, spacetime boosts and translations in space and time. The action of the group can be described by the algebra of the group, which is defined by a set of commutation relations between the generators of infinitesimal group transformations. These are all bosonic symmetries, which ought to be so because momentum conservation and Lorentz invariance are present in classical physics.

But the Poincare' group also has representations that describe fermions. Since spin 1/2 particles arise as solutions to a relativistically invariant equation – the Dirac equation – this is to be expected. If there are spin 1/2 particles, could there be spin 1/2 symmetry generators in a spacetime symmetry algebra? Yes! By introducing such symmetry generators Golfand and Likhtman have constructed the first example of supercharges mentioned above. What Gol'fand and Likhtman ended up with was the group theory of supersymmetric transformations in four spacetime dimensions, and using this new type of symmetry, they constructed the first supersymmetric quantum field theory.

Unfortunately for them, their work was ignored, both in the Soviet Union and in the West, until years later when supersymmetry finally mushroomed into a major topic of investigation in particle physics. In 1972, Gol'fand was judged one of the least important researchers in his group at FIAN in Moscow, and so he was let go in a cost reduction drive in 1973. He remained unemployed for seven years, until pressure from the world physics community led to his rehiring in 1980. A vivid account of these dramatic events and other related matters can be found in [2].

[1] GOLFAND Yu. A. , LIKHTMAN E.P. JETP LETTERS-USSR 13,323 (1971)

[2] M. Shifman, Introduction to the Yuri Golfand Memorial Volume "Many Faces of Superworld" (World Scientific, 2000), available online from http://arxiv.org/abs/hep-th/9909016v1