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**Experimental investigation of freely falling thin disks: Transition of three-dimensional motion from zigzag to spiral** ZHUANG SU, CUNBIAO LEE, Peking Univ — The motion of a freely falling thin disk was investigated experimentally. Different motion modes, including planar zigzag and three dimensional spiral, were identified based on the measurements of the whole six degrees of freedom of the disk. The final motion modes in the fall were found to change with the dimensionless moments of inertia ( $I^*$ ), which is determined by the aspect ratio of the disk and the density ratio between the disk and water. The motion mode is zigzag in the range of  $2.95 \times 10^{-3}$  to  $1.17 \times 10^{-2}$  and spiral in the range of  $7.36 \times 10^{-4}$  to  $1.47 \times 10^{-3}$  in our experiments. A zigzag to spiral transition process was found in the lower  $I^*$  range. Two different types of transition were identified, which are zigzag-spiral monotonous transition in the lower and higher Reynolds number range (600 to 1000 and above 2900 in our experiments) and zigzag-spiral-zigzag intermittence transition in the middle range. The forces acted on the disk were also investigated. Different force behaviors corresponding to different types of wake structures were identified and analyzed.

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