

Potential contribution of University of Belgrade to the FCC studies



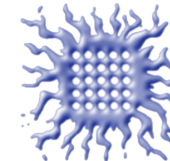
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& University of Belgrade



Institute of Physics
Belgrade



Faculty of Physics



Vinca Institute of
Nuclear Sciences



A brief history of Serbia and CERN relations



September, 1954: The Former Yugoslavia was **one of twelve founding states** of CERN

January, 1961: Yugoslavia **pulls out** from CERN and receives an **observer** status

June, 1995: Serbia as an independent state **establishes formal relations** with CERN

June, 2001: **General Agreement** on Scientific and Technical Cooperation with CERN

August, 2005: Serbia signs **MoU for M&O for ATLAS and CMS** experiments

November, 2008: Serbia sends a **letter of intent for admission** to the CERN membership

March, 2009: Serbia files an **application** for a **candidate** for the CERN membership

January, 2012: Serbia signs the **Agreement** on an **associate CERN membership**

March, 2012: National Assembly of the Republic of Serbia **ratifies** this Agreement

February, 2014: **Institute of Physics** and **Faculty of Physics** sign agreement with CERN

Hardware contribution of Serbia to ATLAS and CMS

120 hydraulic jacks for the CMS magnet were made in 2002 by the “ZASTAVA Alati” in Kragujevac and delivered to CMS in July 2003



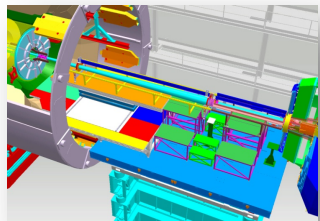
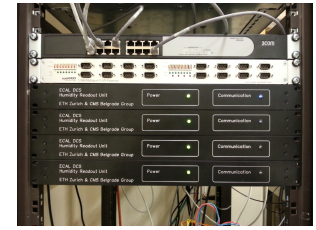
In-kind contribution to ATLAS and CMS

“Disk Shielding (JD) and A-frame supports for the forward shielding (JF) of ATLAS, produced by Lola Korporacija (Zeleznik) and Kryooprema (Belgrade), and transported to CERN in 2004

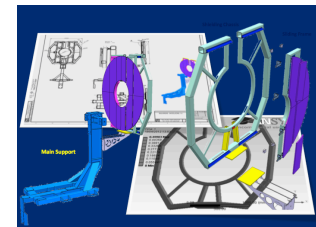


ECAL Safety System – ESS designed, constructed and tested by the Serbian CMS Group and delivered to CMS in 2007

ECAL Relative Humidity System – ERHS, design and construction by the Serbian CMS Group completed in 2012



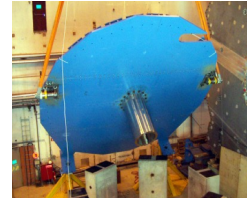
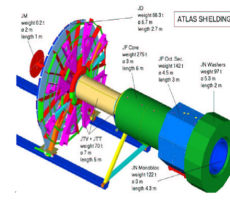
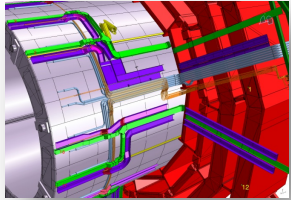
Technical design and realization of plethora of CMS detector infrastructure elements and machine-detector interface. This engineering task has been going on since 2004 and has played a crucial role in the integration of the CMS detector



December 2013 - Company from Gornji Milanovac completed supporting platforms for the CMS

Potential contribution of Serbia to FCC in Hardware

Based on previous experience in LEP and LHC experiments, Serbian researchers and engineers can contribute to **design** and **development** of certain parts of detectors



A specific contribution will be defined more precisely once the parameters of the FCC machine and the detectors in particular are established

More realistic proposal could deal with the involvement within **Detector Control System** for calorimeters, based on the expertise obtained from ESS and EHRS systems at CMS, and also for **tracking detectors** with the implementation of pixel sensors for high-energy particles in the commercial high-voltage CMOS technologies

Contribution to the **LHC GRID Project** since the 2006:
Scientific Computing Laboratory (SCL) is recognized as an EU Centre of Excellence for modeling of complex systems
University of Belgrade: Institute of Physics (5 physicists)



Physics involvement and expertise in ATLAS and CMS

Serbian scientists are coming from the three institutions of the **University of Belgrade**:

- **Institute of Physics Belgrade**
(ATLAS experiment)

Team leader:

Prof Dr. Dragan Popovic



Dominantly
younger
people

- **Faculty of Physics and Vinca
Institute of Nuclear Sciences**
(CMS experiment)

Team leader: **Prof Dr. Petar Adzic**



We have gained experience and contributed to papers in the following physics studies:

- **Higgs searches and studies** in $\gamma\gamma$, ZZ and $Z\gamma$ at CMS, **contributed to the discovery and Higgs properties studies**
- **SUSY searches** in 0-lepton at ATLAS and 2-lepton at CMS, **group coordinator**
- **EWK physics**: W mass measurement and anomalous trilinear couplings (ATGC) searches in $W\gamma$ final state with ATLAS, also ATGC studies in $Z\gamma$ final state at CMS
- **Heavy ion physics**: various contribution to **flow and correlations** studies at CMS

Potential contribution of Serbia to FCC in Physics

Regarding the **FCC-ee** studies we plan to make a contribution to the following topics:

- **Higgs** precision measurements
- **EWK** (W mass, ATGCs) studies

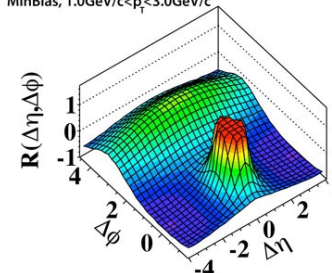
Concerning the **FCC-pp** studies our expertise and interest is expanded to some more topics:

- Extensive **Higgs** studies
- **SUSY** searches
- **EWK** physics
- **Heavy ions:**

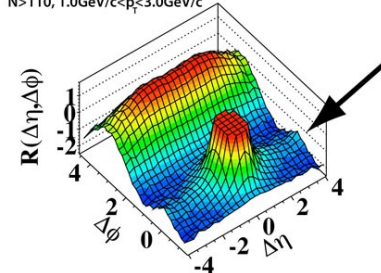
Our involvement in the concrete physics analyses at the FCC is already under discussion and young postdocs and students led by our professors have started a process of forming the small analysis groups ready to contribute

- Long experience in **collectivity** at SPS and LHC
- 1 order of magnitude bigger $\sqrt{s_{NN}}$ w.r.t. LHC
- QGP volume and lifetime will be increased
- Collective phenomena will be **enhanced** at FCC
- Huge number of degrees of freedom leads to collectivity also in small colliding systems (**pp**)

CMS 2010, $\sqrt{s}=7\text{TeV}$
MinBias, $1.0\text{GeV}/c < p_T < 3.0\text{GeV}/c$



$N > 110$, $1.0\text{GeV}/c < p_T < 3.0\text{GeV}/c$



CMS, JHEP 1009 (2010) 091



SERBIA and FCC



Agreement between CERN and the University of Belgrade for the FCC study **is being prepared** and it is planned to be signed in the very near future

After this Agreement is signed, the more specific plans for contribution of Serbia to the FCC will be outlined in the **Addendum of MoU** (signature is expected to take place very soon between the FCC and the University of Belgrade)

For this proposal we have **support** of the **Serbia's HEP Community** and the **Ministry of Education, Science and Technological Development of the Republic of Serbia**