Zoological Studies 34, Supplement I (1995)

The Microscopist Facing Uncertainty

Sterling P. Newberry
CBI Labs, 11 S. Westcott Road Schenectady, NY 12306, USA

With tight budgets and political uncertainty world wide, microscopists indeed face uncertainty, which is worthy of our concern. However, it is the uncertainty principle of physics which is the primary concern here.

In the early days of electron microscopy, it was believed that the ultimate resolution capability would be useless once we could reach a resolution some what less than the cross section of a single atom, since the outer electrons would reveal no detail and the nucleus is so much smaller than the outer electron orbits, that even full theoretical resolution by electron waves could not hope to resolve the nucleus. Your author did not accept this view and talked privately with his colleagues concerning it. There was always the tantalizing wonder of whether we could at least see the electron's average positions in the so called "orbits" similar to the hydrogen orbitals as calculated using the Schroedinger Equation.

With our improved resolution and computing power today we now look at the electron microscope image at highest resolution, not as a true likeness of the subject but as a wave pattern from which we can hope to calculate the true image within the limits of the uncertainty principle. Also with better understanding of the uncertainty principle, we realize that by sacrificing the certainty about other dimensions, we can greatly enhance the measurement in one dimension. Furthermore Scanning Probe Microscopy has been able to sense the electric fields of orbitals in shared bonds. We have only seen the beginning of the fruitful results which will be gained by this combined use of improved microscope and computer. Possibly those actively engaged in this field should try to project what the next steps to improve these techniques will be.

For my part I wish to propose a new approach, which to my knowledge has not yet been proposed, or perhaps, not even conceived by any one else. It concerns how Electron Microscopy may be a help in studying the basic laws of physics but in a less direct manner than currently employed. Microscopes have helped physics in the past. Contrast the discovery of Brownian movement which was direct observation, with the indirect method in the oil drop experiment to determine the charge on the electron.

In objective study we must constantly avoid the human tendency to judge time and space by our own size and speed of sensory comprehension and our human reluctance to work outside the confines of our own laboratory space. As we know, progress in science is usually initiated by experiments which are in conflict with our theories, while understanding has almost always come from indirect measurements; long before we have the experimental capability to do the direct measurements required. What I am proposing is that we use the Electron Microscope's image field as a new vantage point for launching indirect measurements of the interactions of fundamental particles. This is the next logical extension in freeing ourselves from the confines of our environment since we have already created a new vantage point in astronomy by sending probes and telescopes into Outer-Space, beyond earth's atmospheric confines for studies of fundamental physics. With the Electron Microscope we can do more than just interpret observations, we should be able to establish a vantage point for indirect measurements in Micro-Space below the resolution limit of the microscope where the region of nuclear particles is found.

It is my hope that a dialogue can be started among microscopists, especially those who are also physicists, for the possibility of such experiments. Let me offer some opening suggestions of techniques available for such measurements. Annihilations can be used as the driving force for these experiments. Annihilations can be made to occur in large numbers, in a controllable, small area; as is now done experimentally for cancer treatment with anti-protons. Can we reduce and control this area well enough to get a high probability of annihilations occurring in the field of view of the electron microscope; probably so. Furthermore those neutrinos which are thought to carry charge, are also believed to be very plentiful in free space. Do they effect an electron wave pattern? Can Holographic Electron Microscopy detect such interaction? Also, as we go to press we are told of apparent success in detection of the Top Quark in free space(1). These quarks are thought to have a dumbbell shape and if separated to immediately recombine with other released Quarks or with other nuclear particles. Here the "Nuclear Glue" force appears to be exhibiting itself on atomic dimensions. Because of the Top Quark's short half life in free space, it is very rare to find one in experiments on a scale of meters, as need be employed in the high energy machines. Is it not possible, that we may be able to provoke a constant supply of free quarks at near nuclear dimensions and are they not likely to have disturbing effects on the atoms and electrons we observe in the electron microscope? An interesting suggestion that quarks hold protons and neutrons together by acting like shared bonds, which we find at the molecular level, was expressed in an interview with John Domingo to a science editor recently(2). This report is a good summary for the non-physicists which explains why it would be advantageous to be able to observe events in the region close to the nucleus because the particles found by high energy experiments, appear to show their complete characteristics only in association with the nuclear environment. In the past I initiated a call for us to use the power of Electron Microscopy to explore "Micro-Space" as the space to hold our growing information files, today I ask you to consider the possibility of using the power of the Electron Microscope to establish a laboratory in the vicinity of the nucleus.

REFERENCES

Associated Press Release, Batavia, Ill. March 3, 1995.

Flam, Faye (Ed) 1995. "A New Accelerator Explores The Social Life of Quarks", Science V. 267 p 1266-7.