Os metodos aqui empregados sao bastante semelhantes a plotagem 2d.

Vamos ter uma visao dos principais metodos. Em alguns casos basta acrescentar o sufixo $\mathbf{3d}$ no final do metodo.

In [ ]:

```
x,y,z,t=var('x,y,z,t')
```

In [ ]:

```
f(x,y)=cos(x)*sin(y)
```

In [ ]:

```
plot3d(f,(x,0,6*pi),(y,0,6*pi))
```

In [ ]:

```
plot3d(f,(x,0,3*pi),(y,0,3*pi),spin=2)
```

In [ ]:

```
plot3d(f,(x,0,3*pi),(y,0,3*pi),color='red')
```

In [ ]:

```
plot3d(f,(x,0,3*pi),(y,0,3*pi),mesh=True, color='red')
```

In [ ]:

```
plot3d(f,(x,0,3*pi),(y,0,3*pi),mesh=True, color='red',opacity=0.6,spin=10)
```

Plote o grafico do paraboloide eliptico z=4x^2+9y^2, na cor vermelha, incluindo os eixos na plotagem.

In [ ]:

```
##Plotagem Implicita
```

In [ ]:

```

```

In [ ]:

```
implicit_plot3d(x^2+y^2+z^2==9,(x,-3,3),(y,-3,3),(z,-3,3))
```

In [ ]:

```

```

In [ ]:

```
implicit_plot3d(x^2+4*y^2+z^2==9,(x,-3,3),(y,-3,3),(z,-3,3),aspect_ratio=(1,1,1))
```

In [ ]:

```

```

In [ ]:

```
###Plotagem Parametrica
parametric_plot3d([x*cos(y),x*sin(y),y],(x,-1, 1),(y, 0, 2*pi),opacity=0.6, mesh=Tru
e, color='#CC9966',frame=False)
```

In [ ]:

```
sage: u, v = var('u,v')###Tirada da documentação do Sage
sage: f_x = (4*(1+0.25*sin(3*v))+cos(u))*cos(2*v)
sage: f_y = (4*(1+0.25*sin(3*v))+cos(u))*sin(2*v)
sage: f_z = sin(u)+2*cos(3*v)
sage: parametric_plot3d([f_x, f_y, f_z], (u,-pi,pi), (v,-pi,pi), frame=False, color=
'magenta', opacity=0.6,spin=30)
```

In [ ]:

```
###Mobius Strip
parametric_plot3d(((1 + (y/2)*cos(x/2))*cos(x), (1 + (y/2)*cos(x/2))*sin(x),(y/2)*si
n(x/2)),(x,0,2*pi),(y,-1,1))
```

In [ ]:

```
###Mobius Strip
parametric_plot3d(((1 + (y/2)*cos(x/2))*cos(x), (1 + (y/2)*cos(x/2))*sin(x),(y/2)*si
n(x/2)),(x,0,2*pi),(y,-1,1),mesh=True,opacity=0.5, color='yellow')
```

In [ ]:

```
sage: from sage.plot.plot3d.parametric_surface import MoebiusStrip
sage: MoebiusStrip(5, 1, plot_points=200, color=(lambda x,y : sin(x*y)**2,colormaps.
ocean))
```

In [ ]:

```
sage: plot3d(x^2+y^2,(x,-2,2),(y,-2,2), color='green', opacity=0.7)
```

Coordenadas Cilindricas.

$z = x^2 + y^2$ em coordenadas Cilindricas

In [ ]:

```
sage: r,t,z = var('r,t,z')
sage: C = (r*cos(t), r*sin(t), z, [t,z])###Coordenadas Cilindricas
sage: plot3d(sqrt(z),(t,0,2*pi),(z,0,2), transformation=C,color='green', opacity=0.7
)
```

In [ ]:

```
##Ugly Klein Bottle
sage: u, v = var('u,v')
sage: f_x = -(2/15)*cos(u)*(3*cos(v)-30*sin(u)+90*((cos(u))^4)*sin(u)-60*((cos(u))^6
)*sin(u)+5*cos(u)*cos(v)*sin(v))
sage: f_y = -(1/15)*sin(u)*(3*cos(v)-3*((cos(u))^2)*cos(v)-48*((cos(u))^4)*cos(v)+48
*((cos(u))^6)*cos(v)-60*sin(u)+5*cos(u)*cos(v)*sin(u)-5*((cos(u))^3)*cos(v)*sin(u)-8
0*((cos(u))^5)*cos(v)*sin(u)+80*((cos(u))^7)*cos(v)*sin(u))
sage: f_z = (2/15)*(3+5*cos(u)*sin(u))*sin(v)
sage: parametric_plot3d([f_x, f_y, f_z], (u,0,pi-0.1), (v,0,2*pi), frame=False, colo
r="yellow", mesh=True,aspect_ratio=(1,1,1))
```

Coordenadas esfericas.

In [ ]:

```
sage: r,u,v = var('r,u,v')
sage: S = (r*cos(u)*sin(v), r*sin(u)*sin(v), r*cos(v), [u,v])
sage: plot3d(1, (u, 0, 2*pi), (v, 0, pi/2), transformation=S,
aspect_ratio=(1,1,1), color='pink', opacity=0.8,mesh=True)
```

Exemplo de Plotagem mais complexa

In [ ]:

```
t,y,z=var('t,y,z')
sage: r=(1,1,1);
sage: p0=parametric_plot3d((cos(2*pi*t),t,sin(2*pi*t)),(t,0,4),width=5,aspect_ratio=
r,frame=False,color='blue')
sage: p1=parametric_plot3d((-2*cos(2*pi*t),t,-2*sin(2*pi*t)),(t,0,4),width=5,aspect_
ratio=r,frame=False,color='grey')
sage: p2=arrow3d((0,0,0),(0,7,0), color='red',width=5)
sage: p3=implicit_plot3d(7*y==0, (x,-3,3), (y,-1,1),(z,-3,3), color='yellow')
sage: p4=implicit_plot3d((x+2)^2+(y-4)^2+z^2==1/9, (x,-1,-3), (y,3,5),(z,-1,1), colo
r='grey')
sage: p5=implicit_plot3d((x-1)^2+(y-4)^2+z^2==1/4, (x,0,2), (y,3,5),(z,-1,1), color=
'blue')
sage: p6=text3d('Planeta 1', (1,5.5,0))
sage: p7=text3d('Planeta 2', (-2,5.5,0))
show( p0+p1+p2+p3+p4+p5+p6+p7)
```

Como salvas as figuras???

In [ ]:

```
save(p0+p1+p2+p3+p4+p5+p6+p7,'Exemplo.png')#formatos  possiveis para salvar 3d sao p
ng, jpg, svg etc.
```

Exercicio

Plote uma esfera de centro $(0, 0, 0)$ e raio 4 usando:

1. plot3d

2.implicit_plot3d

Plote uma helice usando coordenadas parametricas. Na cor preta, com uma espessura de 10. E salve o arquivo em um pdf.

In [ ]: