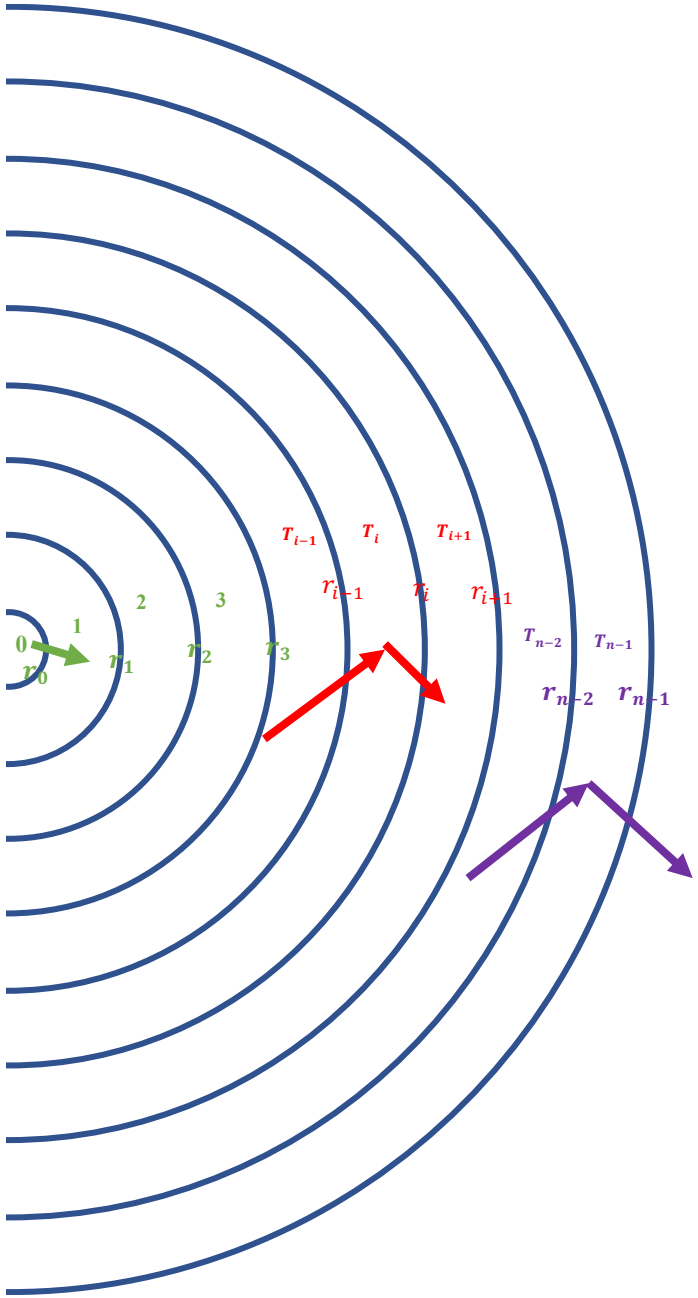
La couche 0



$$\Phi_{out} = -\, s_0\, \lambda \frac{T_1 - T_0}{dr}$$

$$-\quad V_0\, \rho\, * c_p \frac{dT}{dt} = \Phi_{out} = -\, s_0\, \lambda \frac{T_1 - T_0}{dr}$$

$$V_o\, \rho\, c_p \frac{dT}{dt} = s_o\, \lambda \frac{T_1 - T_0}{dr}$$

$$V_o\, \frac{dT}{dt} = s_o\, D\, \frac{T_1 - T_0}{dr}$$

$$dT = \frac{s_o}{V_o} D\, \frac{T_1 - T_0}{dr} * dt$$

$$T_{apres,0} - T_{avant,0} = \frac{s_o}{V_o} D\, \frac{T_1 - T_0}{dr} * dt$$

Surface de la couche 0 :

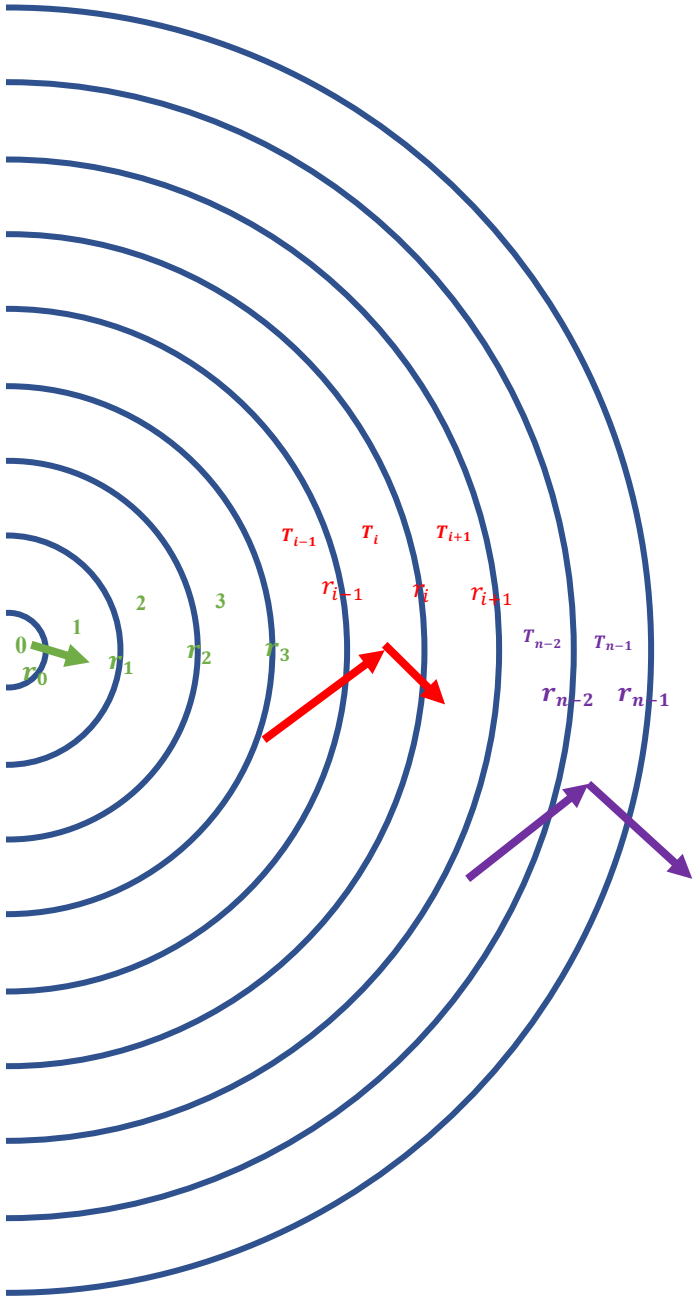
$$s_o = 4\pi\, r_0^{\,2}$$

Volume de la couche 0 :

$$V_o = \frac{4\pi}{3} r_0^{\,3}$$

$$T_{apres,0} = T_{avant,0} + \frac{s_o}{V_o} D\, \frac{T_1 - T_0}{dr} * dt$$

$$D = \frac{\lambda}{\rho\, c_p}$$



La couche i (i=1, ..., n-2)

$$\Phi_{out} = S_{inti} * \lambda \frac{T_i - T_{i-1}}{dr} - S_{exti} * \lambda \frac{T_{i+1} - T_i}{dr}$$

$$-V_i \rho c_p \frac{dT}{dt} = \Phi_{out} = S_{inti} * \lambda \frac{T_i - T_{i-1}}{dr} - S_{exti} * \lambda \frac{T_{i+1} - T_i}{dr}$$

$$-V_i \frac{dT}{dt} = S_{inti} * D \frac{T_i - T_{i-1}}{dr} - S_{exti} * D \frac{T_{i+1} - T_i}{dr}$$

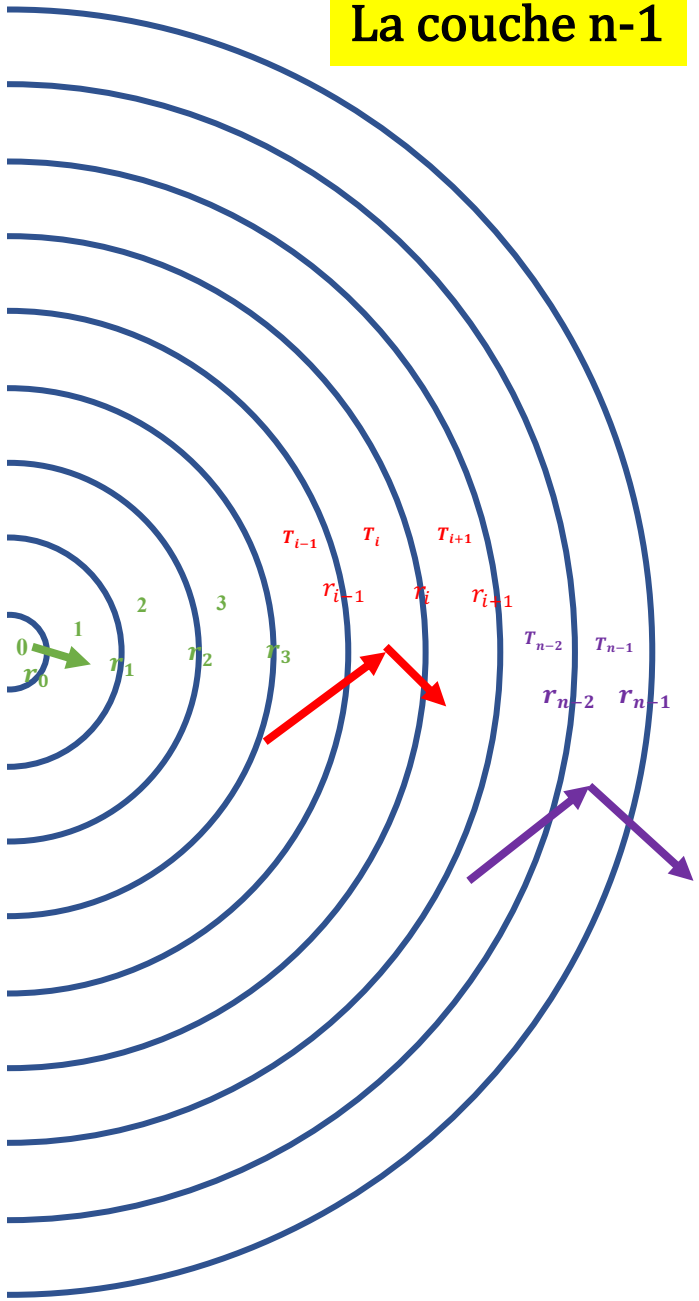
$$dT = -\frac{S_{inti}}{V_i} * D * dt * \frac{T_i - T_{i-1}}{dr} + \frac{S_{exti}}{V_i} * D * dt * \frac{T_{i+1} - T_i}{dr}$$

$$T_{apres,i} = T_{avant,i} - \frac{S_{inti}}{V_i} * D * dt * \frac{T_i - T_{i-1}}{dr} + \frac{S_{exti}}{V_i} * D * dt * \frac{T_{i+1} - T_i}{dr}$$

Surface intérieure : $S_{inti} = 4\pi r_{i-1}^2$
Surface extérieure : $S_{exti} = 4\pi r_i^2$

Volume calculé à partir de la surface intérieure : $V_i = S_{inti}\, dr$
Volume calculé à partir de la surface extérieure : $V_i = S_{exti}\, dr$
Volume réel : $V_i = \frac{4\pi}{3} r_i^3 - \frac{4\pi}{3} r_{i-1}^3$

La couche n-1



$$\Phi_{out} = S_{intfin} * \lambda \frac{T_{n-1} - T_{n-2}}{dr} + S_{extfin} * h(T_{n-1} - T_\infty)$$

$$V_{fin}\,\rho * c_p \frac{dT}{dt} = -\Phi_{out} = -S_{intfin} * \lambda \frac{T_{n-1} - T_{n-2}}{dr} - S_{extfin} * h(T_{n-1} - T_\infty)$$

$$V_{fin}\,\rho * c_p \frac{dT}{dt} = -S_{intfin} * \lambda \frac{T_{n-1} - T_{n-2}}{dr} - S_{extfin} * h(T_{n-1} - T_\infty)$$

$$\rho\, c_p \frac{dT}{dt} = -\frac{S_{intfin}}{V_{fin}} * \lambda \frac{T_{n-1} - T_{n-2}}{dr} - \frac{S_{extfin}}{V_{fin}} * h(T_{n-1} - T_\infty)$$

$$\frac{dT}{dt} = -\frac{S_{intfin}}{V_{fin}} * D * \frac{T_{n-1} - T_{n-2}}{dr} - \frac{S_{extfin}}{V_{fin}} * \frac{h}{\rho\, c_p}(T_{n-1} - T_\infty)$$

$$T_{apres,n-1} = T_{avant,n-1} - \frac{S_{intfin}}{V_{fin}} * D * \frac{dt}{dr} * (T_{n-1} - T_{n-2}) - \frac{S_{extfin}}{V_{fin}} * \frac{h}{\rho\, c_p} * dt * (T_{n-1} - T_\infty)$$

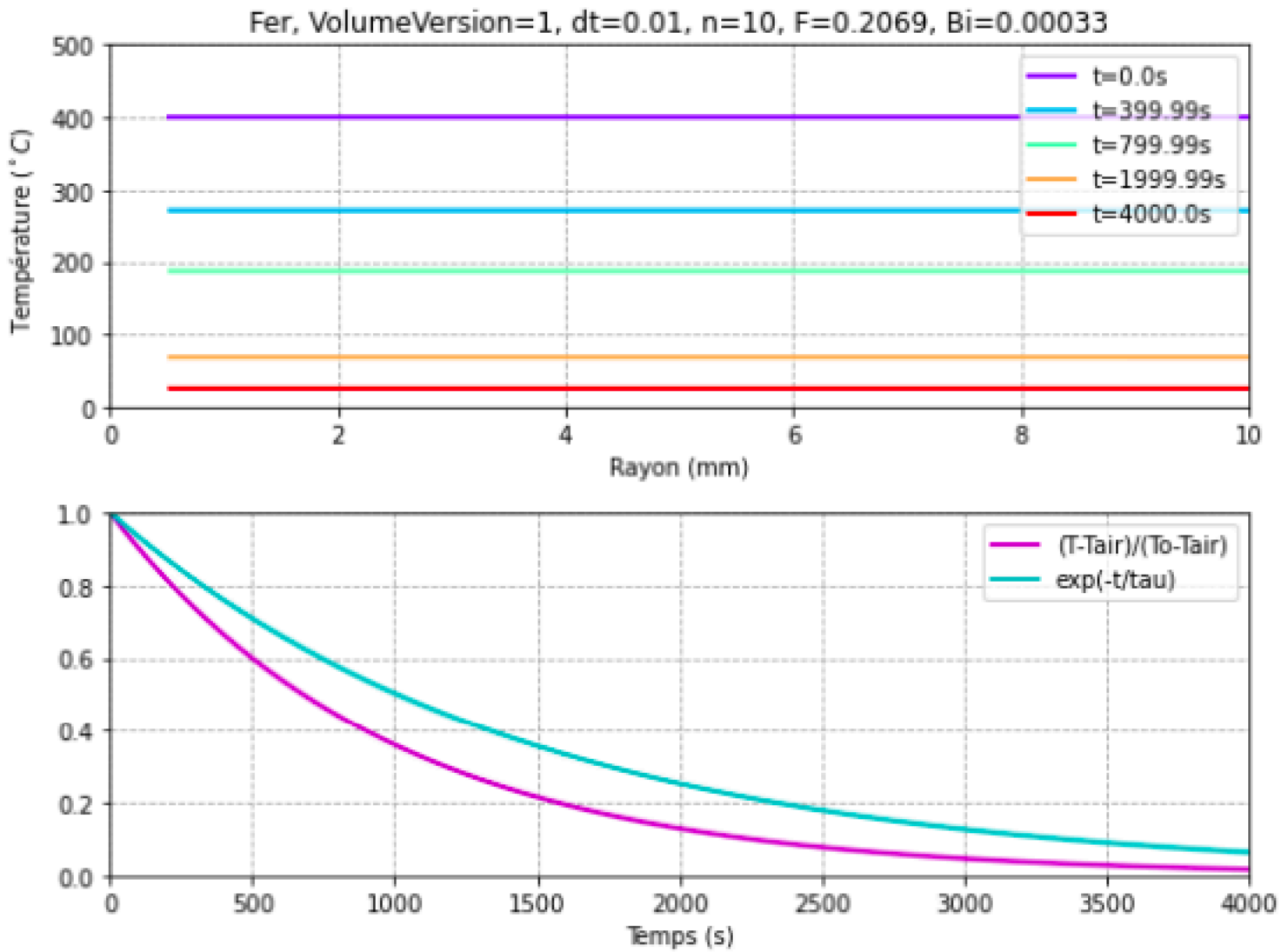
Surface intérieure : $S_{intfin} = 4\pi\, {r_{n-2}}^2$

Surface extérieure : $S_{extfin} = 4\pi\, {r_{n-1}}^2$

Volume calculé à partir de la surface intérieur : $V_{fin} = S_{intfin}\, dr$

Volume calculé à partir de la surface interne : $V_{fin} = S_{extfin}\, dr$

Volume réel : $V_{fin} = \frac{4\pi}{3} {r_{n-1}}^3 - \frac{4\pi}{3} {r_{n-2}}^3$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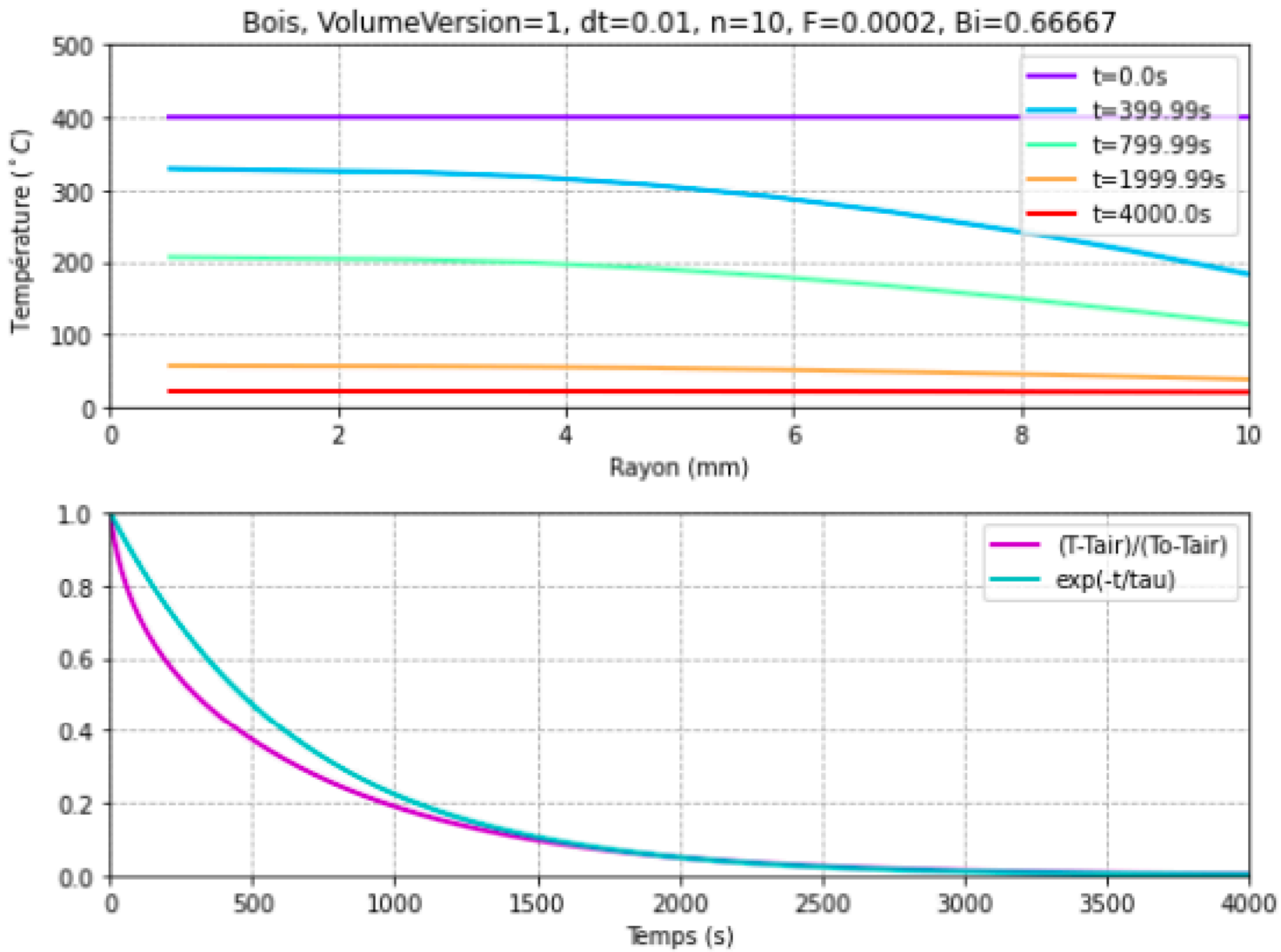
Température (°C)
Rayon (mm)
t=0.0s
t=399.99s
t=799.99s
t=1999.99s
t=4000.0s
(T-Tair)/(To-Tair)
exp(-t/tau)
Temps (s)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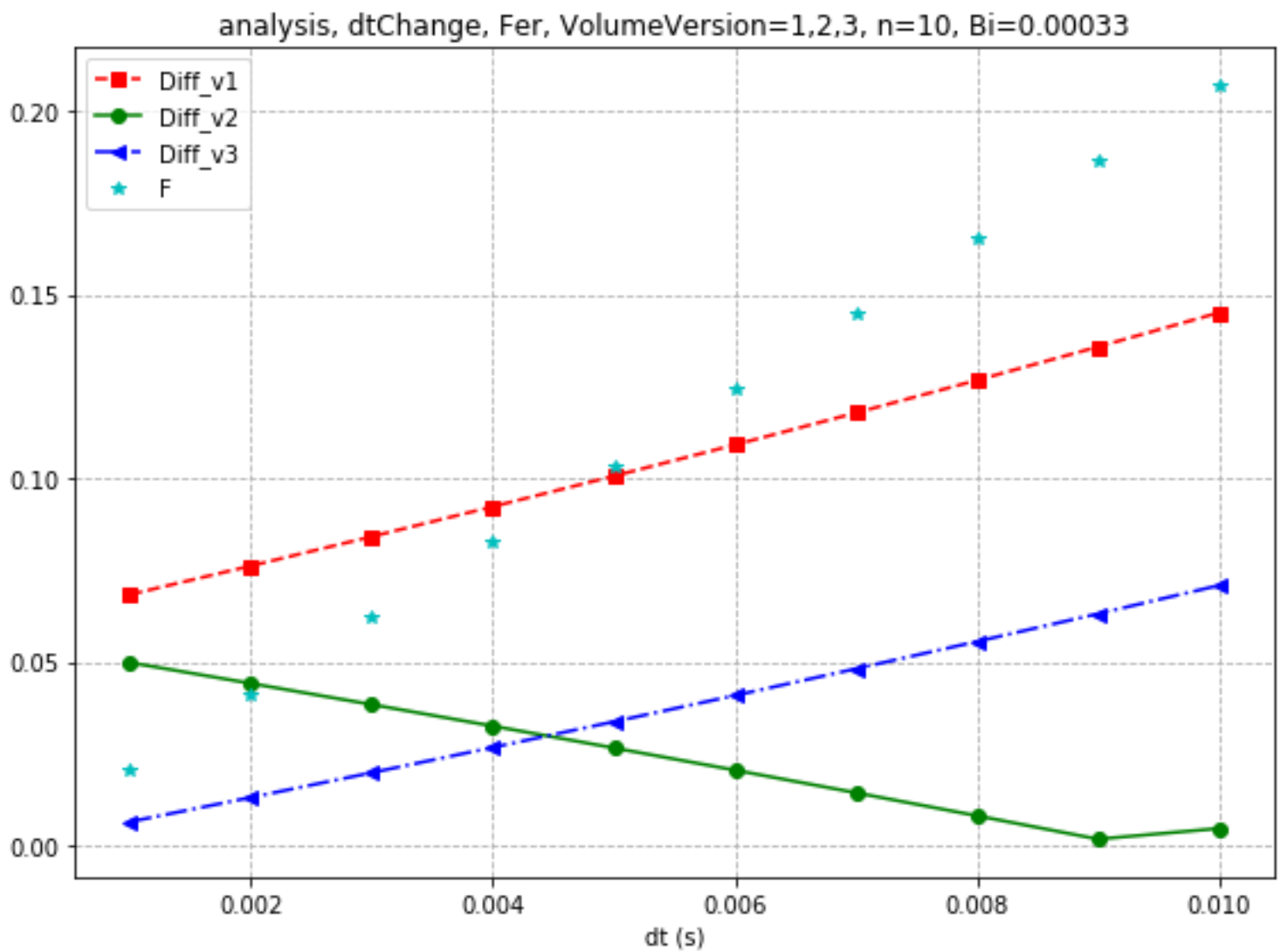
Température (°C)
Rayon (mm)
t=0.0s
t=399.99s
t=799.99s
t=1999.99s
t=4000.0s
(T-Tair)/(To-Tair)
exp(-t/tau)
Temps (s)


analysis, dtChange, Fer, VolumeVersion=1,2,3, n=10, Bi=0.00033
Diff_v1
Diff_v2
Diff_v3
F
0.20
0.15
0.10
0.05
0.00
0.002
0.004
0.006
0.008
0.010
dt (s)