# POSTDOCTORAL POSITION – P2IO/STRONG2020 – YEAR 2020

**DEADLINE for application: review of applications will begin immediately and will continue until the position is filled.**

## PROJECT TITLE

Implementation studies of a fixed-target system and data analysis of quarkonium photoproduction from peripheral to central Pb-Pb collisions in ALICE at the LHC

## JOB DESCRIPTION

We invite applications for a highly motivated post-doctoral researcher for a 3-years duration to work on:

- the implementation of a fixed-target system with the ALICE detectors at the LHC. The candidate will estimate the detector performances with a vertex shifted from the nominal interaction based on the solid-target system developed at IPN Orsay and will perform simulations of soft/hard processes with the ALICE setup (1 year);
- the study of quarkonium photoproduction in peripheral to central Pb-Pb collisions with Run 3 data in ALICE. The candidate will work on the analysis of the photoproduced J/psi polarisation in peripheral Pb-Pb collisions, in the dimuon decay channel, with the ALICE forward muon spectrometer. Benefiting from the high statistics to be collected in 2021, the candidate will also extend the current J/psi photoproduction measurements toward most central collisions, and to other quarkonia (Psi(2S), upsilon) (2 years).

The researcher will be based at IPN, Orsay, France in the ALICE group with frequent travels to CERN. The position is funded for three years and can be filled as soon as March 1st until October 1st, 2020.

## DESCRIPTION OF THE PROJECT

By extracting the beams with a bent crystal associated to a solid target or by using a gas target, the multi-TeV proton and lead LHC beams allows one to perform fixed-target experiments in pp, pA and PbA collisions at an energy between SPS and RHIC top energy. A fixed-target system would address open questions in the domain of the nucleon and nucleus partonic structure at high-x, quark-gluon plasma and, by using polarised targets, spin physics. These physics opportunities were developed by the AFTER@LHC study group [Had18]. A fixed-target programme has been proposed in ALICE [Gal19] and a solid-target system was designed at IPN Orsay. Integration studies have recently shown that the target system would be displaced by about 5 meter from the nominal interaction point. Performance studies are needed to determine the capability of the ALICE detectors, in particular the Time Projection Chamber, with a displaced vertex. Simulations of key processes will be carried on based on the performance results. These studies are one side of the proposed project.

The other side of the project concerns the analysis of ALICE Run 3 data. ALICE offers unique capabilities to study quarkonium production at low transverse momentum ($p_T$) over a wide rapidity range. In ultra-peripheral collisions (UPC), nuclei are separated by impact parameters larger than the sum of their radii and therefore hadronic interactions are strongly suppressed. Photoproduction of vector mesons, in such collisions, gives insight into the gluon distribution of the incoming Pb nuclei over a broad range of Bjorken-x values. The first indication of J/psi coherent photoproduction measured by ALICE [Ada16] at forward rapidity in Peripheral Collisions (PC) with nuclear overlap brings yet another handle to this kind of measurements. The experimental and theoretical challenges of quarkonium photoproduction measurements in AA collisions with nuclear

overlap, are still manyfold. Indeed, the observed J/psi excess at low $p_T$, interpreted as originating from coherent photoproduction, imposes great challenges for the existing coherent photoproduction models, especially in explaining how the broken nuclei satisfy the requirement of coherence. The high statistics Pb-Pb data foreseen in Run 3 together with the already collected data in Run 2 will permit the measurement for the first time of the J/psi excess polarization allowing one to confirm the photoproduction origin of the excess. The measurement of the excess as a function of centrality will be conducted at forward rapidity, to study potential QGP-like effect on the photoproduced J/psi yield. An observation of a broadening of the excess $p_T$ distribution with increasing centrality would also be an indication that the spectator nucleons in the target are responsible for the coherence. The high statistics Run 3 data will also allow one to extend all the previous studies to other quarkonia for the first time.

## EXPECTED PROFILE

Applicants are expected to hold a PhD degree in sub-atomic physics or in a related field. Good programming and computational skills are required. In particular, experience in tracking reconstruction tools, simulations and data analysis will be considered a plus. The eligible candidate should be able to communicate at a scientific level in English. Knowledge of French, although not essential, would be useful. The University of Paris-Saclay is an equal opportunity/affirmative action employer.

The appointment is initially for one year (H2020 funding), renewable for two more years (P2IO funding). To be eligible, applicants must have obtained their PhD degree by the date of appointment and no more than 5 years before the beginning of the contract. Monthly gross salary will be €4583.

Review of applications will begin immediately and will continue until the position is filled.

## APPLICATION:

The applications (including a CV and a statement of research) are to be sent to: Cynthia Hadjidakis (cynthia@ipno.in2p3.fr), Laure Massacrier (massacrier@ipno.in2p3.fr), Christophe Suire (suire@ipno.in2p3.fr).

The applicants should arrange 3 letters of recommendation to be sent separately at the same address. For further information please contact Laure Massacrier -massacrier@ipno.in2p3.fr- and/or Cynthia Hadjidakis -cynthia@ipno.in2p3.fr

## LABORATORY INVOLVED

Institut de Physique Nucléaire (IPN)
15, Rue G. Clemenceau, 91406 ORSAY (FRANCE)

## REFERENCES

[Had18] A Fixed-Target Programme at the LHC: Physics Case and Projected Performances for Heavy-Ion, Hadron, Spin and Astroparticle Studies. By C. Hadjidakis, et al., arXiv:1807:00603.

[Gal19] Physics opportunities for a fixed-target programme in the ALICE experiment. By F. Galluccio, et al., CERN-PBC-Notes-2019-004, https://cds.cern.ch/record/2671944.

[Ada16] Measurement of an excess in the yield of J/ψ at very low pT in Pb-Pb collisions at √sNN = 2.76 TeV. By J. Adam et al., Phys. Rev. Lett., 116(22):222301, 2016.