論文内容の要旨

Search for the Mini Black Hole in the Multijet Final State in pp Collisions at $\sqrt{s} = 7$ TeV

（重心系エネルギー 7TeV 陽子陽子衝突における
多ジェット終状態を用いたミニブラックホールの探索）

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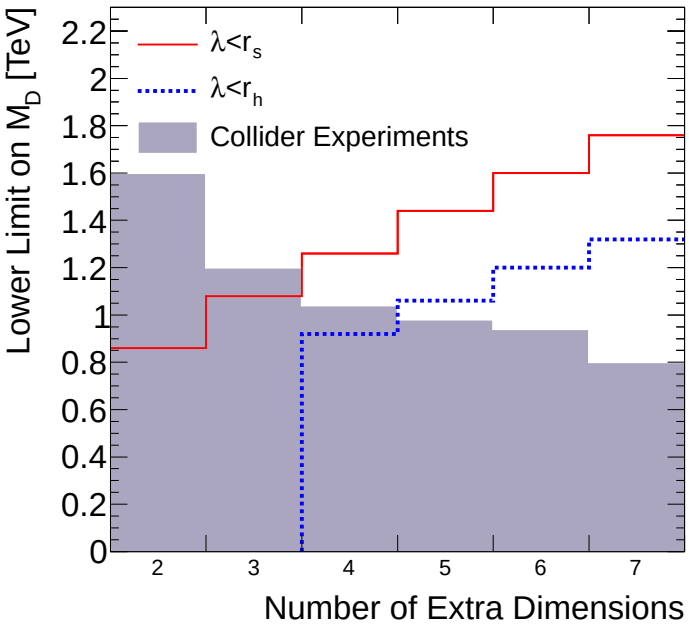
A mini black hole search is motivated by theories of extra dimensions. ADD model is one of extra dimensions theories in which all extra dimensions are compactified in cylinder shape. In the model, only gravitational field can propagate into additional n dimensions. Hence, the fundamental gravitational force is stronger than that measured in $3+1$ space-time dimensions. This could lead the fundamental Planck scale, M_D, of $O(1)$ TeV in $n+4$ dimensions, and solve the hierarchy problem where the Planck scale is vastly large compared with the electroweak scale. On the assumption of $M_D \sim O(1)$ TeV, mini black holes with masses of $O(1)$ TeV could be produced at the Large Hadron Collider (LHC) at CERN.

In this thesis, mini black holes were searched for in a multijet final state in proton-proton collisions at center of mass energy of 7 TeV, produced by LHC. The collision data collected by the ATLAS detector in 2010, corresponding to the integrated luminosity of $36.3\,\mathrm{pb}^{-1}$, were used in the search.

The mini black hole signals for $n = 2$ to 7 and $M_D = 0.8$ GeV to 2 TeV are searched for. For each n and M_D, the mass thresholds of the mini black holes were set by the assumptions that colliding particles collapse in a black hole if the Compton wavelength is equal to or less than the Schwarzschild radius or horizon radius. In case $M_D = 1$ TeV, the assumption with Schwarzschild (horizon) radius gives mass thresholds of about 2 (3) TeV to 4 (5) TeV for $n = 7$ to 2. Mini black holes are decaied

mainly by the Hawking radiation. The model of no graviton emission is used for the decay of mini black holes. The burst model, in which mini black hole decay into multi-body, is adopted for the Planck Phase when the mass of mini black holes become smaller than the Planck Scale.

Observed events are consistent with Standard Model predictions and upper limits on the mini black hole production cross sections are set. This result can be interpreted to the lower limits on M_D for each n by comparing with theoretical cross sections as below figure.



In the figure, 95% CL lower limits on M_D are shown as a function of number of extra dimensions. A solid (dashed) line is the result on the assumption with the Schwarzschild (horizon) radius. A filled histogram shows the lower limit by the previous collider experiments. On the assumption using Schwarzschild (horizon) radius, a lower limit on M_D for $n = 4$ (5) is placed as

$$M_D > 1.26\,(1.06)\ \text{TeV},$$

at 95 % confidence level, which is the most stringent limit obtained by the collider experiments.