Laboratoire Leprince-Ringuet - LLR
CNRS, École polytechnique, Institut Polytechnique de Paris
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Postdoctoral position on LHCb luminosity measurement

A two-year postdoctoral position founded by the IN2P3 / CNRS is opened at Laboratoire Leprince-Ringuet (LLR) in the LHCb team comprised of 3 permanent researchers and two postdocs. The group is involved in the LHCb luminosity measurements and the heavy-ion physics. LLR is the oldest laboratory in École polytechnique, about 15 km in south-west from Paris. The postdoc will be based at LLR with frequent visits to IJCLab, situated in Orsay in the same area, and with regular travels to CERN.

A large fraction of LHCb publications contains new cross-sections. For normalization, they require the integrated luminosity measured with the best possible accuracy, currently 1-2%. Here LHCb holds an absolute record among all bunched hadron collider experiments at the level of 1.16%. The best accuracy is achieved by inventing novel methods: beam-gas imaging (taking"photos" of LHC bunches using their interactions with the injected gas), two-dimensional van der Meer scans, an accurate simulation of the beam-beam electromagnetic repulsion etc.. **The analysis of LHCb Run 2 pp and PbPb luminosity was performed at LLR.**

New LHC Run 3 will start in spring 2022, and the postdoc will participate in the **offline luminosity measurements** for the first 2022 data, necessary for the LHCb Run 3 early publications. (S)he will acquire a broad knowledge on the luminosity calibration at hadron colliders, the principles of the LHC operation, the LHC beam monitoring devices and all LHCb luminometers in general. After that (s)he will be capable of carrying similar offline analyses alone in the following. This implies the **calibration of the luminometers** performed at LHC once per year, per energy and **monitoring their stability** during LHCb running.

The best offline accuracy requires studies of various effects at 0.1-1% level, and in some sense a "perfectionism" of the analyst. The luminosity measurement is important and well visible inside the collaboration and guaranteed to be needed in the long term, including Run 4 and HL-LHC.

For an optimal running of LHCb, the instantaneous luminosity should be known **in real time** with ≤5% accuracy. It will be provided by the new detector called PLUME. It was designed, built and installed by the **PLUME collaboration** gathering 6 LHCb laboratories. The project was initiated by IJCLab.

In close contact with the IJCLab team, the postdoc will be involved in the **commissioning and analysis of the PLUME data,** ensuring stable LHCb **online luminosity** measurement in Run 3 and beyond.

Finally, for the next runs LLR proposed a new "experimental" luminometer based on counting **$Z^0 \to \mu^+\mu^-$ decays.** This will be the only luminometer based on the physics channel. It will both cross-check other luminometers, and provide a detailed information on $Z^0 \to \mu^+\mu^-$ systematics. The simultaneous analysis of $Z^0 \to \mu^+\mu^-$ and the luminosity might allow achieving the best accuracy of the fundamental **Z^0 cross-section measurement** and constraining the parton distribution functions (PDF) of the proton. Current uncertainty is dominated by the luminosity. The postdoc might participate in this task as well.

Applicants should have a **PhD** (or a fixed date of defense) and **not more than 2 years** of postdoctoral experience. The contract should be signed before June and start before November 2022. Please, refer to the CNRS site

https://emploi.cnrs.fr/Offres/CDD/UMR7638-MICHOA-005/Default.aspx

for applying. The curriculum vitae and at least two letters of reference should be sent to Vladislav Balagura (balagura@cern.ch). Please, do not hesitate to contact me directly if you need any additional information or have any questions.