Assuming the following fixed parameters,

Nbar = 1.0

Nstar = 0.1432394487827058

tau\_eq = 1 microsecond

sigma0 = 0.2

when the “baseline” scenario is perturbed a little to the following:

L = 30 micrometer

D = 0.000365 micrometer \*\* 2 / microsecond

nu\_kin = 105 micrometer / second

nu\_kin\_mlyperus = 0.26992287917737784 / microsecond

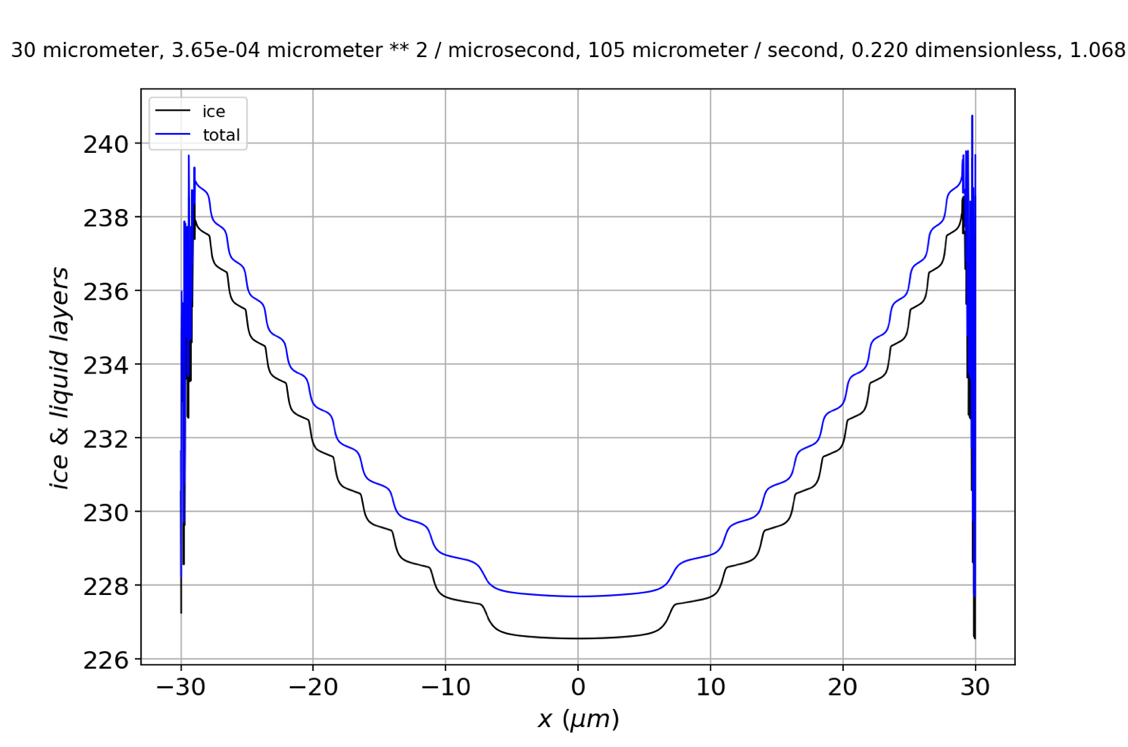
sigmaI\_corner = 0.22 dimensionless

c\_r\_percent = 1.068 dimensionless

nx (crystal) = 2401

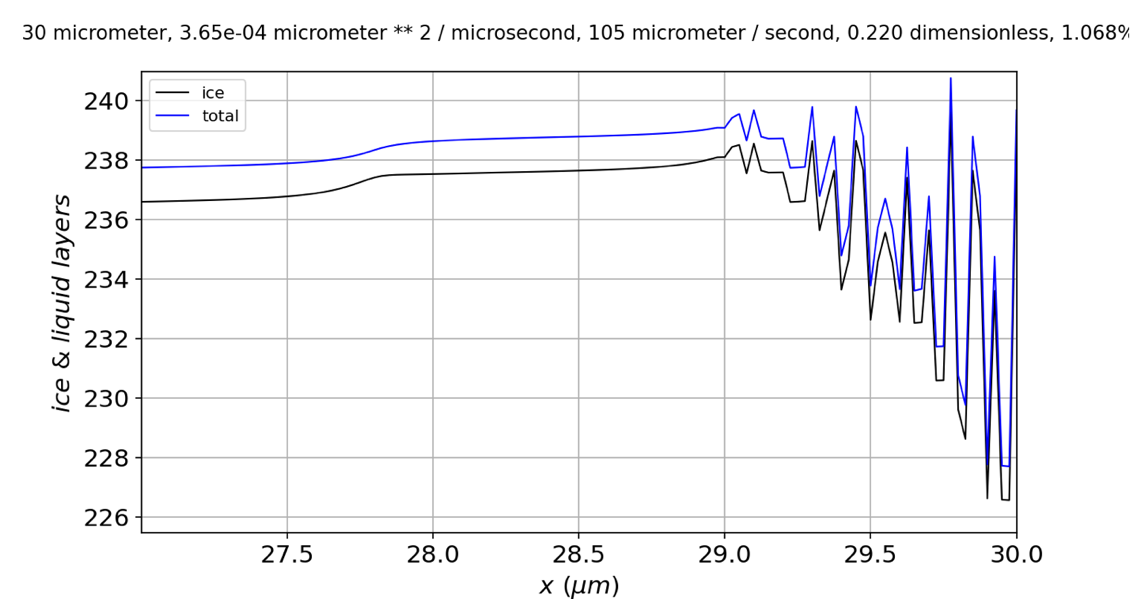
Spacing of points on the ice surface = 0.02499999999999858 micrometer

we get instability:



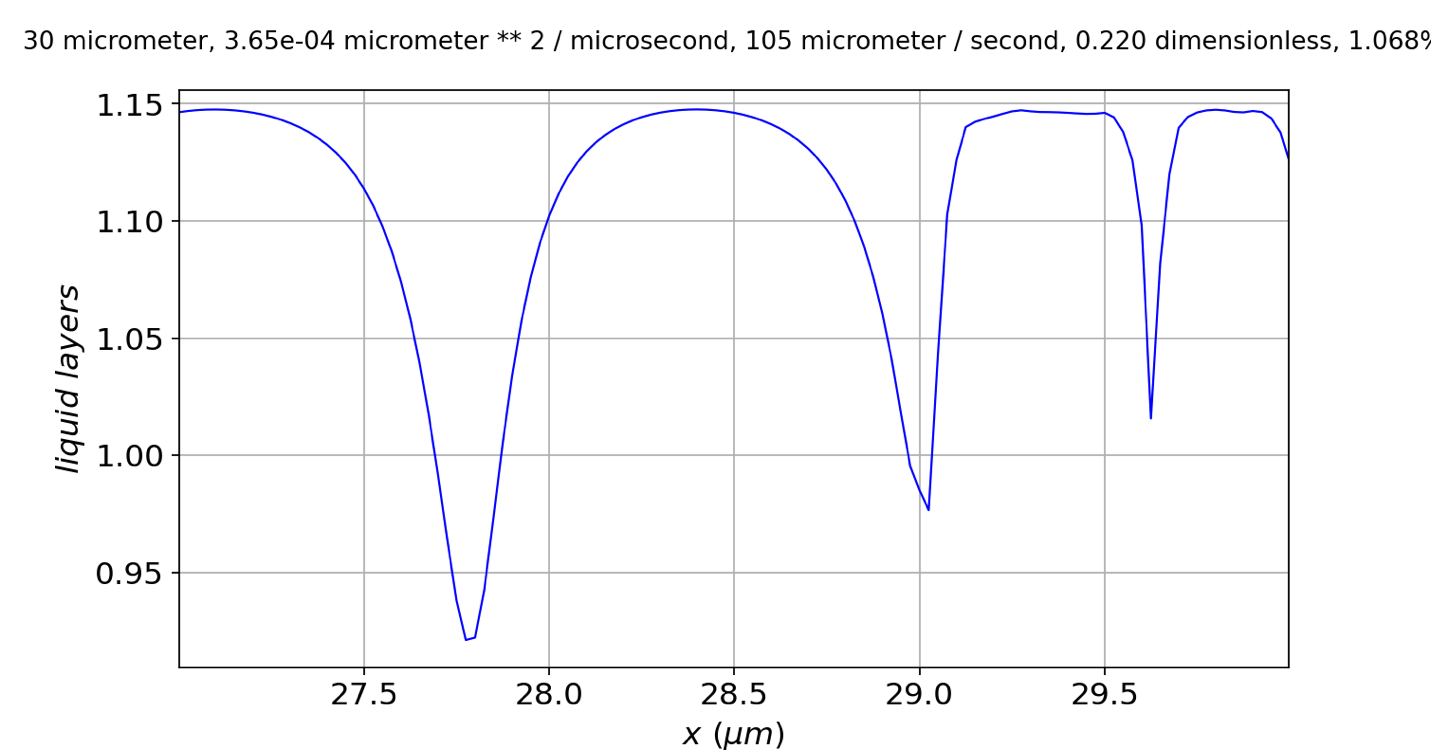
**Figure 1**. Profile showing unstable growth.

If we expand in the corner, it’s clear that instabilities have crept in, by this time, from the edge at to .



**Figure 2**. Expanded view of the profile in Fig. 1.

If we examine the alone,



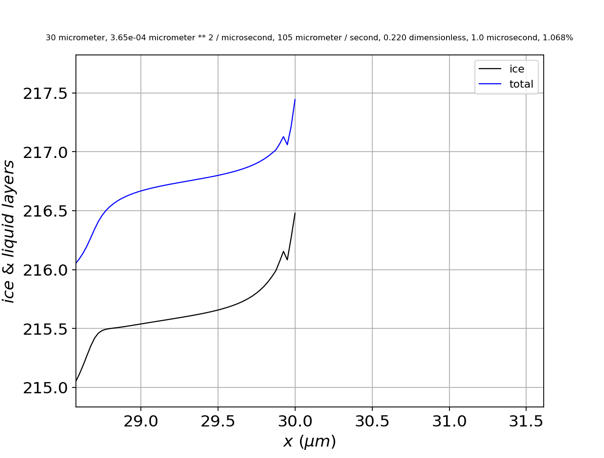
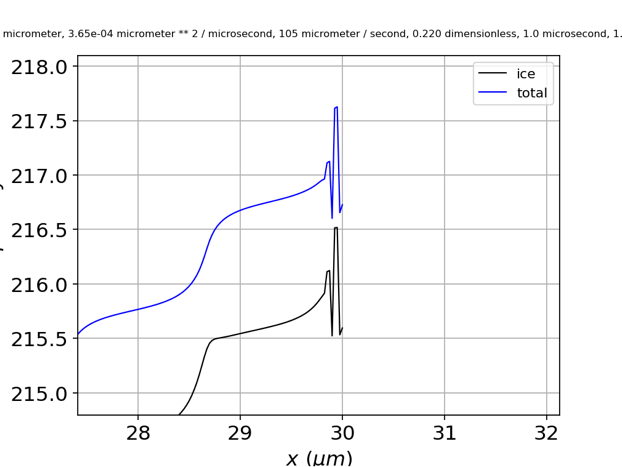
**Figure 2**. Quasiliquid thickness after onset of instability.

we see that the instability seems to originate on a *step*, rather than at a *riser* (solid arrow). The fact that tops out at risers generally (dashed arrows) with a value close to is significant, because the parameterization means that when is at its **maximum** value (), . That means, at that time step, deposition from the vapor phase has slightly exceeded the ability of the quasiliquid to **freeze** or **diffuse away**. If this thinking is correct, then we can predict that stability can be favored by bigger (which is correct) and smaller (which is incorrect).

OK, more data. **Stability is favored by**

* Smaller (from to )
* Bigger (from to )
* Bigger (from to )
* Smaller (from to )

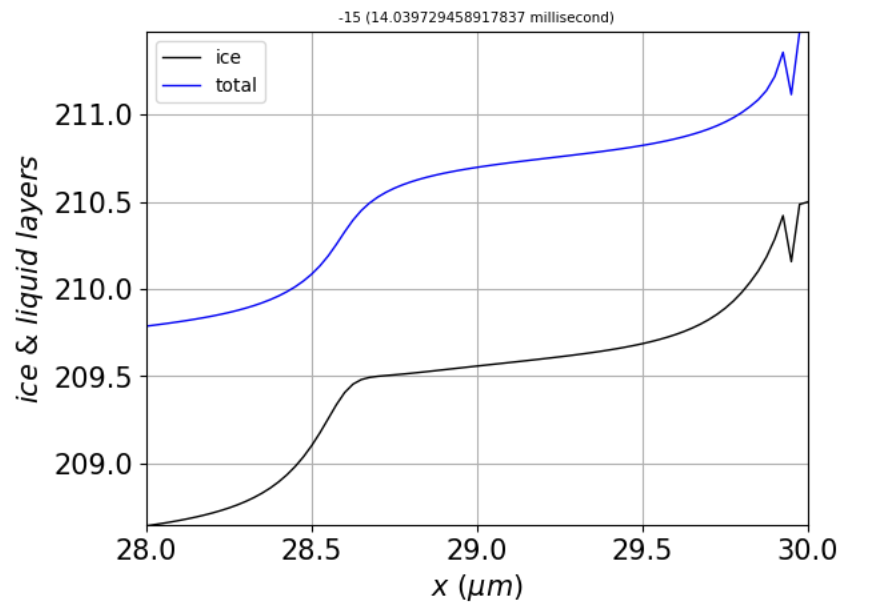
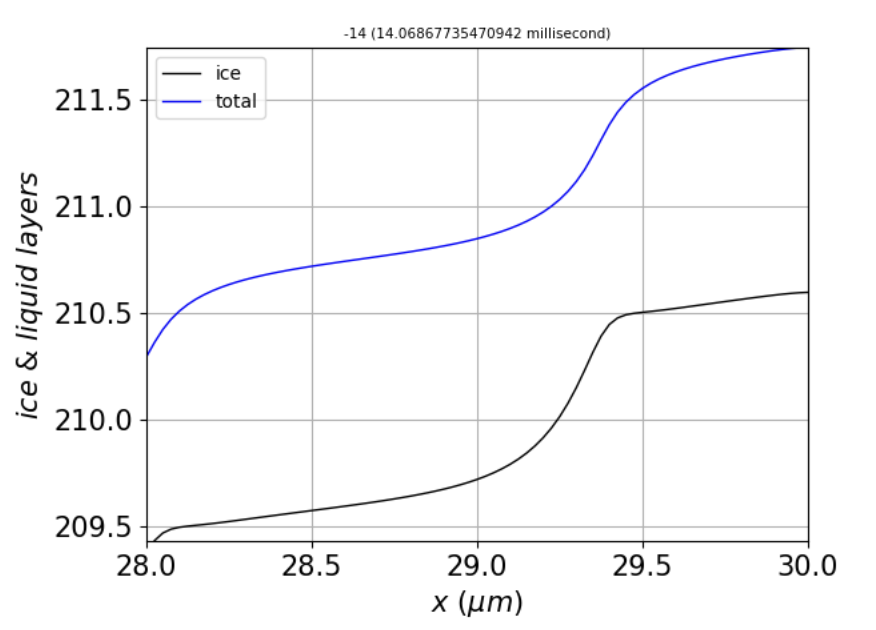
At times 14.445 and 14.446, I get small jumps in :

**Figure 3**. Evolution of a small-amplitude instability showing one glitch, then two.

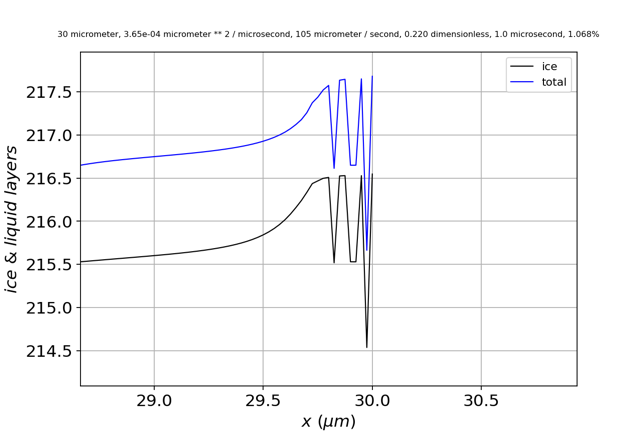
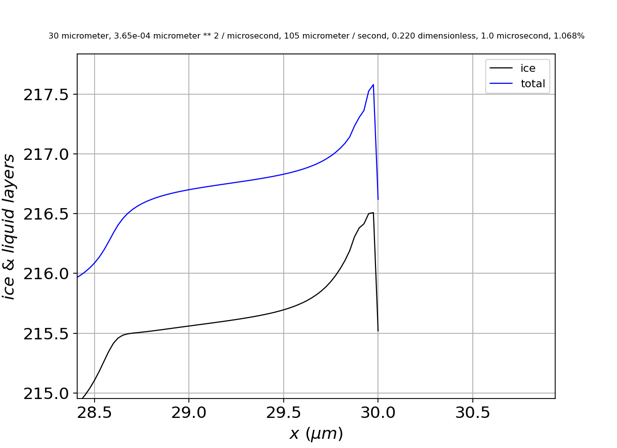
Conclusions …

1. The glitches first appear close to **facet corners**. It’s still not clear whether this has something to do with the imposition of periodic boundary conditions at facet corners, or some other property, like lambda, which happens to be small at facet corners. I think I could explore this with **different supersaturation** profiles, or with **different boundary conditions** (see below).
2. The fact that glitches (when they first appear) are smaller in than in suggests that they originate in **diffusion** or **deposition**, but **not freezing**. (See f1d\_solve\_ivp for a more detailed argument.)
3. In some cases, **glitches disappear in subsequent time steps**. An example is shown in Fig. 4: the glitch where the number of ice layers equals 210.5 (i.e., close to the riser at 30 micrometers) has disappeared at time step -14 (the riser now located closer to 29.4 micrometers).

**Figure 4**. Left: Profile at time step -15. Right: Profile one time step later, showing removal of the glitch.

1. **When glitches persist** over time, however, they grow until they reach increments of layer, then layers, and so on. An example is shown in Fig. 5.



**Figure 5**. Evolution of the small-amplitude instability in Fig. 3 to full layer instability.

Examining **different boundary conditions**: If I replace **periodic boundary conditions** with **reflection** (no-flux) boundary conditions,

# Ntot diffusion

dy = np.empty(np.shape(NQLL0))

for i in range(1,len(NQLL0)-1):

dy[i] = DoverdeltaX2\*(NQLL0[i-1]-2\*NQLL0[i]+NQLL0[i+1])

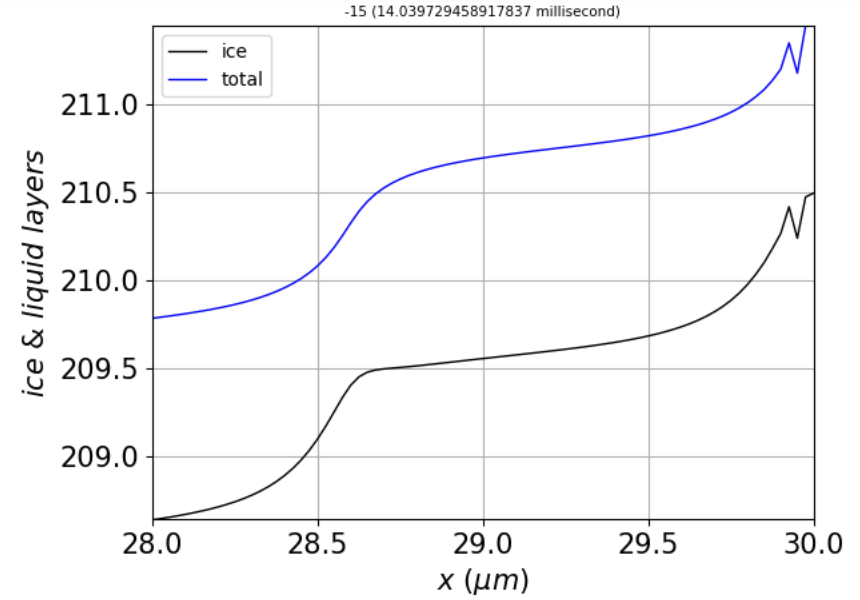
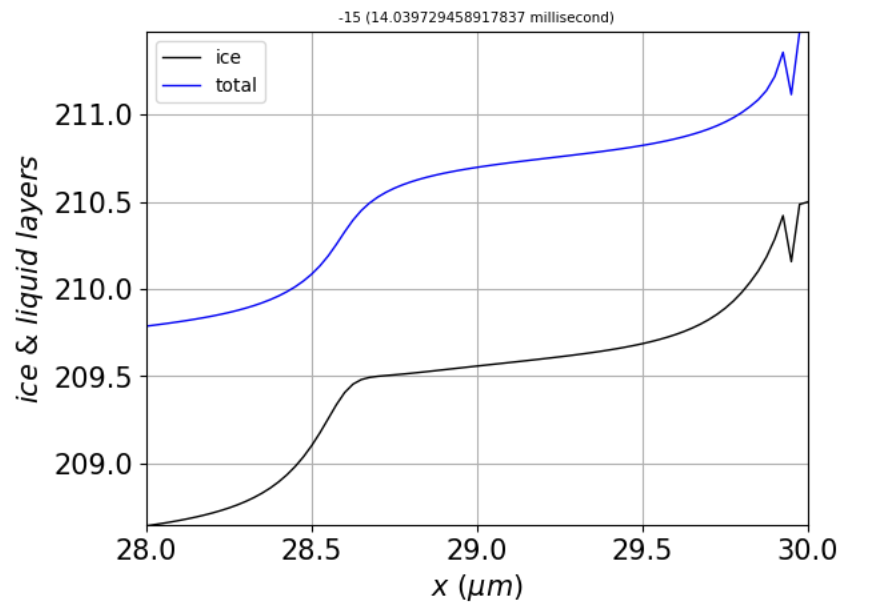
# dy[0] = DoverdeltaX2\*(NQLL0[-1] -2\*NQLL0[0] +NQLL0[1]) # Periodic BC

# dy[-1] = DoverdeltaX2\*(NQLL0[-2] -2\*NQLL0[-1]+NQLL0[0])

dy[0] = DoverdeltaX2\*(NQLL0[0] -2\*NQLL0[0] +NQLL0[1]) # No-flux BC

dy[-1] = DoverdeltaX2\*(NQLL0[-2] -2\*NQLL0[-1]+NQLL0[-1])

the results are a little different, but the **glitches still occur**:



Left: **periodic** boundary conditions. Right: **reflection** (no-flux) boundary conditions.

Indication: glitches may not be due to the imposition of periodic boundary conditions, but rather with some other property, like lambda, which happens to be small at facet boundaries.