In the beginning, there was...Susanna

A profile of Susanna Guiducci, ILC damping ring group leader

Susanna Guiducci has her head in the clouds – electron clouds, that is. (Sometimes she sits in clouds that gather around the Frascati hills south of Rome where she is based at the INFN Laboratori Nazionali di Frascati or LNF, but that is not really relevant to this story – just very picturesque.) As new leader of the damping ring group, one of the key R&D projects in the ILC's Technical Design Phase, she also has her feet firmly planted in electron-positron accelerator physics and has been working on damping rings for ten years. All that experience gives her a clear picture of where the challenges lie in the ILC damping ring design, but she is confident: “I am convinced that the parameters set for the damping rings are feasible.”


Susanna Guiducci, damping ring group leader.

The ILC will need damping rings to guarantee a high rate of particle collisions and thus lots of interesting physics that scientists can then analyse. For a high collision rate, the bunches in which the electrons and positrons travel must follow each other closely and must be very compact – imagine you're making two clouds of water vapour and two water beams bump into each and compare how many water molecules actually hit each other in these two collisions and you get the idea. A damping ring compacts the beams as far as possible before it kicks them out into the main accelerator where they gain energy and collide at the centre.

But there's a catch. To compact the bunches in the damping ring wigglers are used, an array of magnets that forces the particles on a wiggly path so that they lose energy in the form of synchrotron radiation photons. These photons knock electrons out of the inner surface of the beam pipe; these electrons are accelerated by the positron bunches, knock out more electrons and in the end can form a cloud that disperses the bunch and destroys the damping effect. A team of more than 20 people from all around the world are trying to stop these clouds from forming in the first place, and Guiducci oversees them all.

A true Roman by birth, Guiducci studied particle physics in Rome and wrote part of her PhD thesis at DESY before she switched to accelerator physics. “Even though I did 'classical' studies – Latin and Greek – I always liked maths at school,” she says. Physics was a natural choice, and after her PhD she joined the Frascati lab of the Italian research organisation INFN to work on the former electron-positron collider ADONE. Since 1999 she has been working on DAFNE, an electron-positron collider with two storage rings and two straight sections where the particle collide at roughly one GeV, the energy of the phi meson, studies CP violation – the question why the universe is made of matter and not antimatter. Guiducci is less concerned with the phi mesons and more with the behaviour of the beams, the 'beam optics' and dynamics, in the storage rings. “I was very much involved in DAFNE from the very beginning,” she says. “I worked on the first proposal, the layout, the commissioning, running and upgrades.” Today she still has shifts for one week every couple of months running the tried and tested collider.

Her first contact with damping rings came in 1999 when she worked on the technical design report for TESLA, one of the projects from which the ILC emerged. Guiducci was at the very first ILC workshop at KEK in 2004, has worked on the Reference Design Report, now the Technical Design Report and is thus again involved from the very beginning. Before the Technical Design Report can be written in about three years, she sees a lot of R&D going into fast kickers and electron cloud mitigation techniques. At the CesrTA damping ring test facility at Cornell University, scientists are probing various techniques. "The problem, as always, is to get the best possible effect and keep the cost as low as possible at the same time,” says Guiducci. Teams are looking at special coating for the inner surface of the vacuum chambers that could stop electrons being knocked out by photons; other teams examine surfaces with grooves that could have the same effect. “We may find that we need antechambers for the dipoles where electron clouds are stopped,” she explains, “this may have an influence on the cost. There are many things we have to find out, but I am confident that we'll beat the electron cloud!”

-- Barbara Warmbein