

ML and Computing

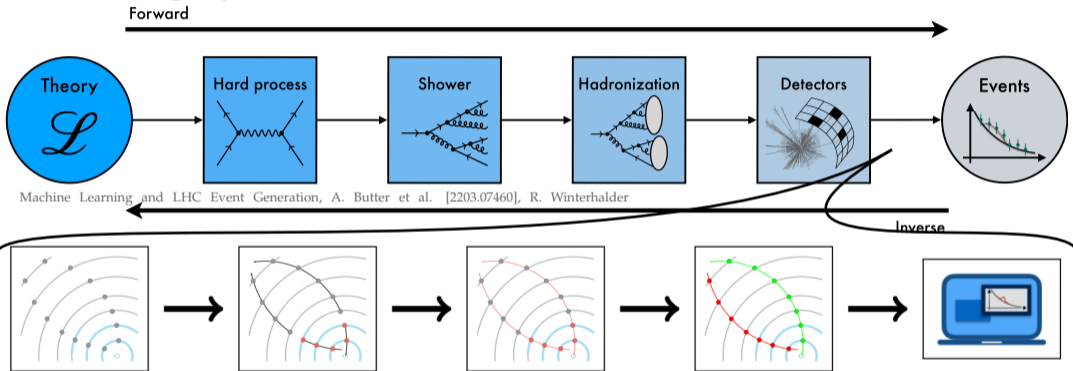
— Austrian Roadmap Round Table Meeting —

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HEP is highly numerical — and we have awesome simulation!



⇒ Machine Learning is already everywhere!

- Experiment / Theory / Lattice
- forward / inverse

Machine Learning is already everywhere!

The <https://iml-wg.github.io/HEPML-LivingReview/> has now 1396 entries.

ML is used ...

- ...at all stages: from proof of principle, R'n'D, to fully deployed in EXP.
- ...for all tasks: regression, classification, generation, optimization, ...
- ...to improve existing algorithms and to enable new ones.

⇒ The prevalence of ML will further increase in the coming years.

- The use of ML is not constrained to HEP-ML groups, but catalyzed by them.

⇒ I expect HEPHY to be well above average in the coming years!

Future plans for ML at HEPHY

- R'n'D on Calorimeter FastSim
 - ▶ HL-LHC
 - ▶ future collider(s)
- CMS: close collaboration, to have algorithms deployed.
 - ▶ Pile-up mitigation
 - ▶ Improved trigger with FPGAs
- Hardware optimization:
 - ▶ OBELIX chip
- Gravitational waves: rather new field, a lot to explore
 - ▶ "FastSim" for wavefronts
 - ▶ fast parameter inference of merging BHs
- Rare Event Searches:
 - ▶ faster background simulation
- Event generation: better hadronization models

Use of ML is not constrained to HEP(HY)

Beyond HEPHY

- Dénes Sexty (Uni Graz): non-perturbative QCD
- Andreas IPP (TU Vienna): SU(3)-equivariant networks
- newly founded “European Coalition for AI in Fundamental Physics” (EuCAIF) for HEP, astroparticle, cosmology, nuclear, gw, simulation

Beyond HEP

- “pure” ML developments at JKU Linz, with former HEP contributors.
- ⇒ Can we benefit from this?
- CAIML of TU Vienna (connection to CS departments)
 - Topical Platform (ML at the Austrian Academy of Science — MLA2S): connecting ML across institutes and domains. (Kick-Off June 24th)

A word on Computing Resources

- As a highly numerical field, we always relied on HPC clusters.
- towards HL-LHC: more data + more simulation = more resources needed
- ML is faster ($\lesssim 20$) on GPUs: become more available
- But: GPUs much more expensive, so shared clusters advantageous
- more other users (bio informatics etc.) means less availability, but also more IT support.
- For us at HEPHY: <https://clip.science>
- Andreas is co-chairing a working group of the Joint ECFA-NuPECC-APPEC (JENA) Computing Initiative (WP4 on Artificial intelligence).