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## Estimate of neutrons event-by-event in the DREAM module

### Summary

Dual readout calorimetry has so far focussed on the large fluctuations in the electromagnetic content of hadronic showers ( $\sim 10\%$ ) which degrade the performance in several respects: poor energy resolution, a non-Gaussian response function, and a non-linear response with increasing hadron energy. The next largest fluctuation is the binding energy loss that is proportional to the MeV neutrons liberated in nuclear break-up.

These liberated neutrons have velocities about  $v \sim 0.05c$  and fill the volume of the module like a gas. We expect to find the neutron signal in the long-time tails of the plastic scintillating fibers which record the recoil protons in  $np \rightarrow np$  elastic scatters, through which the neutrons rapidly lose kinetic energy as  $\Delta E_n/E_n \approx 1/2$  per elastic scatter. The DREAM collaboration is seeking a means to attain the 'ultimate' calorimeter energy resolution, and a measurement of the neutron content shower-by-shower is one component of that goal.

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