Hierarchy of sigmoid growth models – towards justification of sigmoid treatment of nucleation data

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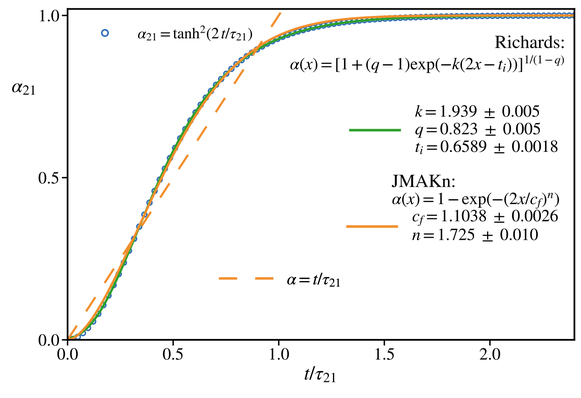
Introduction:

The hierarchy of sigmoid growth models (HSGM), built for first time in Kleshtanova et al, Crystals 2023, 13, 1690.

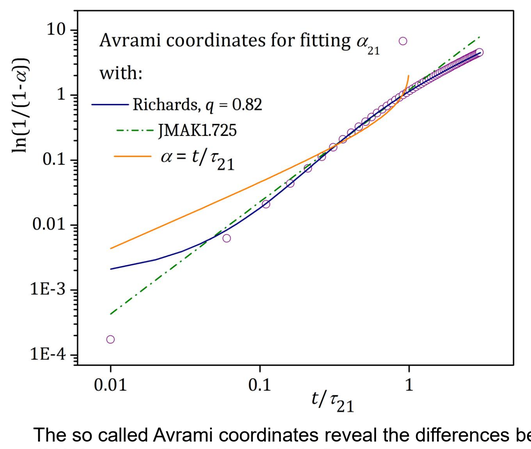
Consists for the moment of 3 models with increasing complexity: α_{Dg}, Johnson-Mehl-Avrami-Kolmogorov (JMAKn) and Richards models

Here we give the equations of the three models from the HSGM for the transformation ratio α:

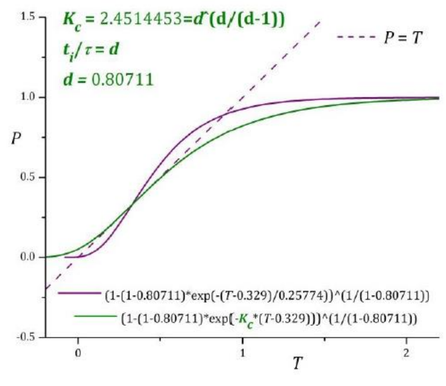
1) α_{Dg} : $d\alpha_{Dg} / d(t/\tau) = 2D(\alpha_{Dg})^{(D-1)/D}(1- \alpha_{Dg})^{g}$; $\alpha_{21} = \tanh2(t/\tau 21)$ (with 1 parameter!)
2) JMAKn: $\alpha = 1 - \exp[-(t/tau_j)^n]$ (with 2 parameters!)
3) Richards: $\alpha = \{1+(q-1)\exp[-(t-t_i)t_k]\}^{(1/(1-q))}$ (with 3 paramete



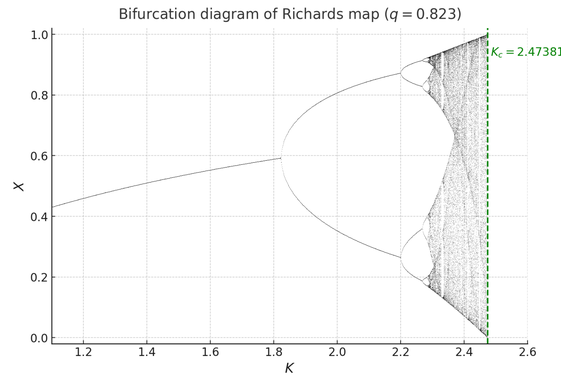
The "sigmoidness" of a sigmoid curve can be measured from the deviations from the line y = x! Only the inflection points of the Richards model are lying strictly on it!



The so called Avrami coordinates reveal the differences between JMAK and the Richards model in fitting α_{21}

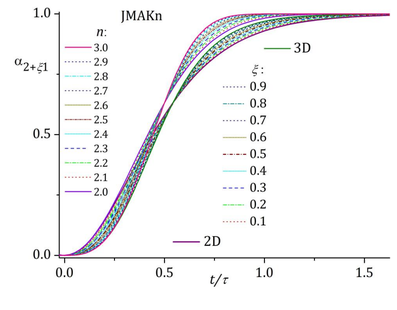


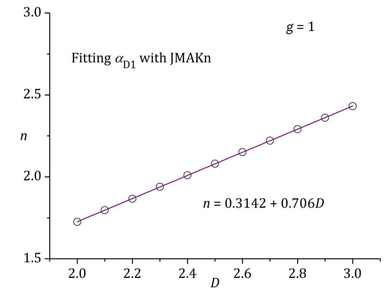
The Richards model is providing a family of curves with same q (here d) that show a catastrophe at certain value of K

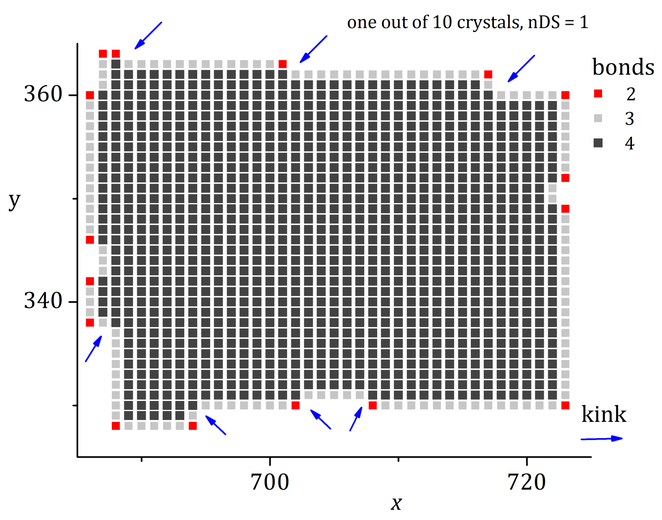


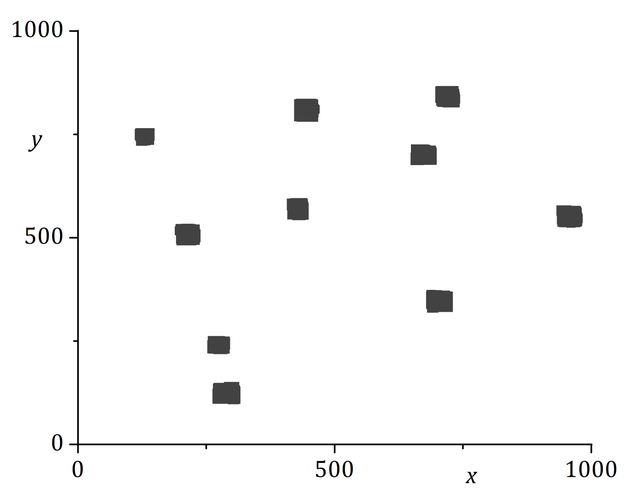
Same value of K is the point of the fully developed chaos in the chaotic map with same q (here d)

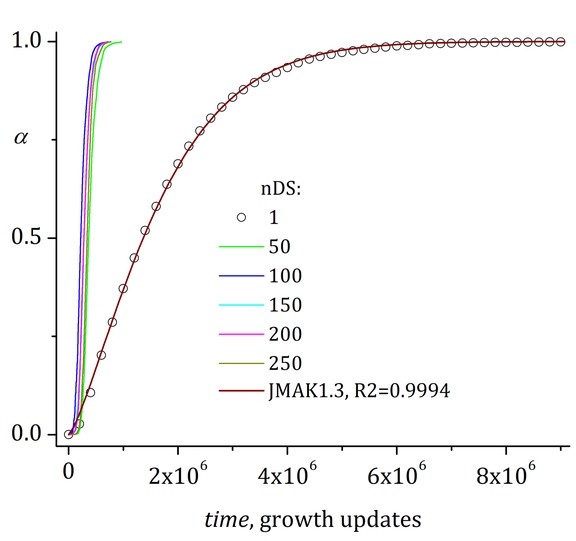
Growth between 2 and 3D



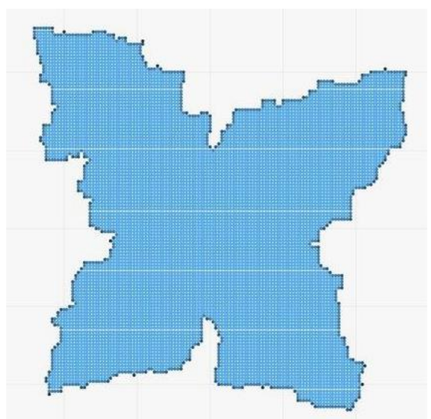




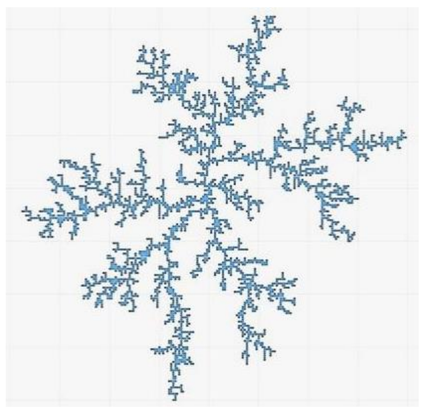




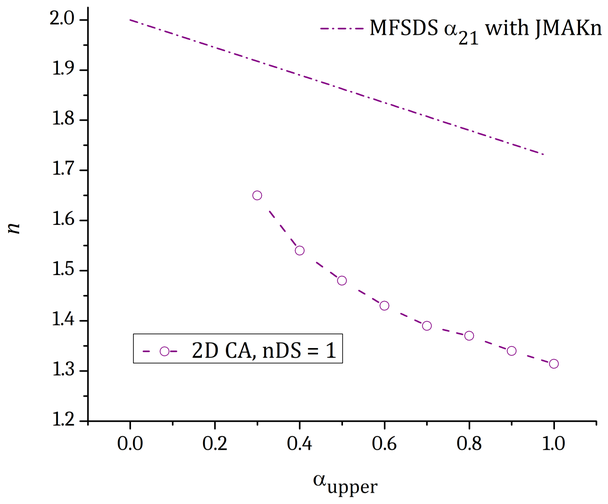
Cellular Automata in 2D are based on attachment rules: to kink position in 2D A2K and to single particle (A21)

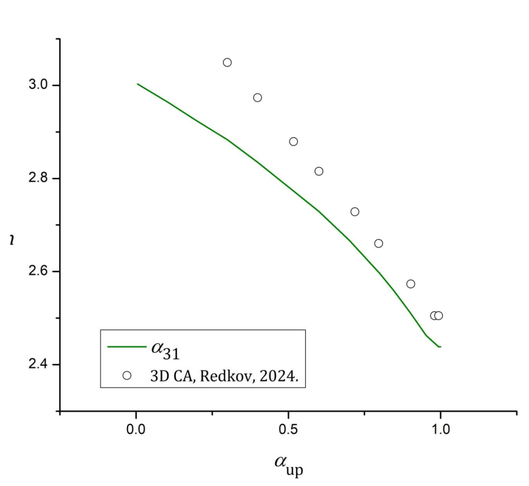


A2K results in a dendrite



A21 results in a fractal cluster





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(The poster develops in three parallel levels)