# Handout 3: Lecture 5.1, Section 5.1.3

You may remember that I made a sign error in Lecture 5.1. This is the correct version of Section 5.1.3 from my notes

5.1.3 Potn energy

$m_2$ moves from A to B [falls under gravity]

$W$ = work done by grav.

$$= \int_A^B \left( -\frac{Gm_1m_2}{r^2}\hat{r} \right) \cdot d\underline{l} \qquad \hat{r}\,dr$$

$$= -Gm_1m_2 \int_{r_1}^{r_2} \frac{dr}{r^2}$$

$$= -Gm_1m_2 \left[ -\frac{1}{r} \right]_{r_1}^{r_2} = Gm_1m_2 \left( \frac{1}{r_2} - \frac{1}{r_1} \right)$$

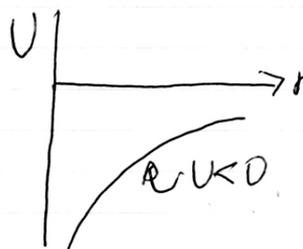$r_1 \to \infty, \; r_2 \to r: \quad W = Gm_1m_2 \left( \frac{1}{r} - \frac{1}{\infty} \right)$

Grav is consrv: $3.3.3.1 \to \Delta U = -W$

$\qquad\qquad\qquad \underset{\substack{\quad\; U(r_2)-U(r_1) \\ \; \downarrow_r \qquad \downarrow_\infty}}{\downarrow}$

Define $U(r=\infty) = 0$
[Could define $U=0$ somewhere else]

ie $\boxed{U(r) = -\frac{Gm_1m_2}{r}}$ 5.1.3.1

$U$ vs $r$ graph, $U < 0$

Wolfgang Pauli once attended a lecture in which a long mathematical derivation concluded with the answer having the wrong sign. "I must have made a mistake" remarked the speaker, whereupon Pauli was heard to say "An odd number of mistakes, more likely."