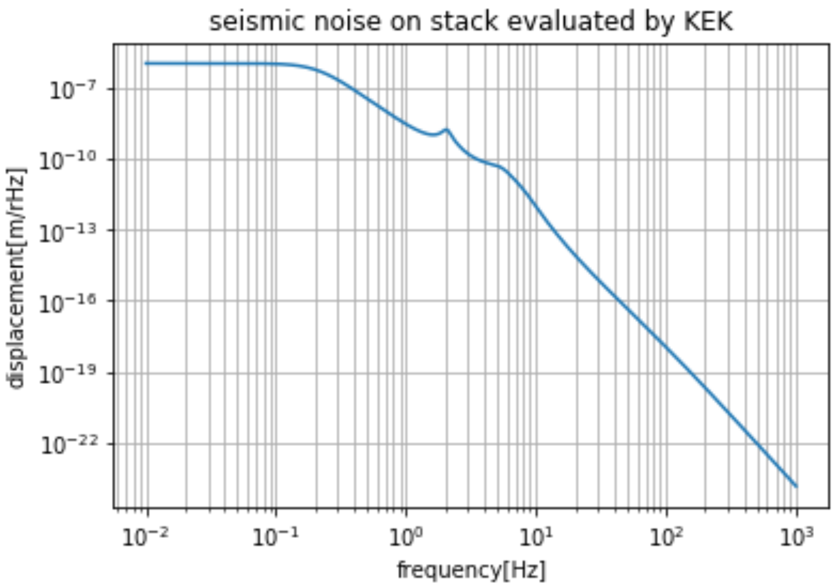
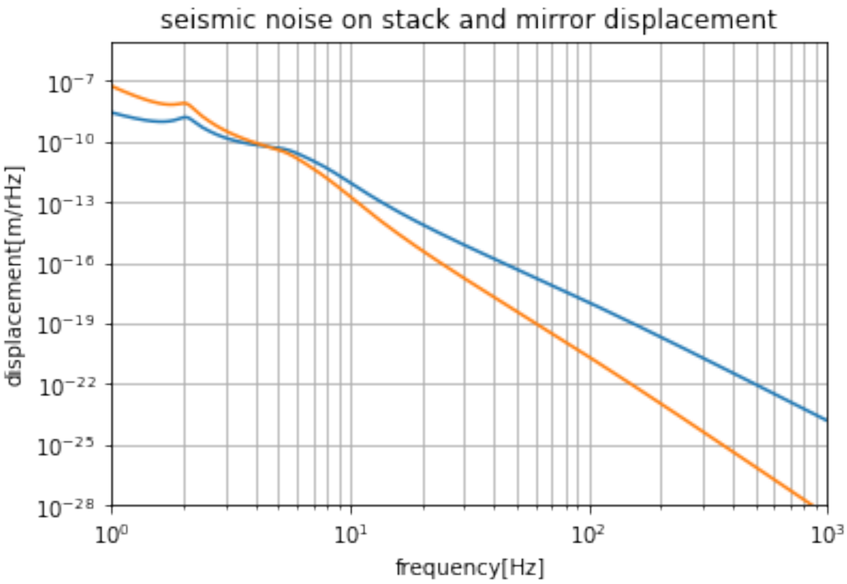
In [1]:
```
import numpy as np
import matplotlib.pyplot as plt
freq1, mprHz1 = np.loadtxt("./stackKEK.dat", unpack=True)
plt.xscale("log")
plt.yscale("log")
plt.grid(which="both")
plt.xlabel(r"frequency[Hz]") # x-axis
plt.ylabel(r"displacement[m/rHz]") # y-axis
plt.title(r"seismic noise on stack evaluated by KEK")#title
plt.plot(freq1, mprHz1)
plt.show()
```



In [ ]:
```
[Rough estimation of the mirror angular motion
 due to extra static  magnetic feature of OSEM]

While the mirror is suspended by Type-C double pendulum,
OSEM is fixed to its suspension frame.
Then the relative displacement between the OSEM and the magnets
on the mirror is about the same as the seismic motion on stack
measured by KEK, if the mirror is isolated well,
in particular in high frequency range.

Because the OSEM has a kind of extra magnetic feature,
the mirror is accelerated due to this relative motion,
about k1=0.2N/mm per 1 magnet;L5phi2.
There are 4 magnets on the mirror, so the coupling coefficient is,
k4=0.8[N/mm]=800[N/m].

The mirror displacement by this force is about
ma=k4[N/m]*x_stack[m/rHz].

Mirror mass is about m=1kg, then a=800[/s^2*m/rHz].
To make this into displacement x, divide the value by (2pi*f)^2,
x_ex=x_stack*800/(2pi*f)^2[m/rHz]
```

In [2]:
```
plt.xscale("log")
plt.yscale("log")
plt.grid(which="both")
plt.xlabel(r"frequency[Hz]") # x-axis
plt.ylabel(r"displacement[m/rHz]") # y-axis
plt.title(r"seismic noise on stack and mirror displacement")#title
plt.plot(freq1, mprHz1)
mprHz2=mprHz1*800/(2*np.pi*freq1)/(2*np.pi*freq1)
plt.plot(freq1, mprHz2)
plt.xlim([1,1000])
plt.ylim([1e-28, 1e-5])
plt.show()
```

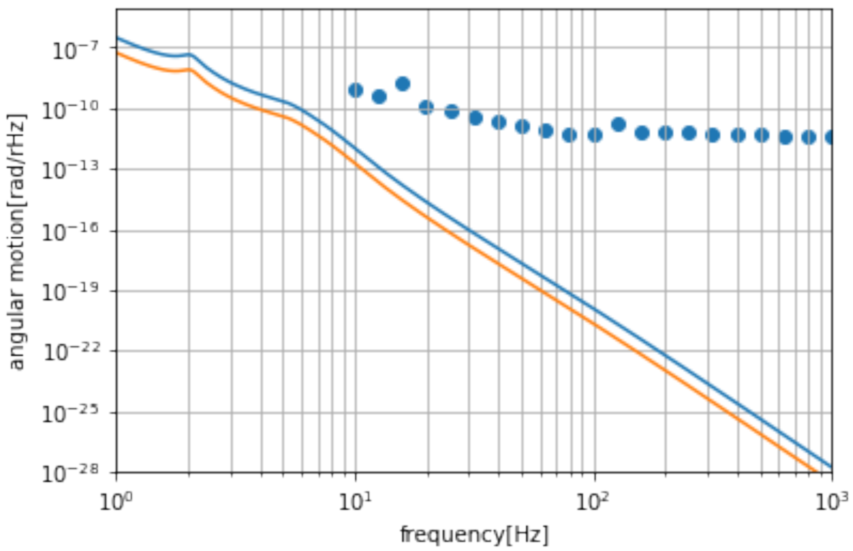


Blue line shows the original stack motion.
Orange line shows excited motion by magnetic feature.
At low frequency region, the assumption of the equation is not valid.

In [ ]:
```
If there is 10% imbalance of the mirror horizontal motion x_stack,
and convert it into angular motion by dividing it by the mirror diamte:
d=10cm, angular motion noise due to extra static magnetic feature,
x_a is evaluated as
x_a=x_stack[m/rHz]*0.1(assumed coupling)/0.1[m]=x_stack[rad/rHz]
```

In [ ]:
```
Other way to estimate the angular motion is to take moment of inertia
into account.

Iz=M/12*(3r^2+L^2)
=1[kg]/12*(3*5[cm^2]+6[cm^2])=9.25[kg.cm^2]

r*F=5[cm]*k1[N/mm]*4*x_stack*0.1(assumed imbalance)
   =5*0.2*4*0.1*10*s_stack=4*x_stack[N.m/rHz]

radprHz=r*F/Iz/(2pi*f)^2
       =4*x_stack/9.25/(2pi*f)^2
       =4444*x_stack/(2pi*f)^2[rad/rHz]
```

In [3]:
```
radprHz=mprHz1*4444/(2*np.pi*freq1)/(2*np.pi*freq1)
plt.xscale("log")
plt.yscale("log")
plt.grid(which="both")
plt.xlabel(r"frequency[Hz]") # x-axis
plt.ylabel(r"angular motion[rad/rHz]")
# y-axis plt.scatter(freq1, radprHz)
hor_req, ver_req, freq_req =
 np.loadtxt("./typeCreq.dat", unpack=True, skiprows=1)
plt.plot(freq1, radprHz)
plt.plot(freq1, mprHz2)
plt.scatter(freq_req, ver_req)
plt.xlim([1, 1000])
plt.ylim([1e-28, 1e-5])
plt.show()
```



Blue dots show required upper limit of the mirror angular motion calculated by Somiya-san.
Blue line shows the angular motion estimated by using moment of inertia.
Orange line shows the angular motion estimated from 10% coupling from horizontal motion.
Both estimations are well below the requirement over 10Hz.