Problem (3) cf

Convective cell modes from NS eqns

Previously, $\partial_t nM\vec{u} = -\vec{\nabla}p$

$$\Rightarrow \omega nM\vec{\nabla}\times\vec{u} = 0 \Rightarrow \boxed{\begin{array}{c}\omega = 0 \\ \vec{k}\times\vec{u} \neq 0\end{array}}$$

Now, $nM\partial_t\vec{u} = -\vec{\nabla}p + nM\mu\left[\vec{\nabla}\vec{\nabla}\cdot\vec{u} + \nabla^2\vec{u}\right]$

$$\Rightarrow nM(-i\omega)\vec{u} = -i\vec{k}p - nM\mu\left[\vec{k}\vec{k}\cdot\vec{u} + k^2\vec{u}\right]$$

$\vec{\nabla} \to i\vec{k}$ and $\vec{k}\times$

$$\Rightarrow (-i\omega)nM\vec{k}\times\vec{u} = -nMk^2\mu\,\vec{k}\times\vec{u}$$

$$\Rightarrow \boxed{\begin{array}{c}\omega + ik^2\mu = 0 \\ \vec{k}\times\vec{u} \neq 0\end{array}}$$

Viscous damping of conv cells