Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

3D Solitons of Capillary-Gravity and Flexural-Gravity Waves

REZA ALAM, University of California, Berkeley — In the context of nonlinear water wave theory an intriguing question has always been if fully-localized 3D wave structures, counterparts of 2D solitons, can exist. These structures are important because, if exist, they can transport mass, momentum and energy over long distances. For pure gravity waves this possibility is already ruled out, but- as we will discuss- few limiting cases of capillary-gravity and flexural-gravity wave equations admit such solutions in the form of dromions and lumps. Here we show that weakly nonlinear flexural-gravity wave packets, such as those propagating on the surface of ice-covered waters, admit three-dimensional fully localized solutions in the form of dromions. This study is motivated by observations of (relatively) large amplitude localized waves deep inside the ice-pack in polar waters. For capillary-gravity wave classical theory obtains dromions for shallow-water and strong surface tension (Bond number, Bo, greater than 1/3). Here we show that capillary-gravity dromions exist beyond this limit for a broad range of finite water depths as well as for sub-critical Bond numbers, i.e. for Bo $< 1/3$.

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Date submitted: 02 Aug 2013 Electronic form version 1.4