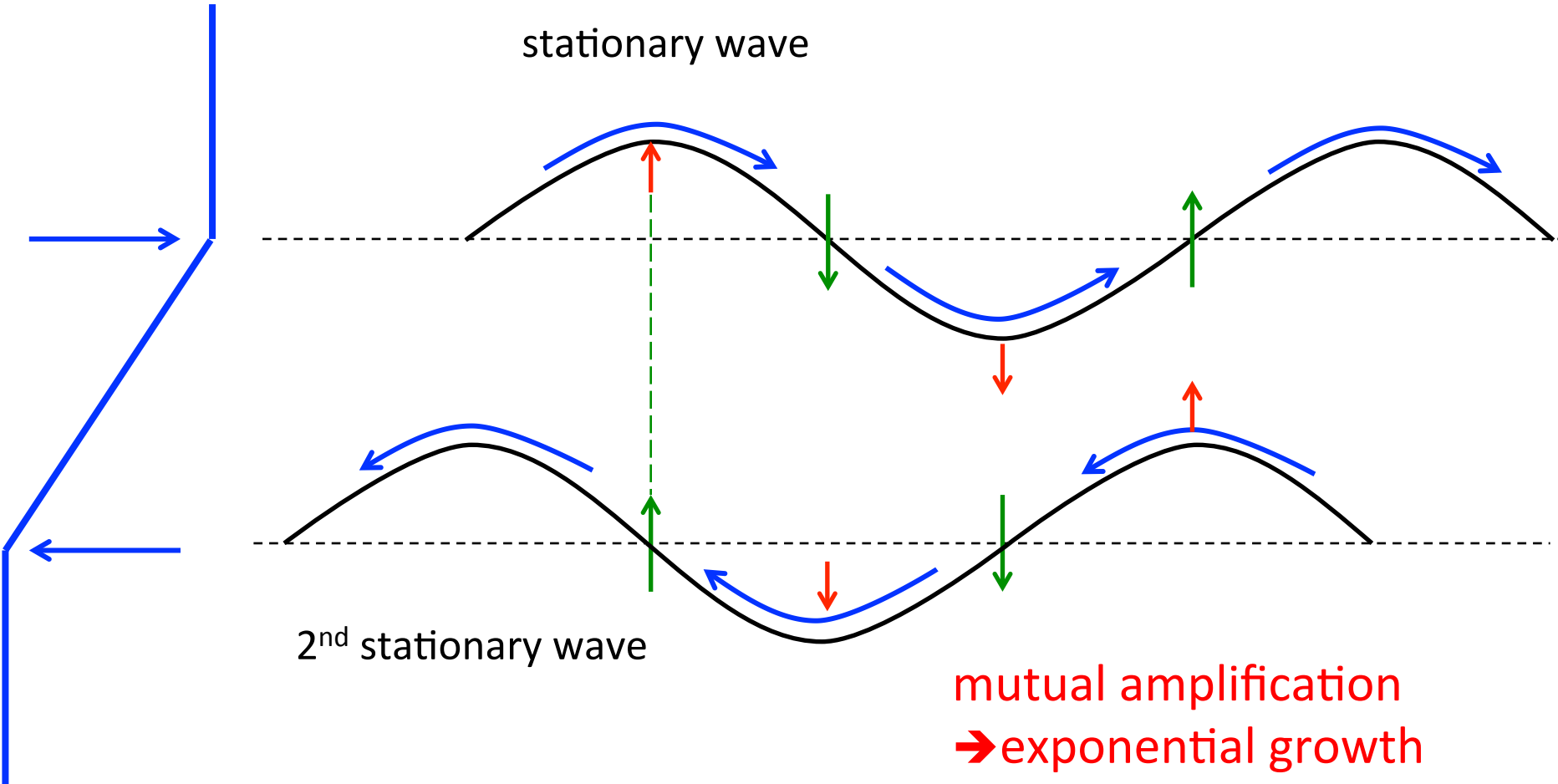


The Holmboe velocity profile

Holmboe movie:

https://www.youtube.com/watch?v=9MT3N9M_vkM

Wave resonance in shear flow



But what makes the waves?

Vorticity-gravity-wave resonance

$B(z)$ $U(z)$

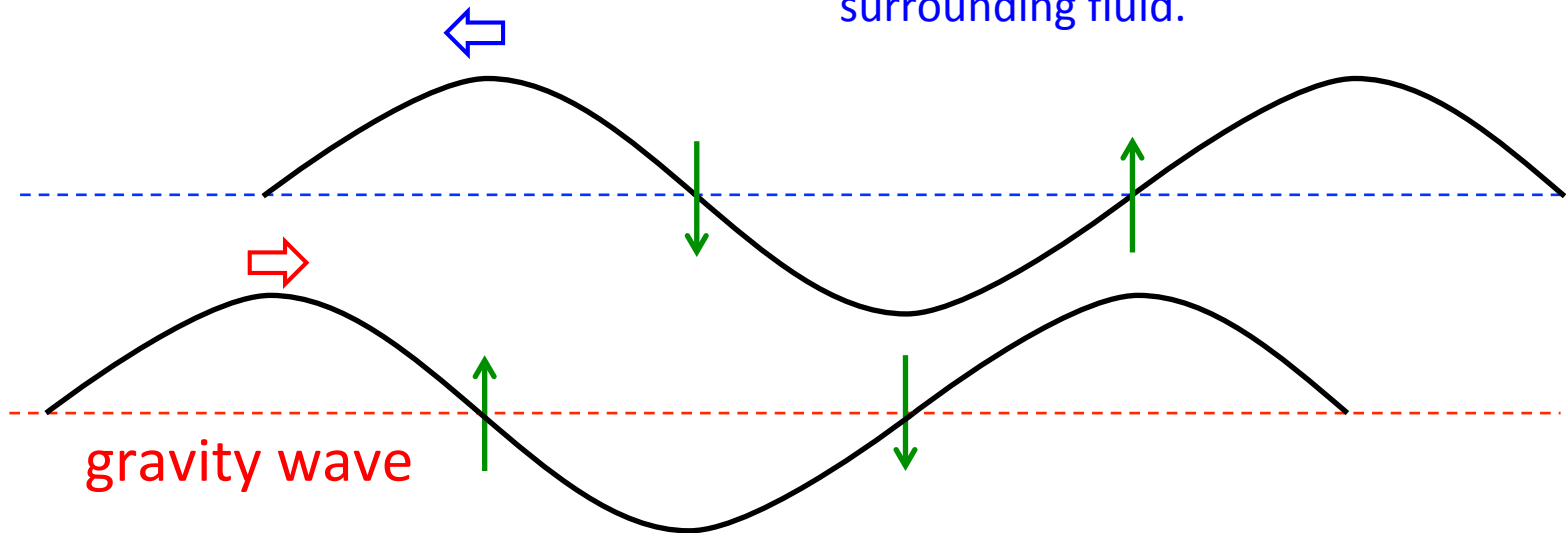
upper pair

vorticity wave

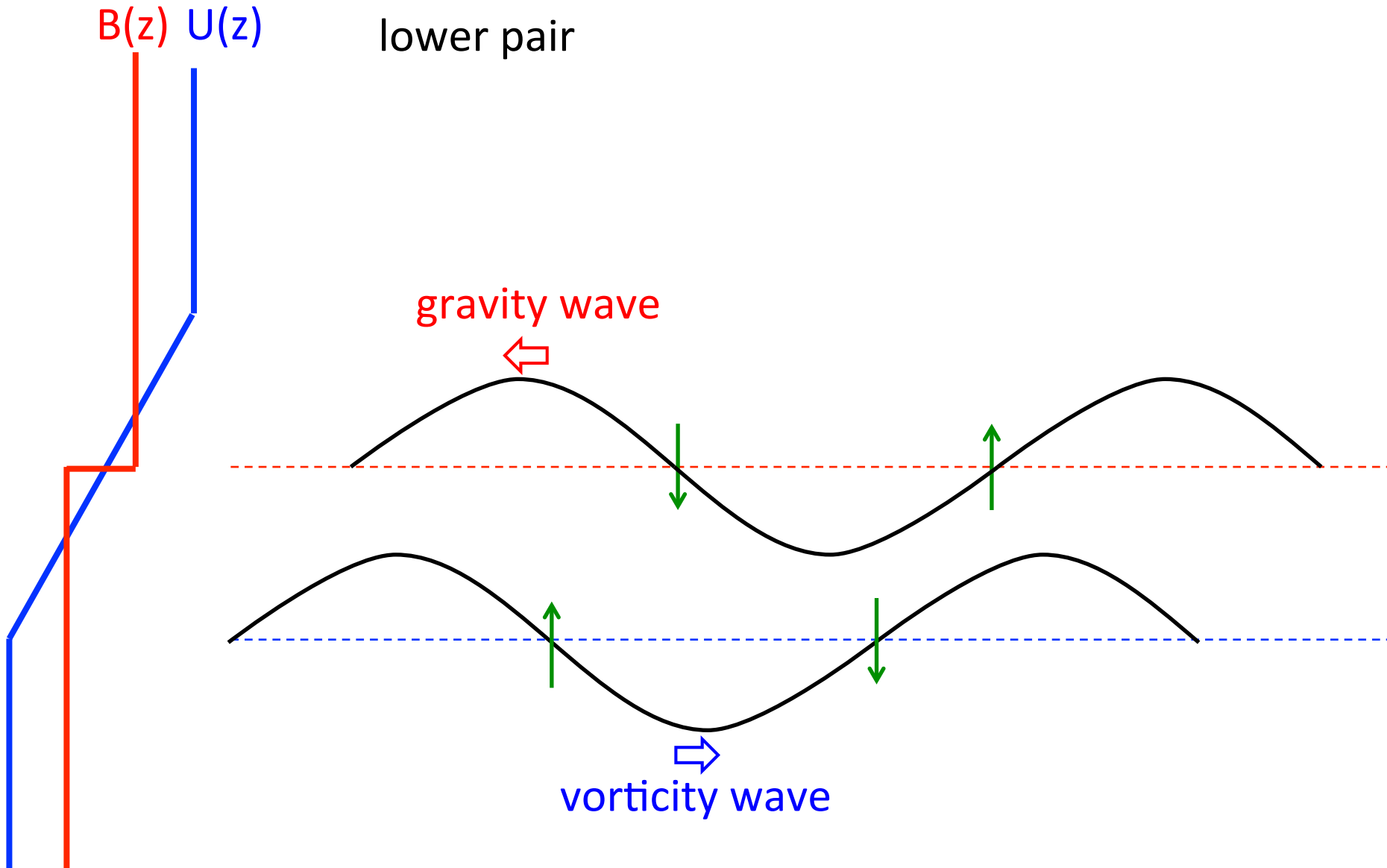
Vorticity wave propagates to the right from the observer's reference frame, to the left relative to the surrounding fluid.

gravity wave

Gravity wave propagates to the right. The surrounding fluid velocity is zero.



Vorticity-gravity-wave resonance



$B(z)$ $U(z)$

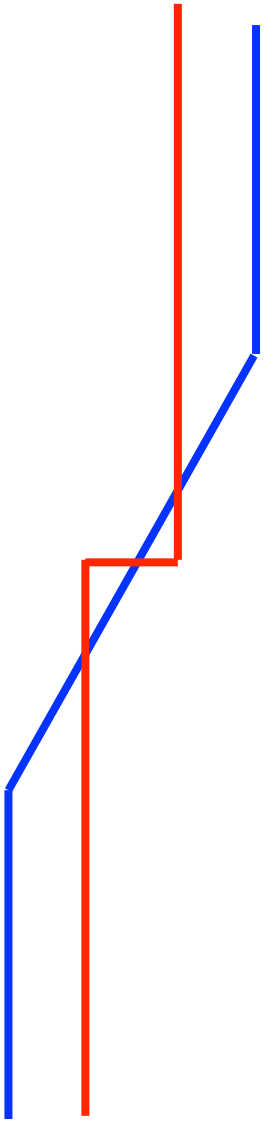
dispersion relation

Assume 2D modes:

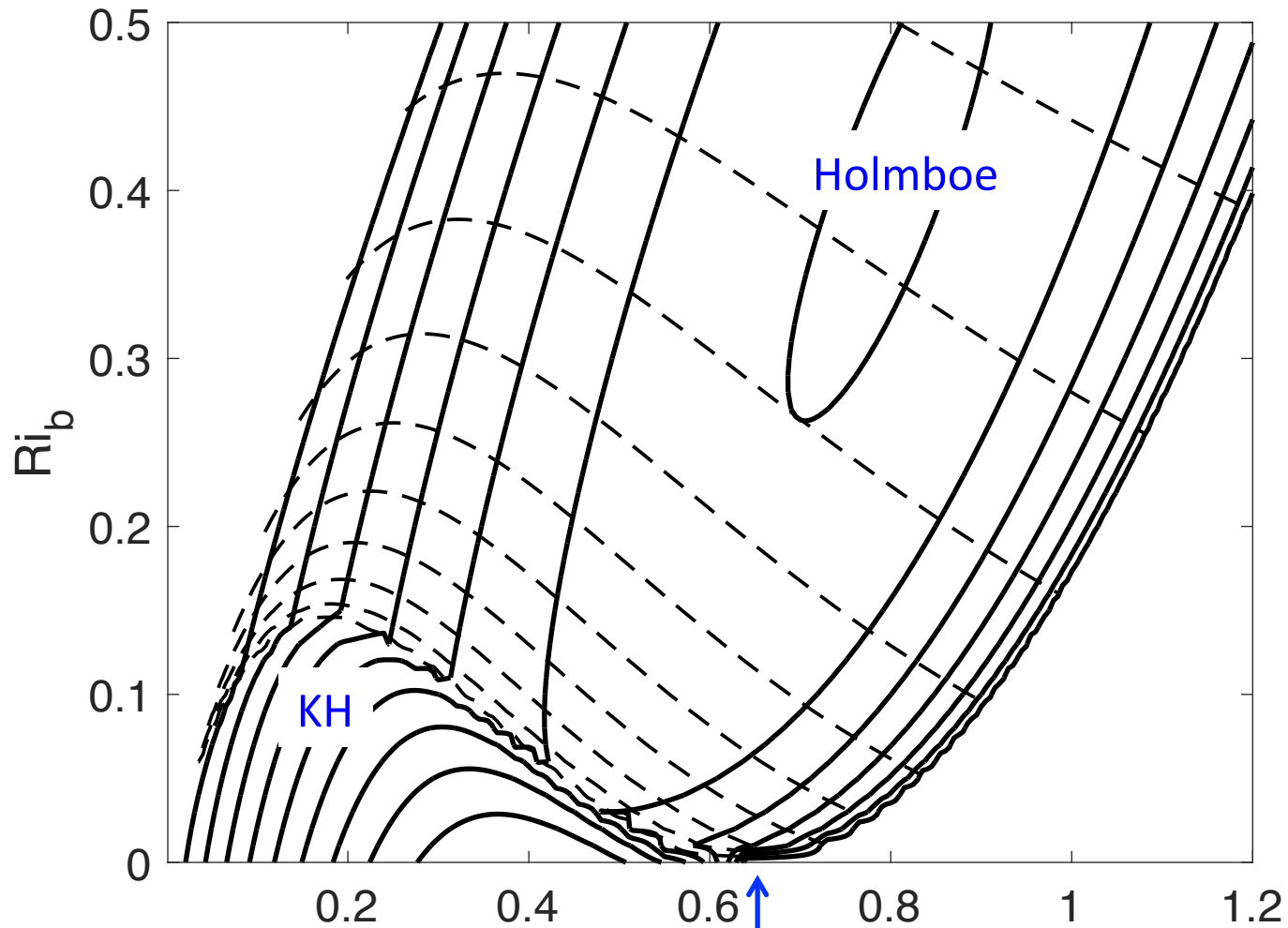
$$\hat{w}'' + \left(\frac{B_z}{(U-c)^2} - \frac{U''}{U-c} - k^2 \right) \hat{w} = 0$$

$$c_*^4 + \left[-\frac{Ri_b}{2k_*} + \frac{e^{-4k_*}}{4k_*^2} - \left(1 - \frac{1}{2k_*} \right)^2 \right] c_*^2 + \frac{Ri_b}{2k_*} \left[\frac{e^{2k_*}}{2k_*} + 1 - \frac{1}{2k_*} \right]^2 = 0$$

$$c = u_0 c_*; \quad k = \frac{k_*}{h}; \quad Ri_b = \frac{b_0 h}{u_0^2}$$



Stability of stratified shear layer

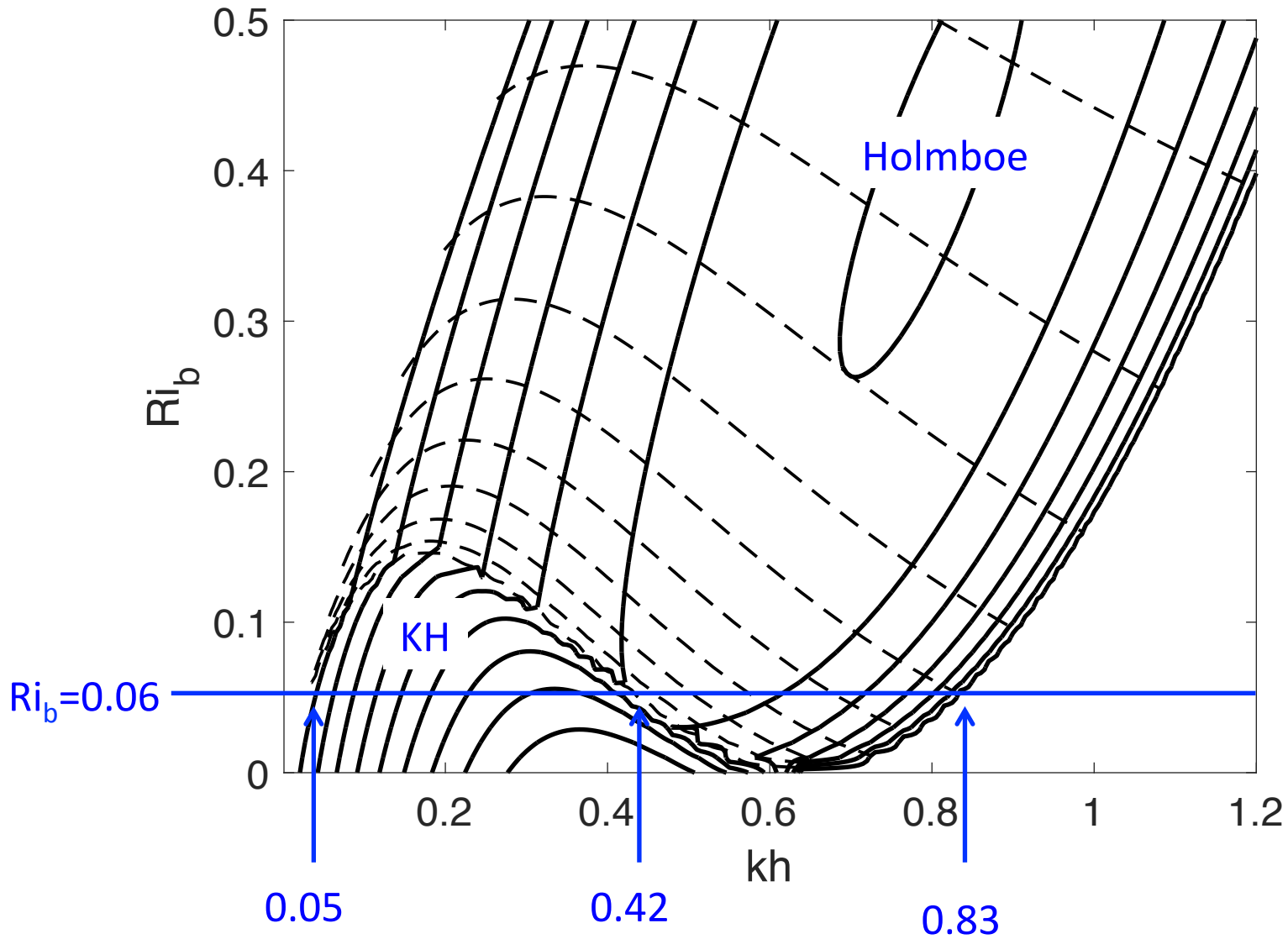


solid: growth rate
dashed: phase velocity

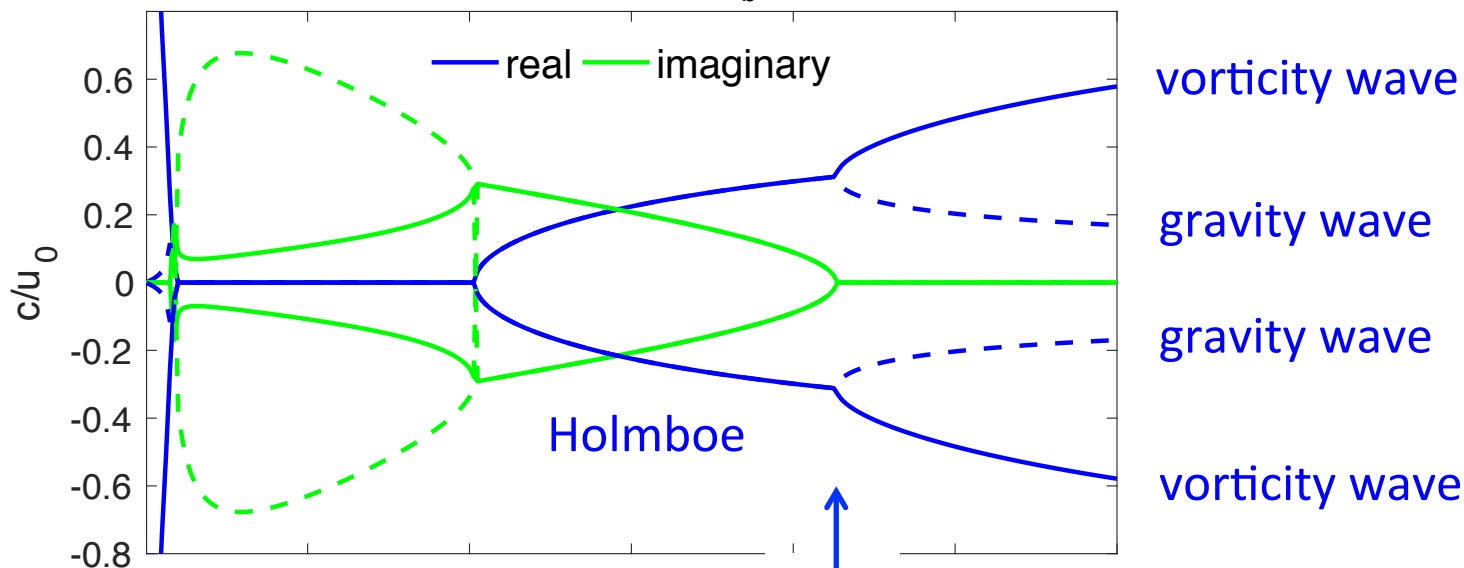
0.40

0.64

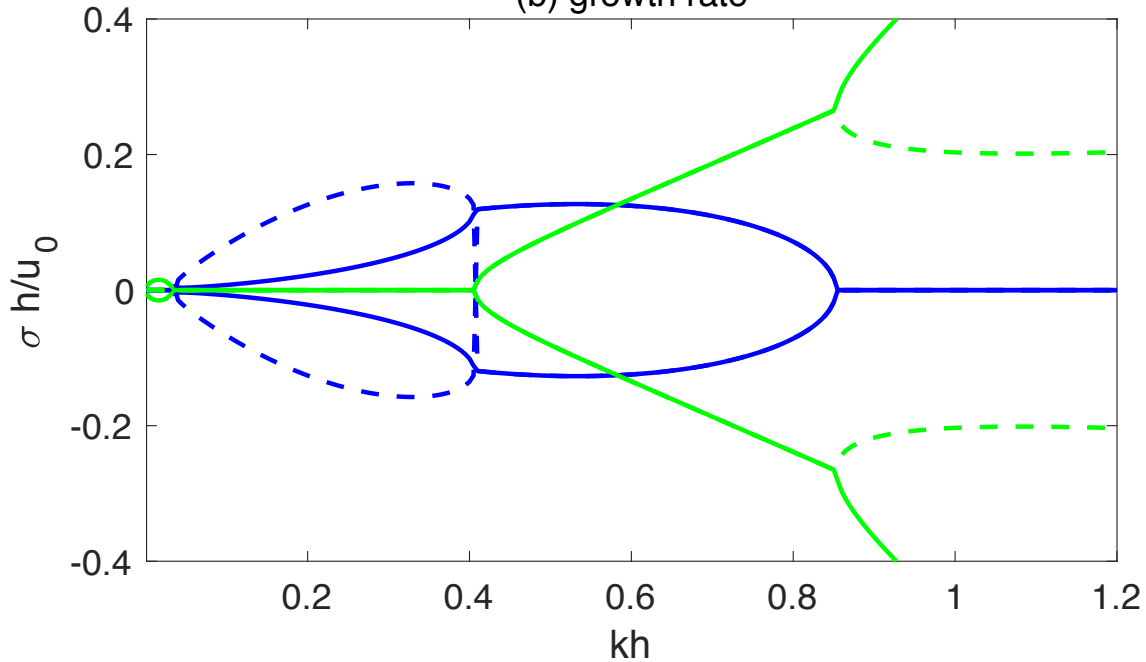
Stability of stratified shear layer



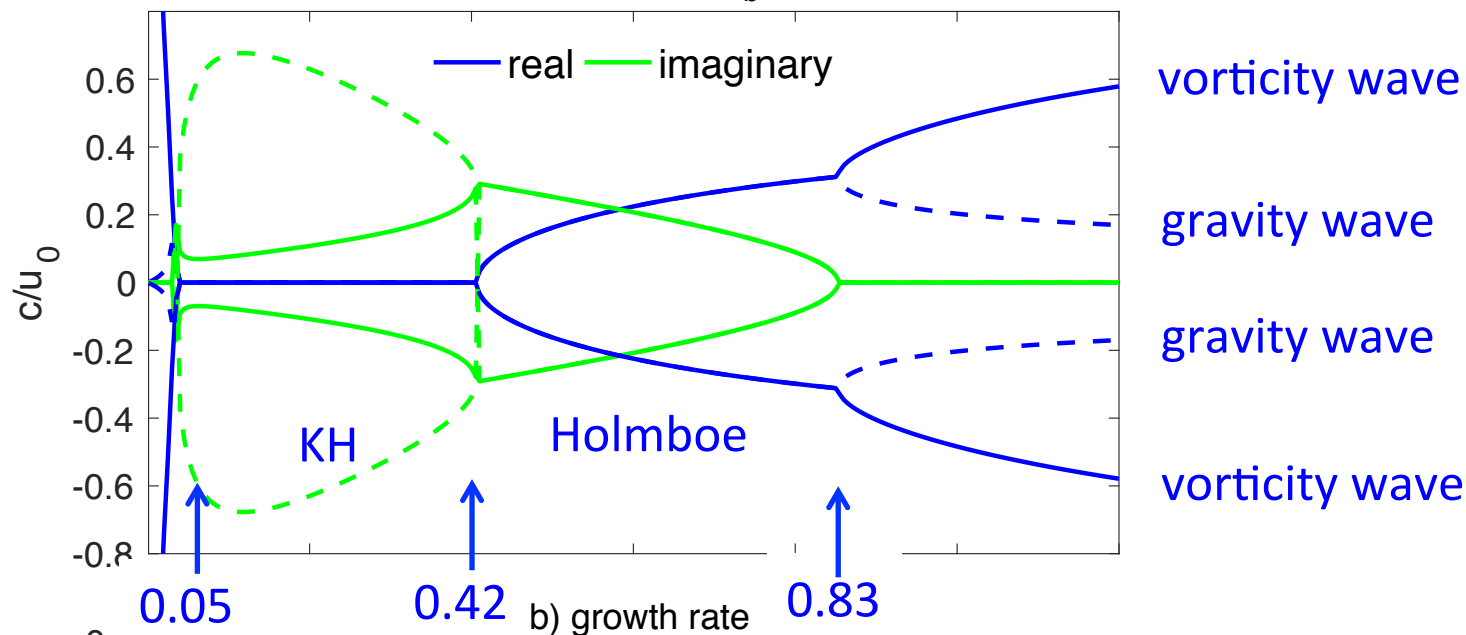
(a) phase speed for $Ri_b=0.060$



(b) growth rate 0.83



(a) phase speed for $Ri_b=0.060$



b) growth rate

