R-H. NEW PHYSICS AT CERN

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Higgs-boson discovery. — All members of the CMS collaboration got the following message in July 5 from Joseph Robert Incandela, the spokesperson of the experiment, who was returning from the Melbourne conference presentation of Higgs discovery on July 4th:

Dear CMS colleagues - dear friends!

I want to congratulate the whole collaboration on an amazingly beautiful result under incredible time pressure. It is the consequence of decades of work and it is something we all made possible and we now all share together.

I had to rush off to Melbourne so I could not send this message sooner than this moment while waiting for a connecting flight in Singapore, reading Wall Street Journal Asia which has a CMS event display on the front page and another one covering a full half page on the inside!!

We have really made an impression worldwide.

Enjoy the moment everyone. It is a truly historic one.

Joe

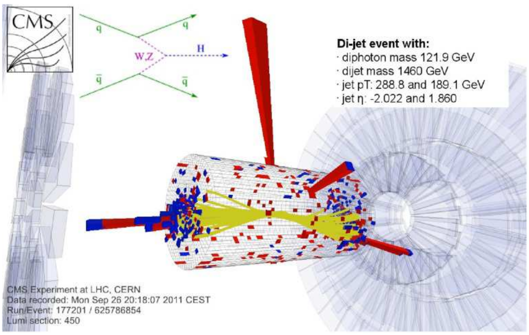

Fig. 1. The figure shows a CMS event similar to a Higgs particle. The boson is born when two quarks are scattered on each other and decays to two high energy photons denoted by red rectangles. The two quarks are flying away and initiate a hadron shower (yellow). The two hadron showers show the possible starting point of the Higgs boson, where the photons are initiated, and this is helpful in the determination of the mass of the boson.

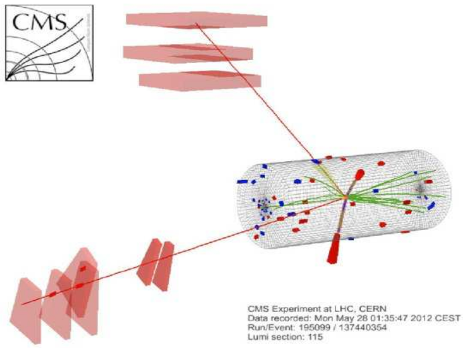

Fig. 2 A CMS event where the hypothetic Higgs boson decays onto a pair of electrons and muons, respectively. The electrons are absorbed by the electromagnetic calorimeter, but the muons leave the system, triggering the muon detectors farther away.

PhD student

The Hungarian physicists as senior funding fathers of RD5=proto-CMS and junior members of the Wigner CMS team had the feeling that the 2 events mentioned by WSJ and shown below really represent the reward of their 20-year work.

Of course, the Wigner team's contribution was marginal in size, but essential in the final outcome, like in a very long chain the breaking of one single element would destroy the whole system. Though the expert teams consisted of much more members than the Hungarian collaborators, the Wigner participants had a considerable share in the pixel and the alignment.

The heart of the CMS detector is the Silicon TRACKER which contains almost 100 million active channels. The heart of the heart is the pixel detector which, practically, consists of hundreds of CCD cameras producing pictures with nanosecond time resolution. It was the responsibility of the Hungarian team to ensure that these cameras make the exposition in the right time. The method was worked out and the continuous monitoring was accomplished.

Another task of the Wigner team was the radiation damage control. The pixel detector is standing in the very front-line only few centimeters away from the collision point (which is one of the hottest points of the Universe). Due to the wonderfully intensive collision rate these detector elements are rapidly collecting huge radiation dose, which causes the performance of the system to deteriorate. This effect was foreseen during design, and one can correct for it by adjusting the voltage on the detector chips. The work-out of this correction method and its regular updating application was also done by the Wigner team.

The in-situ determination of alignment constants for the CMS Silicon Tracker is also an important task. Though it is not known for the public, the accurate determination of the alignment constants is crucial for the physics performance of the experiment. Position and angular orientation, as well as shape parameters are determined at the level of individual sensors, resulting in up to 200000 alignment parameters. An algorithm based on the global minimization of track-to-hit residuals is used, which determines all alignment and track parameters simultaneously. Systematic biases in the geometry are controlled by adding further information into the alignment workflow in form of the known mass of resonances decaying into muons. The time evolution of the position of large structures in the tracker is also a central issue. The Hungarian contribution in these activities mainly was concentrated on the monitoring task. Recently a new method was proposed for the treatment of the so-called weak modes by the Wigner team.

SUSY search. — The discovery of Higgs-boson has double meaning: it is the END and the BEGINNING at the same time. It is the coronation of the Standard Model, the last missing element in the jig-saw puzzle. But if there exsists one Higgs then any number of additional Higgs bosons may exist, too. One of the most popular candidates with 5 bosons is the SUSY model which would solve many fundamental problems of particle physics.

Unfortunately the observed 125 GeV/c^2 mass for Higgs is strongly disfavouring the most popular SUSY versions (CMSSM, mSUGRA)

, therefore working out a new search strategy is on the agenda, where the Wigner team is actively participating in the Single Lepton group.

GRANTS AND INTERNATIONAL COOPERATION

OTKA NK 81447 Hungary in the CMS experiment of the Large Hadron Collider (D. Horváth, 2010-2013)

OTKA K 72172 Study of fundamental symmetries using antiprotons (D. Horváth, 2008-2012)

OTKA K 75129 Theory of quantum effects in nano-systems (L. Diósi, 2009-2013)

SCOPES 128079 (Swiss National Science Foundation) First years of data taking with the CMS experiment at the LHC (Dissertori* G; 2009-2012)

EU COST M1016 Fundamental problems in quantum physics (L. Diósi, 2011-2014)

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