Comments on Penrose's "Conformal Cyclic Cosmology"

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I. **A Personal Preamble**

· **I would like to begin with a Mea Culpa - my mistake for putting myself up for this talk on Penrose's Cosmology, (CCC).**

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· **I am not a cosmologist and know very little of contemporary cosmology. In 1956 I wrote 2 papers on the theory of measuring distance in Cosmology. In 2010, I wrote a third paper on Lorentz transforming the CMB radiation field. The reason for my talking today is my belief that the Penrose theory deserves to be made familiar to cosmology community and that I probably know more about it than anyone else in Pittsburgh - though I am NOT an expert. And I have no personal stake in the theory.**

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· **Though I am not a cosmologist, I, however, was interested and did follow cosmology closely for many years - I even remember back when time scales were such that globular clusters were older than the universe.**

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· **But I gave it all up and lost almost all interest in cosmology with the advent of the inflationary scenario. It struck me then and remains my belief, that it is very reminiscent of epicycles.**

· **Why that reaction?**

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· **From graduate school on I wanted to understand the physics of the big bang itself - what was it? Was there anything "before" and if so what was it?**
AND If nothing, how could something suddenly happen?

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· **Robert Jastrow once called me on the phone and asked me if I did not agree with him that the big bang was proof of the existence of GOD. I am afraid that I did not agree with him.**

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· **I was not and am not interested in understanding how a reasonably smooth universe**

could be made smoother by inflation without first addressing the issue of the physics of the **Big Bang**.

Where did that reasonably smooth universe come from?

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Solving a problem that I did not see as a problem, did not interest me.

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II. · Then about 3 years ago my close friend Roger Penrose produced a physical theory of the Big Bang. It is the least radical departure from standard physical theory, to describe the Big Bang that I am aware of. It changes the metric theory of GR into a conformal geometry theory. It does not need things like extra dimensions, of colliding branes or extra universes.

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· Though not perfect - it does have weak points (several things must be taken on faith) - it nevertheless is a relatively complete dynamic theory (with purely classical evolution equations) for "going thru the big bang". It is based on conformally rescaling the metric - thereby avoiding the big bang singularity - with dynamic equations for the needed conformal factors. It predicts the cyclic repeat of this process in about 10^100 years - i.e., a sequence of "aeons".

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· An important part of the logic or development of the theory involves the Second Law of Thermodynamics via the suppression of gravitational degrees of freedom at the time of the Big Bang - i.e., a low entropy beginning and then the loss of entropy, finally via black hole evaporation.

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· The theory makes rather precise predictions for the existence of observable phenomena.

III. A few words about prediction and observation.

The theory predicts the existence of families of concentric circles (up to 3 or 4 or more) of low variance (temperature) in the CMB background. These circles are to be understood as the relics of violent events (collisions of galactic black holes) from the previous aeon. Each individual family of concentric circles arises fromgalactic black hole collisions within a given galaxy cluster.

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· **In the search through the WMAP data, a large number of such families were found, 352 families of three or more concentric rings and 56 families with four or more concentric rings.**

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· **The physical relevance of these observations was quickly & sharply challenged. By 'sharply' I mean both 'seriously' and 'nastily' - with frequent insults directed against the two principle authors - Penrose and Gurzadyan. The basic complaint was that by looking at simulations of the WMAP data (constructed by using the observed power spectrum), one could find virtually any small scale structures just by chance - and hence, (again by chance) that the Penrose-Gurzadyan low variance rings were statistical artifacts. The authors strongly disagreed and defended their analysis of the data.**

As the issues were subtle and difficult, it was hard for "outsiders" and non-specialists to understand.

IV. New Developments

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In the last few months the situation has changed by two independent developments.

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· **(1) Two months ago I was in Warsaw Poland - with Penrose - when a Polish group headed by an old friend and collaborator of mine - a rather brilliant mathematician - announced after a year of investigation, that, basically, they had confirmed the Penrose-Gurzadyan analysis and conclusions concerning the reality of the ring structures. They worked in all three frequency bands and used over 100 different simulations.**

My own relevance to this work was that early on they had told me that they were totally skeptical of the Penrose claims - and initially they saw all sorts of structures hidden in the WMAP data and simulations - but as they refined their analysis, these structures disappeared. They would not communicate with me until they were finished and became firmly convinced of their results. I would have liked to say that after I had read their finished paper that I had found it convincing - unfortunately there was much in the paper that was technically above my head. Nevertheless, from knowing one of the authors very well and talking to all them - with Penrose - I felt that their work must be taken seriously. Incidentally Penrose was unaware of their work until that meeting in Warsaw.

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· **(2) Last week I received a first draft of a new paper by Penrose and Gurzadyan. Their strategy and analysis has changed.**

Instead of comparing their observations of the circle families with simulations, they simply took just the WMAP data - in all three bands - and looked - in that data - for **concentric families of ellipses** with **varying eccentricities. As their search departed from circles, the number of these families quickly dropped to virtually zero.**

They take this to be an excellent confirmation of their claims.

V. Further Comments & Conclusion

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· **a. I mention again that the CCC is a detailed mathematical theory - largely GR - that takes one smoothly thru the Big Bang. The details are not easy - they do not lie lightly in default knowledge.**

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· **b. I am not telling you that I believe that - in some sense - it is the correct theory of the Big Bang. I am saying that it is (in my judgment) the best theory I am familiar with - far better than the EKPYROTIC universe with colliding branes in 11 and a half or so dimensions or MULTIVERSES. If the data analysis holds up, I would hope that it becomes the default theory.**

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· **c. I have known - and worked with - Roger Penrose for close to 50 years. To me, he is - by far - the most original and creative physicist I have known. And in addition, he is both fearless and honest. And he is extraordinarily careful on what he claims.**
Of course he can be wrong (I have seen it, but not often) - and, of course, he might be wrong in this case.
But I feel it is a serious error to lightly dismiss his ideas - as some do.

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THANK YOU

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References

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K Meissner, P Nurowski, B Ruszczycki
[astro-ph], arXiv:1207.2498v1, July 2012

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2. **Evidence for CCC-predicted concentric low variance circles in the CMB sky**
V.G. Gurzadyan and R. Penrose
finished - going ??? probably arXiv and PRL