Quantum Gravity 166.3: Comparing dy/dt = ky and y = exp(kt) As Linear vs Exponential

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From Osher Doctorow

Now let's look at the special subtype of the Riccati Differential Equation:

1) dy/dt = A(t) + B(t)y + C(t)y^2

in which B(t) = k and A(t) = C(t) = 0, which is exponential growth/ expansion/contraction:

2) dy/dt = ky

The solution is:

3) y = y(0)exp(kt)

Does anybody notice that (2) "looks" linear in some sense? Actually, regarding dy/dt as a differential operator Dt(y) operating on y, there is a linearity in the good old functional sense:

4) Dt(y) = ky

Now, a bounded linear operator or bounded linear transformation T has the properties:

5) T(x + y) = T(x) + T(y), T(kx) = kT(x), ||T(x)|| < = k1 ||x||

for some nonnegative real constant k1 and all x, y in appropriate vector spaces over a field (typically real or complex, but this can be generalized). So if T(y) = Dt(y) = ky as in (4), then if this holds for all appropriate y and x, (5) seems to be correct with a wide variety of norms ||x||, k1 = k.

But the Operator T or Dt is (Probable) Causation approximately, or rather Birkhoff (derivative) Causation which approximates Probable Causation/Influence (PI).

So for Exponential Growth/expansion/contraction, Cause (t) and Effect (y) are to each other as Linearity is to Exponentiation.

We already saw last time that exp(x) or exp(t) and 1 + x or 1 + t respectively are in the same relationship in a sense as that of Cause and Effect in the last sentence.

There is a strange mixture of linear, exponential, Cause, and Effect relationships here, into which from last time finite versus infinite and identical versus orthogonal arguably enter together with equality versus oppositeness and even interchange of space and time (reminiscent, for example, of black holes).

To try to piece together how they relate, look at the curve y = exp(t) and then look at the time point t and then look at the spatial curve y (say, a one−dimensional space coordinate) = kt and then look at the spatial point y. Try to visualize time point t and space point y as single points (separately or together), say to and yo or t1 and y1, etc. Then try to visualize the entire curves y = kt and y = exp(kt) or y = exp(t) as wholes by looking at them "globally" ("seeing all the points at once, at least in a large finite area or length or volume").

What you are doing in terms of Knowledge ("semantic information" without obsession on syntax) is obtaining Knowledge about whole curves or curve segments versus single points, and shifting from one to the other. And if you can do it, then a hypothetical Observer should be able to do it too.

So the Universe very close to the Big Bang should have not only been able to "visualize" a Singularity as a single pointlike or linelike limit, but Infinity in the "opposite" direction! And a Singularity, including a black hole, is not only a Singularity but an Infinity! The infinite tidal force, far from being an embarrassment to physics, is the "other side" of physics, and indicates the extreme importance of Force rather than just Energy or Momentum in the real world. And time and space are not just different directions or different points but opposites with regard to infinity versus finiteness and Observers and Causation.

Osher Doctorow

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