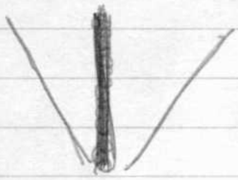
Bondi



Initial conds. on opening light cone do not fully define the system.

System defined through $c_0(u,\vartheta)$ News Fn.

Not straightforward $\because$ of cons. laws & necessary

Space flat suff. far away. completeness of description, involving all matter, stress, energy.

Like edynamics. Waves ~ $1/r$ amp. Static etc $1/r^3$

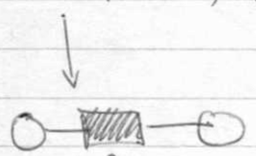
Energy of source msd. by mass — but difficulty that the identification of the mass field in the dynamical sol. is not unique. Easy in static case, but in the dynamic one we must find a new defn.

Given a defn. → static one in limit, $m_0 = -\frac{1}{2}\int_0^{\pi} c_0^2 \sin\vartheta \, d\vartheta$.

So much for Tx. How about Rx?

Large Rx → sphere surrounding syst.

Small Rx → small body that will fall in the field.



↑ pushes spheres in & out.

Different accns. on spheres.

"Tidal forces" are $f(t)$.

Box moves spheres s.t. max energy absorbed as the wave passes.

≡ E/magn. Rx

Complic. is that Rx can gain partly from mass loss, not just radn.

Large Rx, Gravitationally black shell. Only outward waves received.

Someone outside shell does not perceive changes.

Difficulties.

"Static" & "radiating" not exhaustive. $\exists f(t)$ sols not radiative. No news.

These are the states into which the system will relapse. Initial cond. then is puzzling.

What motions of source → what external motions?

Non-radiative if motions unaccelerated, cf. edyn. But acc. cannot be defined locally (Free fall seems unaccelerated locally). Perhaps motions + waves are free motions.

Obsn? Grav. radn. of solar system ~ $1\frac{1}{2}$ kw. Not exactly detectable.

Largely practically insignificant. May be astrophysical.

Quantisation? Why? Because it's there!

Should not be capable by grav. to upset Unc. Princ.

Note — only need quantisation where wave fields occur. (Coulomb field need not be q.)

Extra degrees of freedom only need be attacked.

Field eqns. of relativity only used, note, in case $R_{\mu\nu}=0$.

Not dept. on the Einstein eqns generally.

Large gravl. phenomena?

Does not require large local field strengths.

$$ds^2 = \left(1 - \frac{2m}{r}\right) dt^2 + \text{—}$$

$\downarrow$

Grav. red shift. Trouble if ( ) goes -ve! Grav redshift $\to \infty$.

Newtonian pote $= \frac{1}{2}$ $\to$ the critical. No info gets past $\phi \sim \frac{1}{2}$.

Want an $m$ with only a small $r$.

Gravl. field without a source (ie. undiscoverable source).

Theory would struggle if we could have field effectively without sources.

Consider sphere contracting without mass loss.

It gets redder & redder & the clock on it gets slower & slower.

$\infty$ time taken for collapse as seen from outside.

Can never develop these things. If none @ $t=0$, none never ever.

$\downarrow$

Not v. satisfactory.

What would sphere have to be like to get $m > \frac{1}{2} r$.

Not N high $\rho$. $\rho \sim 1/m^2$ if $m = \frac{1}{2} r$. eq. $3\times 10^9 M_\odot$, air @ gaseous $\rho$'s.

To formicate highest $\phi$ @ a surface - sphere. $\exists$ surf. s.t. we need $\rho_{min}$ inside, & $\rho_{max}$ outside.

$\frac{m}{r}$ cannot be $> 0.485$. — $= 6\sqrt{2} - 8$ if $\rho_{min} \geq 0$, $\rho_{max} = \infty$.

Even if $\rho_{min}$ -ve allowed cannot quite get to $\frac{1}{2}$.

If $\rho \geq 3p$ N, cannot exceed $\phi$ 0.352

$\rho \geq p$ 0.432

Suppose $\rho$ must decrease going outside, $\therefore$ cannot get $\phi > 0.32$.

Cannot find anything from which we could get to $\frac{1}{2}$.

Only way is perhaps high tensions.

Static spheres seem to be immune from this $\frac{1}{2}$ trouble.

Contracting spheres not so obvious.

In G.R. we find that need an unlimitedly vicious $p(\rho)$ relation to hold it.

Newtonian wants $p \sim \rho^{4/3}$. Degenerate rel. $\beta$'s have this $\to$ s/novae.

Quasars. May be linked with the field eqns for matter.