

RESEARCH WITH FRED

A small memoir about his response to a discovery that has turned out to have important relevance to cosmology and cosmogony.

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Pasadena 1971

The phone rang in my office at Santa Barbara St.

”This is Fred Hoyle calling from the Cal Tech campus. Can I come up and see some of your pictures of connected objects of different redshifts?”

I was thrilled that a person of such eminence would come to see my observations. As he sat across the desk from me he pushed his glasses up on his forehead and brought the glass plate almost touching his face, I started to explain the features of the image but he immediately said:

”No, don’t tell me anything I just want to look.”

I sat for a long time in silence while he looked at a smaller galaxy attached to one of much lower redshift. Finally he gave me back the plate without saying anything, thanked me, got up and left.

Seattle 1972

The American Astronomical Society had scheduled Fred Hoyle to give its prestigious Russell Lecture in the spring of 1972. I did not know what it would contain but I was looking forward to hearing his assessment of the state of astronomical theory. I myself gave a short observational paper in the general session, the last paragraph of which summarized the empirical conclusions and is reproduced below.

I present the paper heading and the last paragraph as it appeared in the Society (BAAS) publication. I see that I had somehow gotten the idea from Fred that particle masses growing with time could explain my evidence that the intrinsic redshift of young objects was high and then diminished as they aged. I do not remember discussing this with him but then I would not even remember the events of that meeting if it were not for an incident which happened after his talk.

05.01.10 Morphology and Redshifts of Galaxies. HALTON ARP,
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—————-three paragraphs omitted—————

The present observations are used inductively to conclude that the compact objects originate in the nuclei of large galaxies where the physical conditions approach singular values and that their excess redshifts are related to their young age as measured from this event. In my opinion, of the kind of explanations that the current observations require, one of the simplest is one along the lines of Hoyle's suggestion that electrons and other atomic constituents can be created with initially smaller mass. Then smaller $h\nu$ emissions result from a given atomic transition, and radiation from all objects in the new galaxy is shifted to the red. As the galaxy ages, its atomic parameters asymptotically approach that of older matter.

On the opposite page I reproduce the title page of Fred's Russell Lecture. I think the juxtaposition on facing pages of the observational conclusions compared to the theoretical analysis *given at the same AAS meeting* emphasizes the critical nature of the moment. It seems even more critical now, looking back on it and considering the importance accorded the Russell lecture. I had no idea what the Lecture would contain but clearly I sensed it would be of importance in attempting to get the observations of discordant redshifts seriously considered by a larger number of astronomers. There is even the amusing irony that the "Developing Crisis in Astronomy" was "Supported in part by the National Science Foundation".

THE DEVELOPING CRISIS IN ASTRONOMY*

FRED HOYLE

Institute of Theoretical Astronomy, Cambridge, England

and

California Institute of Technology, Pasadena, California

Henry Norris Russell Lecture

Presented at

The Seattle Meeting of the American Astronomical Society

April 8-12, 1972

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The Lecture

I was enthralled at Fred's presentation. He opened by saying,

"It is sometimes said that nothing is known from astronomy which goes outside the range of currently known physics . . . if one accepts . . . the origin of the universe at some moment of time . . . then it is this phenomenon of "origin" which lies outside currently-known physics."

Following this shot across the bows he went on to say ". . . $t = 0$ represents a discontinuity not an origin . . . The emergence of a discontinuity suggests a quantum transition . . . Physical systems cease to be classical when the action becomes small, as it certainly does near $t = 0$ because all masses are zero at $t = 0$." There was the key I had been waiting for. And in the mathematical equations he presented he derived a Hubble law solely from a non-velocity, particle mass growth as a function of t^2 .

He continued, "Under conditions of weak local gravitational fields particle masses are dominated by . . . distant interactions." Ah, Machian not Einsteinian physics. On the other hand Hoyle pointed out ". . . particle masses within [dense] aggregates arise only from internal interactions" which led him to remark, ". . . I have little faith in the usual treatment of the "black hole" problem.

Then came the part that electrified me - after showing how the particle masses as a function of cosmic time could be related by strict mathematical transformations to the usual cosmological models - he then said, "*This concept appears necessary if we are to understand the result reported by Arp for the galaxy NGC 7603 and its appendage.*" So I finally knew, *that* is what he had concluded when he silently returned the plate of this object to my desk!

After his talk we were standing outside the lecture room discussing the relation of the observations to what he had said when we were approached by one of the leading astronomers of the day, Martin Schwarzschild. Martin stood there looking up at us and, in his inimitable way, slowly contorting his expression in an effort to say something of evident importance. Finally he blurted out,

"You are both crazy"

I was startled, but flattered to be linked together with Fred. Fred just looked blank. It is interesting for me to reflect that this is the incident that remained foremost in my memory. It was only after recalling it, that I then made an effort to remember, and, rereading material of that time, I was able to recall all the further details that I am now reporting.

Publication Problems with the Russell Lecture

The tradition had always been for the Astrophysical Journal to routinely publish the Russell Prize Lecture. So Fred sent his manuscript in shortly after the meeting. To everyone's utter amazement, sometime later he received a referee's report from the editor! Fred was angry and simply never replied to the editor. When I asked where the paper would appear he merely indicated that he was interested in other matters.

About that time a debate on the reality of discordant redshifts had been organized in Washington D.C. by the American Association for the Advancement of Science. I was asked to represent the affirmative side and a leading conventional advocate was sought unsuccessfully among many candidates for the opposing side. Finally John Bahcall seized

the opportunity to defend the status quo. The debate was published in a book titled "The Redshift Controversy" (Frontiers in Physics, W.A. Benjamin Inc. 1973, ed. George Field). Both sides of the debate were invited to republish papers that supported their side of the argument. I suddenly realized that here was an opportunity to get Fred's Russell lecture published. He consented. The title page of his lecture as published in the book is reproduced here. The Lecture is reproduced in the book just as Fred had submitted it to the ApJ but which was never published there. I would urge all people interested in the history of this subject to read the paper and realize at the same time that this seminal paper would never have been available in published form if it had not been for the above, fortunate happenstance.

Subsequent Developments

In his Russell Lecture Fred already mentioned how the association of quasars with low redshift, active galaxies had made it improbable at the much less than 10^{-5} level that their apparent physical association was accidental. Jayant Narlikar, a former Hoyle student, made an elegant solution of the field equations with particle masses variable with time which showed how the discordant redshifts could be physically understood (Narlikar 1977) - completely in the spirit of Hoyle's Russell Lecture . In the following years detailed evidence has built up demonstrating how quasars are ejected from active galaxies and how their redshifts evolve from high to low with cosmic time. (see for example Narlikar and Arp 1993 and Arp 1998.) (Recent reviews of new evidence may be referenced also in Hoyle, Burbidge and Narlikar 2000; Arp, Burbidge, E., Chu et al. 2002.)

But the climaxing observation appeared in year 2002. How exceedingly ironic that 30 years after Fred Hoyle pointed to NGC 7603 as a crucial system which must force our acceptance of the existence of discordant redshifts - after a generation has passed - the luminous link between this active Seyfert and its appendage is observed to have two high redshift, quasar-like objects in it.

Two young spanish astronomers with the modest aperture Nordic Optical Telescope on La Palma took spectra of the two knots imbedded in the optical filament which joins the $cz = 8,000$ km/sec Seyfert with the 16,000 km/sec companion galaxy. They found compact, emission line objects with redshifts of $z = .243$ and $z = .391$. (López-Corredoira and Gutiérrez 2002). Their results are summarized here in Fig. 1.

Unfortunately it will come as no surprise to researchers in this field to learn that despite a probability of less than 8×10^{-10} of being accidental this decisive observation with fundamental consequences was rejected by Nature and by the Astrophysical Journal and has only now appeared in Astronomy and Astrophysics.

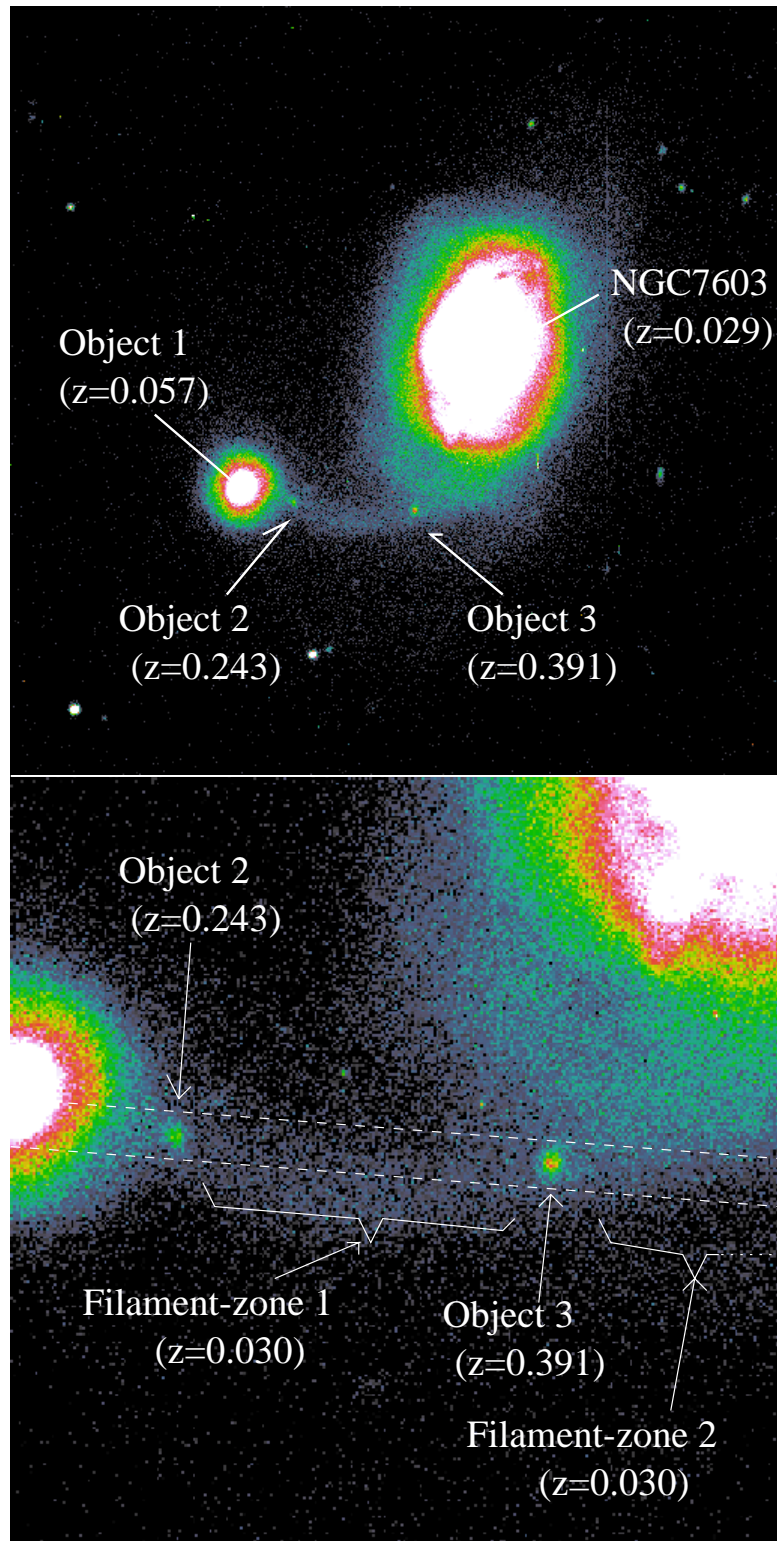


Figure 0.1: The main galaxy, NGC 7603 is an active, X-ray bright Seyfert with a redshift of 8,000 km/sec. The companion is smaller with a redshift of 16,000 km/sec and a bright rim where the filament from the Seyfert enters it. The recent measures indicate the filament is drawn out of the low redshift parent and contains the two emission line, high redshift, quasar like objects. From López-Corredoira and Gutiérrez 2002.

An even more recent discovery supports this kind of ejection origin for quasars. The large, X-ray and hydrogen ejecting galaxy NGC 3628, has been shown to contain *two quasars of $z = .995$ and $z = 2.15$ in an X-ray filament which emerges directly from the nucleus of the galaxy.* (See Arp, Burbidge, E.M. Chu et al. 2002.)

What have we done to Science?

During the years I visited with Fred from time to time to show him the newest observational results which were struggling to get published. He would instantly size up the results and say something like, "Well chip, they will certainly have to admit now that their assumptions are wrong." After a while we both knew that it would not be accepted in the foreseeable future. He never dwelt on the lost effort, money or the dismal state of the science. He was always trying to think ahead to the next insight, the next synthesis of physics. It will always be a pleasure and inspiration however to look back and read his clear, courageous logic and also sad to think how far ahead we might be now if more people had joined in the discovery of new understandings instead of insisting on complexifying and patching up their commitment to old dogma. I can still hear him saying, "They defend the old theories by complicating things to the point of incomprehensibility."

We should have crossed over that bridge to a more correct physics that Fred pointed to so clearly more than three decades ago.

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