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Investigation of a Plasma Ball using a High Speed Camera JAMES LAIRD, University of Michigan SULI PPPL, STEWART ZWEBEN, YEVGENY RAITSES, ANDREW ZWICKER, IGOR KAGANOVICH, PPPL — The physics of how a plasma ball works is not clearly understood. A plasma ball is a commercial "toy" in which a center electrode is charged to a high voltage and lightning-like discharges fill the ball with many plasma filaments. The ball uses high voltage applied on the center electrode ($\sim$5 kV) which is covered with glass and capacitively coupled to the plasma filaments. This voltage oscillates at a frequency of $\sim$26 kHz. A Nebula plasma ball from Edmund Scientific was filmed with a Phantom v7.3 camera, which can operate at speeds up to 150,000 frames per second (fps) with a limit of $\geq$2 μsec exposure per frame. At 100,000 fps the filaments were only visible for $\sim$5 μsec every $\sim$40 μsec. When the plasma ball is first switched on, the filaments formed only after $\sim$800 μsec and initially had a much larger diameter with more chaotic behavior than when the ball reached its final plasma filament state at $\sim$30 msec. Measurements are also being made of the final filament diameter, the speed of the filament propagation, and the effect of thermal gradients on the filament density. An attempt will be made to explain these results from plasma theory and movies of these filaments will be shown. Possible theoretical models include streamer-like formation, thermal condensation instability, and dielectric barrier discharge instability.

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