

Integrallösung einer Linienquelle im unendlichen Raum um einen Zylinder

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> restart :

> $T(r, t) := \frac{1}{4 \cdot \text{Pi} \cdot \text{lambda} \cdot L} \cdot \text{int} \left(\frac{Q(t) \cdot \exp \left(-\frac{r^2}{4 \cdot a \cdot (t - \text{tau})} \right) \cdot 1}{t - \text{tau}}, \text{tau} = 0 .. t \right);$

$$T := (r, t) \rightarrow \frac{1}{4} \frac{\int_0^t \frac{Q(\tau) e^{-\frac{1}{4} \frac{r^2}{a(t-\tau)}}}{t-\tau} d\tau}{\pi \lambda L} \quad (1)$$

> T3 := subs(Q(t) = Q0·exp(-b·tau), T(r, t));

$$T3 := \frac{1}{4} \frac{\int_0^t \frac{Q0 e^{-b\tau} e^{-\frac{1}{4} \frac{r^2}{a(t-\tau)}}}{t-\tau} d\tau}{\pi \lambda L} \quad (2)$$

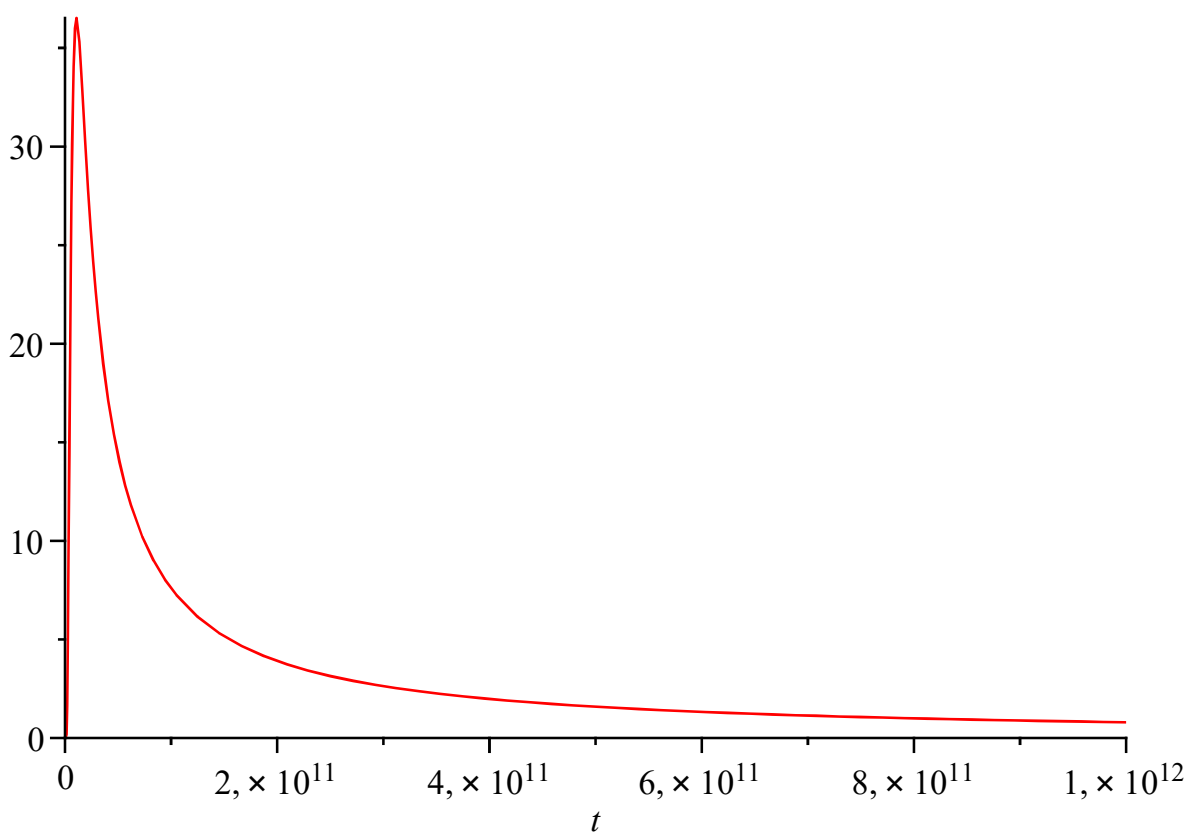
> expand(T3);

$$\frac{1}{4} \frac{Q0 \left(\int_0^t \frac{e^{-\frac{1}{4} \frac{r^2}{a(t-\tau)}}}{e^{b\tau} (t-\tau)} d\tau \right)}{\pi \lambda L} \quad (3)$$

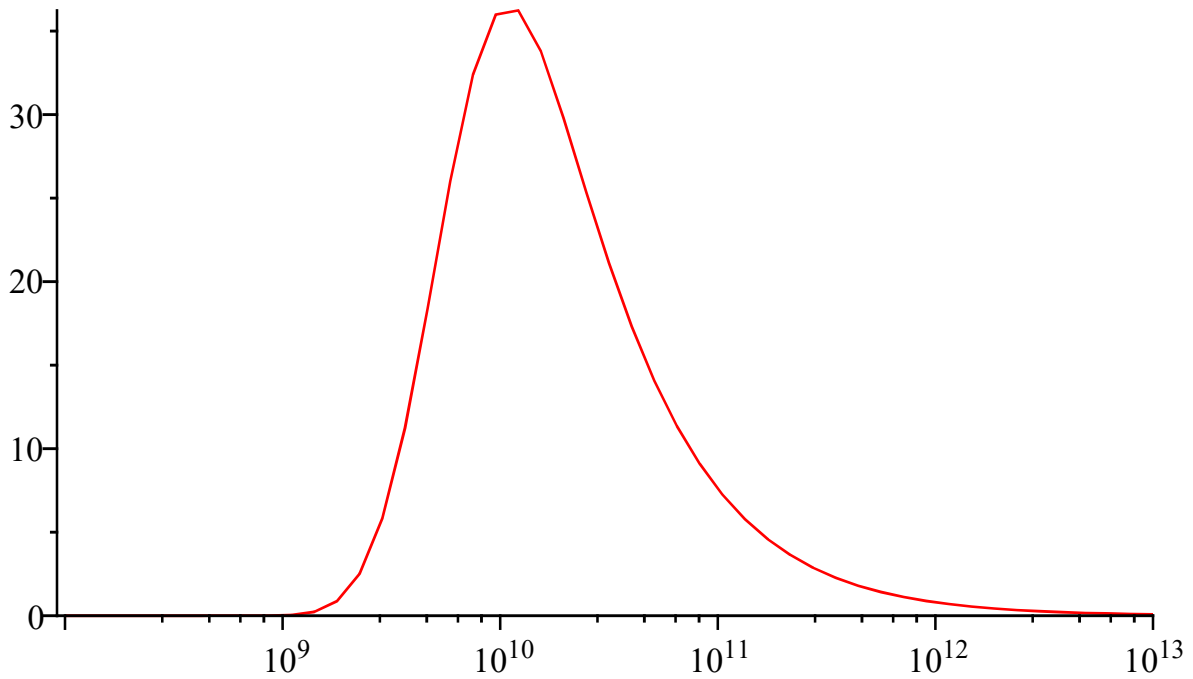
> T3a := evalf(subs(a = $\frac{\text{lambda}}{\text{rho} \cdot \text{cp}}$, lambda = 5.4, rho = 2200, cp = 1200, b = 4.588e-10, L = 800, Q0 = 2e7, T3));

$$T3a := 0.00001842071100 \left(\int_0^t \frac{2 \cdot 10^7 e^{-4.588 \cdot 10^{-10} \tau} e^{-\frac{1.222222223 \cdot 10^5 r^2}{t - 1. \tau}}}{t - 1. \tau} d\tau \right) \quad (4)$$

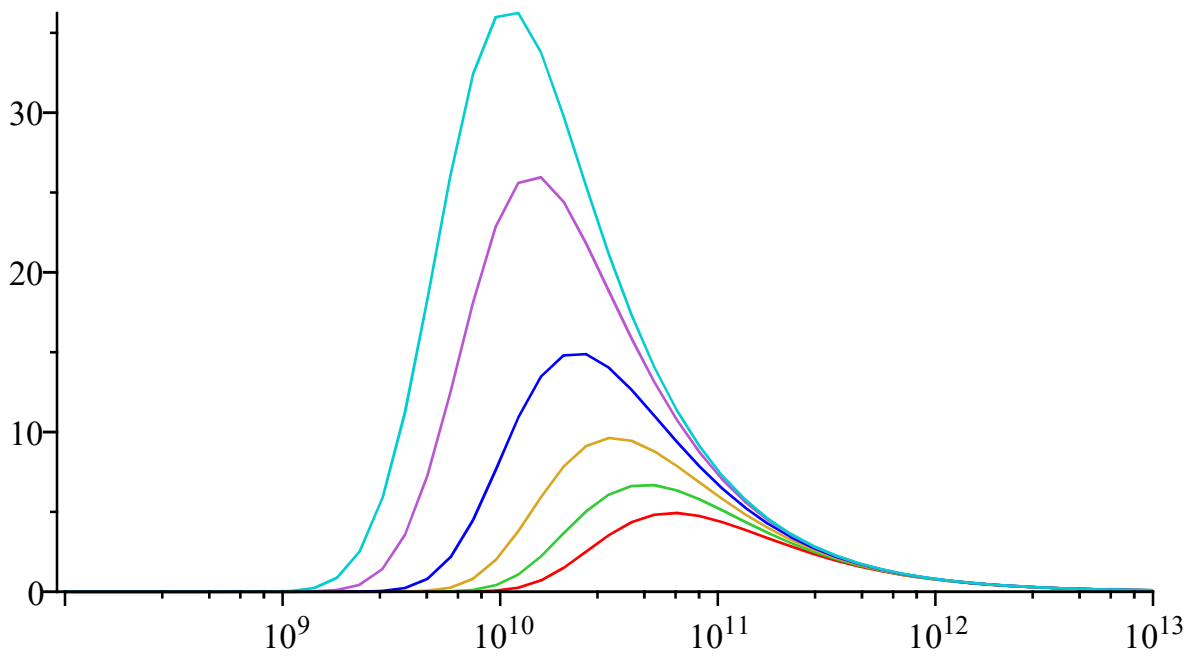
> plot(subs(r=250, T3a), t=1e5..1e12);



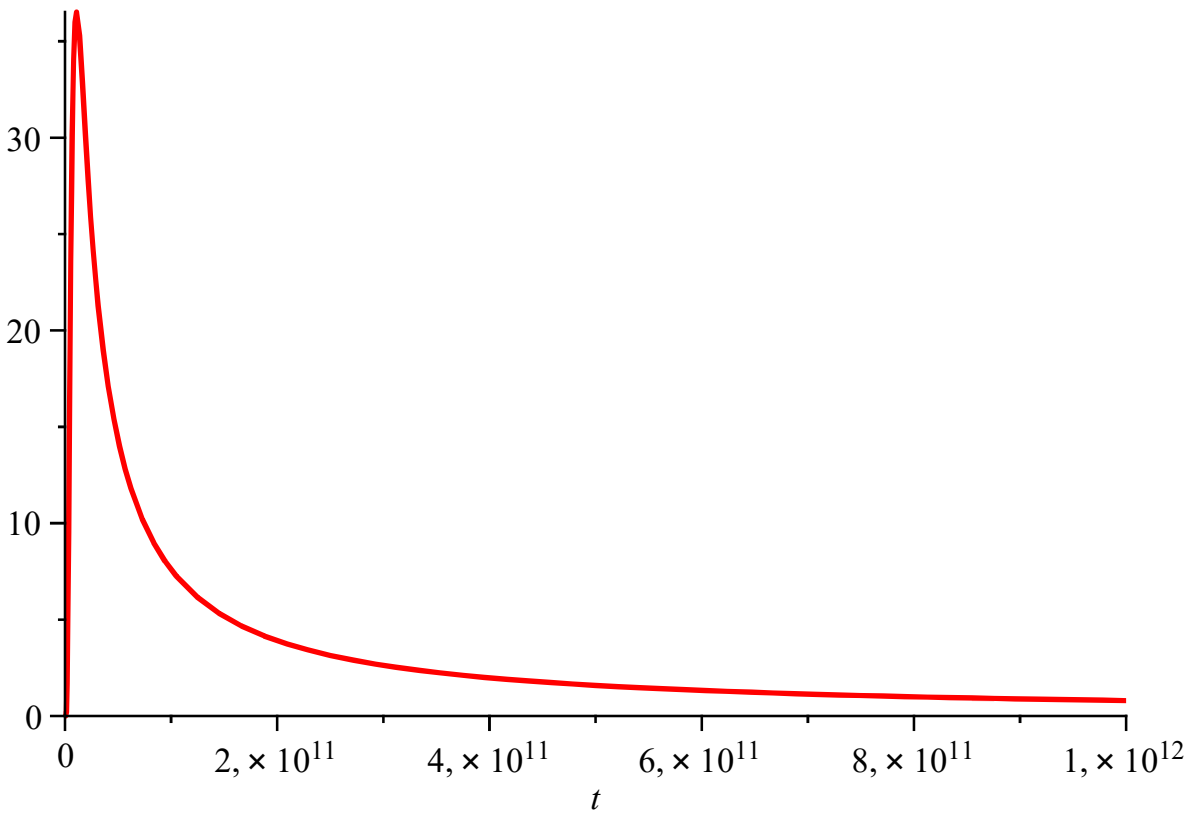
```
> with(plots) :
> semilogplot(subs(r=250, T3a), t=1e8..1e13);
```



```
> semilogplot( {subs(r=250, T3a), subs(r=300, T3a), subs(r=400, T3a), subs(r=500, T3a),
subs(r=600, T3a), subs(r=700, T3a) }, t=1e8..1e13);
```

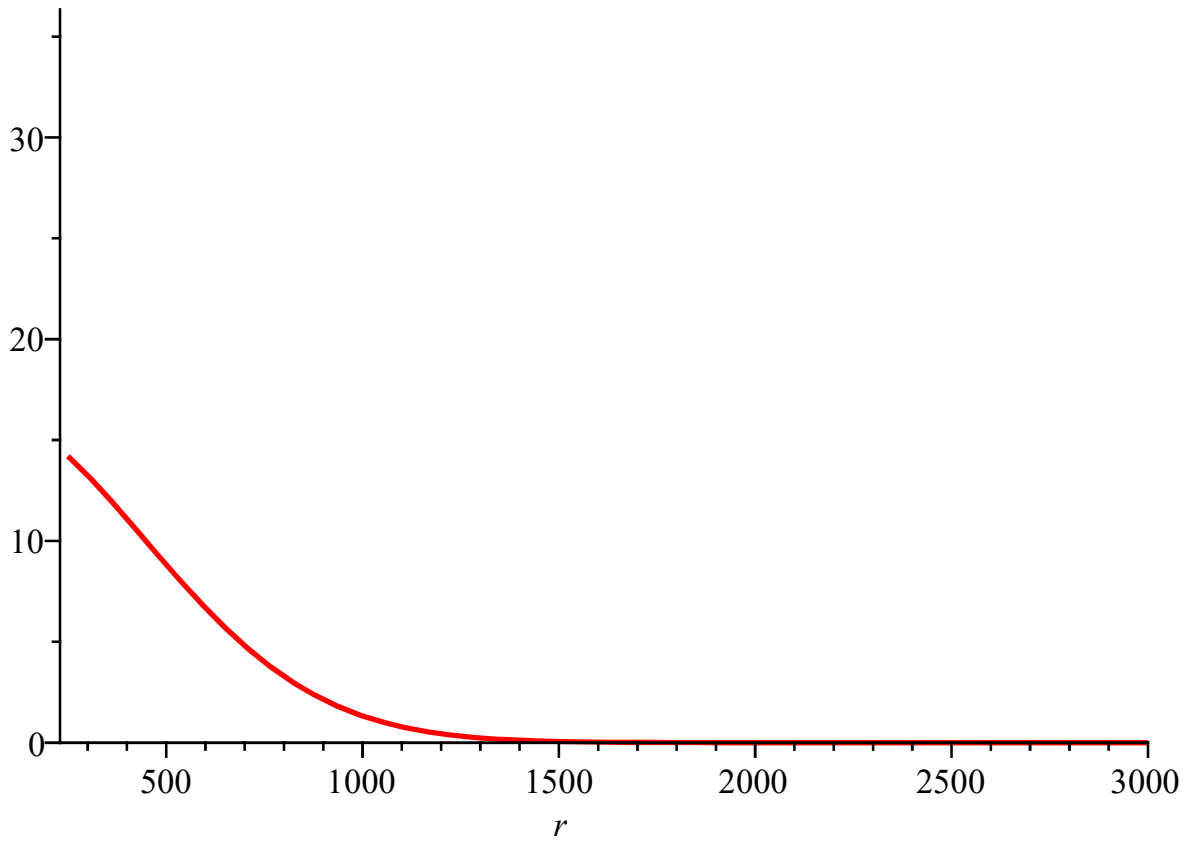


```
> animate(plot, [T3a, t = 1e7 .. 1e12, thickness = 2], r = 250 .. 3000, frames = 100);
           r = 250.
```



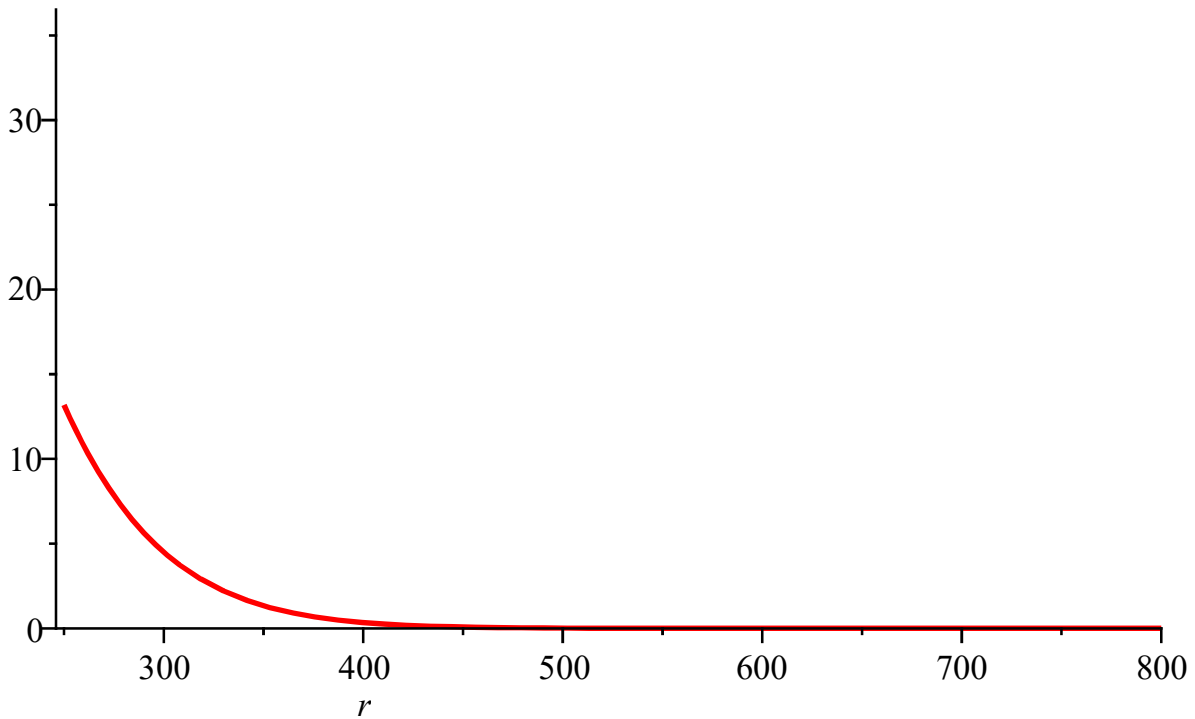
```
> animate(plot, [T3a, r = 250 .. 3000, thickness = 2], t = 1e7 .. 1e12, frames = 100);
```

$$t = 5.0515 \cdot 10^{10}$$



```
> animate(plot, [T3a, r=250..800, thickness=2], t=1e8..2e10, frames=100);
```

$$t = 3.9192 \cdot 10^9$$



```
> animate(plot, [T3a, r=10..250, thickness=2], t=1e6..2e9, frames=100);
```

$t = 2.0000 \cdot 10^9$

