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(SUMMARIES)

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SINGULARITIES IN GENERAL RELATIVITY

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Although gravity is the weakest known interaction it has the advantage over strong and weak nuclear forces of being long range and over electromagnetism of being always attractive. This latter property arises because the local energy density of matter is always positive. For a large body the gravitational forces all add up and can dominate over all other forces. Since gravity also affects light, one can have a sufficient concentration of matter in a region of space so that no light can escape. This kind of situation can be characterized by the existence of a closed trapped surface (1). This is a closed spacelike 2-surface such that both the ingoing and outgoing light rays orthogonal to it are converging. Because nothing can travel faster than light, the matter inside the trapped surface is trapped within a region of smaller and smaller boundary, and so something must go wrong. In fact one can show that a singularity must occur (2). Singularities will occur in collapsing stars and at the beginning of the present expansion phase of the universe. These latter singularities are in principle visible to us.

What the singularity theorems indicate is that gravitational fields will become so strong that quantum effects will become important and the classical theory will break down.

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