

Simon van der Meer's Nobel Prize in Control Engineering¹

The Winter 2016 issue of CACHE News [1] discussed the Nobel Prize in Physics awarded to Nils Gustaf Dalén in 1912 for an accomplishment in control engineering, namely, the “invention of automatic regulators for use in conjunction with gas accumulators for illuminating lighthouses and buoys.” This column describes a later Nobel Prize awarded for a control engineering accomplishment.

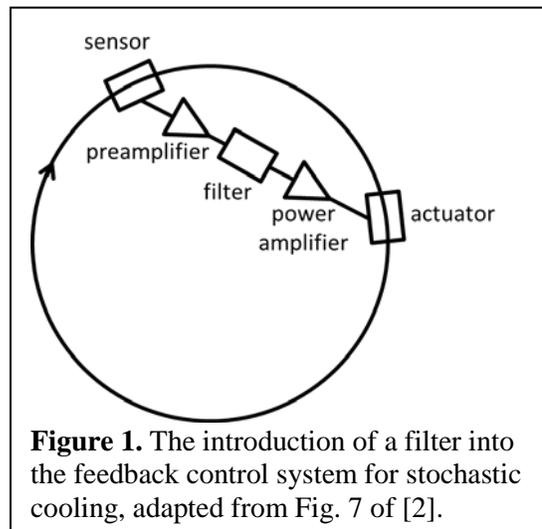
In 1984 the Nobel Prize in Physics was awarded to Simon van der Meer for developing a technique for controlling beams of subatomic particles [2]. The fact that feedback control is central to the technique is not immediately obvious from its name, “stochastic cooling.” “Stochastic” refers to the randomness of particles in the system and “cooling” refers to the reduction of the movements of particles with respect to each other. The implementation of the technique in 1983 at the European nuclear research center CERN produced the subatomic particles known as the W and Z intermediate vector bosons.

The Nobel Prize in Physics in 1984 was awarded for control engineering.

The Nobel prize-winning experiment in 1983 employed stochastic cooling to create a head-on collision of a dense beam of protons with a dense beam of antiprotons. Antiprotons are not easy to create and do not last long in the presence of ordinary matter, so a feedback control system was needed to keep the antiprotons in a carefully controlled beam. A sensor measured the deviation of the antiprotons from a ring-shaped orbit; the deviation was amplified and sent to an actuator that pushed the particles back towards the central orbit, as shown in Figure 1. Simon's 1985 Nobel Lecture described the feedback control system accompanied by a block diagram and stochastic and frequency-domain analyses [2].

Simon was born and raised in the Netherlands. He received a degree in electrical engineering from Delft University of Technology where he specialized in feedback circuits and measurement techniques. After graduation, he worked in industry for several years. In 1956 he moved to work at a research laboratory (CERN), where he worked for more than 25 years before receiving the Nobel Prize in Physics with his colleague Carlo Rubbia “for their decisive contributions to the large project, which led to the discovery of the field particles W and Z, communicators of weak interaction.”

Readers interested in learning more about Simon van der Meer's life and control accomplishments are referred to [2–3].



–Richard D. Braatz

References

- [1] Richard D. Braatz, “The first Nobel Prize in control engineering,” *IEEE Control Systems*, vol. 33, no. 4, pp. 6–7, August 2013. Adapted version published in CACHE News, Winter 2016.
- [2] Simon van der Meer, “Stochastic cooling and the accumulation of antiprotons,” *Reviews of Modern Physics*, vol. 57, no. 3, pp. 689–697, 1985.
- [3] Rolf Heuer and Steve Myers, “Simon van der Meer (1925-2011),” *CERN Bulletin*, No. 11–12, pp. 14, March 16 and 23, 2011, <http://cds.cern.ch/record/1335396/files/2011-11-12-E-web.pdf>.

¹ This article is adapted from Richard D. Braatz, “Simon van der Meer's Nobel Prize in Control Engineering,” *IEEE Control Systems*, vol. 34, no. 2, p. 6, 2014