# SOME REMARKS ON EQUIVALENCE PRINCIPLES

by

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The experiment of Baron Roland v. Eötvös on the equivalence of intertial and gravitational mass was more than just an inprovement by one or two orders of magnitude in a result already known to be true. His result constitutes one of the primary pillars upon which general relativity rests. His result, that with an accuracy of better than 1 part in $10^8$ the gravitational acceleration of a body is independent of the structure of the body, is a necessary condition to be satisfied if the formalism of general relativity is valid.

The experiment of Eötvös is sometimes called an experiment on the equivalence principle. It is necessary to remark, however, that the direct test of the equivalence principle represented by the Eötvös experiment is a test of a limited form of equivalence principle, a form which I have called the "weak principle of equivalence". Einstein's theory is based on the "strong equivalence principle". This principle states that, neglecting effects due to gravitational gradients, the laws of physics seen in a freely falling non-rotating laboratory are the same, including all their numerical content, independent of the position and velocity of the laboratory. It is interesting that Eötvös's experiment is capable of supplying valuable information about the strong equivalence principle in addition to the weak one. Thus, using the results of the modern version of his experiment carried out recently at Princeton, an experiment which gave an equivalence of inertial and gravitational mass with an accuracy of 1 part in $10^{11}$, it has been possible to conclude that certain parts of the numerical content of physical laws are indeed constant. Thus most of the dimensionless numbers encountered in physics, such as ratios of intertial masses, and the coupling constants for the electromagnetic and nuclear forces, are constant, that is independent of the position of the laboratory. It has not been possible from the experiment to conclude that the gravitational coupling "constant" is constant or that the $\beta$ decay coupling "constant" is fixed. However, it is interesting and remarkable that this one experiment is capable of supporting such a large part of the strong equivalences principle.

I wish to express my regrets at being unable to be present at the conference and wish you and the whole conference a very informative and productive session in honour of Baron Roland v. Eötvös.