

# Next generation colliders: Fixing inaccuracies

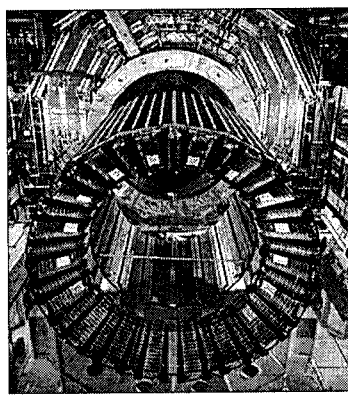
An Indian physicist's research on short-lived particles in colliders holds the key to future collider design

**VIVEK DESHPANDE**

THE complex web of high-energy particle physics has cast a spell on physicists across the world. They are busy looking at the “faster-than-light” journey of neutrinos starting from CERN, Geneva—home of the Large Hadron Collider (LHC)—as a gateway to the post-Einstein world of physics, and searching for possible solutions to the puzzle of an accelerating universe, a discovery honoured with the Nobel Prize this year.

Colliders like the LHC could throw light on startling phenomena, and more importantly, discover elusive particles like the Higgs-boson. To speed up these discoveries, particle physicists are already working on the next generation of electron-positron ( $e+e-$ ) or lepton colliders. An Indian physicist, Rohini Godbole, from the Indian Institute of Science, Bangalore, along with Manuel Drees, currently a pro-

fessor at the University of Bonn, has mathematically calculated that the complex interplay of particles inside  $e+e-$  colliders, like the future International Linear Collider (ILC) or the Compact Linear Collider (CLIC) under planning, leads to the creation of high-energy photons (the particle form of light) that in turn create particles such as protons and pions at a rate higher than predicted earlier. These particles can sully the clean atmosphere inside the collider; hence it is imperative to either prevent these particles from being born or to know exactly at what rate they are produced, so they could be taken into account while making precision measurements at future linear electron positron colliders. This observation is referred to by some as the Drees-Godbole Effect. The scientists arrived at this observation while studying theoretically the issue of interactions of high-energy photons for the electron-proton (ep) collider HERA in



**Large Hadron Collider**

Germany, and for  $e+e-$  colliders at CERN, Geneva, as well as KEK in Japan. It is now widely acknowledged that it is crucial to take into account this observation while designing future  $e+e-$  colliders.

Says Godbole: “Emission of photons is not a serious problem for the colliders built so far. But the ones that will come after the LHC will have to take the photon interaction factor into account at the design stage itself so as to be able to perform accurate physics studies. We hope that our case studies and approximation schemes will be useful in further optimising the designs for linear colliders.”

## WHAT ARE COLLIDERS?

The world of colliders is about 50 years old. Since the 1960s, various kinds of colliders have been built, including proton-proton, proton-anti proton, electron-proton and electron-positron. The LHC is an example of the first kind of collider whereas the soon-to-be-shut-down collider at Fermilab in the US is an example of the second. There is no running electron-proton collider now and only a few low-energy electron-positron colliders are around. Proton-proton and proton-anti proton colliders are good for large-energy field studies while the  $e+e-$  colliders are good for micro-level studies. All these colliders are circular. In a circular collider, the same bunch of particles circulates a million times, hence the particles bump into each other many times. In a linear collider, that chance gets drastically reduced as bunches meet only once

Godbole's work in high energy physics phenomenology over the last 30-odd years has been highly effective. She has published over 200 papers and has been instrumental in forming the ILC-India Forum for discussing the feasibility and the physics potential of the next generation of higher energy  $e+e-$  colliders