

# Microelectronics

- A brief introduction to three subjects
- Noise in front-end electronics
  - Now well established, and you may not need to know the details
  - But at least you should know why and how it arises
- How microelectronic circuits (and silicon sensors) are made
  - Try to give some insight into factors that affect this (expensive) technology
- A short summary of how radiation affects integrated circuit electronics
  - highly relevant to LHC
  - but also some future projects, such as muon colliders
- Some additional backup slides in case further details are of interest

# Radiation effects on IC electronics

- **CMOS circuits**

- mostly sensitive to surface states at oxide-silicon interface
- charge build-up, some fixed and some less permanent
- changes conditions under gate, so alters transistor behaviour

- **Other transient effects**

- **Single Event Upset** – charge in a small volume changes a binary state
  - typically generated by knock-on ion, which can deposit very large charge
- **Latch-up** – charge generates parasitic circuit connection
  - can be destructive – but generally avoided by manufacturing process

- **Silicon sensors**

- atomic displacement is the most important effect
- leads to increased leakage current (noise, power) and changes in effective dopant concentration