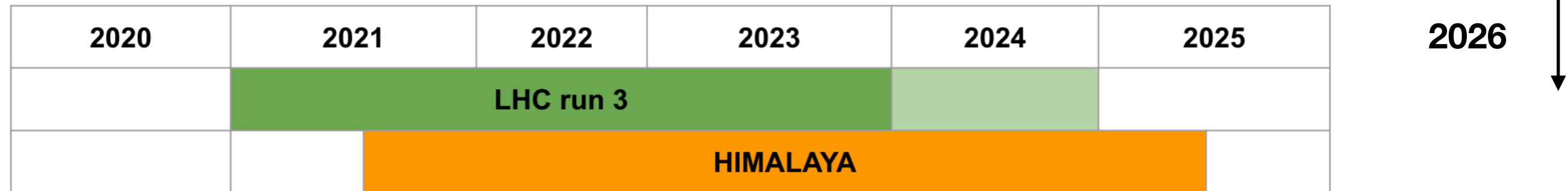


Recycle proposal of last year

**Event reconstruction with ML techniques and impact on the HH produced through VBF sensitivity.**

Related to the Phase 2



Content: reconstruction with the future HGCAL (High Granularity Calorimeter)  
[HGCAL video \(youtube\)](#)

## Event reconstruction with ML techniques and impact on the HH produced through VBF sensitivity. (WP1, WP2)

**Objectives:** This project tackles machine learning-based event reconstruction in the upgraded detector that will be installed to optimally exploit the High Luminosity-LHC (HL-LHC) data. The detailed understanding of the HH production will require a significant integrated luminosity that will only be available at the HL-LHC that will start in 2026 and deliver 10 times that of the Run 3.

To optimally exploit the data, the CMS detector will undergo major and innovative upgrades. The future HGCAL (High Granularity Calorimeter) will comprise 6M channels measuring energy and timing. The thousands of particles coming from the multiple interactions impinge the HGCAL where they create showers, depositing energy simultaneously in adjacent cells. These showers should be identified by gathering the cells from a given particle. Thus, the problem consists in identifying known patterns in a 3D image. ML-based solutions will be developed to localize and identify all the showers in an event. It faces several technological challenges: 3D images instead of 2D and very strict CPU time constraints. In the first 6 months the ESR will develop visualisation tools to understand the characteristics of the electromagnetic and hadron showers and develop the reconstruction of the former. After this experience, the secondment at ENW working on ML computer vision will be very beneficial to develop reconstruction and identification techniques for hadron showers at the beginning of the second year. The next 6 months will be devoted to putting the building bricks together and deploy a ML-based particle flow event reconstruction. The physics performance and the impact on the HH→bbττ analysis will be assessed during the last year of the thesis and the projected sensitivity studies will be published.

## **Secondment:**

A secondment in a company doing medical imaging would be very relevant.

Last year foreseen secondment was EnergyWay.

We could prospect and see if other companies can join the ETN.