In [1]:
```python
import numpy as np
import matplotlib.pyplot as plt
```

# Ex 10

Given is the likelihood function for a measured value $x$ at a given parameter $a$ $L(X;a)$=1 1 mit $a$>0. (1) $\pi$ 1+($x$−$a$)2

## a)

Using the Neyman construction, determine the central frequentist 90 % confidence interval for $a$ when a value $x$ = 10 was measured.

Likelihood funktion integerieren:

$\int L(x,a) = \frac{1}{\pi}\arctan(x-a)$

Symmetrisches Intervall bestimmen. Untere Grenze, indem integrieren bis $x_{unten}$, wo integral 0,05 ist:

$\int_{-\infty}^{x_{unten}} L(x,a) = 0.05$

$\Leftrightarrow \frac{1}{\pi}\arctan(x-a)|_{-\infty}^{unten} = 0.05$

$\Leftrightarrow \lim_{u\to-\infty} \frac{1}{\pi}(\arctan(x_{unten}-a) - \arctan(u-a)) = 0.05$

$\Leftrightarrow \frac{1}{\pi}(\arctan(x_{unten}-a) - \frac{-\pi}{2}) = 0.05$

$\Leftrightarrow \arctan(x_{unten}-a) = 0.05\pi - \frac{\pi}{2}$

$\Leftrightarrow x_{unten} = \tan(\frac{-9}{20}\pi) + a$

$\Rightarrow x_{unten} \approx -6.31 + a$

Obere Grenze:

$\Rightarrow \frac{1}{\pi}\arctan(x-a)|_{x_{oben}}^{\infty} = 0.05$

$\Leftrightarrow x_{oben} = \tan(\frac{9}{20}) + a$

$\Rightarrow x_{oben} \approx 6.31 + a$

In [2]:
```python
x = np.tan(9/20 * np.pi)
x
```

Out[2]:
```
6.313751514675041
```

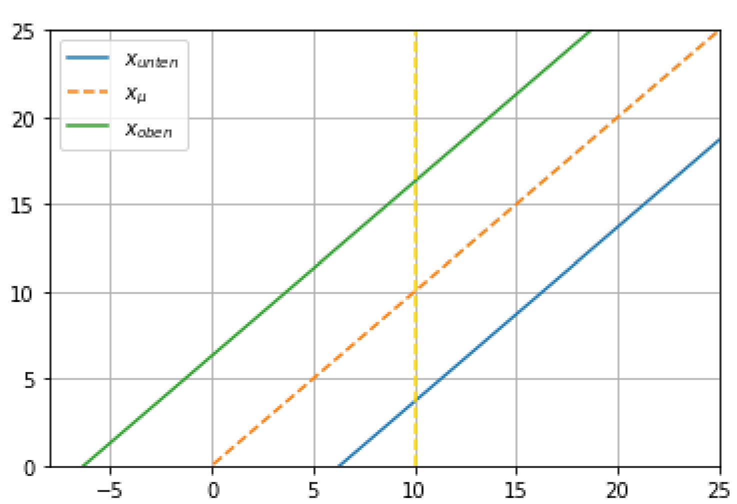
In [3]:
```python
def L(a,x=10):
    return 1/np.pi * 1/(1+(x-a)**2)

a = np.linspace(-10,25,1000)

fig, ax = plt.subplots(1,1)
ax.plot(a,-6.31+a, label = "$x_{unten}$")
ax.plot(a,a, ls = "dashed", label = "$x_{\mu}$")
ax.plot(a,6.31+a , label = "$x_{oben}$")
ax.set_xlim(-8,25)
ax.set_ylim(0,25)
plt.grid()
plt.legend()

ax.vlines(10, 0,25, ls = "dashed", color = "gold")
```

Out[3]:
```
<matplotlib.collections.LineCollection at 0x7f22e116f970>
```




Haben nicht verstanden was man machen muss, ist wahrscheinlich falsch der plot.