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Essay: Bob Siemann—SLC days at SLAC

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Bob Siemann was a great experimentalist and an excellent teacher. We will greatly miss him. Bob came to SLAC in early 1991 to work on the Stanford Linear Collider (SLC). The SLC was a challenging accelerator which began operating in the late 1980's but still had numerous obstacles to be overcome years into operation. One of the compounding difficulties was making reproducible measurements, since the stability of the collider was poor and the diagnostics were insufficient. Bob dove into this challenge and helped design experiments and diagnostics that provided further clarity.

I first got to know Bob while I was still a graduate student, trying to finish my thesis and performing some experimental studies on the SLC, which, at the time, was proving to be very difficult. Most of my expertise had been in beam theory and simulation. Dealing with the real issues of the accelerator was challenging. Bob helped me understand the difference between systematic and statistical errors, and separate operational issues from the fundamental physics. His way of teaching was not to provide an explanation but to ask enough questions so that I could find the answer on my own—this was the best way to learn. I later asked Bob to be a reader on my thesis. As in all things, he took this role extremely seriously. He read through the draft and marked every page to the point where I was regretting my decision. However, his questions again helped me understand my own work better and greatly improved my thesis.

Bob was also the *de facto* leader of an effort focused on the damping rings and the bunch compressors. He was great to work with. He made people think for themselves and refused to simply provide answers. He also worked hard himself, expressing real interest and curiosity. After the studies of the SLC damping rings identified a sawtooth instability due to the vacuum chamber impedance as a source of many downstream fluctuations, Bob took charge of upgrading the rings. As part of this program, I suggested an extensive upgrade that also replaced the dipoles with combined function magnets which might have reduced the horizontal emittance another factor of 3. Although he was extremely busy, Bob helped me develop the proposal and understand the magnetic limitations as well as the potential impacts on the beam dynamics. He helped me consider issues well beyond my initial scope. While the proposal

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never went anywhere and I think Bob had been aware that there was no funding to pursue the option, he saw that it would be a great learning experience for me and it was.

In the early 1990's I had simulated a new regime for the beam-ion instability and, with Frank Zimmermann, I developed a model for the effect which was predicted to occur within the high current, low emittance bunch trains in future storage rings or linear colliders. I thought this was pretty good work but Bob convinced me that the next step had to be confirming the theory with measurements. Because the growth rate was inversely dependent on beam sizes and proportional to the vacuum pressure, measurements required significantly increasing the vacuum pressure in existing facilities. Most people discounted trying such an experiment, but with Bob's urging and suggestions and John Byrd's excitement, we managed to make the measurements at the Advanced Light Source (ALS) at Berkeley.

By the mid-1990's Bob was completely focused on advanced acceleration concepts and I was not interacting with him as often. At the time, SLAC was putting together a large effort in designing and documenting a design for the Next Linear Collider (NLC) while constructing the NLC Test Accelerator. Bob was worried that a straightforward extrapolation of the microwave technology would be difficult to bring to fruition because of the cost. He wanted to focus on more cost-effective approaches that could enable future accelerators for high energy physics. As usual, he was correct. The experimental programs that he started in direct laser acceleration and plasma-wakefield acceleration have made great progress. He accomplished this with lots of hard work and by engaging the people around him, especially students and postdocs. In the process, he created a group of extremely talented people which has enabled these technologies to be developed to the point where it seems likely that they are viable and will offer two cost-effective approaches to high-gradient acceleration.

Sometimes Bob was gruff, sometimes he was excited, and sometimes he was measured but, in all of our interactions, he modeled intellectual integrity. At times we disagreed but I always trusted him. He pushed people to think for themselves, but would provide the guidance by asking the right questions. He loved experimental physics and loved designing experiments to get at the physics. We will all greatly miss him.

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