John Moffat… with provocative ideas

by Eniko Madarassy

"*When you start to change physics on a fundamental level, when you start to change Einstein's theory, you're changing our whole understanding of space-time"*
–John Moffat

With my second article in the Postgraduate Magazine, I would like to continue a tradition of presenting scientists with different backgrounds. In the history of science, we find that new results were reached in two ways. The first one is a step by step process, while the second one is pioneering a totally new path.

In a conservative environment such as the physics community, introducing new, provocative ideas is not easy. An example – is the suggestion that the speed of light has changed over cosmological time scales.

In the early 1990s, Moffat suggested that the speed of light was 10^30 times greater in the early Universe (shortly after the Big Bang) than today.

I met Prof. John Moffat at the Department of Mathematical Sciences, Science Laboratories - Durham University, on 29th February, 2007. He made an agreeable impression as a person who is consistent and very precisely follows logical-guiding principles.

John Moffat is Professor Emeritus of physics at the University of Toronto and a talented amateur painter. He began his physics careeer as a youth in Copenhagen, self-educating himself as he took advantage of a library that was open to the public.
When he was about twenty, he started a correspondence with Albert Einstein. Moffat wrote to him about his studies concerning Einstein's Unified Field Theory.
"*Dear Professor,*
I would be eternally indebted if you could find time to read my work…"
In 1953, Einstein replied and a conversation between them began. In Copenhagen, Niels Bohr learned about this correspondence from the local press and became interested.

In 1958, Moffat received his PhD from the University of Cambridge. He became the only Trinity College student who was awarded a PhD without a first degree. His supervisors were Fred Hoyle and Abdus Salam. As post - doc, he worked at CERN and at the Imperial College London. Finally, he received a full professor position at the University of Toronto.

Keywords to his research interests: modified gravity, quantum field theory, cosmology, quantum gravity, fundamental problems in quantum mechanics, cosmological constant problem, cosmic microwave background and alternative models of the early Universe.

" *I like to question things"*

"to push things around and see how they work"- ***John Moffat***

In *Physics Letters,* Moffat argued that even though the speed of light may be constant *now*, that doesn't mean that the speed hasn't changed since the beginning of the Universe. A variable speed of light theory breaks Lorentz invariance, and leads to interesting cosmological consequences. More and more physicists (*Michael Clayton* / Virginia Commonwealth University, Joao Magueijo / Imperial College London) agree with him.
John Barrow (author and professor at Cambridge University) says:
"The simplicity of this new model and the striking nature of its predictions suggest that we should investigate it more seriously", and
"[It] should provoke us to take a wide-ranging look at the constancy of nature's constants."

Moffat's original gravity theory, called Nonsymmetric Gravitational Theory (NGT), extends on Einstein's idea of a unified field theory. Einstein used a generalized (nonsymmetric) metric tensor that naturally splits into a symmetric and an antisymmetric part; the former, he identified with gravity, the latter, with the electromagnetic field tensor. Unfortunately, this approach did not work. Moffat's idea was to identify the antisymmetric part with a brand new (massive) field that couples universally to matter, i.e., modify gravity with a skew-symmetric tensor. Later, he created several variations of this theory, moving away from the geometric foundations and focusing on simplifications based on an appropriately chosen action functional that incorporates scalar, vector, and tensor fields. In its present form, Scalar-Vector-Tensor Gravity (STVG) successfully predicts stellar motion in star clusters and galaxies, and agrees with key cosmological results, without resorting to dark energy or dark matter.

Moffat is also working presently on a non-local quantum field theory that is finite to all orders and predicts the W and Z boson masses without resorting to a Higgs mechanism.

Selected Publications:

Galaxy Rotation Curves Without Non-Baryonic Dark Matter, J. R. Brownstein, J. W. Moffat, Astrophys.J. 636 (2006) 721-741, astro-ph/506370, 2005-06-16

Scalar-Tensor-Vector Gravity Theory, J. W. Moffat, JCAP 0603 (2006) 004, gr-qc/0506021, 2005-06-03

Late-time Inhomogeneity and Acceleration Without Dark Energy, J. W. Moffat, JCAP 0605 (2006) 001, astro-ph/0505326, 2005-05-16

Large Scale Cosmological Inhomogeneities, Inflation and Acceleration Without Dark Matter, J. W. Moffat, astro-ph/0504004, 2005-03-31