IDEA detector Letter of Intent

IDEA (Innovative Detector for an Electron-positron Accelerator) is an innovative general-purpose detector concept, designed to study electron-positron collisions in a wide energy range provided by a very large circular leptonic collider, with a typical circumference of 100 km. IDEA is a hermetic detector, geometrically subdivided in a cylindrical barrel region, closed at the extremities by two endcaps, as can be seen in Figure 1.

The detector is composed of the following subdetectors, in order of increasing distance from the primary vertex: a central tracking system composed of a vertex detector made of silicon pixel and strip detectors, and a large drift chamber with a 2 m outer radius, providing more than 100 measurements along the track of every charged particle. The vertex detector measures tracks of charged particles with very high precision, of the order of 3 μm in the innermost layers, and is able to reconstruct secondary vertices, originating for example from decays of heavy flavor hadrons, with exquisite precision. The drift chamber also offers outstanding particle-identification performance using the cluster counting technology. The central tracker is then completed by a silicon wrapper, made of silicon detectors, that surrounds the drift chamber. The central tracker is surrounded by a large but thin and low-material-budget solenoidal magnet that provides a 2 T magnetic field. The solenoid is followed by the preshower detector. The preshower allows to identify and measure electromagnetic showers that originate in the material of the solenoid, before reaching the calorimeter. The preshower is constituted of a large array of a novel type of micro pattern gas detectors, the μ-RWELL. The preshower provides a space resolution for charged particles of about 60-70 μm. The preshower is followed by a dual-readout (DR) calorimeter. The DR calorimeter has the particularity of simultaneously measuring the electromagnetic and hadronic components of the showers originated in the calorimeter volume. The DR calorimeter uses 1 mm diameter alternate scintillating and Čerenkov fibers, read at the back end by SiPMs. The DR calorimeter provides an excellent energy resolution, of the order of 30%/ $\sqrt{E}$, on the measurement of hadronic jets. The electromagnetic energy resolution is of the order of 10%/ $\sqrt{E}$, while maintaining a high granularity needed to disentangle close-by shower pairs from neutral pion decays. The last subdetector is the muon detection system. The muon detector uses as well the μ-RWELL technology, like the preshower, but with a coarser strip pitch. It is subdivided in three stations at increasing distance from the vertex, located within the iron return yoke that closes the magnetic field. Each muon station can provide a space point with a spatial resolution of about 400 μm in the plane perpendicular to the particle direction. Combining the three stations allows to perform standalone tracking of charged particles at 5-6 m from the vertex. Such a precision also allows to identify secondary vertices that could be produced by long lived particles.

The IDEA detector concept has been considered by both the FCC-ee [1] collider, proposed to be built at CERN, and the CEPC [2] collider, proposed to be built in China. The IDEA detector is described in detail in both Conceptual Design Reports [1, 3].

The IDEA detector concept was initially proposed by researchers from CERN and many INFN sections (Bari, Bologna, Catania, Ferrara, Firenze, Lecce, LNF, Milano, Padova, Pavia, Pisa, Roma III and Torino). Now several foreign colleagues from many countries, like UK, France, Switzerland, Croatia, Russia, South Korea and China have decided to collaborate on various aspects of this detector concept.

Specific LoI's for parts of the IDEA detector have been submitted, in particular: cluster counting drift chamber (main contact Franco Grancagnolo), dual readout calorimeter (main contact (Roberto Ferrari) and chambers based on the μ-RWELL technology (main contact Paolo Giacomelli).

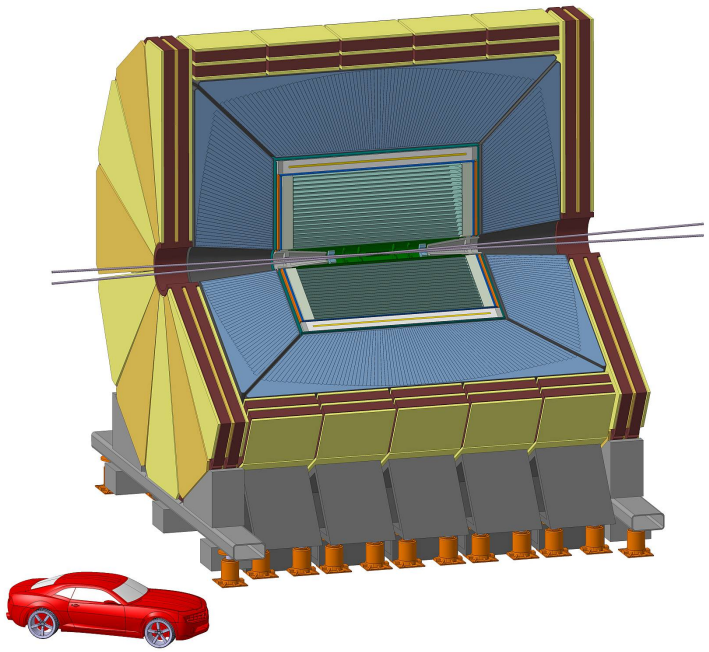

Figure 1: Drawing of the IDEA detector concept and its subdetectors.

Contacts

Some contacts for the general IDEA detector concept and specific hardware solutions are:

Franco Bedeschi, Massimo Caccia, Roberto Ferrari, Paolo Giacomelli, Franco Grancagnolo.

Contacts for the detector simulation and physics studies are:

Patrizia Azzi, Sylvie Braibant.

References

[1] M. Benedikt at al., *FCC-ee: The Lepton Collider : Future Circular Collider Conceptual Design Report Volume 2*, Eur. Phys. J. Spec. Top. **228** (2019) 261–623. 1

[2] The CEPC Study Group, *CEPC Conceptual Design Report, Volume I - Accelerator*, arXiv:1809.00285 [physics.acc-ph]. 1

[3] The CEPC Study Group, *CEPC Conceptual Design Report, Volume II - Physics and Detector*, arXiv:1811.10545 [physics.hep-ex]. 1