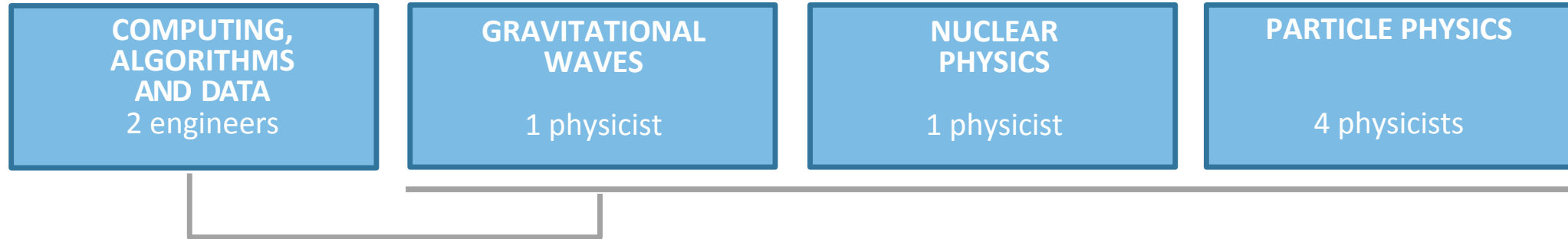


Computing activities at L2IT

Catherine Biscarat (catherine.biscarat@l2it.in2p3.fr)

L2IT – a new lab' in Toulouse

- Key activity: Algorithms, Computing and Data (simulation, data analyses, innovative algorithms)
- Four research teams, among them “Computing, Algorithms and Data” (CAD)



- CAD, 2 members
 - Catherine (team leader)
 - Sylvain (ML expert): dedicated to the ATLAS project (the first one established at L2IT)
 - Another engineer to join in October 2021
- Computing activities at the lab (with CAD):
 - Particle Physics: ML is established (starting core SW activities)
 - Gravitational waves: under discussion (ML and SW dev)
- ML is one of the 4 main axes of the University
 - We aim to work (publish) together with ML researchers (IRIT)
 - Some experiments make it difficult

We rely on the CC-IN2P3 for all our computing needs (CPU, GPU, storage).

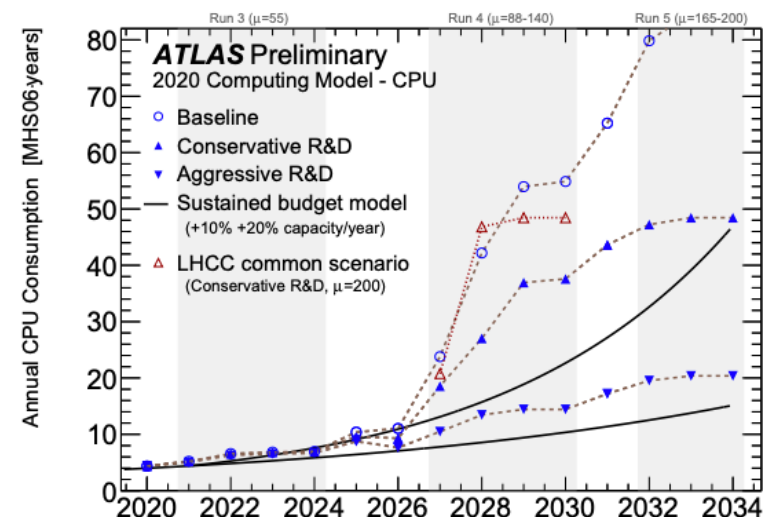
ML activities @L2IT – Particle Physics

Computing challenge at the HL-LHC

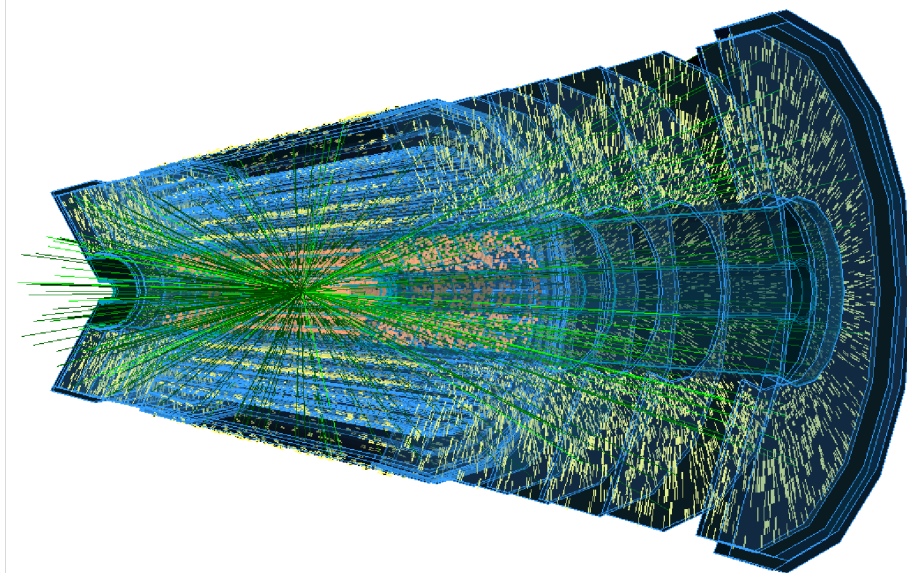
- Increase in the event complexity
- Increase in the event rate
- Needs for new algorithms

GNN for track pattern recognition

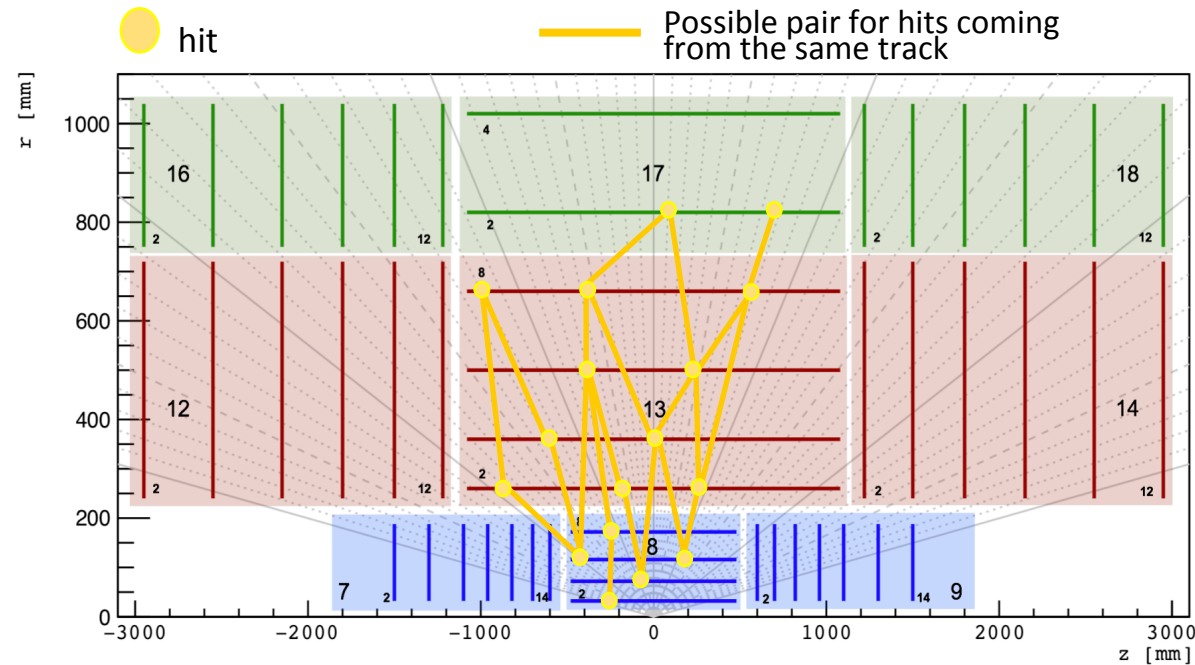
- Track reconstruction algorithm = CPU intensive stage
 - 100k hits in the future tracker of ATLAS (Itk)
 - Classical algorithms do not scale
 - ML methods can help ?
- Raw data from collisions are *sparse* data
- **Graph Neural Networks** (GNNs) were identified as suitable
 - Earlier proof of principle: ExaTrk.x project



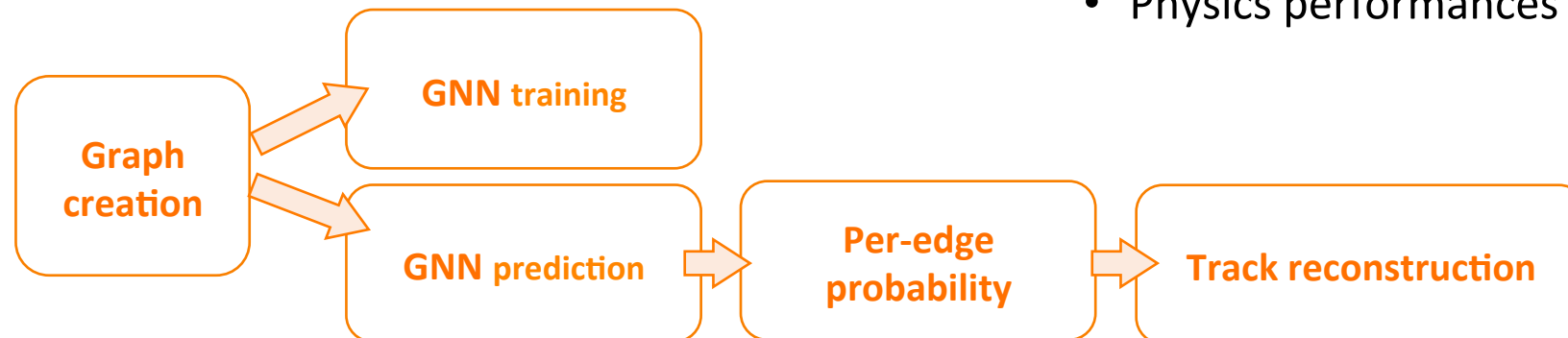
From [ATLAS HL-LHC Computing Conceptual Design Report](#) Year



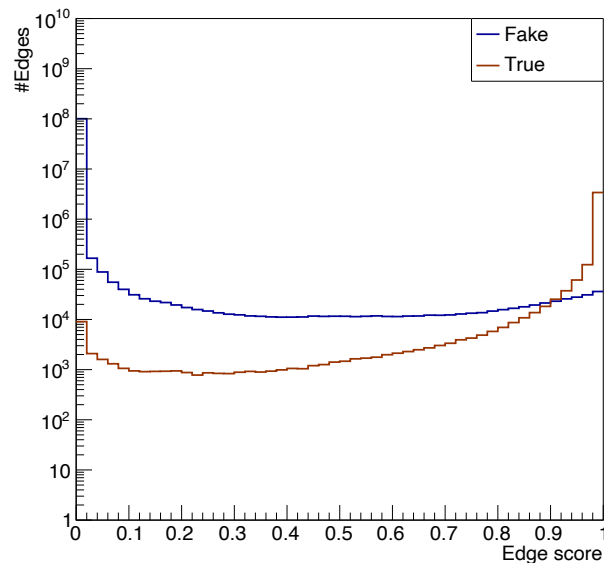
ML activities @L2IT – Particle Physics



- Graph creation (nodes and edges)
- GNN will give the probability that a pair of hits (an edge) comes from a true given track
- Study on the full detector (first)
- Simple architecture
- Memory consumption
- Physics performances

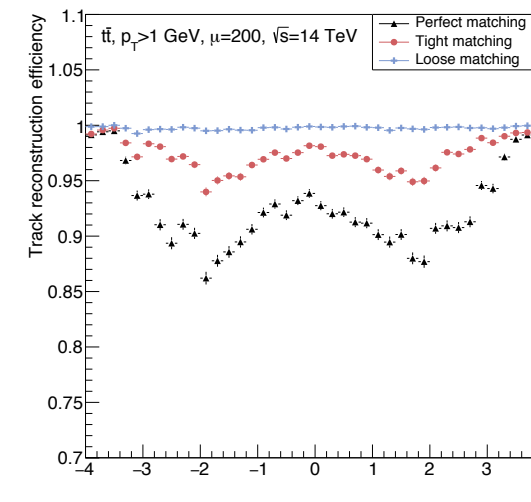
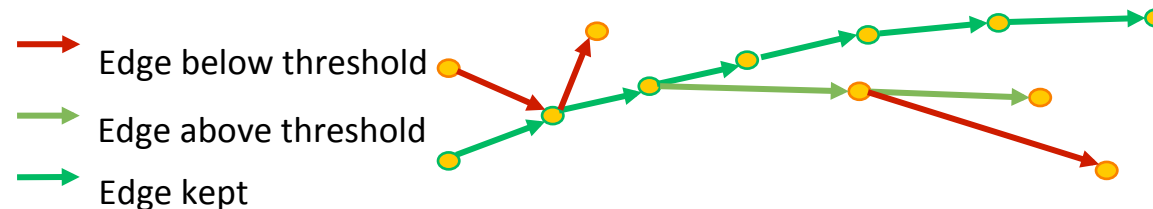


ML activities @L2IT – Particle Physics



Cut on edge score	0.8
Per-edge efficiency	0.982
Per-edge purity	0.950

Turning edge scores
into track candidates



arXiv:2103.00916

Joint effort CAD and
PP team

Towards a realistic track reconstruction algorithm based on graph neural networks for the HL-LHC

Catherine Biscarat¹, Sylvain Caillou¹, Charline Rougier¹, Jan Stark¹, and Jad Zahreddine¹

¹Laboratoire des 2 Infinis - Toulouse (L2IT-IN2P3), Université de Toulouse, CNRS, UPS, F-31062 Toulouse Cedex 9, France

Plenary talk at the International conference on Computing in High-Energy and Nuclear Physics



ML in our community

- ML is popular
 - GNN is one of the newest technics explored
- ML is established now in « production » streams
 - E.g. ATLAS run3 fast simulation is hybrid between parametrisation and ML

- ML@IN2P3
- ML@ATLAS
- ML@CERN inter experiment
- Springer: « Computing and Software for Big Science »

