Applications
› Vehicle Control Module uses Virtex-II devices
  - gearbox, differential, traction control, launch control and telemetry
› High speed real-time control and DSP application

Source: BMW Williams
Compact Muon Solenoid

- $10^{15}$ collisions per second
- Few interesting events ~ 100 Higgs events per year
- 1.5Tb/s real-time DSP problem
- More than 500 Virtex and Spartan FPGAs used in real-time trigger

Source: Geoff Hall, Imperial College
Square Kilometre Array (SKA) will be one of the largest and most ambitious international science projects ever devised (€1.5 billion).

CSIRO Developing Australian SKA Pathfinder (ASKAP), a $150M next-generation radio telescope using FPGA technology for the data collection & processing.

Source: John Bunton CSIRO
Other RC Applications

› Applications suited to acceleration
  - seismic processing astrophysics FFT
  - adaptive optics (transforming to frequency domain and removing telescope image noise)
  - biotech applications such as BLAST, Smith Waterman and HMM
  - computational finance

› Functions well suited to FPGA acceleration
  - searching & sorting
  - signal processing (audio/video/image manipulation)
  - encryption
  - error correction
  - coding/decoding
  - packet processing
  - random-number generation for Monte Carlo simulations

Source: cray.com
uPs are the most flexible technology but performance (speed and power) is relatively low

FPGAs provide
- Easy interfacing with hardware (tighter coupling than GPUs)
- Parallelism
- Have become large enough to implement DSP and ML algorithms
- Very interesting research area: architectures, tools, applications

ASICs becoming only be suitable for highest volume, highest performance applications, FPGAs will do the rest

Many of the highest performance accelerators, particularly for real-time problems, are FPGA-based
› Read the Chisel tutorial
  - https://chisel.eecs.berkeley.edu/2.2.0/chisel-tutorial.pdf

(Tutorial 1 for this course is https://chisel.eecs.berkeley.edu/2.2.0/chisel-getting-started.pdf and you might find this useful https://chisel.eecs.berkeley.edu/2.2.0/chisel-cheatsheet.pdf)