Highlights from the LAA project

Host Wenninger & Fabio Sauli

What is LAA
LAA was the first **special** program at CERN dedicated to prepare the future beyond the ongoing CERN LEP construction program 1980 to 1989.
LAA was the first **special** program at CERN dedicated to prepare the future beyond the ongoing CERN LEP construction program 1980 to 1989

Unlike all previous CERN projects (PS, BOOSTER, BEBC, ISR, SPS)

LEP approval: conditional to stay within the CERN budget level
LAA was the first special program at CERN dedicated to prepare the future beyond the ongoing CERN LEP construction program 1980 to 1989

Unlike all previous CERN projects (PS, BOOSTER, BEBC, ISR, SPS)
LEP approval: conditional to stay within the CERN budget level

An early retirement programme "imposed" on CERN to reduce staff
Facilities and many experiments closed to free resources for LEP construction + the proton-antiproton runs
CERN staff reduction to provide resources for the Tunnel infrastructure

It was a “chance for CERN” that Prof. A. Zichichi launched the special activity project LAA
The idea behind LAA
develop tools ( technologies / detectors) for experiments
in view of a high intensity proton-proton collider in the LEP tunnel
as discussed at least since 1984
The idea behind LAA
develop tools (technologies / detectors) for experiments
in view of a high intensity proton-proton collider in the LEP tunnel
as discussed at least since 1984

Use LAA funds to hire dedicated staff
(physicist, engineers, technicians)
and form collaborations supported by LAA
to prepare the future beyond LEP
The idea behind LAA
develop tools (technologies/detectors) for experiments in view of a high intensity proton-proton collider in the LEP tunnel as discussed at least since 1984

Use LAA funds to hire dedicated staff (physicist, engineers, technicians) and form collaborations supported by LAA to prepare the future beyond LEP

40 LAA staff and 80 unpaid scientist worked together for 6 years LAA activities are published in over 350 papers and journals
The idea behind LAA develop tools (technologies / detectors) for experiments in view of a high intensity proton-proton collider in the LEP tunnel as discussed at least since 1984

Use LAA funds to hire dedicated staff (physicist, engineers, technicians)

after 6 years LAA was extended by CERN Council and is still active today

40 LAA staff and 80 unpaid scientist worked together for 6 years
LAA activities are published in over 350 papers and journals

after LEP start during the 1990th the CERN DRDC complemented LAA
The LAA Project

by

A. Zichichi
CERN – Geneva
Switzerland

Geneva, 14 July 1987

Abstract
A comprehensive R & D project to study new experimental techniques for the next step in multiTeV hadron collider physics is described.
THE LAA PROJECT

- 5 - SUBNUCLEAR MULTICHANNEL INTEGRATED DETECTOR TECHNOLOGIES
- 6 - DATA ACQUISITION AND ANALYSIS

- 1 - HIGH PRECISION TRACKING
- 2 - CALORIMETRY
- 3 - LARGE AREA DEVICES
- 4 - LEADING PARTICLE DETECTION
- 7 - SUPERCOMPUTERS AND MONTECARLO SIMULATION
- 8 - VERY HIGH MAGNETIC FIELDS
- 9 - SUPERCONDUCTIVITY AT HIGH TEMPERATURE
- 10 - RADIATION HARDNESS

Fig. 5 - The ten components of the LAA Project.
PROGRESS REPORT 1988–1989

DEVELOPMENT OF INTEGRATED CMOS CIRCUITS AND SILICON PIXEL DETECTORS IN THE CERN–LAA PROJECT

F. Anghinolfi, P. Aspell, M. Campbell, E.H.M. Heijne, P. Jarron and G. Meddeler
CERN, EF-Division, Geneva, Switzerland

Ch.C. Enz and F. Krummenacher
LEG–EPFL, Lausanne, Switzerland

L. Moult and P. Sharp
Rutherford Appleton Laboratory, Chilton-Didcot, UK

A. Olsen
Senter for Industriforskning, Oslo, Norway

Abstract
The start of the LAA project in 1986 propelled electronics at CERN into the era of microelectronics, and laid crucial foundations for the success of the LHC experiments.
Two decades of microelectronics at CERN enabled by the LAA project. In 1988, the AMPLEX multiplexed read-out chip used in UA2 Hybrid pixel devices, with a read-out chip “bump bonded” to the detector, were used in WA97 in the mid-1990s. By 2002, CERN had developed a bump-bonded 8000-channel pixel for the ALICE silicon-pixel detector at the LHC.
NINO: an ultra-fast and low-power front-end amplifier/discriminator ASIC designed for the multigap resistive plate chamber

F. Anghinolfi\textsuperscript{a}, P. Jarron\textsuperscript{a}, A.N. Martemianov\textsuperscript{b}, E. Usenko\textsuperscript{c}, H. Wenninger\textsuperscript{a}, M.C.S. Williams\textsuperscript{d,\ast}, A. Zichichi\textsuperscript{d,\ast}

\textsuperscript{a}EP Division, CERN, Geneva, Switzerland
\textsuperscript{b}Institute for Theoretical and Experimental Physics, Moscow, Russia
\textsuperscript{c}Institute for High Energy Physics, Protvino, Russia
\textsuperscript{d}Sezione INFN, Bologna, Italy
\textsuperscript{e}Dipartimento di Fisica dell’Università, Bologna, Italy

Available online 28 July 2004

Abstract

For the full exploitation of the excellent timing properties of the Multigap Resistive Plate Chamber (MRPC), front-end electronics with special characteristics are needed. These are (a) differential input, to profit from the differential signal from the MRPC (b) a fast amplifier with less than 1 ns peaking time and (c) input charge measurement by Time-Over-Threshold for slewing correction. An 8-channel amplifier and discriminator chip has been developed to match these requirements. This is the NINO ASIC, fabricated with 0.25 \textmu m CMOS technology. The power requirement at 40 mW/channel is low. Results on the performance of the MRPCs using the NINO ASIC are presented. Typical time resolution \( \sigma \) of the MRPC system is in the 50 ps range, with an efficiency of 99.9%.

Keywords: Resistive plate chambers; ALICE; Time-of-flight; Fast amplifier; Discriminator; ASIC; CMOS technology
Description

CERN has available a low power front-end amplifier discriminator ASIC chip for use in applications based on electron and photon detecting in medical imaging, life science or material research. This so-called NINO ASIC allows for an 8-channel input signal charge measurement through encoding discriminator pulse width with excellent timing resolution at very high rate, while at the same time providing a very low noise performance and power consumption characteristics per channel. This ASIC was developed by the LAA project at CERN and is used for time-of-flight measurements for particle vertex reconstruction in the ALICE experiment of the LHC collider.
The original idea of the LAA project to perform technology R&D as an independent research program with its own, independent funding has meanwhile been adopted for present and future R&D initiatives.
The impact of LAA on the LHC Detectors has been outlined in the books....
TECHNOLOGY meets RESEARCH
60 Years of CERN Technology:
Selected Highlights

Edited by:
Christian Fabjan (CERN & TU Vienna, A)
Thomas Taylor (CERN)
Daniel Treille (CERN)
Horst Wenninger (CERN & GSI Darmstadt G)

With members of the Editorial Group: Cristoforo Benvenuti, Giorgio Brianti, Kurt Hübner, Pier Giorgio Innocenti, Philippe Lebrun, Romeo Perin, Christine Sutton and Valeria Brancolini.

http://www.worldscientific.com/worldscibooks/10.1142/9921#t=toc
<table>
<thead>
<tr>
<th>Allardyce Brian</th>
<th>Hofmann Albert</th>
<th>Ullaland Olav</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baillon Paul</td>
<td>Hubner Kurt</td>
<td>Virdee Tejinder</td>
</tr>
<tr>
<td>Ball Alan</td>
<td>Innocenti P.- G.</td>
<td>Wenninger Horst</td>
</tr>
<tr>
<td>Ballarino Amalia</td>
<td>Jarron Pierre</td>
<td>Williams Crispin</td>
</tr>
<tr>
<td>Benvenuti Cris</td>
<td>Jenni Peter</td>
<td>Wilson Edmund</td>
</tr>
<tr>
<td>Beusch Werner</td>
<td>Kirkby Jasper</td>
<td></td>
</tr>
<tr>
<td>Brianti Giorgio</td>
<td>Lebrun Philippe</td>
<td></td>
</tr>
<tr>
<td>Brun Rene</td>
<td>Lecoq Paul</td>
<td></td>
</tr>
<tr>
<td>Burkhardt Helmut</td>
<td>Linsen Lucie</td>
<td></td>
</tr>
<tr>
<td>Burnet Jean-Paul</td>
<td>Matthiae Giorgio</td>
<td></td>
</tr>
<tr>
<td>Campbell Michael</td>
<td>Mayoud Michel</td>
<td></td>
</tr>
<tr>
<td>Caspers Fritz</td>
<td>Niinikoski Tapio</td>
<td></td>
</tr>
<tr>
<td>Chanel Michel.</td>
<td>Nordberg Markus</td>
<td></td>
</tr>
<tr>
<td>Chiaveri Enrico</td>
<td>Perin Romeo</td>
<td></td>
</tr>
<tr>
<td>Chohani Vinod</td>
<td>Petrilli Achille</td>
<td></td>
</tr>
<tr>
<td>Cundy Donald</td>
<td>Petrucci Guido</td>
<td></td>
</tr>
<tr>
<td>D'Ambrosio C.</td>
<td>Pirkl Werner</td>
<td></td>
</tr>
<tr>
<td>Damaraus Heiko</td>
<td>Quercigh E.</td>
<td></td>
</tr>
<tr>
<td>Darriulat Pierre</td>
<td>Ravn Helge</td>
<td></td>
</tr>
<tr>
<td>Dijkstra Hans</td>
<td>Revol Jean-Pierre</td>
<td></td>
</tr>
<tr>
<td>Doble Niels</td>
<td>Riegler Werner</td>
<td></td>
</tr>
<tr>
<td>Doser Michael</td>
<td>Robertson Les</td>
<td></td>
</tr>
<tr>
<td>Fabjan Christian</td>
<td>Rolandi</td>
<td></td>
</tr>
<tr>
<td>Fardouhout Philippe</td>
<td>Rossi Leonardo</td>
<td></td>
</tr>
<tr>
<td>Fidecaro Giuseppe</td>
<td>Rossi Lucio</td>
<td></td>
</tr>
<tr>
<td>Fidecaro Maria</td>
<td>Sadulet Bernard</td>
<td></td>
</tr>
<tr>
<td>Fluckiger Francois</td>
<td>Sauli Fabio</td>
<td></td>
</tr>
<tr>
<td>Gatignon Lau</td>
<td>Schindl Karlheinz</td>
<td></td>
</tr>
<tr>
<td>Gilardoni Simone</td>
<td>Schulte Daniel</td>
<td></td>
</tr>
<tr>
<td>Giovannizzi M.</td>
<td>Segal Ben</td>
<td></td>
</tr>
<tr>
<td>Goessling Claus</td>
<td>Stenbach Charles</td>
<td></td>
</tr>
<tr>
<td>Gourber J. - P.</td>
<td>Stumpe Bent.</td>
<td></td>
</tr>
<tr>
<td>Hancock Steven</td>
<td>Sutton Christine</td>
<td></td>
</tr>
<tr>
<td>Heijne Erik</td>
<td>Syratchetv Igor</td>
<td></td>
</tr>
<tr>
<td>Hemmer Frederic</td>
<td>Taylor Thomas</td>
<td></td>
</tr>
<tr>
<td>Herve Alain</td>
<td>Thorndahl Lars</td>
<td></td>
</tr>
<tr>
<td>Hohbach Reinhard</td>
<td>Treille Daniel</td>
<td></td>
</tr>
</tbody>
</table>

**Contributions**

<table>
<thead>
<tr>
<th>Gianotti Fabiola</th>
<th>Anelli Giovanni</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Brancolini Valeria</td>
</tr>
<tr>
<td></td>
<td>Dosanj Manjit</td>
</tr>
<tr>
<td></td>
<td>Evans Lyn</td>
</tr>
</tbody>
</table>

**Total 84**
A Lesson for the Future of Our Science

My Testimony on Lord Patrick M S Blackett
Science and Peace the World Over
The New Manhattan Project

Section 1:
SCIENCE CULTURE needed
in the III Millennium

The LAA Project
Ongoing Project 2

ELN, LAA, AMS(TOF), ALICE(TOF), EEE(RPC)
Pilot projects
I had proposed at the end of my presentation on LAA in 2016 to have closer follow-up of development of electronics and detectors and in particular on
The GEM consists of a thin, metal-clad polymer foil, chemically pierced by a high density of holes. With a potential difference between the two electrodes, electrons released by radiation in the gas on one side of the structure drift into the holes, multiply and transfer to a collection region.

The GEM consists of a thin, metal-clad polymer foil, chemically pierced by a high density of holes. With a potential difference between the two electrodes, electrons released by radiation in the gas on one side of the structure drift into the holes, multiply and transfer to a collection region.


http://cerncourier.com/cws/article/cern/44361
Nov 30, 2010 by Ioannis Giomataris, CEA-Saclay.

Georges Charpak – a true man of science

In a Micromegas detector, the gas volume is divided in two by a metallic micro-mesh placed between 25 µm and 150 µm of the readout electrode. This allows for a high gain $10^4$ and a fast signal 100 ns.
Let us listen to the inventor of GEM
Fabio Sauli

He works together with the
CERN detector development laboratory
directed by Leszek Ropelewski