



# Data

## Intensive Science

### THE PHYSICS OF THE UNIVERSE

*The enigmatic Big Bang, Quantum Mechanics, plus a small zoo of particles and forces — with these physicists account for almost everything on earth and in the skies. But many questions remain ...*



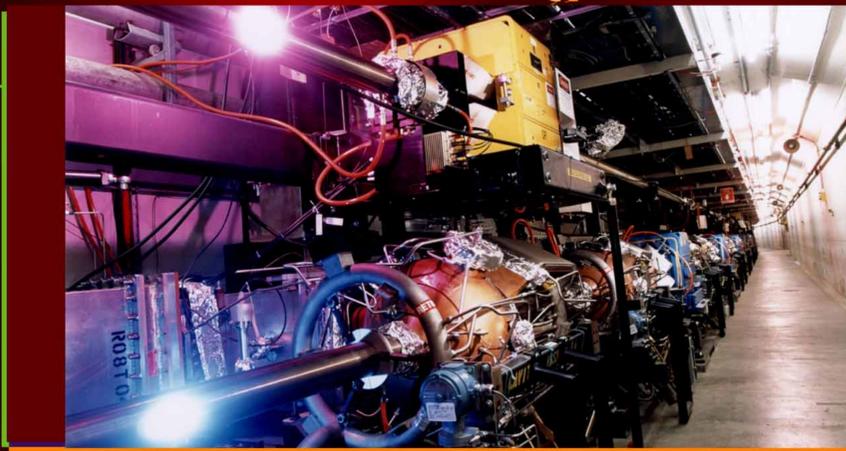
#### Questions?

#### COMPUTING HOLDS THE KEYS

*Computing is vital in designing instruments, collecting and analyzing uncomfortable quantities of data, and collaborating worldwide.*

- A billion collisions per second: how can we analyze them all?
- How much data is a billion particle collisions?
- Can we understand the data visually?
- How much software is needed to analyze data?
- Who writes it? What languages?
- Why do we have to simulate (billions of) collisions?
- What does the computing hardware for a large high-energy physics experiment cost?
- What sort of computers do we need?
- Is there anything new in the Grid?
- Can the Grid facilitate scientific discovery?

#### Questions Answered: Discoveries in Particle Physics



#### Questions?

#### DEEP AND FUNDAMENTAL MYSTERIES

*Modern Physics is confronted with deep mysteries about the character of matter, space and time.*

- Why is there almost no antimatter in the universe?
- What causes mass?
- What is dark matter and dark energy?
- The fate of the universe?
- Where do very high energy cosmic rays come from?
- Does quantum mechanics work for gravity?
- Do gravity waves exist?
- Do gravitons exist?
- What is a Higgs particle and will we ever find one?
- What are squarks, selectrons, photinos, higgsinos and gravitinos and does anyone need them?
- Why are there 6 types of quarks (we are made up of only two types)?
- Why is the top quark as heavy as a gold atom?
- What are neutrinos and do they have mass?
- Why can neutrinos pass through the earth?
- Could we calculate the nature of neutrons and protons from first principles? Why does it seem to be so difficult?

#### Questions?

#### MARVELOUS INSTRUMENTS

*The new generation of instruments will deliver data containing many of the answers to the mysteries. You may wonder...*

- Why are high-energy physics particle accelerators miles long?
- Why are some accelerators straight and some circular?
- Why do particle detector instruments often weigh over 10,000 tons?
- Why do particle detector instruments contain millions of sensitive channels?
- Who designs the detectors?
- Who builds the detectors? How long does it take?
- Who operates the detectors? How long does it go on?
- Can a collaboration of 2000 physicists from 100 countries achieve anything?
- How do we detect a neutrino?
- Why do we measure millions or billions of particle collisions? Why not measure a few very carefully?
- Why do we put telescopes in orbit?
- Why do we still bother using telescopes on the earth's surface?