ACEOLE
OPTICAL TRANSMISSION SYSTEMS FOR SLHC EXPERIMENTS

Sarah Seif El Nasr–Storey

Biography

Born : 10.01.1986 , Cairo , Egypt
Nationality : Canadian , Egyptian
Education : BSc. in Physics , Saint Mary's University , Canada

Fellow since : 01.06.2009
Interests : Reading , hiking , skiing , running , cooking

Training

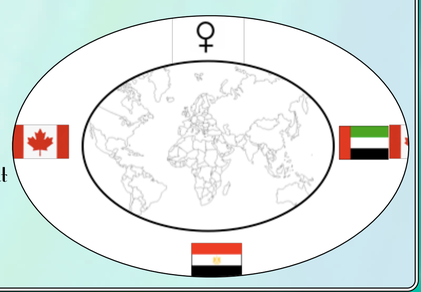
Technical :
I. On the job training on radiation effects on electronics and characterizing optical signals
II. Improved my skills in several software packages : LabView , AutoDesk Inventor, and various analysis packages(Igor,Matlab)
III. "Towards Modeling Radiation Effects in Nano–Scale Systems" – RADECs 2009 Short Course

Conferences :
I have not yet had the opportunity to present my work at any conference but will be attending RADECs 2010.

Complimentary Training :
I. CERN French Language Course
II. Presentation Course
III. "Leaders in Science" – Confidence Building Course
IV. Participant ("coachee") in Coaching Management Course

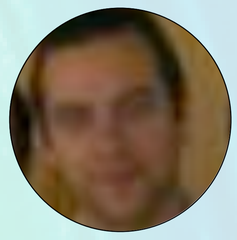
Impact

ACEOLE has provided me with my first opportuinity as young researcher to conduct my own experiment – from the design stage up to analysis.
The funds available for training have increased my exposure to areas of knowledge that I otherwise would have been hard pressed to come by.
I think my unique background brings further diversity yo European Research.



Spyridon Papadapolous

Biography



Born : 26.03.1980 , Athens, Greece
Nationality : Greek
Education : MEng in Electrical and Computer Engineering , Auth , Greece
MSc. in Telecommunications, University College London , United Kingdom
Fellow since : 05.01.2009
Interests : Passive Optical Networks and Optical Communications

Training

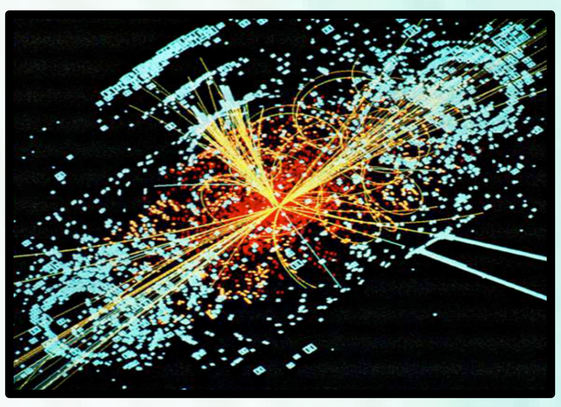
Technical :
I. UCL Course on Optical Sources and Components
II. UCL Course on Optical Transmitter Characterization
III. "The Where, Why and How of Optical Access" – Seminar on Passive Optical Networks presented at CERN

Conferences :
I. European Conference on Technical Communications
II. ITU Telecom World Exhibition Visit
III. London Communications Symposium

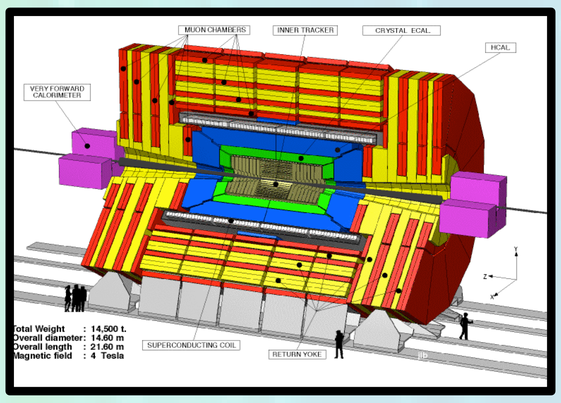
Complimentary :
I. CERN French Language Course
II. Presentation Course
III. "Leaders in Science" – Confidence Building Course

Impact

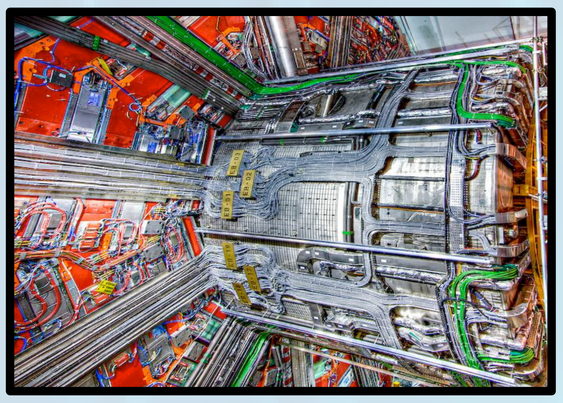
I have found the conferences and the complimentary training very simulating
ACEOLE has also provided me with the opportunity to gain skills that will help me in reaching my career goals



Particles collide at 4 points around the LHC , the "experiments".



Particle detectors sense the particles (picture of the CMS detector).



Collision and control data from the different subsystems in the detector need to be communicated to the outside world.

Background :

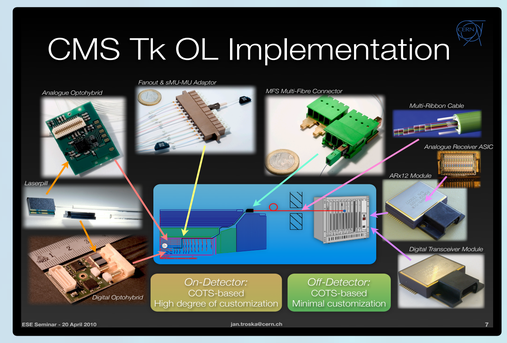
Inside the LHC two counter propagating beams collide 40 million times every second. The collisions are recorded by each of the four experiments(detectors) around the ring : ATLAS , CMS , ALICE , LHCb.
For the first time in High Energy Physics, Optical Links were used on a large scale in the CERN LHC experiments. They :
I. in the Upstream direction: extract raw data from the detector, feed processing electronics situated in shielded and accessible areas.
II. in the Downstream direction: distribute clock and control data.

Project Description:

ACEOLE , and the work package on optical transmission systems allows us to prepare for the challenges upgrading to a SLHC environment will present the experiments at the level of : Components and System Architecture.

Challenges:

The eventual upgrade to Super LHC(SLHC), the already challenging requirements for the successful operation of these optical links will increase by an order of magnitude. The effect this has on the optical links are :
I. Passive Components transmitters and receivers): must be qualified as radiation hard.
II. Existing CMS links require 25 Tbps capacity – Global IP traffic (average) ~ 60 Tbps(2009). Optical network technologies required to handle the increase in bit–rate.
III. Periodic collision of particles requires a very high "snapshot" timing accuracy .



Data is transmitted using optical links.

Radiation Assurance :

Total Fluence Test

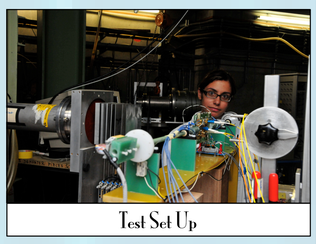
The total fluence tests are carried out by a colleague in the Optoelectronics group here at CERN,and require monitoring the characteristics of the devices as they are irradiated to SLHC fluences. A neutron irradiation has been carried out in August of 2009, and a pion test in August 2010.

Single Event Upset Test

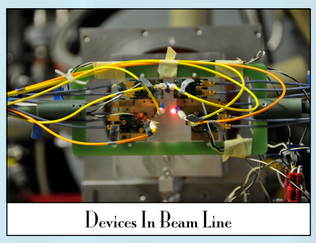
Carried out to discover the statistics of single event upsets in optical receivers – to establish what forward error correction (FEC) scheme needs to be used to mitigate these errors.
The first SEU test was carried out in July 2010.

SEU Test :

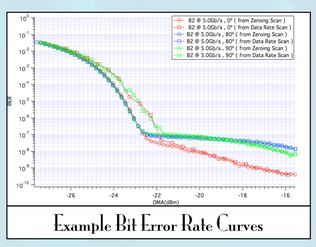
The SEU test was conducted at the low energy proton irradiation facility at PSI, using a 63 MeV proton beam over two 8 hour irradiation periods. This is the second SEU test that has been performed by the group, the first's aim was to survey as wide a range of devices as possible and measure the error statistics.
The aim of this test is to study the combined effect radiaiton has on the receiver and its amplifier by irradiating 3 types of optical receivers :
I. Receiver: : a single–mode(SM) photodiode, the amplifiers(transimpedance amplifier(TIA) and limiting amplifier(LA)) were not within the same package as the receiver, but were placed on the test board and shielded from the beam.
II. GBTIA ROSA : a SM photodiode packaged with a custom built, radiation hard (by design) TIA .
III. ROSA : :a multimode(MM) photodiode packaged with a TIA.



Test Set Up



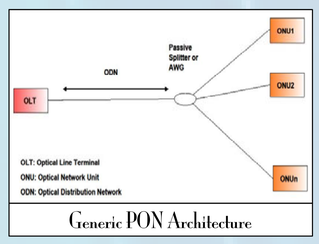
Devices In Beam Line



Example Bit Error Rate Curves

Passive Optical Networks:

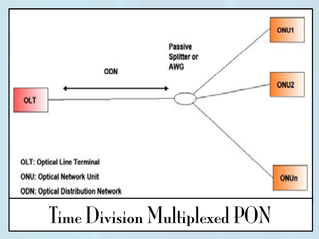
Optical fiber access networks consisting primarily of passive components. Considered to be the optical counterpart of xDSL, intended to deliver Gbps bandwidth to end users.



Generic PON Architecture

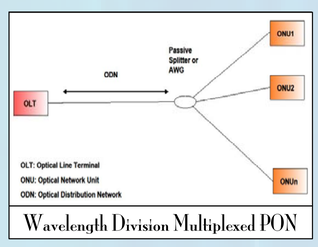
Achievements(To Date) :

I. Development of a Time Division Multiplexed(TDM) PON for the distribution of Timing,Trigger,and Control(TTC) signals at the SLHC.
Special Features:
i. Fixed and deterministic jitter.
ii. Very low jitter.
iii. Latency monitoring capability.



Time Division Multiplexed PON

II. Design and Simulations of a Wavelength Division Multiplexed(WDM) PON for data read–out at the SLHC.
Special Features:
i. High upstream bandwidth.
ii. Downstream broadcasting.



Wavelength Division Multiplexed PON

13 – 17 September 2010

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