

Experimentalphysik IV (WS 2023/2024)

Übung 4

Tutorium: 2

Abgabe: 08.05.2024

Aufgabe 1:

Aufgabe 2:

Aufgabe 3:

Python-Code

```
from sympy import *
from sympy.plotting import *

a = 5.291e-11

Z, a0, r, theta, phi = symbols("Z a0 r theta phi")
x, y, z = symbols("x y z")

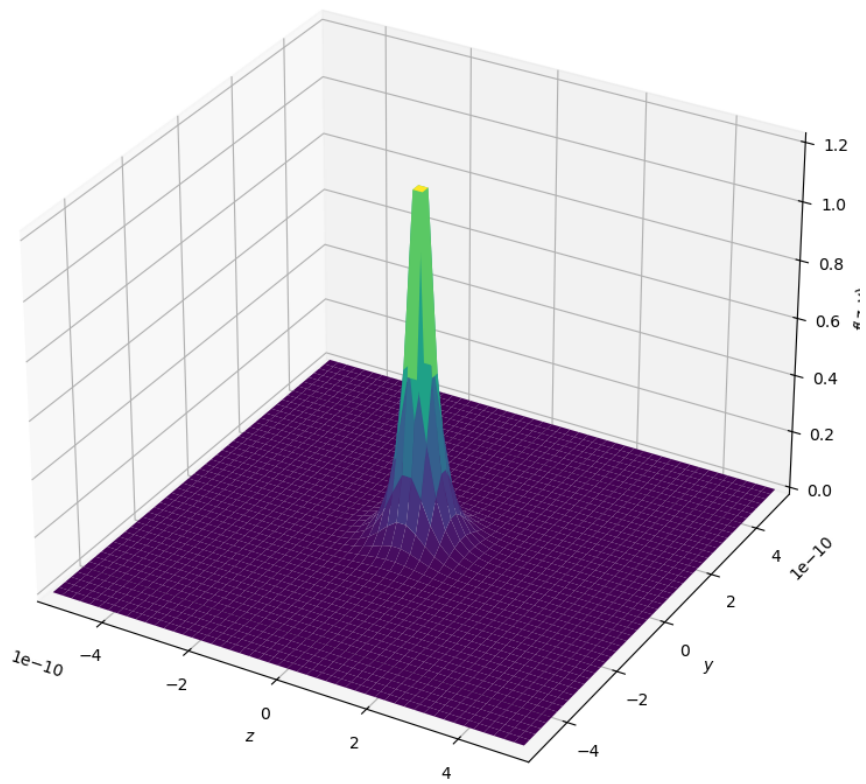
phi1 = 1/sqrt(pi) * (Z/a0)**(3/2) * exp(-Z*r/a0)
phi2 = -1/(8*sqrt(pi)) * (Z/a0)**(3/2) * (Z*r)/a0 * exp(-Z*r/(2*a0)) * sin(theta) * exp(1j *
↳ phi)
phi3 = sqrt(2)/(81*sqrt(pi)) * (Z/a0)**(3/2) * (6-Z*r/a0) * (Z*r)/a0 * exp(-Z*r/(3*a0)) *
↳ cos(theta)

cartesian = lambda f: f.subs({r: sqrt(x**2 + y**2 + z**2),
                             theta: acos(z / sqrt(x**2 + y**2 + z**2)),
                             phi: atan2(y,x),
                             Z:1,
                             a0:a})

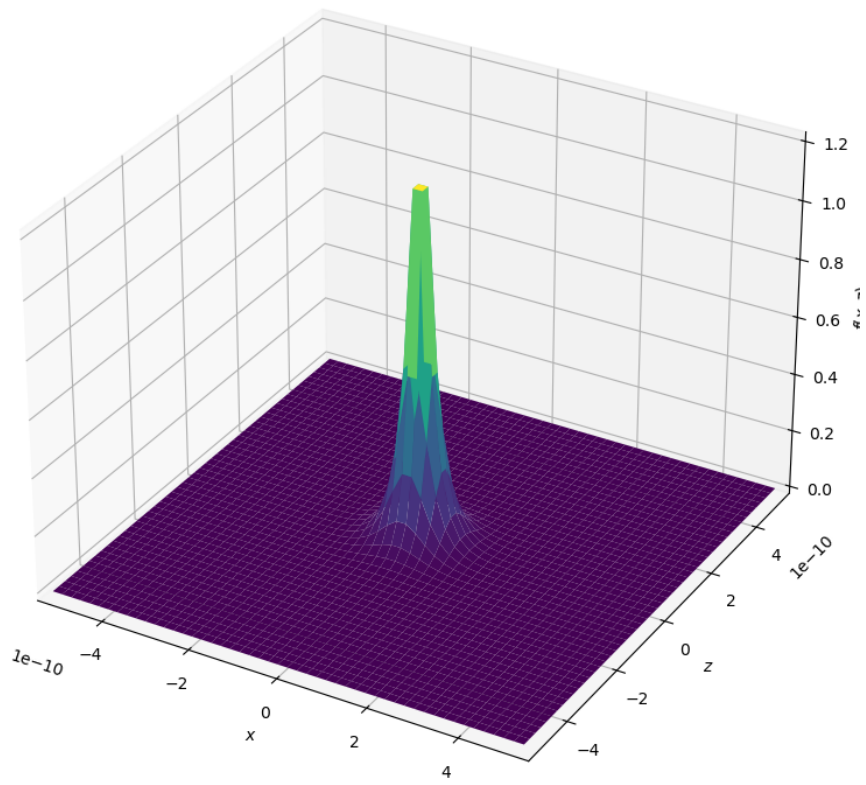
cart_phi = [(abs(cartesian(phi)))**2 for phi in [phi1,phi2,phi3]]

for phi, name in zip(cart_phi, ("phi_1,0,0",
                                "phi_2,1,+1",
                                "phi_3,1,0")):
    try:
        m = 10
        plot3d(phi.subs(x, 0), (z,-m*a,m*a),(y,-m*a,m*a), size=(8,8), title=name+", z-y")
        plot3d(phi.subs(y, 0), (x,-m*a,m*a),(z,-m*a,m*a), size=(8,8), title=name+", x-z")
        plot3d(phi.subs(z, 0), (x,-m*a,m*a),(y,-m*a,m*a), size=(8,8), title=name+", x-y")
    except:
        pass
```

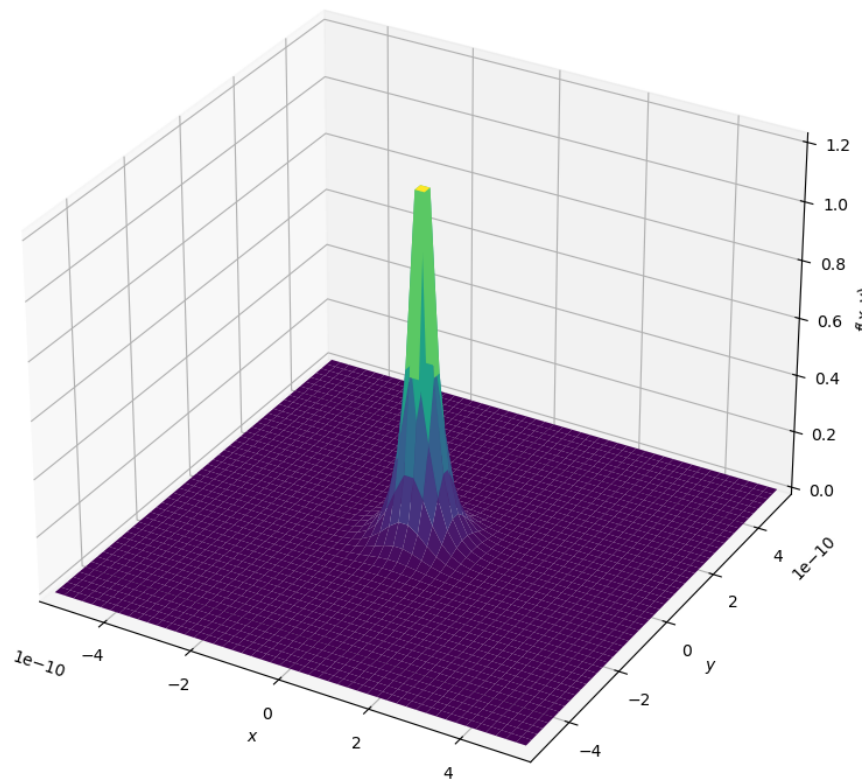
phi_1,0,0, z-y



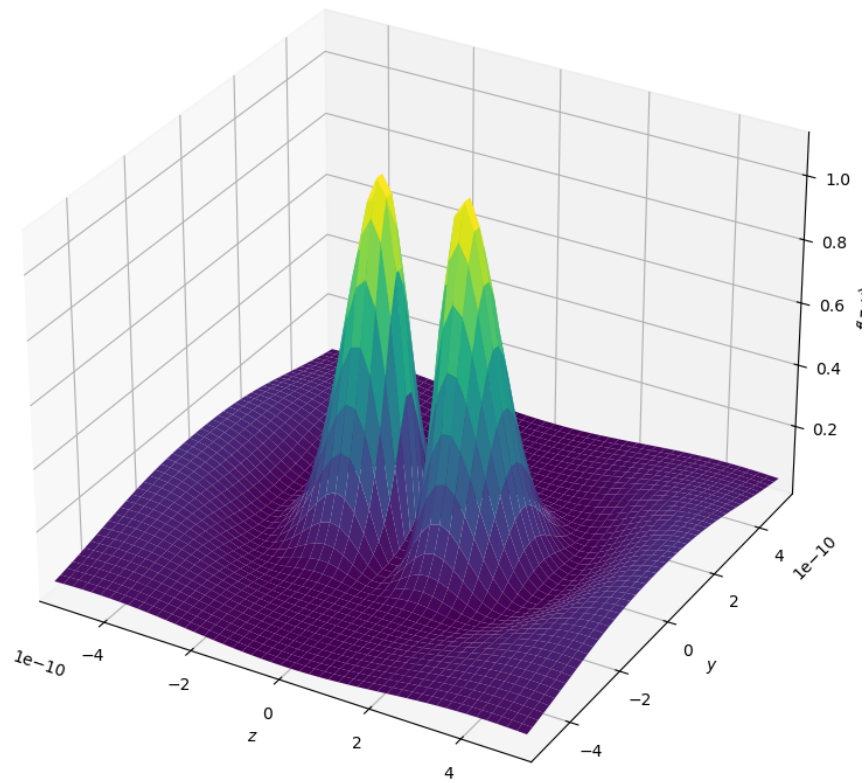
phi_1,0,0, x-z

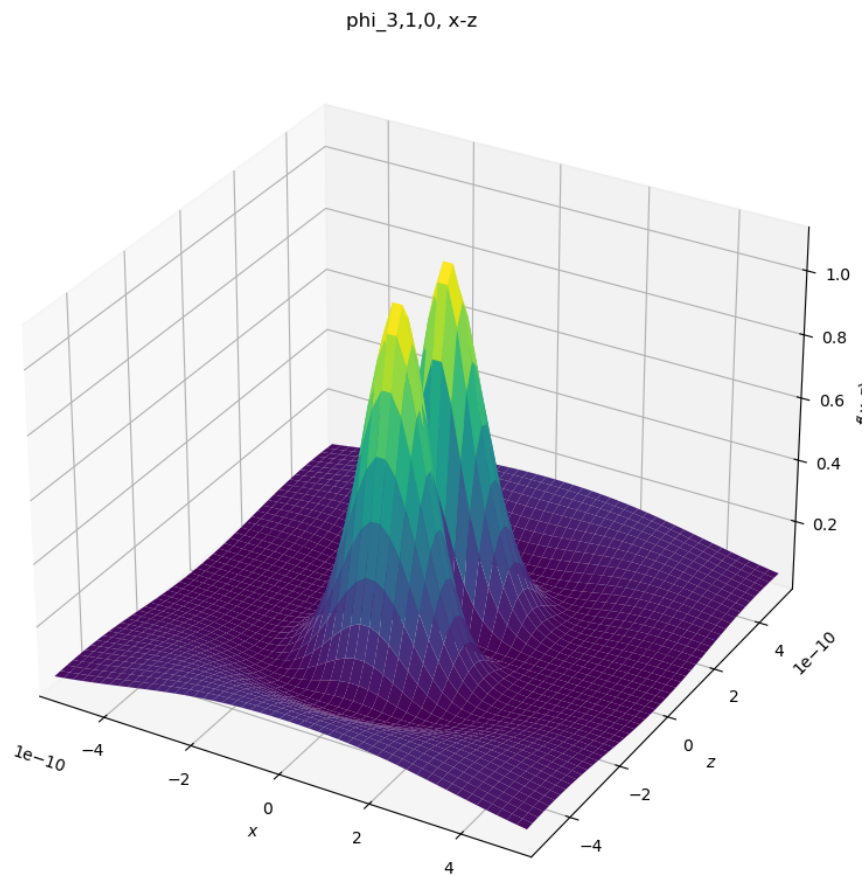


phi_1,0,0, x-y



phi_3,1,0, z-y





Bei den anderen Plots werden leider Fehler generiert, weil im Ursprung Polarkoordinaten nicht wohl definiert sind.