# INTERNSHIP PROGRAM FOR INTERNATIONAL STUDENTS

# INTERNSHIP SUBJECT FORM

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| Name of the Host Laboratory | Laboratoire Leprince-Ringuet |
| Website of the Host Laboratory | http://llr.in2p3.fr |
| Research Group | CMS |
| Internship Supervisor | Computer scientist and administrative supervisor : Gilles Grasseau (grasseau@llr.in2p3.fr)<br>Physics supervisor: Florian Beaudette (beaudette@llr.in2p3.fr) |
| Internship Subject | Deep Learning & High Granularity Calorimeter (DL-HGCAL) |
| Student's level | ☐ Advanced Undergraduate Students (3rd or 4th year)<br>☒ Master's students (1st or 2nd year)<br>☒ PhD students |
| Proposed Duration | ☒ 3 months<br>☒ 4 months<br>☒ 5 months<br>☒ 6 months |
| Prerequisites | Knowledge of the main models in Deep Learning and more especially CNN and Object Detection Models. Physics background<br>Skills : TensorFlow, python 3 and python 2.7, general programming skills, using 3D graphics tools, github. |
| Internship description (max. 15 lines) | Future collider projects such as the High Luminosity LHC at CERN will require advanced detectors in order to provide high precision measurements. For the phase 2 upgrade of the endcap calorimeters for the High Luminosity LHC, the CMS collaboration made the ambitious choice of a high granularity design.<br>The CMS group of Leprince-Ringuet laboratory (LLR) at Ecole Polytechnique has been involved in this High Granularity CALorimeter (HGCAL) project since the very beginning.<br>Deep Learning based methods are currently investigated to localize and identify the thousands of showers in simulated events, which are assimilated to a 3D images, and will be compared with more classical approaches, like clustering methods.<br>Based on the recent developments in the "object detection" models like Fast(er) R-CNN, YOLO, Mask R-CNN, etc., the main target of this internship will focus on building the Region Proposal Network (RPN) to extract the Region of Interests (RoI) of the numerous showers in our 3D-events. The refinement part (classification, bounding box, and mask) will be the next priority of this internship (if the RPN extraction is done). The implementation will be done in TensorFlow (TF) or TF API (Keras, PyTorch), based on the 2D published implementations. The training process with be part of the internship with event pre-processing steps and various numerical surveys should be implemented (2D/3D graphics tools) |