Refutation of Poincaré recurrence theorem

This paper began by reading a physics paper, subsequently published in *Science* (2018):

> Rauer, B. (brauer@ati.ac.at); Erne, S.; Schweigler, T.; Cataldini, F.; Tajik, M.; Schmiedmayer, J. (schmiedmayer@atomchip.org. (2017). Recurrences in an isolated quantum many-body system. arxiv.org/pdf/1705.08231.pdf.

wherein:

> "Half way to this full recurrence the system rephases to the mirrored initial state. As we initially start from a nearly flat relative phase profile and our observable C is insensitive to the transformation $\varphi(z) \rightarrow \varphi(-z)$ this point is equivalent to the full recurrence." (1.1)

To evaluate Eq. 1.1 we assume the Meth8/VŁ4 apparatus and method with the designated *proof* value of `T` tautologous. Other values are: `F` contradiction; `N` truthity; `C` falsity. The 16-valued truth table results are row-major and presented horizontally.

LET p q: φ lc_phi; z;
~ Not; > Imply, greater than; = Equivalent to; @ Not Equivalent to; - Not Or.

(p&q)>(p&~q) ; `TTTF TTTF TTTF TTTF` (1.2)

Eq. 1.2 as rendered is *not* tautologous. Eq. 1.1 on its face reads phi-z implies phi-not-z, or alternatively phi-z as potentially true implies something false as phi-not-z. Of course, that is mistaken because truthity may not imply falsity.

This led us to look at the basis of the captioned paper, which from paragraph one relies on the recurrence theorem of Poincaré and Zermillo. (We previously showed elsewhere that ZMC set theory is *not* tautologous, except for the trivial axiom of specification, so we evaluate the former author).

From: planetmath.org/proofofpoincarerecurrencetheorem1

$\mu(E\text{-}A_n) \leq \mu(A_0\text{-}A_n) = \mu(A_0)\text{-}\mu(A_n) = 0.$ (2.1)

LET p q r s: μ lc_mu, E, A_n A-sub-n, A_0 A-sub-zero;
% possibility, existential for one or some; # necessity, universal for all; ~(p>q) (p≤q);
(p@p) logical 00; (%p>#p)-(%p>#p) numerical zero, as one minus one.

Using the main connective in Eq. 2.1 as equivalent to and the logical 00,
(~((p&(q-r))>(p&(s-r))) = ((p&s)-(p&r))) = (p@p) ; `TTTT TFTF TTTF TFTF` (2.2.1)

Eq. 2.2.1 as rendered is *not* tautologous. This refutes the Poincaré recurrence theorem.

We modify Eq. 2.2.1 by *changing* the first Equivalent to into the Imply connective.

~((p&(q-r))>(p&(s-r))) > (((p&s)-(p&r)) = (p@p)) ; `TTTT TTTT TTTT TTTT` (2.2.2)

Eq. 2.2.2 is tautologous.

We modify Eq.2.2.2 by *changing* the logical 00 into a numeric zero, as one minus one.

~((p&(q-r))>(p&(s-r))) > (((p&s)-(p&r)) = ((%p>#p)-(%p>#p))) ;
TTTT TNTT TTTT TTTT (2.2.3)

Eq. 2.2.3 is *not* tautologous, diverging by one value N for truthity as Non-contingent.

Next, we modify Eq.2.2.2 again by *changing* the second Equivalent to into the Imply connective.

~((p&(q-r))>(p&(s-r))) > (((p&s)-(p&r)) > (p@p)) ; TTTT TTTT TTTT TTTT (2.2.4)

Eq. 2.2.4 is tautologous.

Finally, we modify Eq.2.2.3 by *changing* the second Equivalent to into the Imply connective.

~((p&(q-r))>(p&(s-r))) > (((p&s)-(p&r)) > ((%p>#p)-(%p>#p))) ;
TTTT TTTT TTTT TTTT (2.2.5)

Eq. 2.2.5 is tautologous.

What the *change* modifications of Eqs. 2.2.2-2.2.5 as rendered demonstrate is that the formula to prove Eq. 2.1 can only be coerced into a proof by using the Imply connective instead of the Equivalent to connective.

Remark: Eq. 2.2.3, using a numeric zero, shows a finer level of proof value and contradicts Eq. 2.2.2 using a logical zero.

What follows is that the Poincaré recurrence theorem as a starting point for quantum theory and quantum physics is suspicious.

We then ask how the experimental results of the captioned paper can be reconciled with the refuted Poincaré recurrence theorem. We reply that assuming the physical experiment cannot be falsified (such as by probabilistic objections), then the experimental results are obviously misinterpreted into a mistaken conclusion.