says that publicizing a finding of guilt is a matter of principle. "Secrecy has proved to be the enemy of justice," he says. "Moreover, there are quite enough cases where people have committed misconduct and have gone on to commit it elsewhere to show that it's a bad idea not to make findings public."

At Illinois, the results are kept quiet only if the investigation concludes that no misconduct was committed and the allegations haven't been aired already. (If someone—say the whistleblower—has publicized the accusations, the exoneration will be publicly announced as well.) UCSF likewise tries to communicate findings of misconduct, first by notifying the journals, then the faculty and the community. It's not always easy, notes Hittelman, who has met with resistance from lawyers for the accused, from the university, and even from the journals. In one case, the journal in which the original paper appeared was willing to announce the finding of misconduct. But the university's general counsel raised legal concerns and instead insisted that the retraction say only that the paper's data could not be substantiated, without mentioning misconduct. "I find that very troubling," he says. "Here we are with a very carefully examined instance of an individual having committed scientific misconduct, and we're being thwarted from coming out and saying that."

The other challenge at the conclusion of a misconduct investigation, says Shore, is the process of healing. However the investigation ends up, someone—the accuser, a researcher who was falsely accused, or even researchers called as witnesses—will need to be "made whole," in Shore's words. Often this entails transferring researchers to other labs, while assuring the continuation of their salary and research. "If you have brought an allegation against people you're working with," says Shore, "you can't go back in the lab easily and say all is forgotten. Sometimes [people] just have to be separated."

Gunsalus tells of one such incident at Illinois, when a student came forward with an allegation that turned out to be groundless. At the same time, she says, based on the information at hand "it was absolutely proper and appropriate for him to do what he did. He was just wrong, and we ended up moving him to another department, because the person wrongly accused was extremely upset, as one might imagine."

Everyone agrees that that kind of risk is unavoidable with a topic as thorny as misconduct. "It's a very treacherous business," says UCSD's Friedman. "No one loves you for dealing with these cases." And no protocol or procedure handles all contingencies well. Adds Gunsalus, "Every time you do one of these, you encounter new problems and new ways to do it wrong. What we have is a framework that tends to work for us. It's not a problem-free process, but we work pretty hard at thinking these problems through."

–Gary Taubes

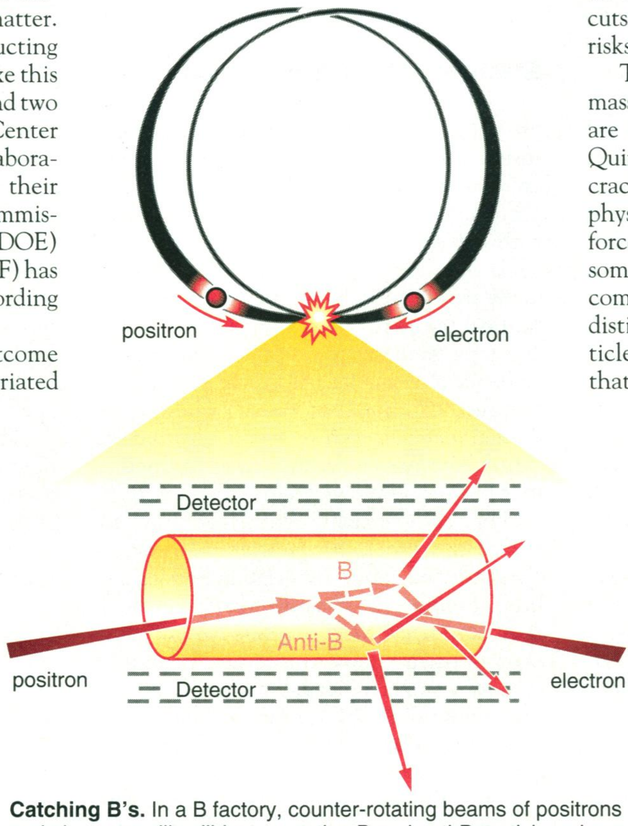
HIGH-ENERGY PHYSICS

Cornell Leads Battle of the B Factories

These are lean times for particle physics, and the stakes have never been higher in the competition over who will get to build scarce new facilities. The fiercest battle is now raging over the B factory, a $100 million to $200 million particle accelerator that promises insight into such questions as why the universe contains more matter than antimatter. Other than the $11 billion Superconducting Super Collider, which Congress may axe this year, it's the only big project in sight, and two labs, the Stanford Linear Accelerator Center (SLAC) and Cornell University's Laboratory of Nuclear Studies, have staked their futures on building it. A report commissioned by the Department of Energy (DOE) and National Science Foundation (NSF) has just strengthened Cornell's hand, according to some who've seen it.

For physics as a whole, a happy outcome is likely: The House has already appropriated money for the project, and sources at the Office of Science and Technology Policy and DOE doubt that the Senate will delete the funding. But for SLAC—which has been teetering near extinction since its last big project, the Stanford Linear Collider, proved a disappointment (*Science*, 24 April 1992, p. 432)—the prospects of losing this prize are painful to contemplate. Many physicists fear that it would spell the end of this world-renowned facility.

DOE is closely guarding the report of the 12-person review panel, headed by Massachusetts Institute of Technology physicist Stanley Kowalski, pending a verdict by DOE Secretary Hazel O'Leary, who may make the decision along with presidential science adviser Jack Gibbons. But directors at both labs say they've seen the report, completed last month, and they confirm its bottom line: Although it makes no recommendations, it says both proposals are workable but Cornell's, as advertised, will cost much less. That appears to support a public claim by the Cornell laboratory, now the world leader in studies of the B particle, that it can build a B factory for just over half the price of the SLAC proposal. But the SLAC team is doing its best to argue that the Cornell proposal cuts too many corners and takes too many risks to be considered a bargain.



SOURCE: CORNELL

Catching B's. In a B factory, counter-rotating beams of positrons and electrons will collide, generating B and anti-B particles whose decays should hold clues to new physics.

The goal of both designs is the same: mass-producing short-lived "B" particles. B's are in demand, says SLAC theorist Helen Quinn, because their decays may reveal cracks in the so-called Standard Model, physicists' working picture of matter and forces. Most subatomic processes conserve something called charge-parity (CP)—a combination of charge (the property that distinguishes particles from their antiparticles) and parity (a kind of "handedness" that distinguishes a particle from its mirror image). But the Standard Model makes room for a small amount of CP "violation"—and predicts it should show up in the decays of B particles.

Physicists suspect, however, that something is wrong with the Standard Model's prediction. Subatomic processes that violate CP conservation affect matter and antimatter differently, so physicists believe CP violation is the reason the Big Bang produced a universe that contains more matter than antimatter. But the amount of CP violation predicted by the Standard Model is too small to account for all the matter we see around us. Something is fishy in the

Standard Model, say Quinn and other physicists, and they hope to find it by studying CP violation, which shows up as a difference in the lifetimes of the B particles and their antimatter counterparts.

To measure these lifetimes with any reliability, however, these investigators need a machine that can make a million B particles per year—hundreds of times more than current accelerators can muster. That, in turn, requires a collision rate, or luminosity, 10 times higher than ever achieved before. "Each lab is pushing the state-of-the-art in luminosity," says panel head Kowalski. Both propose to do so by mating an existing accelerator with a new one. The two rings will accelerate electrons and positrons, the antimatter counterpart of electrons, in opposite directions and at slightly different energies. When the beams collide, the energy difference will give the B particles spawned in the collision a push away from the collision point, making it easier to track their decay into more stable particles.

In spite of the overall similarities, the designs differ in philosophy. Cornell's is widely considered more daring technologically—something the report is said to confirm. To SLAC director Burton Richter, it also "has some major risks." For one thing, Cornell's smaller rings will generate more synchrotron radiation because they will force the charged particles to move in tighter circles, and that can sap energy from the beam and throw it off course. Second, he says, Cornell is planning to use superconductors rather than the traditional copper in the radio-frequency cavities that will accelerate the charged particles—an untried innovation.

The biggest risk, Richter claims, is a novel plan to collide the beams of particles at an angle instead of head-on, as SLAC plans to do. The object is to fix the collision point precisely; the collision of two beams approaching from exactly opposite directions tends to get smeared out. To avoid that beam-degrading effect, Cornell has devised a way to angle the beams in a technique called "crab crossing," which brings them to a sharp collision point and keeps uncollided particles from traveling on into the other beam. "That's never been tried before," says Richter. Cornell has done some experiments with the technique, he says, but never employed it in a working accelerator.

To SLAC proponents, all that venturesome technology makes Cornell's low price tag alarming. SLAC physicist Michael Riordan charges that the Cornell people plan to build their accelerator on the cheap and tinker with it once it's running. That's the approach, he notes, that got SLAC itself into trouble with the Stanford Linear Collider.

But the head of the Cornell team, physicist Karl Berkelman, argues that their design comes at a lower price not because they are skimping on engineering, but because Cornell is starting with some advantages. For one thing, the existing accelerator at Cornell that would serve as the basis for the B factory is much smaller than its counterpart at SLAC, making it cheaper to build the second ring, says Berkelman. In addition, Cornell has a working detector, known as CLEO, while SLAC must build a new one.

Berkelman also argues that he and his colleagues have done plenty of computer simulations and small-scale experiments to show that their design should work. SLAC's decision to stick with tried-and-true technology, meanwhile, entails risks of its own, he says. SLAC's design forgoes a fancy beam crossing pattern, but as a result the beams run close to each other beyond the intended collision point, something he thinks might spell trouble with the torrential beams needed for the B factory. SLAC also risks excessive heat buildup by doing without superconductors in the accelerating cavities, he claims.

Richter, however, makes an argument that goes beyond the merits of the two proposals and invokes SLAC's history. The community has far more at stake in SLAC, he says, than in the lesser known Cornell lab. "Putting it [the B factory] at SLAC is the best choice for the long-term future of the field.... The government has invested a billion dollars in SLAC—we have been leaders in electron-positron physics," he says. "If you want to preserve the vitality of this lab in the future it makes a great deal of sense to put in a B factory."

But in these lean times, says one source at NSF, Cornell's low bid may be hard to resist. "The report says there is a top-rate lab, with a good record for B physics, that claims it can build [the facility] for $100 million less," says the source. "If it is not selected, someone will face some serious questions."

–Faye Flam

MEETING BRIEFS

Innovative Techniques on Display at Boston Meeting

Boston may be one of the United States' more tradition-laden cities, but a few weeks ago when more than 1800 exhibitors and scientists descended on Beantown for the ScienceInnovations meeting, the ideas they tossed about were anything but old. Here's a small sample of the talks that caught our eye.

Stepping Out With Kinesin

Steve Block, a biophysicist at the Rowland Institute for Science in Cambridge, generally draws a crowd at scientific meetings. His good humor and mixture of scientific data with video clips of tractor beams from "Star Trek: The Next Generation" have helped many an audience delight in the potential of "optical tweezers," a laser-based system that uses light gradients to trap and move objects cell-sized and smaller. At this year's Innovation meeting, however, Block eschewed his normal stump speech to report on what he called "the most exciting thing in science that I've been involved with."

The achievement that's got him so revved up? Block, his Rowland colleagues Karel Svoboda and Christoph Schmidt, and Bruce Schnapp of Harvard Medical School devised a new optical tweezers method that allowed them finally to measure the movement of a single molecule of kinesin, one of the important "motor molecules" that power the movements of the cell's internal structures (*Science*, 26 June 1992, p. 1758). It's only the second time that researchers have been able to document the motion of a single protein. (The first was when patch clamp techniques were used to watch the opening and closing of ion channels.) And it certainly won't be the last time. James Spudich, a cell biologist at Stanford University School of Medicine, says his group has also recently made use of optical tweezers to watch myosin, one of the molecules that power muscle contraction, take strides across actin filaments. Such methods have enormous potential, said Block: "If you want to look at the actions of a single molecule, this is the way to go. It opens up whole new avenues of research."

That would be welcome news to cell biologists. A wide variety of cellular activities, including muscle contraction, the separation of the chromosomes before cells divide, and in kinesin's case, the ferrying of small vesicles containing enzymes and other proteins through cells on tracks called microtubules, depend on the ability of motor molecules to convert the chemical energy stored in attached ATP molecules to movement. But despite years and even decades of study, researchers don't fully understand how motor molecules actually move. Does kinesin, for example, glide smoothly down the microtubules, or move more jerkily? And if the latter, does it take small steps or big ones? The an-