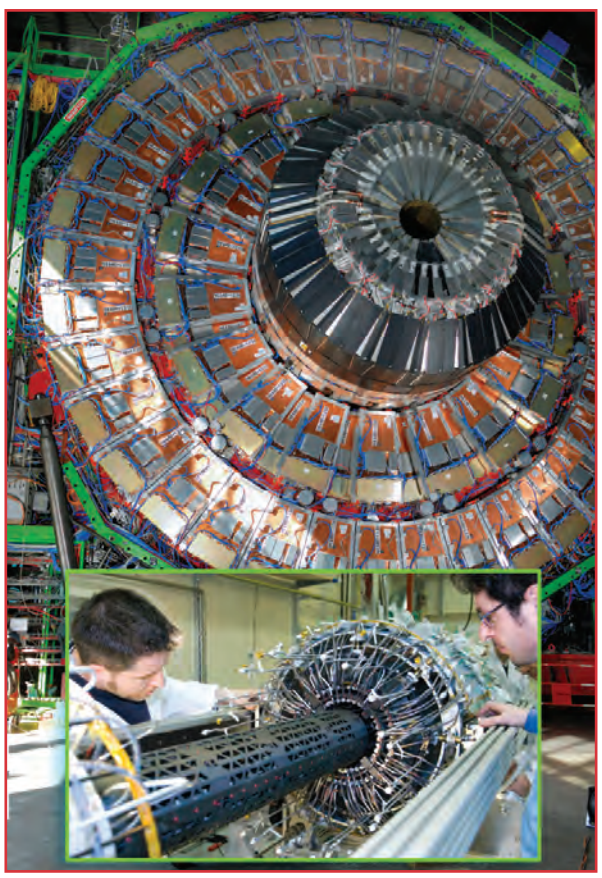
Let's Hear It For Head-On Collisions

You'd think being in Switzerland, I'd visit with the FIA people at 2 Chemin de Blandonnet, but science enthralls me so when I was running around Europe this summer I was fortunate to arrange a day-long tour of CERN, the brain stretching science project where they are sorting out a spec sheet for the universe. Located a tad west of Lake Geneva, hugging France's Jura Mountains on the east, the facility is about 90 miles south of where Louis Chevrolet was born.

By sheer luck, my visit coincided with the scientific community's biggest announcement in 50 years: the discovery of a new sub atomic particle - a Higgs Boson - a building block of our universe. This particle is a sign that an all-pervasive "field" exists in the universe, without which matter would always move at the speed of light, a sort of cosmic soup, and not slowed-down to thicken into stars, planets and, eventually…life. For you techies, the newly found Higgs-type Boson has a mass of about 125 GeV (gigaelectronvolts), a unit of energy equal to a billion electron volts.



Mind you, although two separate competitive but collaborative search teams, Atlas and CMS, found this thing simultaneously, they need more time to figure out just exactly what they've got. Some physicists are hoping the 5-Sigma discovery (99.99995% sure) IS NOT actually a Higgs, because it would open more paths into the ripe old unknown. Stand by, more data is being taken and the hope is that by year's end they will know more precisely what it is they have discovered. You can't set the track record on the first lap!

Recall the dawn of nitromethane use in motorsport; it took awhile to sort out how much to use and when to use it. That was back in the 1950s, coincidentally, when CERN also got its start and has been a site for scientific experimentation and soaring imagination ever since.

Driving through the area you would never suspect anything audacious was going on - the buildings are industrial drab, save a couple spiffy murals. Only the CERN interpretative center catches the eye from the street - a three-story wooden globe that looks remarkably like rusted iron.

The dedication and congenial rivalry these science people display mimics what we share in land speed racing: a distinct, specialized solidarity. Unlike the salt, this place is heaving with humanity from every walk of life. Let's call it a "sigma infinity" irrefutable discovery demonstrating that diverse peoples can work together splendidly to achieve spectacular common goals if they damn well want to. Global effort begets global success.

If Bonneville is the Mecca of speed experiments, CERN is the planet's foremost science project. In terms of size and scope, it makes Florida's Cape Canaveral look like a bus stop, and I have great respect for the launch facility. Never have I seen such colossal equipment controlled by a mind-scrambling instrumentation array and supported by a ginormous computing grid all designed, built and operated to search for a few eenie weenie, teeny-tiny, invisible-to-the-naked-eye clues.

Yep. Clues. Playing daily with CERN's Large Hadron Collider (LHC) simply called, "the machine," particle physicists don't expect to find actual bits, only clues that will help them update their measly "standard model". Nothing like what rolls out of Detroit, think of the model as a pizza with 12 ingredients scientists call fundamental particles - the building blocks of the universe. Some bits are heavy like sausage, others are light like mushrooms and it all rests in Higgs Field "dough." Together with four forces of nature, this model does for physicists what the theory of evolution does for biologists: creates a baseline.

OK, back to the machine. It's CERN's racecourse. Comprised of eight arc sections, essentially a pair of 16.7 mile near light-speed salad spinners carrying proton saturated beams in counter circulating directions that wind up to more than 11,245 revs per SECOND guided by cryogenically cooled magnets humping away at a constant 8 teslas - about 1,000 refrigerator magnets - sounds deceptively easy, but try doing this on the shop tool box!

Inserted around the circular piping are six intellectually seductive experiments: Alice, Atlas, CMS, Totem, LHCb and LHCf. Think of them as data loggers of the starship class. I spent time with Outreach & Education Coordinator Dr. Steven Goldfarb from the University of Michigan and Dr. Dave Barney, self-proclaimed "Lord of all He Surveys and King of Speed," at Atlas and CMS, home of two gigantic subterranean detectors. It is inside the detectors that multiple collisions take place and the secondary particles produced are tracked and positions measured. Sounds boring, but makes fabulous artwork.

The mechanisms are installed in a sloping cavern 300 feet down. Atlas is considered a "general purpose" detector that uses a gargantuan doughnut-shaped magnet system, the largest collider-detector ever constructed. CMS is similar to Atlas, but built around a mammoth solenoid, a cylindrical coil of superconducting cable. It required five years to wind the CMS coil that generates a magnetic field of 3.84 teslas – 100,000 times that of Earth!

This particle party all happens in a vacuum. Well, three vacuums, the beams have their own, another for the magnet's insulation and the third is for the liquid helium distribution line. Most of those magnets, nearly 10,000 of 'em, operate best at temps colder than outer space: 1.9 Kelvin (-455.98°F). They are "beam-herders", making sure the protons zooming round the rings keep on track - where +/- of less than a millimeter in more than 16 miles brings success or failure.

And the next time you crab about your tune-up, pity the particle pokers who have to lunar tune their rigs at the new and full moon due to "ground tides" that cause the earth's crust to rise 25 centimeters changing the circumference of the machine ring which affects the beam energy path.

Still with me? OK, so the LHC machine is the wing-ding zinger of crasher smashers. Land speed racers (and most other sensible people) take every precaution to avoid a crash, but collisions, about 600 million head-on events per second, are precisely what thousands of scientists are intentionally causing, generating temps 100,000 times hotter than the center of the sun.

Because it is a head-on proton smasher, not a one-way wall crasher, it is the darling of CERN and currently produces a stupendous 8 teraelectron volts (TeV) of collision energy. That's momentum folks. Someone smarter than me will have to tell you the equivalent in horsepower. Because the stuff they are searching for is so stinking small, precious few of the right kind of collisions occur.

One example given filled an Olympic-size swimming pool with sand and only those grains that clung to the very tip of your wetted pinkie would be comparable to the number of collisions that produced the aforementioned Higgs bosons. It is easy to see the "run vs. record ratio" for the LHC is staggeringly low, but these folks can optimize like nobody's business.

Bonneville and CERN share the mantra: "design, build, test and evaluate." CERN is after energy and mass secrets, not speed. The explosions create new particles of the primordial kind that the CERNies detect and analyze in insufferable detail. They are convinced that mapping the universe's particle assortment will give us answers that we don't even have questions for yet. First find the needle in fields full of haystacks. Sheesh.

We don't know much or can't see that much; the idea is that you can't figure out where you want to go if you don't know where you have been and how you got there. So-called dark energy and dark matter accounts for 96% of the theoretical pie with a lousy 4% left over for the matter we can observe. It's this slender area that the scientific community is reverse engineering and firmly believes the events of long gone yesterdays will bring them to tomorrow's truths.

Just as Glinda the good witch told Dorothy the only way to find her way out of Oz was to start at the very beginning, the CERN teams are recreating condi-

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tions that were present one-billionth of a second after the "big bang" - the accepted beginning of space and time. Think "ignition" moments before "exhaust."

These folks measure on what I call the "invisibility scales" where "micro," "nano" and "pico" are the norm. And even some of that stuff is too big. The collisions generate a whopping pile of data so that terms like "tera" and "peta" are needed because "mega" and "giga" are far too skimpy.

Dr. Mike Lamont, LHC Operations Group Leader and general dog's body for the beams, taught me a new measurement term: inverse femtobarns. I am not making this up. It's how they determine particle collider productivity and coveted luminosity, which to me is like measuring horsepower on a dyno. Not that most of us ever need to fret about femtos, but it took Illinois' Fermilab a decade (2000-2010) to gather 10 fb-1 while CERN'S Atlas and CMS experiments each reached over 5 fb-1 of proton smashing data in 2011 alone. That's hauling data butt.

Walking into the LHC "machine" control room I spoke with such thought-provoking people as Lamont, Dr. Gerard Willering who specializes in superconducting magnet technology, Tobias Baer a cheerful doctoral student specializing in unidentified falling objects (beam dust) and Dr. Lorna who drives the collider. Yes indeed, a lady does the light speed particle beam driving. You go girl. Andy Green is a mere supersonic shoe.

Let's talk about the "parachute system," how they stop, or dump the beam using the machine protection system (MPS). It consists of a group of inputs from various systems into a beam interlock system (BIS). When the BIS is triggered it provokes a beam dump within three to four turns (that is, in a few hundred millionths of a second). The MPS has worked flawlessly, always pulling a beam abort when called upon to do so.

The LHC machine alone cost 3.75 billion U.S. dollars. Each experiment is funded independently so the total CERN operating cost is much higher. Staffed by more than 10,000 scientists and engineers from some 500 academic institutions worldwide, I had to laugh when I found out when the machine does misbehave, it tends to do so a bit more often at night and weekends.

"Who cares," you say? "What's in it me for me?" Plenty. The trickle down perks have thus far been nothing less than monumental.

A worldwide social structure game changer started because these particle pokers were spread out all over the globe but still needed to regularly communicate gobs of information. This prompted a couple of guys in a non-descript, closet-size office a few hundred feet from the CERN cafeteria to dream up and implement what we now call the World Wide Web. Saw the place myself. Today, the CERN "computing grid" is morphing daily to harness networked computer powers that will doubtless bring new cultural shifts. Dr. Dave showed us rows upon rows of processors.

CERN has a monopoly on anti-matter. It's the only place where they make the stuff. Who needs anti-matter? Well, it's part of the Alpha Project that will use highly efficient magnetic nozzles for a proposed propulsion engine. I have long held that magnetics will obsolete fossil fuel engines some day.

Practically speaking, CERN officials report that for every dollar, euro, pound invested by supporting companies, the average return is 3.5 times with an added kicker of working in the forefront of technology.

How about detecting and curing cancer? Technologies used in the giant Atlas and CMS "cameras" (and others before them) have been applied to medical imaging - providing ever more accurate diagnoses. And using precise 3D pencil beam positioning and light-ion therapy to treat and cure some cancers is a direct result of all the proton and lead ion (aka hadrons) crashing and smashing. When you consider that radiation therapy is used to cure upwards of 50% of all cancers, is a bunch cheaper and usually has only short-lived side effects, you begin to think they ought to crash more often. GG