RXon's Photo Gallery

In God we trust! Everyone else must provide either cash or hard evidence!
(The Antitrust Law)

A) The IskraScope LCD

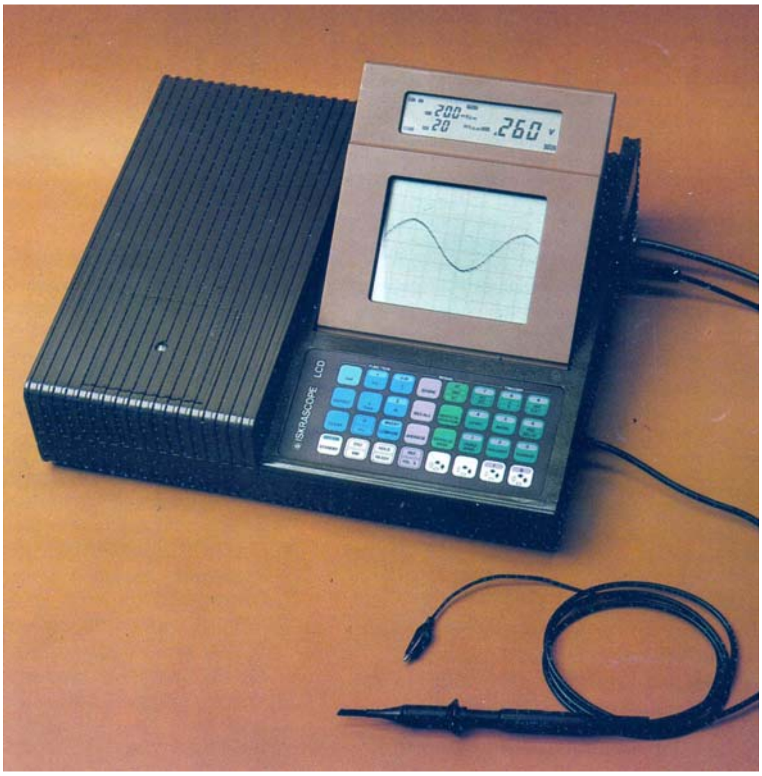


Fig. 1: June, 1984. The first official photo of the 'IskraScope LCD', developed at the 'Jožef Stefan' Institute, Ljubljana, and produced by Iskra, the major Slovenian electronics company (first prototype September 1982). A twist–nematic 120×200 pixel matrix (non-multiplexed) Liquid Crystal Display was driven by 16 Hitachi HD44100 chips. The display had a pixel size of 0.5 mm and featured a designed-in inter-electrode grid to eliminate the parallax error. The 'video' RAM access was of a dual port design, allowing simultaneous read and write operation for faster screen refresh. The signal refresh rate was selectable from 0.2 to 10 frames per second (intentionally limited to ensure a good contrast, which would deteriorate with faster frame rates owing to a relatively long orientation time of the LC molecules). A separate conventional LCD (above the signal display) was used for displaying the 'scope settings and values measured. The instrument was contained in a hermetically sealed brown (and ugly!) plastic case, metal coated inside to reduce EMI, weighing some 2.5 kg, mostly owing to four 0.5 Ah NiCd batteries which provided for a 6 hour workinglife (or 2 weeks in sleep–mode). The scope parameters were set from the 8×4 key membrane keyboard. Besides the signal and trigger inputs, the instrument also contained a $3\frac{1}{2}$ digit DMM, a galvanically insulated analog XY plotter output, and a galvanically insulated (2 kV!) RS-232 digital serial interface for remote control and data exchange with a PC.

Fig. 2: Step response measurement and trigger delay in pre-trigger mode recording. In the background the HP-3312A function generator supplies the test signals. The input signal was fed either directly or through a 100:1 attenuator with a DC-GND-AC selector formed by 4 bi-stable relays driven directly from CMOS logic, to the Siliconix 2N5911 dual JFET source follower, followed in turn by two LF357 opamps (5 mV/div max. vertical sensitivity), driving the 1-2-5 attenuator sections, in addition to the offset and trigger-level controls using two AD7524 8–bit DACs. The ADC was a TRW TDC1001J 8-bit with successive approximation conversion, driven by a 20 MHz clock, sampling at 2 MHz in real time (and 10 MHz equivalent time in only 5 acquisition sequences, using a patented 5-step 200 ns 'trigger shifting clock sync' method of my own design, employing just 3 standard CMOS logic ICs). The time base could be set down to 50 s/div, allowing very slow events to be recorded.

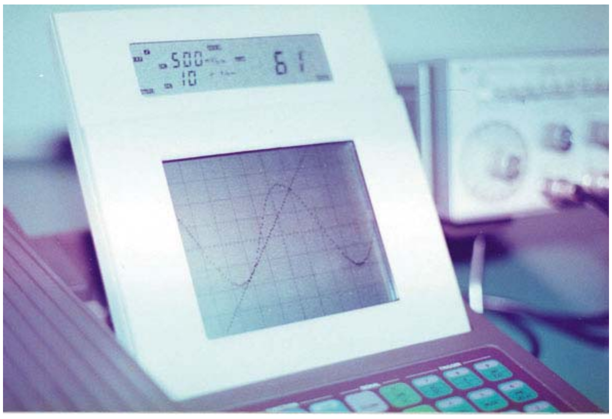


Fig. 3: All instrument operations were controlled by a Hitachi HD63B03 CMOS microprocessor (functionally equivalent to the Motorola MC6802 NMOS chip used in the first prototype). The software included math functions such as sum, difference, and multiplication of signals, integrals, and differentials (shown above) within a cursor selected range, averaging up to 128 events, and even FFT spectral analysis. A 2k×8 6116 CMOS RAM, addressed by a ring counter, was used to store the digitized signal (10 screen long time acquisition), of which 256 bytes were pre-trigger time. An additional 2k RAM could store up to 10 signal single screen records. A HD6350 serial interface (RS-232, Baud rate 38400 max.) was used for remote control and data transfer to a PC or to print a signal directly by a dot matrix printer. The serial port used opto-couplers, allowing floating ground operation on up to 500 V DC/AC peak. The price was from US$ 1600 to 2000, depending on options, which was "too much money for a child's toy with a *LEGO* resolution display", as I was told by a visitor at the 1985 local electronics fair. In total, some 500 instruments were sold.

Fig. 4: The IskraScope development team of the IJS Condensed Matter Physics Department (Liquid Crystal Lab.). Sitting in front: Eng. *Silva Pirš*; standing, left to right: team leader Dr. *Janez Pirš*, Dr. *Andrej Gartner*, Erik Margan, Mag. *Bojan Marin* and Dr. *Igor Muševič*. Not shown here, but also making important contributions were Mag. *Andrej Vučković* and *Stanimir Vasić* (microprocessor programming), joined later by Eng. *Ivan Kvasić* on circuit design, and Eng. *Peter Stavanja*, Mag. *Anton Pleteršek* and *Damijan Luin* on microprocessor programming and PC communication interface.

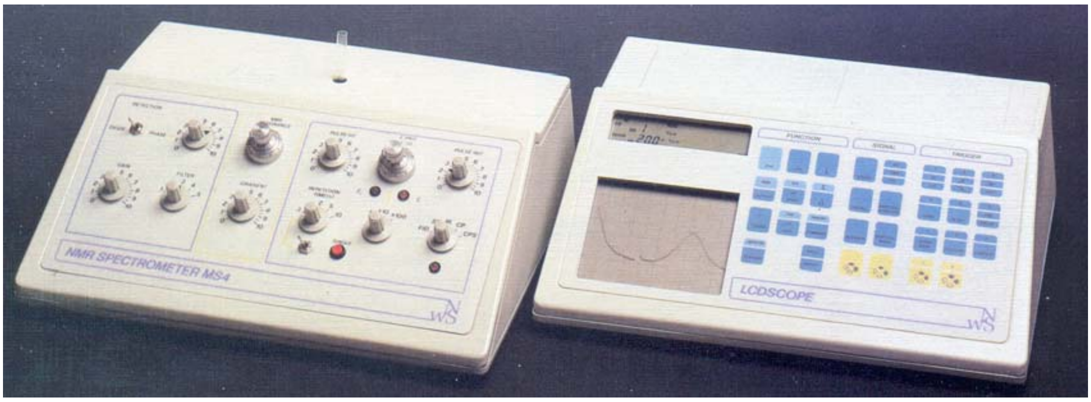


Fig. 5: The next evolution of the IskraScope was a small nuclear magnetic resonance imaging (MRI) system. The original digital oscilloscope was modified by the addition of a programmable ‘pulse sequencer’, occupying a single 10 × 16 cm board, providing 10 output channels, each adjustable in pulse width from 250 ns to 100 µs, in 10 ns increments; the delay between pulses was adjustable from 1 µs to 100 ms. These pulses were used to control the RF section of the magnetic field drive, modifying the static field of a strong permanent magnet (in the back of the box on the left). The material sample to be investigated was put into the magnetic field (top) and rotated to obtain 8 slices from which the computer could reconstruct the sample figure. The time domain signals recorded by the ’scope were FFT’d to obtain the spectrum which represented the shape of each slice.

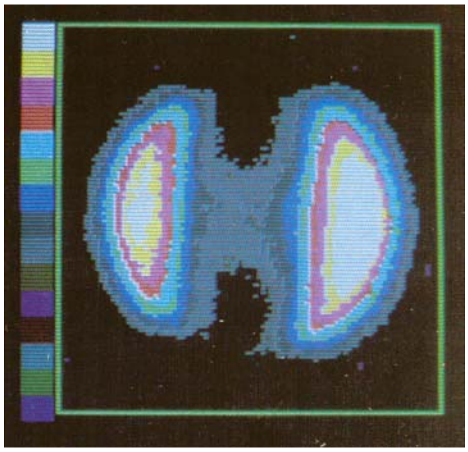
 

Fig. 6: An IBM PC-XT (running at 12 MHz only!) was used to transfer the recorded signals to the floppy disc and then run the 2D image reconstruction by an operation called 'back projection' (a form of a 2D convolution). The phantom sample on the screen represents the concentration of water in a glass tube with a plexy stick in the middle; the concentration of water is color coded.

B) The Marx Generator

Fig. 7: No, this is not the Dexter's Laboratory of Cartoon Networks! This is the High Voltage Laboratory of the Elektro–Institute 'Milan Vidmar' in Ljubljana. My colleague *Marko Janša* is desperately trying to identify a programming bug which I made the day before by fixing another bug. The Marx generator (invented it in 1924 by *Ernst Marx*, 1898–1980) outside the cabin produces, when triggered by a LASER pulse, a multi-megajoule surge of up to 800 kV, with a risetime of 1.2 μs and a decay time of 50 μs. The surge is applied to a power line insulator being tested for breakdown (see **Fig. 9**). The two stacks of HV capacitors are charged in parallel via

the X–mounted resistors and reconnected in series by 8 spark gaps (not seen, owing to the cabin window’s border), which fire upon a trigger. The two large metal balls on the right form a protective spark gap, limiting the maximum allowable voltage across the object tested. The voltage across the object tested is measured by a frequency compensated attenuator (÷50 000, far right). The attenuated signal is sampled by an HP54504A digital sampling oscilloscope, which in turn is read by the PC using a GPIB interface. The adjusting of the charging voltage, the spark gaps’ width, the trigger generation, and data acquisition are all controlled by the click of a mouse, while the high voltage is applied. The system also reads the sensors for the atmospheric pressure, humidity, and temperature, in order to refer the measured breakdown voltage to nominal conditions.

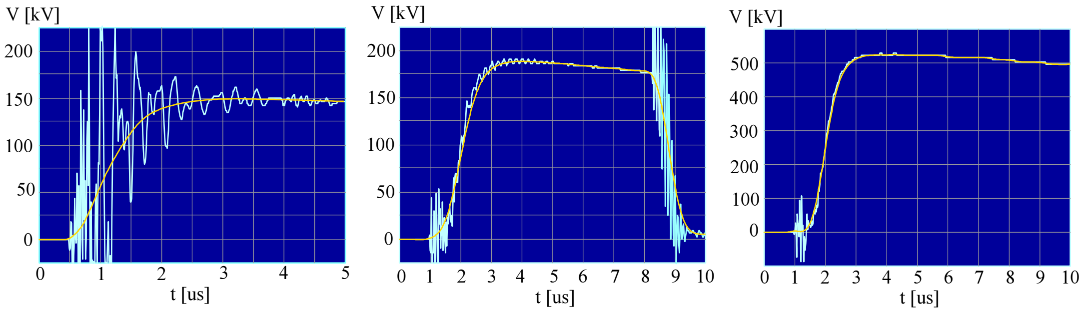


Fig. 8, Left: One of the first records of the Marx generator’s voltage surge. The EMI was so high that even with intensive digital filtering (yellow trace) the signal was indeterminable. **Middle:** Improved layout of the interconnections reduced the initial triggering EMI, but long ringing remained; also, the breakdown (at 8–9μs) with its long discharge arc still caused too much EMI. **Right:** Final system configuration with further improved layout, several decouplers and cable clip chokes, and ground common mode rejection decoupling at strategic points reduced EMI to a level where digital filtering was almost unnecessary, even with peak surges of more than 500 kV.

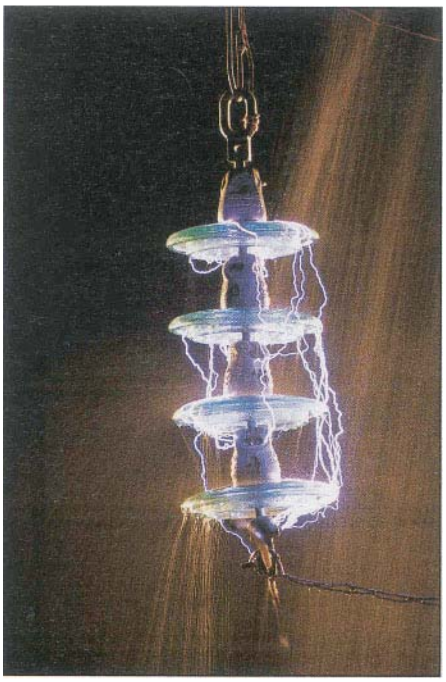


Fig. 9: Amazing what can be done by a single click of a humble ‘mouse’, isn’t it ? A four-element HV insulator gets a 270 kV surge, while under a heavy artificial shower. With a long photo exposure multiple breakdown partial discharge paths are revealed.

C) CERN (Conseil Européen pour la Recherche Nucléaire)
(European Organization for Nuclear Research)
<http://www.cern.ch/>

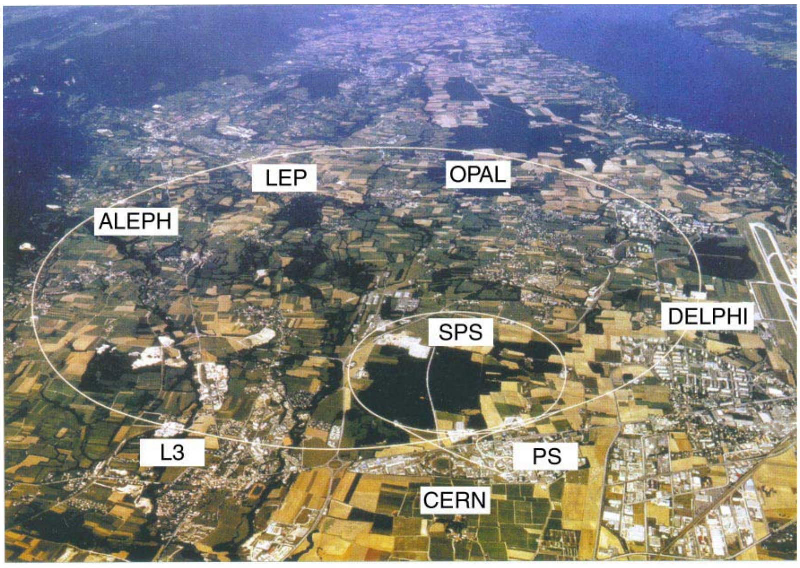


Fig. 10: The rings and experiment sites of LEP, the Large Electron–Positron collider (about 27 km in circumference) near Geneva, on the border between Switzerland and France. The first 'events' were recorded in 1989, the last in 2000.

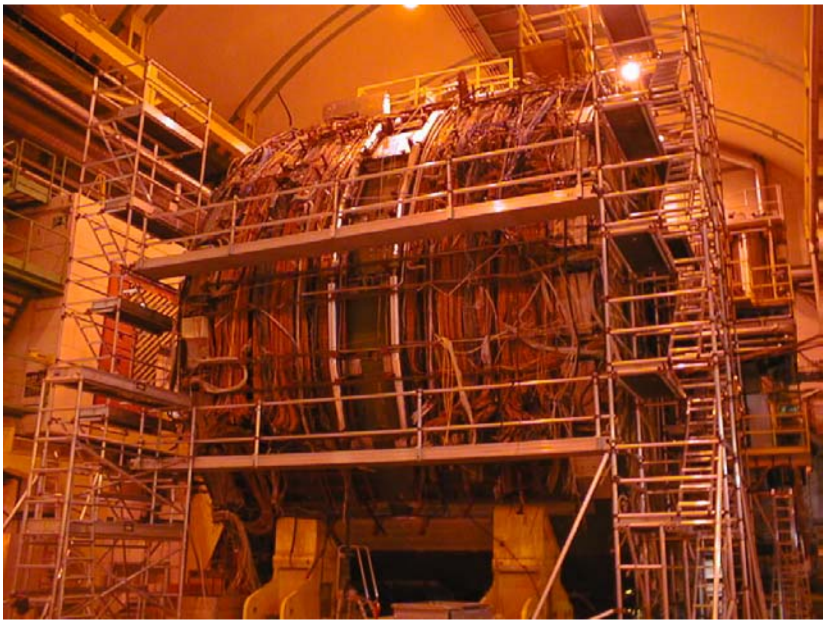


Fig. 11: The DELPHI main section (DEtector with Lepton, Photon, and Hadron Identification).

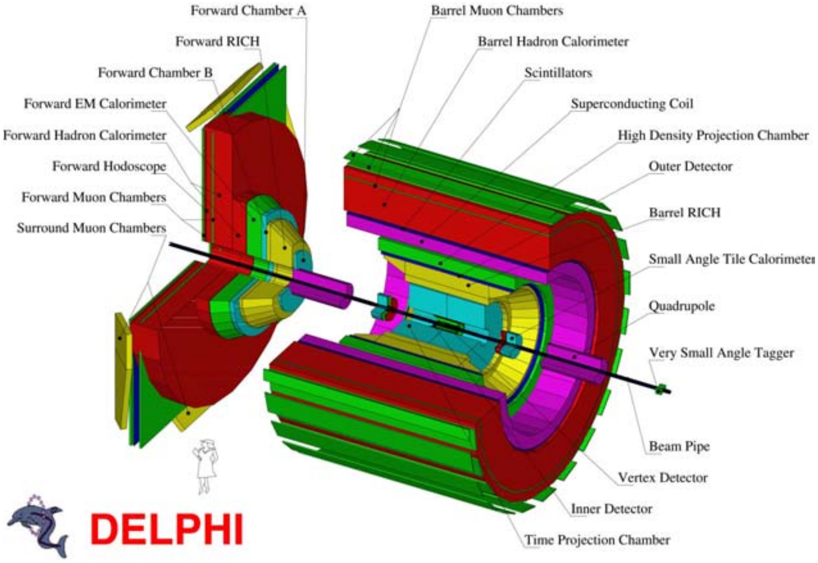
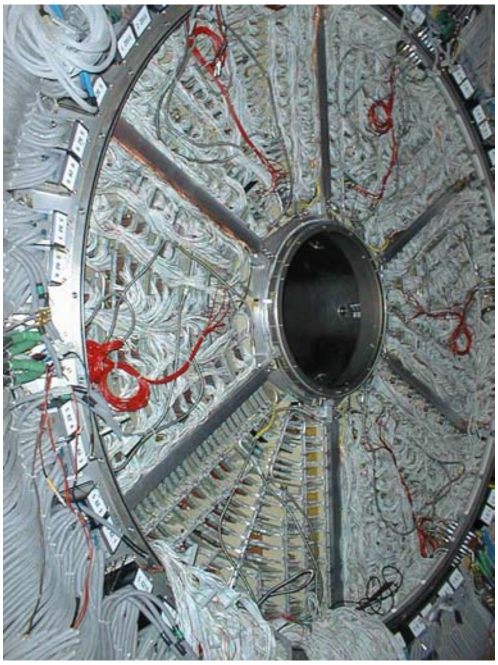


Fig. 12: The DELPHI cross-section and layers. The Vertex detector is inside the Inner detector.



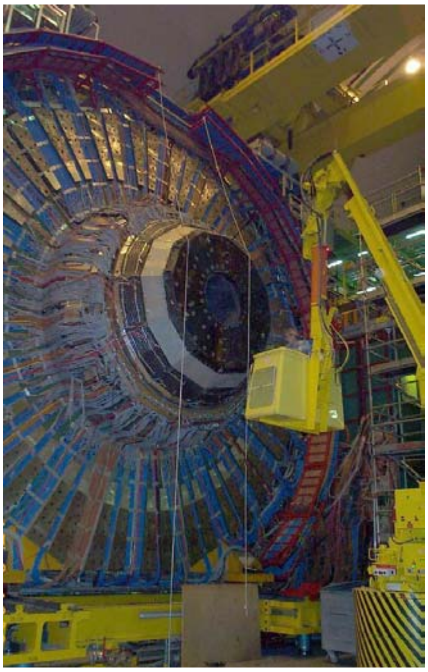


Fig. 13 & 14: The end cap ‘rosettas’. It’s a jungle of cables down there!

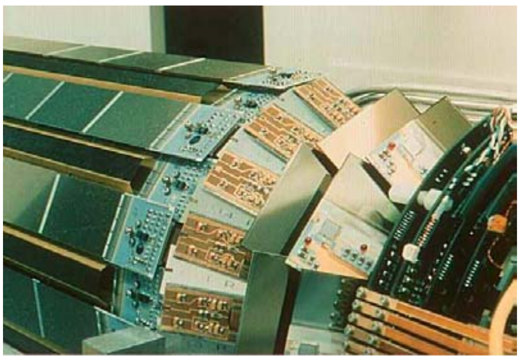


Fig. 15 & 16: The Vertex detector. The silicon pixel detector forms a barrel, whilst the Very Forward Tracker is on both ends.

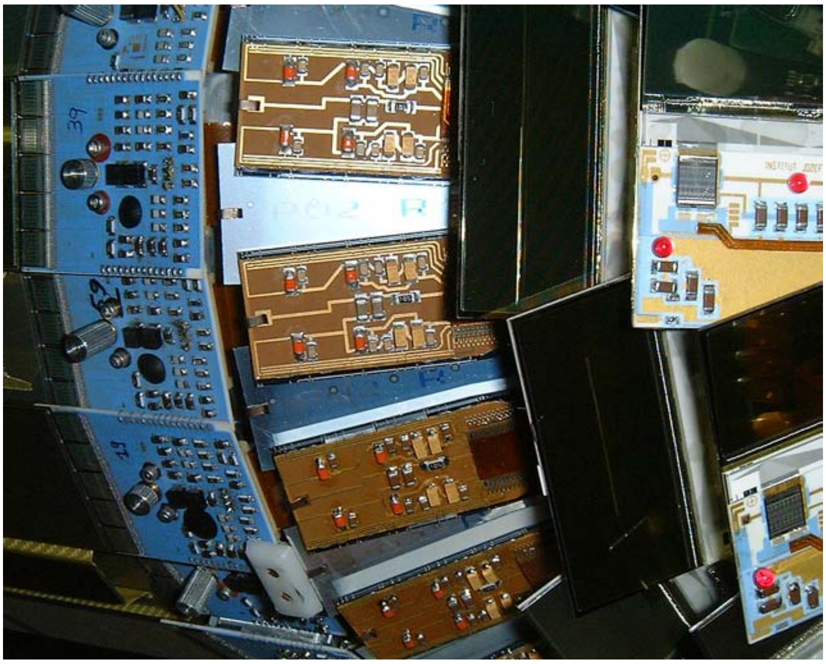
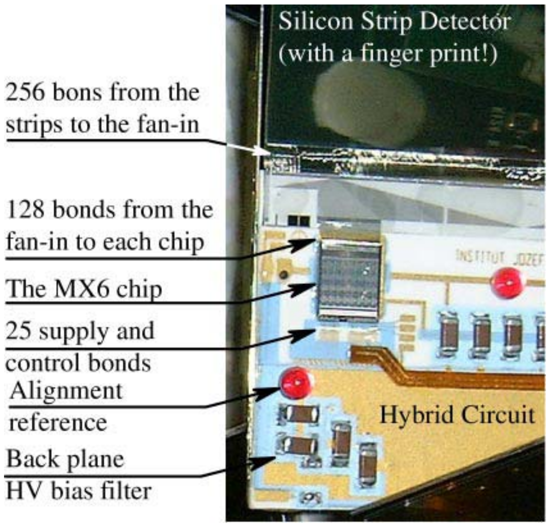


Fig. 17: The Very Forward Tracker silicon strip detectors (on the right) consisted of a total of 56 panes at each end. The panels were 5×5 cm with a 5×3 cm hybrid circuit supporting the readout chips (two 128 channel charge-sensitive amplifiers on each chip, with serial readout). Two such detectors were mouted back to back at 90° so that the 256 active and 255 interpolation strips on each side formed a matrix. A high energy particle passing through (in ~5 ps) ionized the strips and after readout and computer analysis the trajectory could be reconstructed. The small red plastic balls were reference points for the LASER guided positioning and alignment of each detector (to <20 μm).



The bonder automatic control box

Fig. 18 & 19: In order to bond (with an 18 μm Al wire) all the detector modules we had to automate our manual bonding machine. I made this little box to drive the two stepper motors of the XY table and read the incremental position to a 24 bit precision (or 3 μm resolution) and activate the bonder under PC control. A game joystick was used to drive the bonder manually to set the first and the last bond, then the PC took control. It still works today, proving that temporary solutions are eternal!

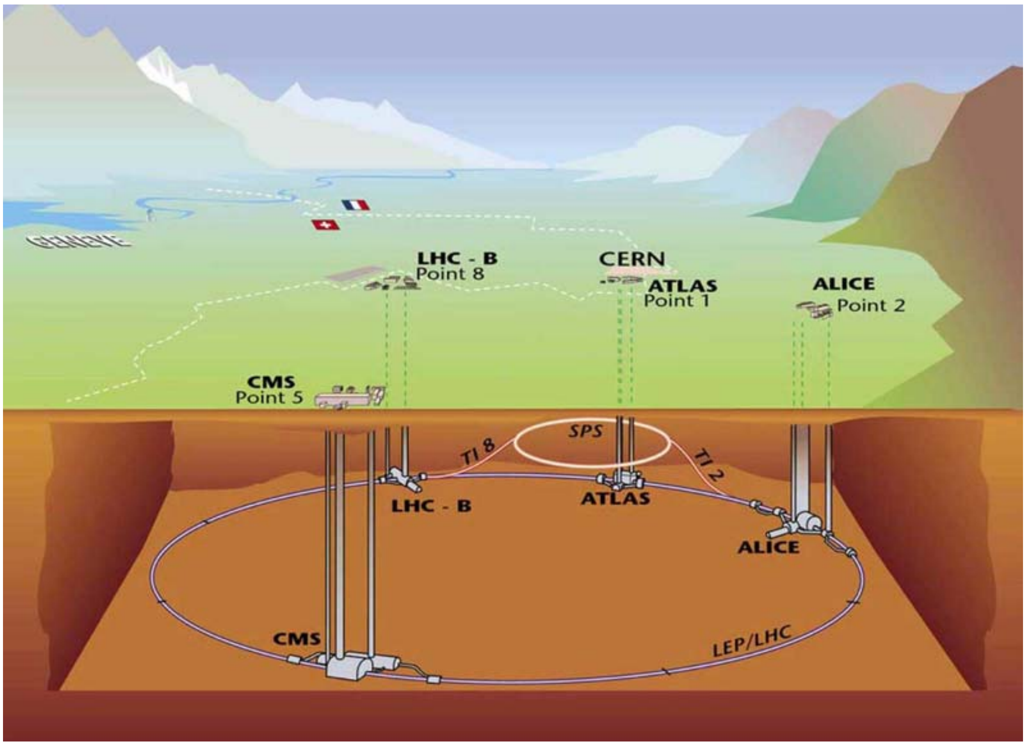


Fig.20: The new LHC (Large Hadron Collider) underground configuration.

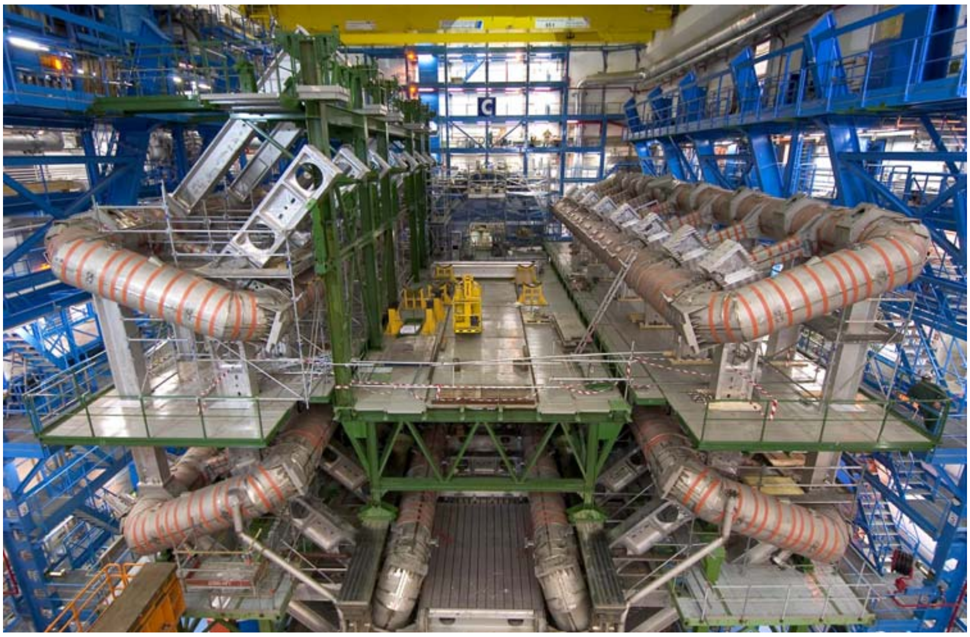


Fig. 21: The ATLAS cavern in July, 2005. Six of the eight toroidal superconducting coils have already been mounted.

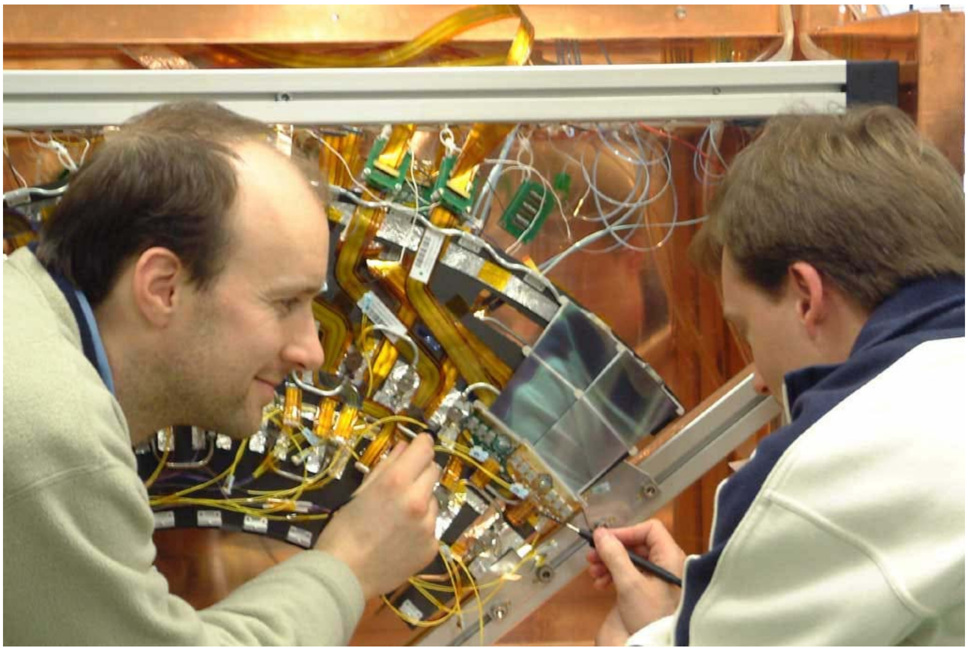


Fig. 22: Part of the ATLAS SCT (Silicon Tracker) on the test bench. The detector modules have 6 readout chips, each of 128 channels. The power and control signals are supplied by thin Al on Kapton tapes (up to 4.5 m long), designed at IJS and produced by Elgoline, a Slovenian PCB production company (aluminum is used because it is not activated by radiation, unlike Cu). The readout is performed through optical links (the thin yellow cables).

Fig. 23 & 24: In my lab: testing the automatic Test Box for the test of 3×4160 cables for the ATLAS SCT detector.

Fig. 25 & 26: Testing the first bunch of cables in the tunnel behind the ATLAS cavern. The cable (four power lines, four sense lines, two HV lines, six control lines, and a shield) is tested for connectivity identification, insulation (20 MΩ), line resistance (to 5 mΩ resolution), and for HV leakage (to 1 nA at 500 V). My colleague Gregor Kramberger wrote the PC software (and his 18 months old daughter Živa supervises the test operations from the laptop screen).

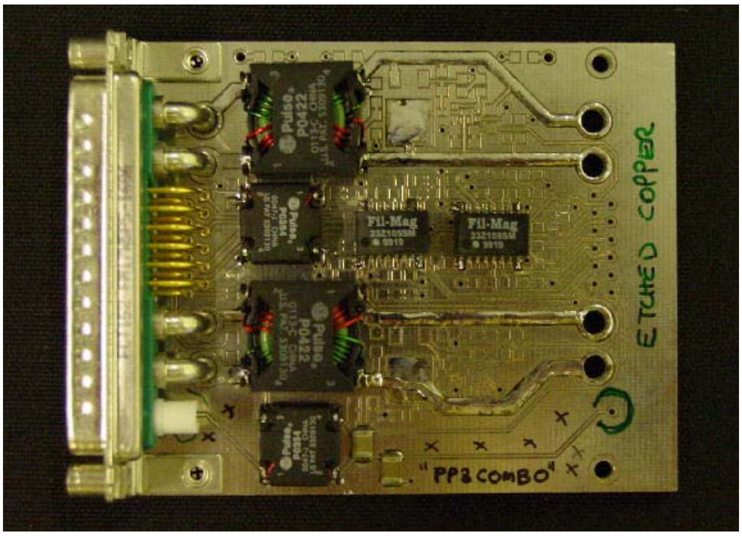


Fig. 27: In addition to the cables, the Test Box must verify the activation thresholds of voltage limiters (my design) which protect the SCT detector electronics from power surges. The limiters were tested for high radiation hardness in the IJS TRIGA Reactor. The protection circuits, mounted together with the common mode analog and digital power supply filters, are made by the Melbourne group.

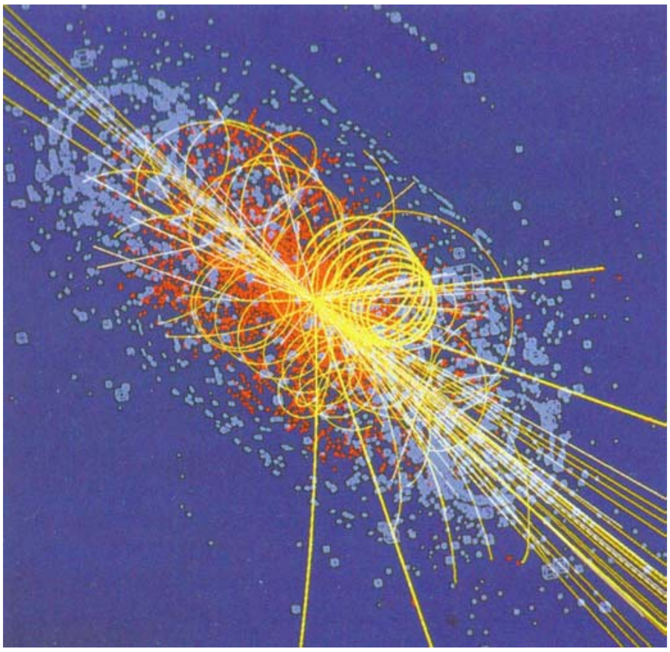


Fig. 28: A glimpse into the Big Bang: Simulation of a possible collision outcome as might be recorded by the ATLAS detector and reconstructed by a computer. A Zoo of particles is created in a proton–antiproton pair collision, with several secondary jets owed to the decay of short-living products. The curved trajectories are those of charged particles twisting in the strong magnetic field of the detector. Neutral particles and photons have straight paths.

More info can be found at the following links:

50 years of CERN – the W and Z at LEP
http://cerncourier.com/main/article/44/4/15/1

Postcards from CERN: 50 years through a lens
http://cerncourier.com/main/article/44/8/16/1

LEP gets a stay of Higgs execution
http://cerncourier.com/main/article/40/9/1/1

LEP reaps a final harvest
http://cerncourier.com/main/article/40/10/1/1

CERN split over collider closure
http://physicsweb.org/articles/world/13/12/9

DELPHI Very Forward Tracker (VFT)
http://delphiwww.cern.ch/vd/vft.html

DELPHI Silicon Tracker 1996
http://delphiwww.cern.ch/vd/
http://delphiwww.cern.ch/vd/pics.html

The new LHC:
http://atlas.ch/atlas_photos.html
http://atlas-bt.web.cern.ch/atlas-bt/gallery/photos/

D) High Speed? High speed of WHAT?

I intended to make a point on how it is still possible to earn well in the electronics business, even if the prices of electronics equipment fall as Niagara Falls. But then I said “the heck with didactics, let’s have fun!” .

Fig. 29: Alfa 156 — the Sleeping Beauty. She wakes up by a soft kiss of the RF code and starts dancing around when a prince steps on her foot, revealing her beastly nature. The color was a good compromise between a careful choice and what was available at the moment, so that the three fairies (my wife, her mother and my own mother) could finally agree upon it. The figure testifies that amplifier designers are fond of both dx/dt and d^2x/dt^2, whatever the x (even if $d\$/dt$ might not be amongst the most favorable). So what makes the Alfa a great car? Think of it in this way: it is about $1/2$ of a Dodge Viper in terms of power, with a classic elegance of the Jaguar E type. Even if a front wheel only drive, it offers the sincere handling of a Ferrari F-512, but without needing a hammer and a French key just to change gears. Also, you won’t be deafen by the rumble, in fact, it is as quiet as a Mercedes, allowing you to appreciate the ‘hi’ and ‘fi’ of the hi-fi, which you would switch off immediately anyway, and rather listen to the cat–like purr of the exhaust pipe just above the threshold of hearing, while engaging the Alpine serpentines with a determination and a grip of a locomotive. At 200 km/h its suspensions act as smoothly and gracefully as those of a Citroën at 60, but with a negligible side–roll in curves. In addition it has 4 normally sized doors and some decent space for 4 average basketball players, and there’s even an air–conditioner that actually works! The seats offer you a comfort of the home sofa, you can stretch your legs and relax, so you won’t get back pain even if your spinal cord is straight and rigid as a drunk serpent (such as mine). What’s more, it doesn’t cost a fortune, in fact, even I myself could afford it! All in all, I really don’t understand why it looses its value as quickly as it accelerates. One buys a car to drive it, not to resell it two years later, right? OK, so it is not as reliable as a Toyota, but who cares? The servicing is cheap and uncomplicated. And it doesn’t look like a cheap copy of a VW Golf (which it certainly isn’t!), nor does it express the conservative restraint of an Audi or a BMW, so praised by those who need a status symbol. And it’s such a nice place to be in! As the great Enzo once said: “*Quando passa un' Alfa, mi tolgo il capello!*” (When an Alfa passes by I take my hat off!).