Particles, forces and the Universe at the smallest distances

- What high energy particle physics can tell us.
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- What high energy particle physics can tell us.
- How it is done.
Particles, forces and the Universe at the smallest distances

- What high energy particle physics can tell us.
- How it is done.
- An equation, a diagram and a plot.
What high energy particle physics can tell us

- Investigating nature at the smallest scales
  - Hopefully things are simpler there (?)
  - Need high energy to gain high resolution.
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High energy wave means small wavelength
High Energy means near the big bang

High energy density

THEN
High Energy means near the big bang

High energy density

THEN

Lower energy density

NOW
How are such high energies achieved?
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• Collisions at big, and unfortunately expensive, accelerators.
How are such high energies achieved?
The detectors
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- Many technological challenges -
  - High speed, high data volumes
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The collaborations
An equation

\[ E = mc^2 \]
A diagram
Nearly the same diagram
Another slightly different diagram
A plot

Total Cross Section [pb]

Center of Mass Energy [GeV]

- $e^+e^- \rightarrow \nu \nu$
- $e^+e^- \rightarrow \mu^+\mu^-$
- $e^+e^- \rightarrow \gamma\gamma$
- CESR DORIS
- PEP PETRA
- LEP
- TRISTAN

$e^+e^- \rightarrow$ hadrons
A similar plot
Summary

- Brief tour of one aspect of particle physics
  - Missed out neutrinos experiments, precision e+e- machines, strong interaction physics...
- The machines & collaborations are big, but there is plenty of data (and work!) to go around.
- Pushing the “small” frontier throws up surprises, and has changed our picture of nature many times.
Summary

- Watch out ... 1997.
  - LHC turns on
  - Either we find the Higgs, or the “standard model” comes crashing down
- And UCL physicists will probably be to blame...