

# LONG TIME BEHAVIOR OF THE 2D WATER WAVES WITH POINT VORTICES

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ABSTRACT. We consider the motion of inviscid, incompressible and infinite depth water waves with point vortices in the fluid in two space dimensions. We show that the Taylor sign condition  $-\frac{\partial P}{\partial n} > 0$  can fail if the point vortices are sufficiently close to the free boundary, so the motion of the water waves can be subject to the Taylor instability. And we show that for certain initial configurations, the point vortices will keep moving away from the interface, so that the free interface will remain smooth for a long time; and for initial data of size  $\epsilon \ll 1$ , the lifespan of the smooth solution is at least of order  $\epsilon^{-2}$ .