Serial Communications in HEP

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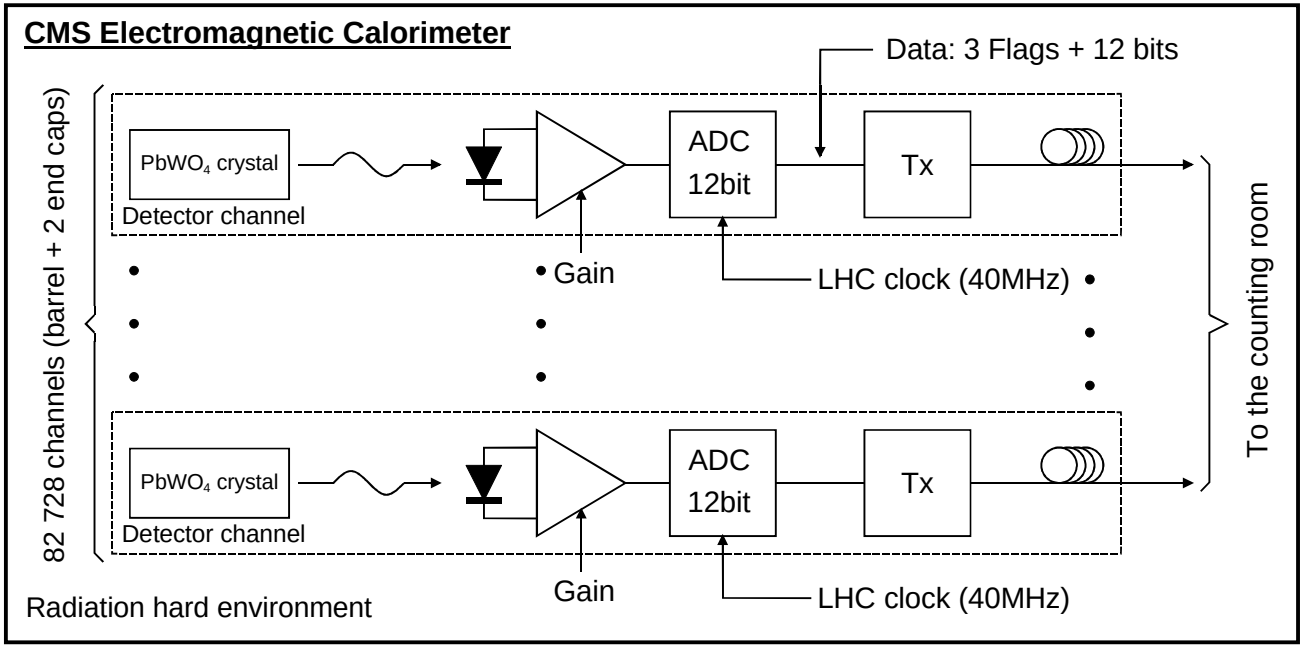
Outline

- Introduction:
  - Serial communications in HEP?
- Serial communication principles
  - Optical signaling
- Digital optical communications
  - Performance metrics
  - Transmission impairments
  - Fundamental limits
  - Capacity
- Functions and circuits
  - Transmitters
  - Receivers
- Practical examples from HEP
  - The TTC system
  - The CMS tracker analogue data link

Serial communications in HEP?



- Brut force: (parallel)
  - # Links = (3 Flags + 12 Bits) × 82.7K channels = 1.2M links @ 40Mbit/s
- Serial approach:
  - # Links = (3 Flags + 12 Bits) in 25ns × 82.7K channels = 82.7K links @ 600Mbit/s
  - in reality a higher bit rate is required for synchronization and link control (800Mbit/s)
- **HEP specific requirements:**
  - Radiation hardness
  - Fixed latency (for trigger links)