Future Information and Communications Technologies for HL-LHC Era:
Beyond CMOS and Beyond the Shannon Limit

Harvey Newman, Caltech, August 2020

The revolutionary developments underway to overcome the looming barriers in electronic and photonic systems, and hence in computing and communications systems, to maintain progress and economies, offer unprecedented opportunities for our field. These include

- Nanophotonics, plasmonics, and/or spintronics for ultrafast low energy signaling
- Beyond CMOS: memory, logic devices, integrated electronic/photonic systems
- Beyond Shannon long haul optical communications systems and methods: multicore fibers, spatial division multiplexing, orbital angular momentum and other degrees of freedom
- Metamaterials and devices: To shape and direct light, form wavefronts and frequency dependent beams; + programmably, on several time + distance scales

HEP, and community planning have until now taken only limited account of these Revolutions which will which affect more than computing: TriDAS, all communications, intelligent "coherent" systems; as well as our working + home environments

There will be great design and physics opportunities at the HL-LHC in 2030-38, and beyond for future experiments and accelerators.

The conclusion that follows from the above is that as a community we need to follow, join and lead some of these forefront developments, as part of our longterm experimental roadmap and our "frontiers". The above technologies and new directions will have an increasing role in the 2020s, and dominate the 2030s.

The issues, barriers, next generation technologies and opportunities are introduced and discussed further in this presentation, a short version of which was presented at the Snowmass Computational Frontier Kickoff Meeting on August 11 2020:

https://www.dropbox.com/s/61ym4u4gl3oayi7/FutureICTfor%20theHLLHC_2020to2030andBeyond_LongVersionhbn081020.pptx?dl=0