Inside BaBar's Control Room

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Day and night, weekends, weekdays, and holidays, physicists from around the world take shifts in BaBar's Interaction Region 2 control room. The BaBar detector records the products of the positron-electron collisions generated by the PEP-II rings. The two particle beams are carefully tuned to energies that, when combined, produce particles made of a bottom quark and its antiquark, or B-mesons.

"We take data as efficiently as possible and solve problems as they arise," explains shift leader Gabriele Benelli. "In BaBar things are very aggressive. On average, we're very close to 99 percent efficiency."

The main goal in the nine-year project is to generate as much usable data

as possible about B-meson decays in the quest to understand the dominance of matter over anti-matter. Six separate systems—or subdetectors—within BaBar track, identify, and measure the energy of individual particles and photons that burst through the layers of chambers and sensors.

Such sensitive and complex systems require round-the-clock monitoring. Two physicists are always in IR-2 to run the detector and keep the data flow smooth. A run coordinator is always on duty, liaising between the PEP-II physicists, subdetector experts, and shift workers, as well as keeping continuity as shift workers from the collaboration of more than 600 physicists come and go.

Recently, Benelli, a postdoc from The Ohio State University, took the day shift as BaBar pilot in IR-2, while PhD student Ian Bingham, from the University of Liverpool, worked as data quality manager. They started by going over the latest events with the physicists who had just finished the midnight to 8 a.m. "owl" shift. They also conferred with run coordinator Katherine George for the day's schedule of events: IR-2's backup power system needs a new part. The repair requires notifying operations managers of the subdetectors, but will not require shutting off the beams. Soon after the shift starts, Benelli confirms the schedule with the accelerator physicists in PEP's main control room.

Two walls of screens show detector controls and data streaming in from the subdetectors, as well as the detector controls. Benelli points to the panel that shows the limited streamer tubes (LSTs) detector controls, particle sensors which he helped design. Columns of numbers in a reassuring green indicate voltage and current levels for the hundreds of tubes are all hovering within the safe range.

Operations managers Virginia Azzolini and Roberto Sacco arrive in preparation for the scheduled repair. Azzolini, from the University of

Valencia, oversees the silicon vertex detector system, which tracks charged particles that burst into existence near the interaction point. Sacco, from Queen Mary College, University of London, is concerned about the electromagnetic calorimeter, which measures the energy of particles and photons. If a mishap during the backup power system's repair causes a power outage—which has happened before—either subdetector could be affected. As they wait for the repairman, they discuss their other concern: IR-2's low level of coffee.

It's 8:53 a.m., and a voltage level on Benelli's screen blares red. "Uh-oh, there is going to be a trip," he says. A cluster of ions in an LST is probably what pushed the current into the danger zone. Too much charge could damage the tube's wire. "It's normal," says Benelli. "With 500 tubes, and these high luminosities, we expect one of these trips a day." He lowers the voltage so ions can dissipate. But the tube keeps tripping each time the voltage is ramped up, so Benelli decides to keep it running at a lower voltage for a few hours, a move that does not affect the quality of the data, he explains.

"LER beam lost," announces a robotic female voice in BaBar's control room. It's 9:21 a.m., and the low-energy ring that stores the positrons has stopped working. The automated announcements are part of the communication system between PEP and BaBar.

"Injection requested," the monotone tells us, referring to process of filling the rings with electrons and positrons. Once each beam reaches a certain current, BaBar can take data and PEP-II will use "trickle injection"—letting small bursts of particles stream into the rings—to keep the luminosity high.

Then, "LER beam lost" and they start the process again. On the phone with a PEP-II physicist, BaBar shift leader Gabriele Benelli decides to keep taking data with the high-energy beam only, useful for studies of

the machine itself, while waiting for the LER beam to recover.

Once the beam is up again, the shift runs smoothly. The backup power system is repaired without incident. Near the shift's end, some two dozen operations managers convene for the daily update of all the subdetectors. Most linger in IR-2 afterward, talking animatedly in English with accents from three continents and other languages, as the next shift starts its watch.

"You cannot be bored as a physicist at BaBar," Benelli says. "A lot of physics still needs to be done."

Source: by Krista Zala, SLAC Today, Stanford Linear Accelerator Center