CP1 Blatt9 Abgabe Lapp & Brieden

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In [1]:
```
import numpy as np
import matplotlib.pyplot as plt
import scipy.integrate as integrate
import scipy.constants as constants
plt.style.use('bmh')
plt.rcParams['figure.figsize'] = (15.0, 5.0)
plt.rcParams['figure.dpi'] = 200
plt.rcParams['font.size'] = 14
```

Aufgabe 9.1 Radiation in the visible

$$u(\nu, T) = \frac{2h\nu^3}{c^2} \frac{1}{exp(h\nu/k_B T) - 1}$$

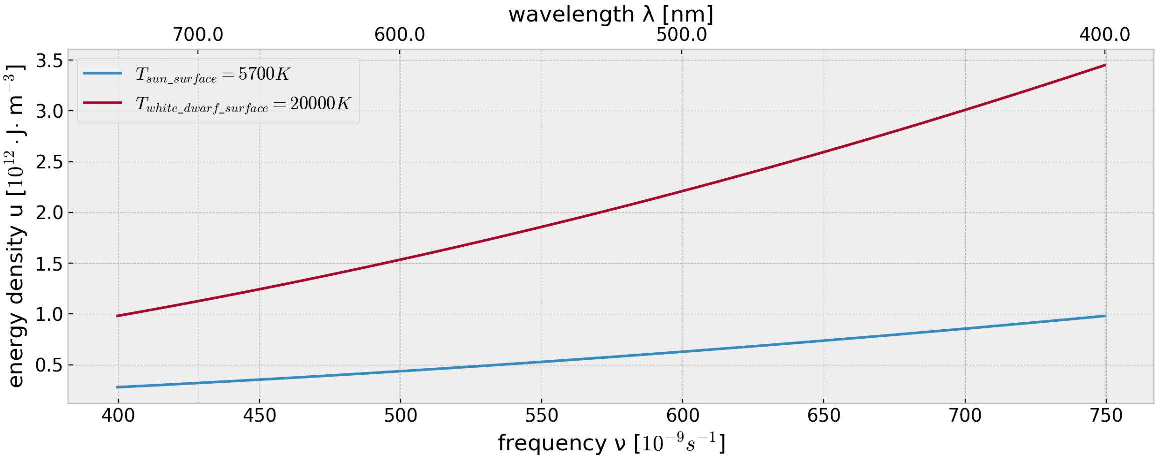
$$\lambda = \frac{c}{\nu}$$

In [2]:
```
u  = lambda ν, T:  2 * h * ν**3 / c**2 * 1 / (np.exp( h * ν / (k_B * T)) - 1)

h = constants.h
c = constants.c
k_B = constants.Boltzmann

λ = np.linspace(400e-6, 750e-6,100)
ν = c/λ
u_5700 = u(ν, 5700)
u_20000 = u(ν, 20000)

fig = plt.figure()
ax1 = fig.add_subplot(1,1,1)
ax1.plot(ν * 1e-9, u_5700 * 1e12, label= "$T_{sun\_surface}= 5700K$")
ax1.plot(ν * 1e-9, u_20000 * 1e12, label= "$T_{white\_dwarf\_surface}= 20000K
$")
ax1.set_ylabel("energy density u [$10^{12}\cdot$J$\cdot$ m$^{-3}$]"),ax1.set_x
label("frequency ν [$10^{-9}s^{-1}$]"), ax1.legend(),
ax2 = ax1.twiny()
freq = np.array([4e5, 5e5, 6e5, 7e5])
ax2.set_xlim(ax1.get_xlim()), ax2.set_xticks([c/λ for λ in freq]), ax2.set_xti
cklabels(freq*1e-3), ax2.set_xlabel("wavelength λ [nm]")
plt.show()
```



9.2 Period of oscillation

$$T = \sqrt{2m} \int_{x_-}^{x_+} \frac{\mathrm{d}x}{\sqrt{E - V(x)}}$$

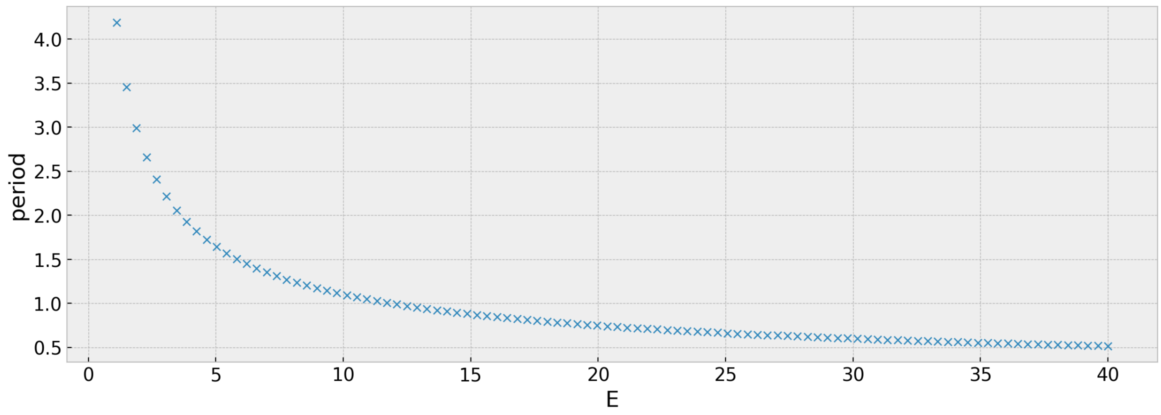
$$V(x) = \frac{V_0}{\cos(x)}$$

$$E = V(x_\pm) = \frac{V_0}{\cos(x_\pm)}$$

$$\Rightarrow x = -x_- = x_+ = \arccos(\frac{V_0}{E})$$

In [3]:
```
V_0, m = 1, 0.5
V = lambda x: V_0/np.cos(x)
T = lambda E: np.sqrt(2*m) *integrate.quad(lambda x: 1/np.sqrt(E-V(x)), -np.ar
ccos(V_0/E),np.arccos(V_0/E))[0]

for e in np.linspace(1.1,40,100):
    plt.plot(e, T(e), "x", c="C0")
plt.xlabel("E"), plt.ylabel("period")
plt.show()
```



9.3 Asymptotic expansion

In [4]:
```
def factorial(n):
        return np.prod(range(1,n+1))

for x in range(2,41,2):
    Ei = np.exp(x)/x * sum([(-1)**n*factorial(n)/x**n for n in range(1,21)])
    plt.plot(x, abs(Ei), "x", c="C0")
plt.show()
```