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Development of muon radiography for a repetitional phenomenon

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The time resolution of dynamic muon radiography is limited by the angular resolution, the detection area, and the cosmic ray muon flux (=70 muons/m^2 sr sec). For example, if we employ an angular resolution of 30 mrad, we need a detection area of 3.9 m^2 to collect 100 muons in 8 hours for each bin. However, usually, such a large space is not available in an industrial plant system. In this work, we developed a new technique to dynamically image a high speed phenomenon using a detector with a more practical size. This technique can be applied to any repetitional phenomena by superimposing radiographs collected during different intervals of time. In the coarse of this work, we collected muon data every 10 minutes in order to analyze the internal density distribution of an electric furnace for different operating conditions. Here we report the results for (a) different electric load conditions, (b) different electric resistance conditions, and (c) for different production efficiencies. We clearly distinguished the difference in the spatial distribution of the melt objects inside the furnace between the daytime and the nighttime.