

## rhobar

```
(* rho bar *)
jacobian := 4 π k2
fungsi := 
$$\frac{2}{(2\pi)^3} \frac{1}{(1 + \beta k^2)^2}$$

fungsi = Series[fungsi * jacobian, {β, 0, 1}];
fungsi = Integrate[fungsi, {k, 0, kF}, Assumptions → And[kF > 0, β ≥ 0, ms > 0]];
fungsi = Normal[Series[fungsi, {β, 0, 1}]] // FullSimplify // TrigToExp];
fungsi

$$\frac{kF^3}{3\pi^2} - \frac{2kF^5\beta}{5\pi^2}$$

```

## dapetin kF sbg fungsi rhobar dalam bentuk kasar

```
(* dapetin kF sbg fungsi rhobar dalam bentuk kasar *)
Solve[rhobar == 
$$\frac{kF^3}{3\pi^2} + \beta \text{small}, kF][[3]] /. \{ \text{small} \rightarrow -\frac{2kF^5}{5\pi^2} \}
\{ kF \rightarrow 3^{1/3} \pi^{2/3} \left( rhobar + \frac{2kF^5\beta}{5\pi^2} \right)^{1/3} \}

Series[3^{1/3} \pi^{2/3} \left( rhobar + \frac{2kF^5\beta}{5\pi^2} \right)^{1/3} /. \{ kF \rightarrow (3\pi^2 rhobar)^{1/3} \}, \{ \beta, 0, 1 \}]
3^{1/3} \pi^{2/3} rhobar^{1/3} + 
$$\frac{6}{5} \pi^2 rhobar \beta + O[\beta]^2$$


3^{1/3} \pi^{2/3} rhobar^{1/3} /. \{ rhobar \rightarrow 
$$\frac{kF^3}{3\pi^2} - \frac{2kF^5\beta}{5\pi^2} \}
3^{1/3} \pi^{2/3} \left( \frac{kF^3}{3\pi^2} - \frac{2kF^5\beta}{5\pi^2} \right)^{1/3}$$$$

```

## rho bar s

```
(* rho bar s *)
jacobian := 4 π k2

fungsi := 
$$\frac{2}{(2\pi)^3} \frac{1}{(1+\beta k^2)^2} \frac{ms}{\sqrt{\frac{1}{\beta} \operatorname{ArcTan}[\sqrt{\beta} k]^2 + ms^2}}$$


fungsi = Series[fungsi * jacobian, {β, 0, 1}];
fungsi = Integrate[fungsi, {k, 0, kF}, Assumptions → And[kF > 0, β ≥ 0, ms > 0]];
fungsi = Normal[Series[fungsi, {β, 0, 1}] // FullSimplify // TrigToExp];
fungsi


$$\frac{kF ms \sqrt{kF^2 + ms^2} + ms^3 \operatorname{Log}\left[\frac{ms}{kF + \sqrt{kF^2 + ms^2}}\right]}{2\pi^2} +$$


$$\left(\beta \left(-10 kF^5 ms + kF^3 ms^3 + 3 kF ms^5 + 3 ms^5 \sqrt{kF^2 + ms^2} \operatorname{Log}\left[\frac{ms}{kF + \sqrt{kF^2 + ms^2}}\right]\right)\right) /$$


$$\left(24 \sqrt{kF^2 + ms^2} \pi^2\right)$$

```

## eden

```
(* eden *)
jacobian := 4 π k2

fungsi := 
$$\frac{2}{(2\pi)^3} \frac{1}{(1+\beta k^2)^2} \sqrt{\frac{1}{\beta} \operatorname{ArcTan}[\sqrt{\beta} k]^2 + ms^2}$$


fungsi = Series[fungsi * jacobian, {β, 0, 1}];
fungsi = Integrate[fungsi, {k, 0, kF}, Assumptions → And[kF > 0, β ≥ 0, ms > 0]];
fungsi = Normal[Series[fungsi, {β, 0, 1}] // FullSimplify // TrigToExp];
fungsi


$$\frac{kF \sqrt{kF^2 + ms^2} (2 kF^2 + ms^2) + ms^4 \operatorname{Log}\left[\frac{ms}{kF + \sqrt{kF^2 + ms^2}}\right]}{8\pi^2} + \frac{1}{144\pi^2}$$


$$\beta \left(kF \sqrt{kF^2 + ms^2} (-56 kF^4 - 2 kF^2 ms^2 + 3 ms^4) + 3 ms^6 \operatorname{Log}\left[\frac{ms}{kF + \sqrt{kF^2 + ms^2}}\right]\right)$$

```

## press

```
(* press *)
jacobian := 4 π k2

fungsi := 
$$\frac{2}{(2 \pi)^3} \frac{1}{(1 + \beta k^2)^2} \frac{k^2}{\sqrt{\frac{1}{\beta} \operatorname{ArcTan}[\sqrt{\beta} k]^2 + ms^2}}$$


fungsi = Series[fungsi * jacobian, {β, 0, 1}];
fungsi = Integrate[fungsi, {k, 0, kF}, Assumptions → And[kF > 0, β ≥ 0, ms > 0]];
fungsi = Normal[Series[fungsi, {β, 0, 1}]] // FullSimplify // TrigToExp];
fungsi


$$\frac{1}{144 \sqrt{kF^2 + ms^2} \pi^2} \beta \left( -40 kF^7 - 2 kF^5 ms^2 + 5 kF^3 ms^4 + 15 kF ms^6 + 15 ms^6 \sqrt{kF^2 + ms^2} \left( \operatorname{Log}[ms] - \operatorname{Log}\left[kF + \sqrt{kF^2 + ms^2}\right] \right) \right) + \frac{1}{8 \pi^2} \left( kF (2 kF^2 - 3 ms^2) \sqrt{kF^2 + ms^2} + 3 ms^4 \left( -\operatorname{Log}[ms] + \operatorname{Log}\left[kF + \sqrt{kF^2 + ms^2}\right] \right) \right)$$

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