ACCELERATOR SEMINAR

"Orbits in Superconducting RF Cavities: A Challenge for Established Physics, II"

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A number of data runs have been performed at TJNAF by the ALE Collaboration (with membership from TJNAF and SLAC). These runs were to study anomalous light emissions generated in the interior of high vacuum superconducting cavities (at 2 K) under (1.5 GHz) RF excitation. This light emissions and their associated phenomena were observed by a small monochrome video camera, looking through a standard optical viewport, as well as by other instrumentation. Of the several phenomena observed, the most perplexing are what appear to be small luminous long-lived objects moving about in the vacuum space in the interior of the cavities without wall contact (although at times these objects also bounced off of the cavity walls). In our several runs, more than a dozen (closed) orbits of these Mobile Luminous Objects (or MLOs) were observed, six of which lasted longer than 10 s. The orbit of longest duration lasted 40 s. These orbits were often elliptical or near elliptical. Orbital frequencies ranged from 5 to 80 Hz. This orbital motion is included in what we label as Mode I behavior, also described as ballistic behavior. By using reflections in the wall of the cavity beam tube (where available), it is shown that the trajectories of these orbits are in, or near, the equatorial plane of the cavity and not in contact with the cavity walls. A video clip of Mode I behavior is shown.

A second and even more intriguing MLO behavior, which we will call Mode II, or Macromolecular behavior, has also been observed. In this case, several MLOs gather into what might be a macromolecule, which appears to move as a single unit, the several MLOs appearing to be bonded to each other. (A configuration containing as many as seven MLOs was observed.) These configurations were seen not only to orbit (i.e. rotate about) the cavity axis in the cavity vacuum volume, but also to come to rest in the vacuum and not in contact with the cavity walls. A video clip of Mode II behavior is also shown.

Of the various anomalous luminous phenomena in the data, these long-lived orbiting MLOs present the greatest challenge to theoretical explanation. To proceed with an analysis, the MLO physics is partitioned into internal and external. While the internal physics is as of yet unknown (which also constitutes a major challenge to a proper physics explanation), an analysis of the external physics, that is the MLO orbits, is straightforward.

Using the data as a guide, it is argued that the MLOs are coherent entities of small size (< 2 mm) and carry a certain mass. Thus, one expects them to obey Newton's equations. Then MLO models are formulated by characterizing these (small) entities by various electromagnetic features (charges, dipoles, etc.) that can interact with each other and with the cavity environment. It is observed that one does not have to understand the internal MLO dynamics that lead to these assumed electromagnetic features; given the specified electromagnetic features of the (model) MLOs, the analysis of the external MLO dynamics will still be valid.

Based upon the character of the experimentally observed orbits, several criteria are developed, all of which a satisfactory theoretical explanation for the MLO orbits would have to successfully address. A number of model MLOs are analyzed in detail. Some models are more successful than others, but it is shown that none of the models that are considered have a viable parameter space that can accommodate all of the orbital criteria. It is further argued that the set of models analyzed herein exhaust the plausible MLO modeling possibilities available from the realm of established physics. This line of argument leads to a challenging conclusion.

Tuesday, April 26, 2011
11:00 a.m.
CEBAF Center, Room L102/104

Coffee before seminar at 10:45 a.m.

Jefferson Lab

For further info, please contact Alex Bogacz at x5784 or Anne-Marie Valente at x6073