

## rhubar

```
(* rho bar *)
jacobian := 4 π k²
funksi :=  $\frac{2}{(2 \pi)^3} \frac{1}{(1 + \beta k^2)^2}$ 
funksi = Series[funksi * jacobian, {β, 0, 1}];
funksi = Integrate[funksi, {k, 0, kF}, Assumptions → And[kF > 0, β ≥ 0, ms > 0]];
funksi = Normal[Series[funksi, {β, 0, 1}] // FullSimplify // TrigToExp];
funksi
```

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

## 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]] /. {small →  $-\frac{2 kF^5}{5 \pi^2}$ }
```

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

```
Series[ $3^{1/3} \pi^{2/3} \left( \text{rhobar} + \frac{2 kF^5 \beta}{5 \pi^2} \right)^{1/3}$  /. {kF →  $(3 \pi^2 \text{rhobar})^{1/3}$ }, {β, 0, 1}]
```

$$3^{1/3} \pi^{2/3} \text{rhobar}^{1/3} + \frac{6}{5} \pi^2 \text{rhobar} \beta + O[\beta]^2$$

```
 $3^{1/3} \pi^{2/3} \text{rhobar}^{1/3}$  /. {rhobar →  $\frac{kF^3}{3 \pi^2} - \frac{2 kF^5 \beta}{5 \pi^2}$ }
```

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

## rho bar s

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

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


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

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

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

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

## eden

```
(* eden *)
jacobian := 4 π k2

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


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

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

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

press

```
(* press *)
jacobian := 4 π k2

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

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

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