Physical Description and Modeling of Paper Strip Flights

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When a confetti cannon is fired, a turbulent spectacle follows: hundreds and hundreds of paper snippets swirl through the air in fantastic trajectories. When we looked at these more closely, the following question occurred to us: can the flight of paper strips be described in terms of physics and mathematically modelled? We noticed that the flight can be divided into three phases. In the first phase, the strip falls vertically downwards. At a certain point, it usually slips out of the fall line and starts rotating. In the following second phase, the rotation times are still very irregular. The strip rotates with constant frequency in the third phase, which encouraged us to search for a physical description. We analyzed the flight of a well-observable class of experiments, and extracted motion parameters. To create consistent results, we constructed a mechanism to let individual, well-defined rectangular strips of paper drop to the floor reproducibly. We used a slow-motion camera and computer software to record and analyze the strips motion. In total, we evaluated 800 videos. By systematically varying combinations of width, height and mass, we arrived at surprising dependencies with a wide range of validity and were then able to establish very precise trends. Among other things, we obtained a formula to precisely calculate how fast paper strips of a certain shape, mass and size rotate when they fall. In summary, we compiled a very accurate physical description and a mathematical model for characteristic behavior of the paper strip flights.

Awards Won:
Second Award of $2,000
Sigma Xi, The Scientific Research Honor Society: Second Physical Science Award of $1,000