## (Not so) quantum ducks

Consider a duck which is smoothly swimming on a quiet lake as shown in the picture. Using the concepts of the Landau-Čerenkov theory of wave emission by an object that is uniformly moving through a homogeneous medium, study the main qualitative properties of the wake that is observed on the surface of the lake past the duck. In particular:

1. Under the point-like duck approximation, calculate the aperture of the main conical wake.
2. Give an explanation for the modulation that is visible on the main conical wake.
3. What is the physical origin of the oscillations that are visible inside the conical wake?
4. Taking into account the finite size of the duck, estimate the critical velocity for the appearance of the wake.
5. How can you interpret the sudden change in the wake that is visible on the bottom-left side of the picture?

**Suggestion:** the dispersion of deep-water surface waves has a square-root form $\omega(k) = \sqrt{g\,k}$, where $g$ is the gravitational acceleration.