Contributions from (I)EKP



The Many Faces of a Particle

Contributions from (I)EKP •000000000 Manuel Kambeitz, Ivan Shvetsov, Michael Ziegler – What is a particle?

CMS



- Goal: Measure Higgs properties, search for physics beyond Standard Model and multiple other purposes
- Detect particles produced in proton-proton-collisions

How particles look like in a detector



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CMS



- Usual case: Measure properties of very short-lived particles
- Calculate their mass from decay products, for example $\mu^+\mu^-$

How particles look like in an analysis



BELLE



- Goals: B physics (CP violation, rare decays), charm physics
- Less energy, but much cleaner environment
- Allows different types of analyses than CMS

Comparison of typical events in CMS (left) and Belle (right)



KATRIN

Karbruhe Institute of Technology

- Goal: Measure mass of electron-neutrino
- Tritium decay releases $E_0 = 18552 \text{ eV}$ energy
- Energy is randomly distributed to all decay products
- In some cases, electron can get almost all of the energy



Neutrino mass becomes visible in these cases



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KATRIN



- Energy hard to measure:
- Let electrons fly against given electric field, and see how many arrive
- In principle binary decision, but in practice more information is needed

Detector for electrons with 148 pixels



KASCADE/AUGER



- Goal: Measure energy spectrum and composition of cosmic rays
- Array of surface detectors, radio detectors and fluorescence telescopes
- Cosmic rays interact with the atmosphere and produce showers of particles

Particles of a shower can hit several surface detectors



AMS



- Goal: Search for dark matter
- Dark matter: Unknown type of matter, we think that it must exist
- Particle detector in space, mounted on the ISS



EDELWEISS



- Goal: Direct search for dark matter
- Array of detectors made of germanium crystals
- Elastic scattering of dark matter with detector material

Scattering leads to "heat" and ionization



Conclusion



- Contributions from Karlsruhe to broad variety of experiments
- Today: Methods of particle physics very specialized
- Particles can look very different to different physicists