

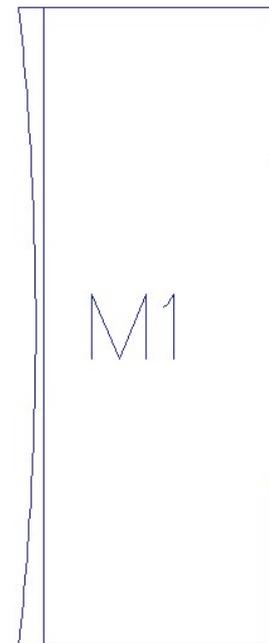
# gtrace

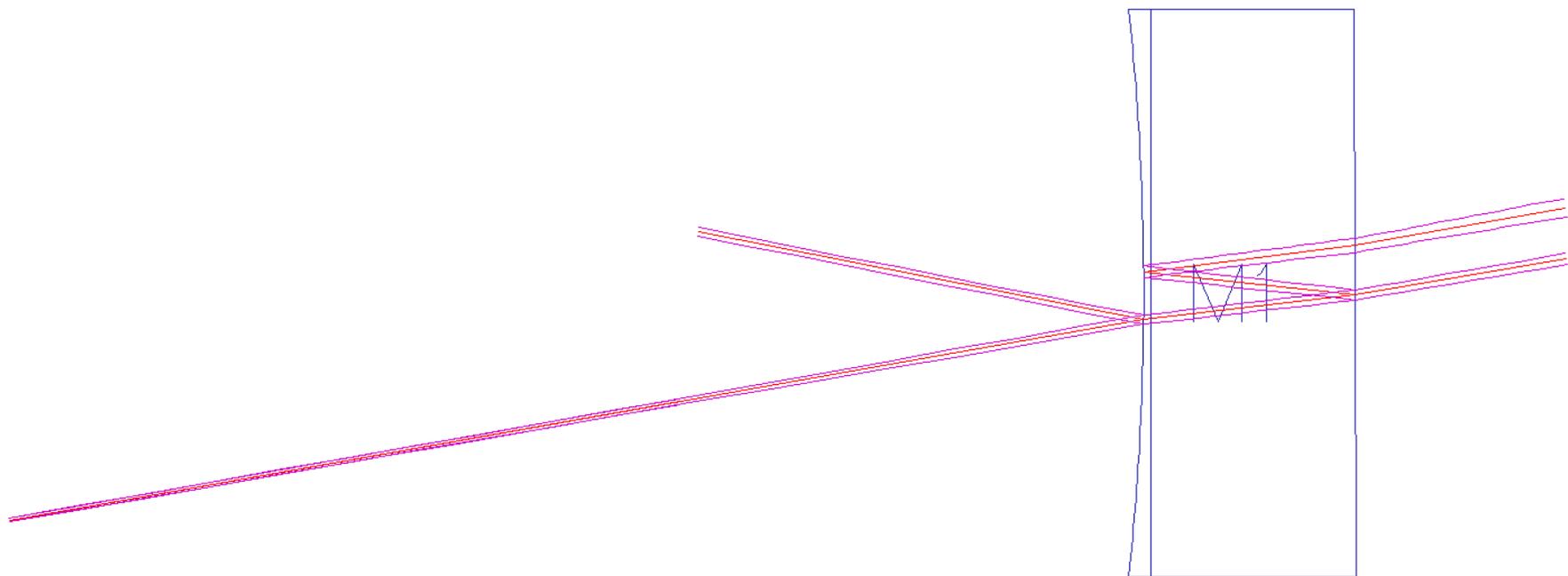
Gaussian beam ray-TRACE package  
for Python

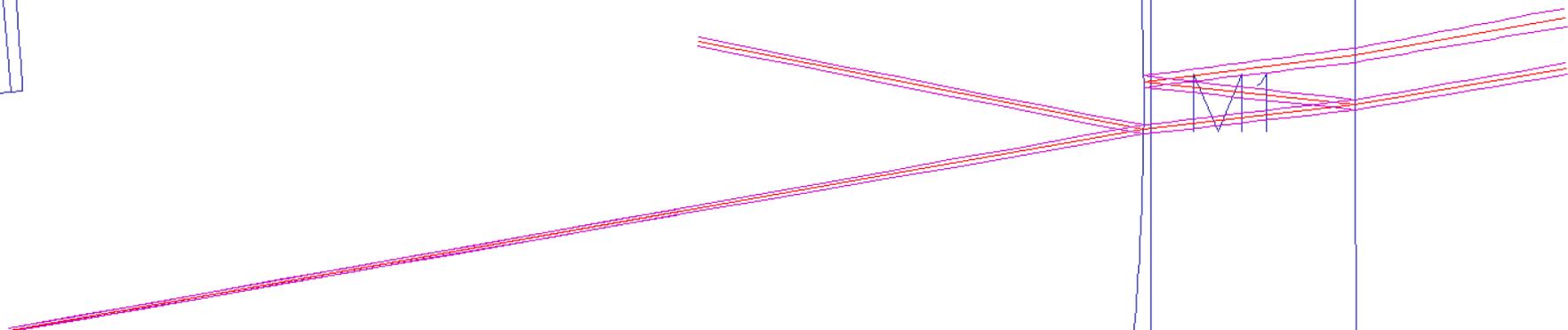
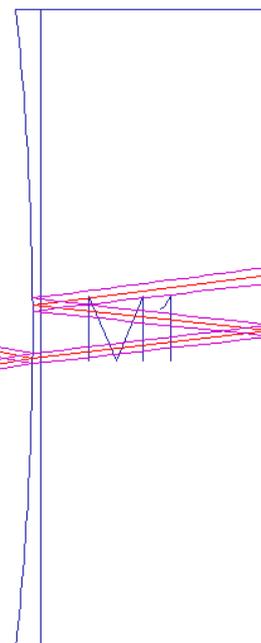
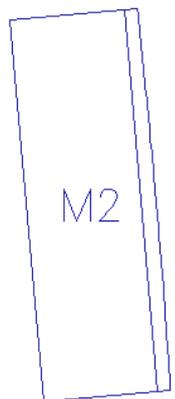
Yoichi Aso  
University of Tokyo

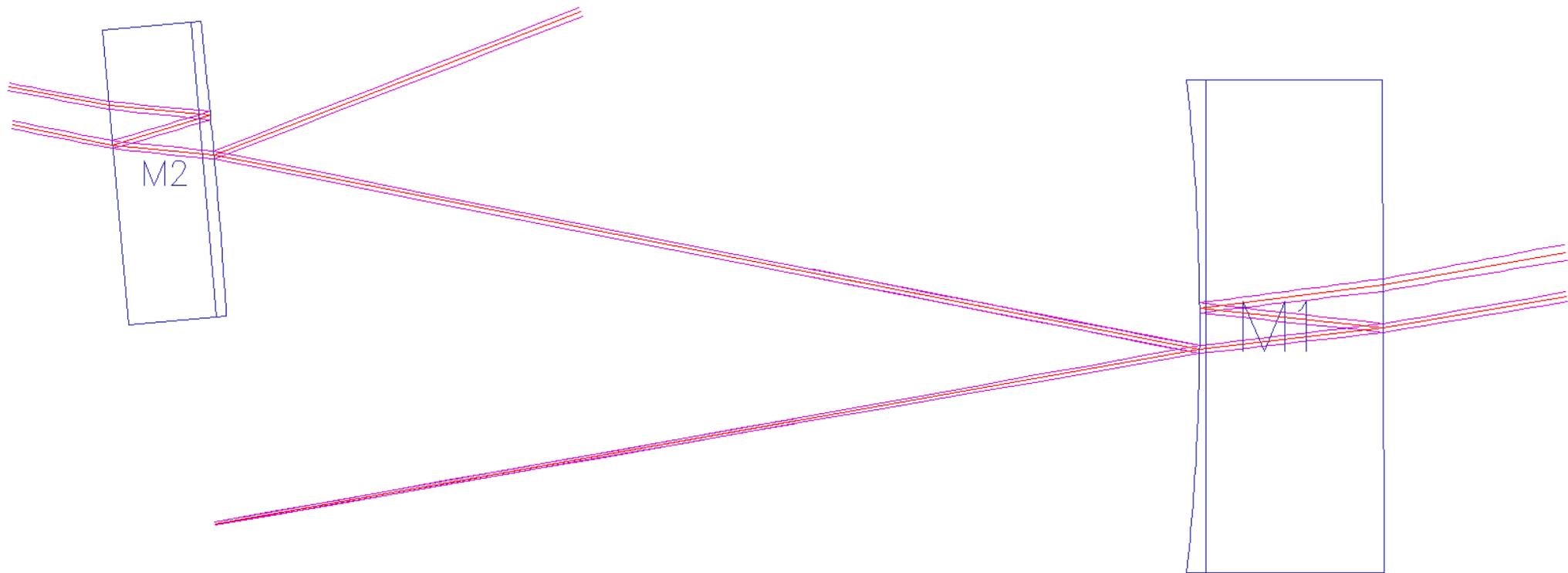
# Programmatically Optimize Optical Layouts

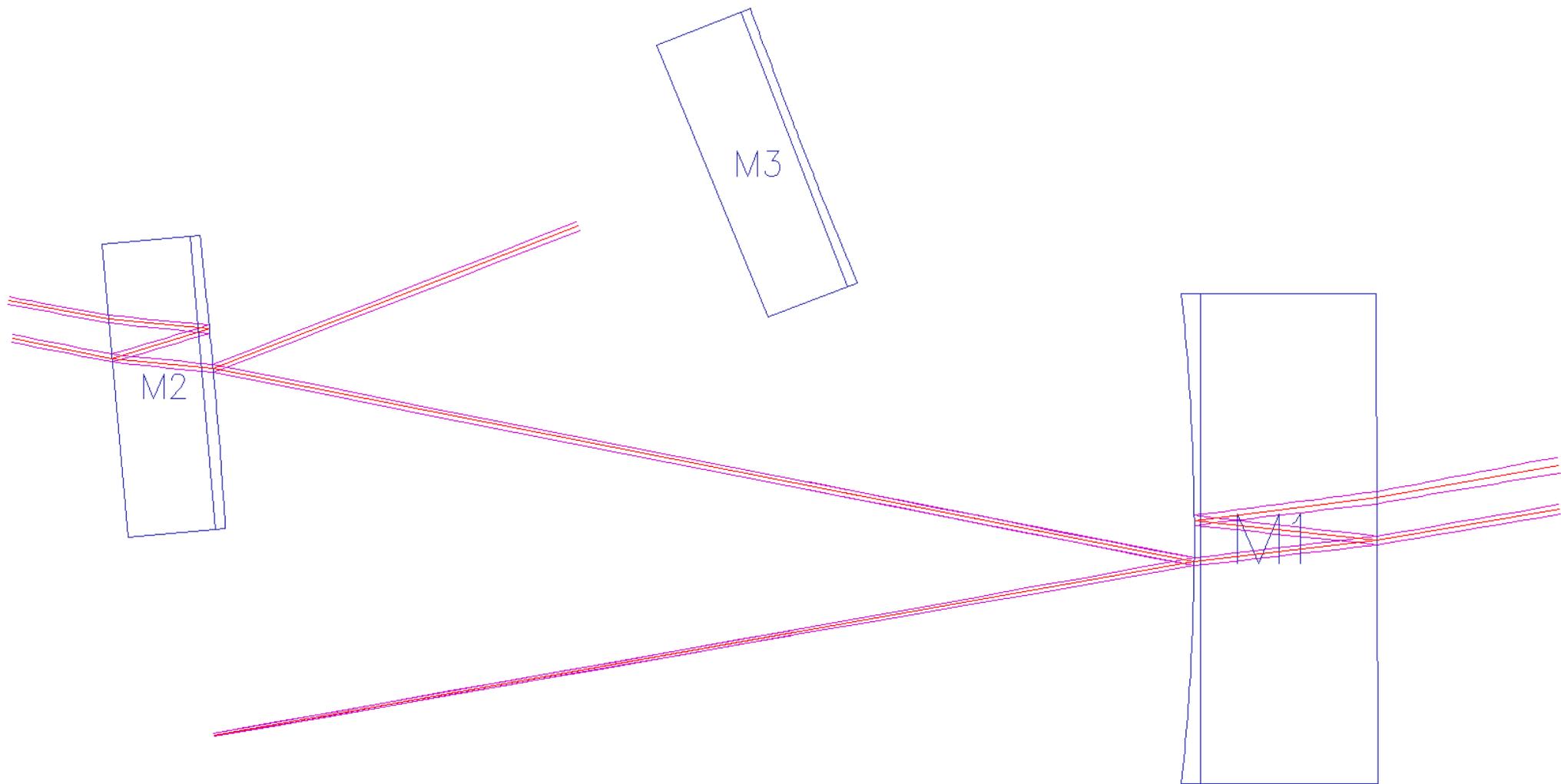


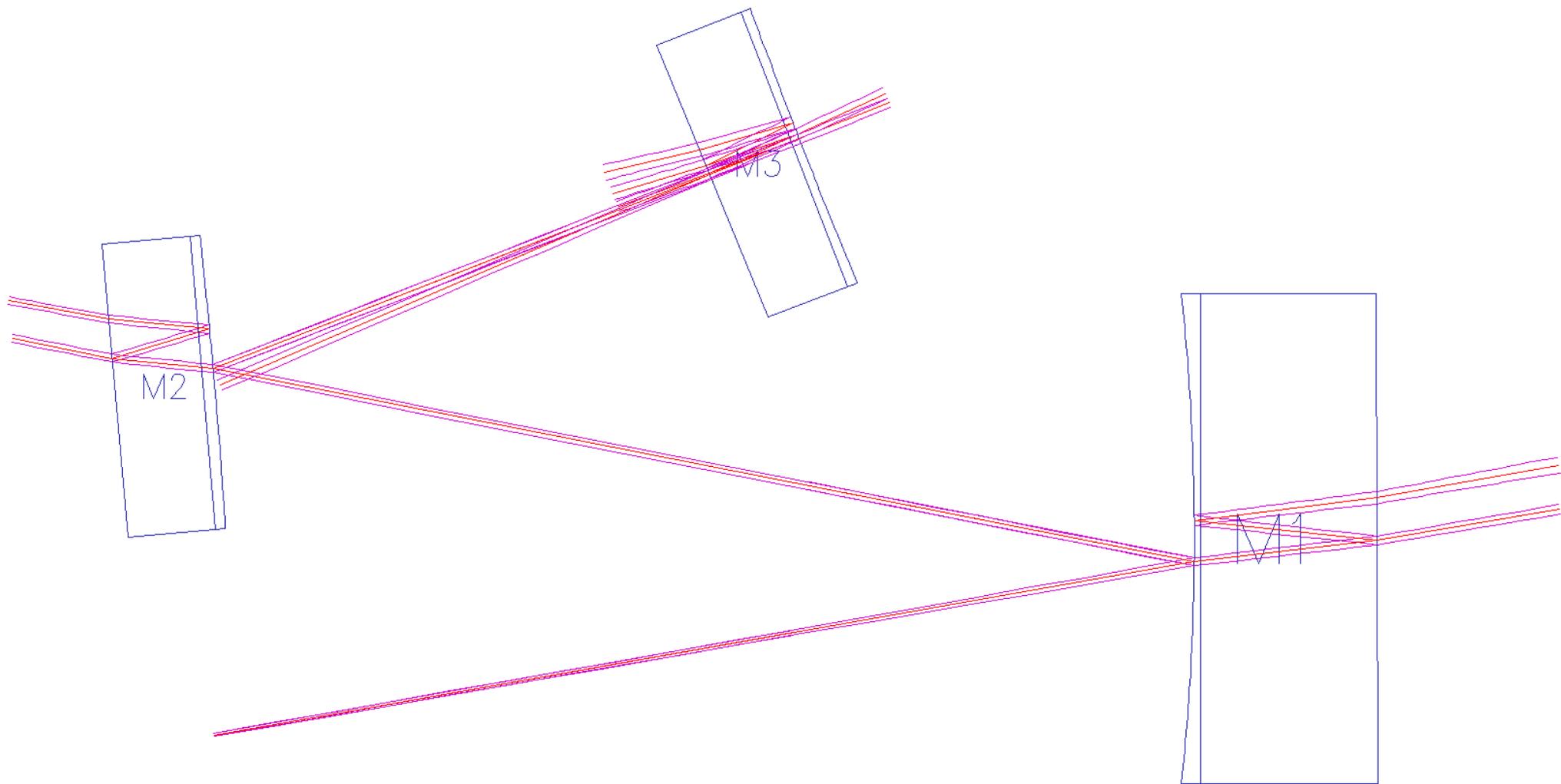




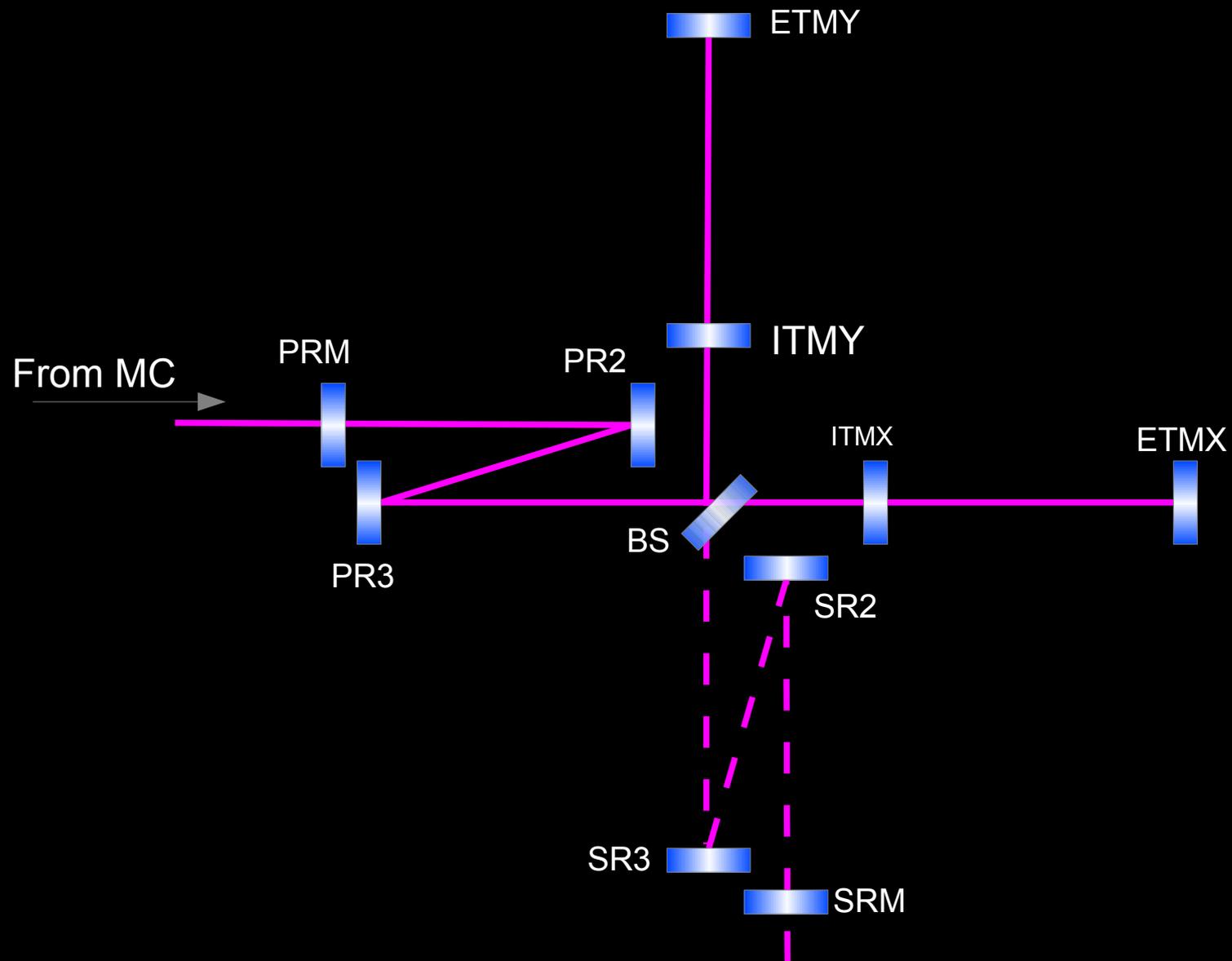


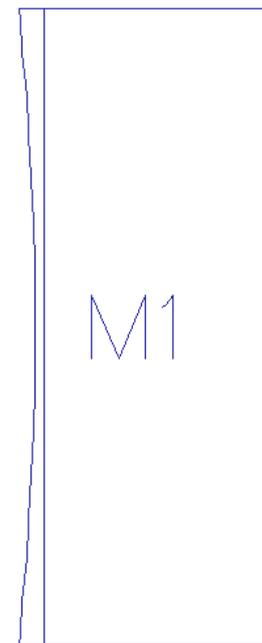
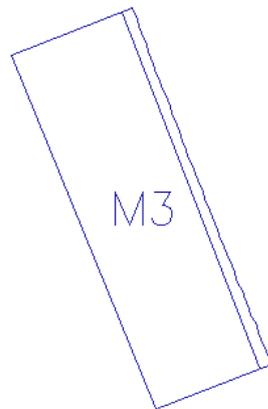
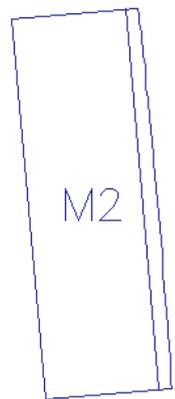


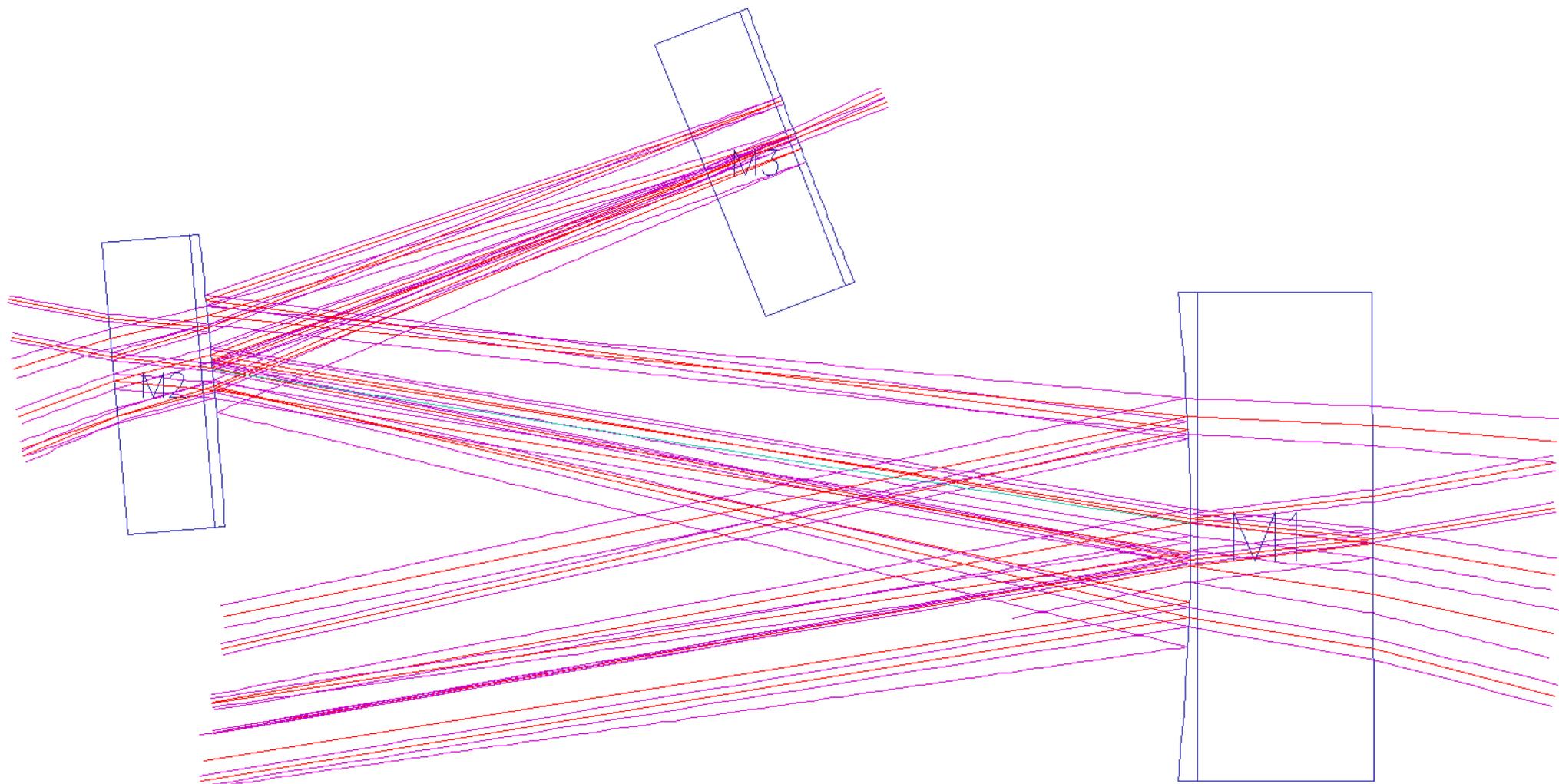


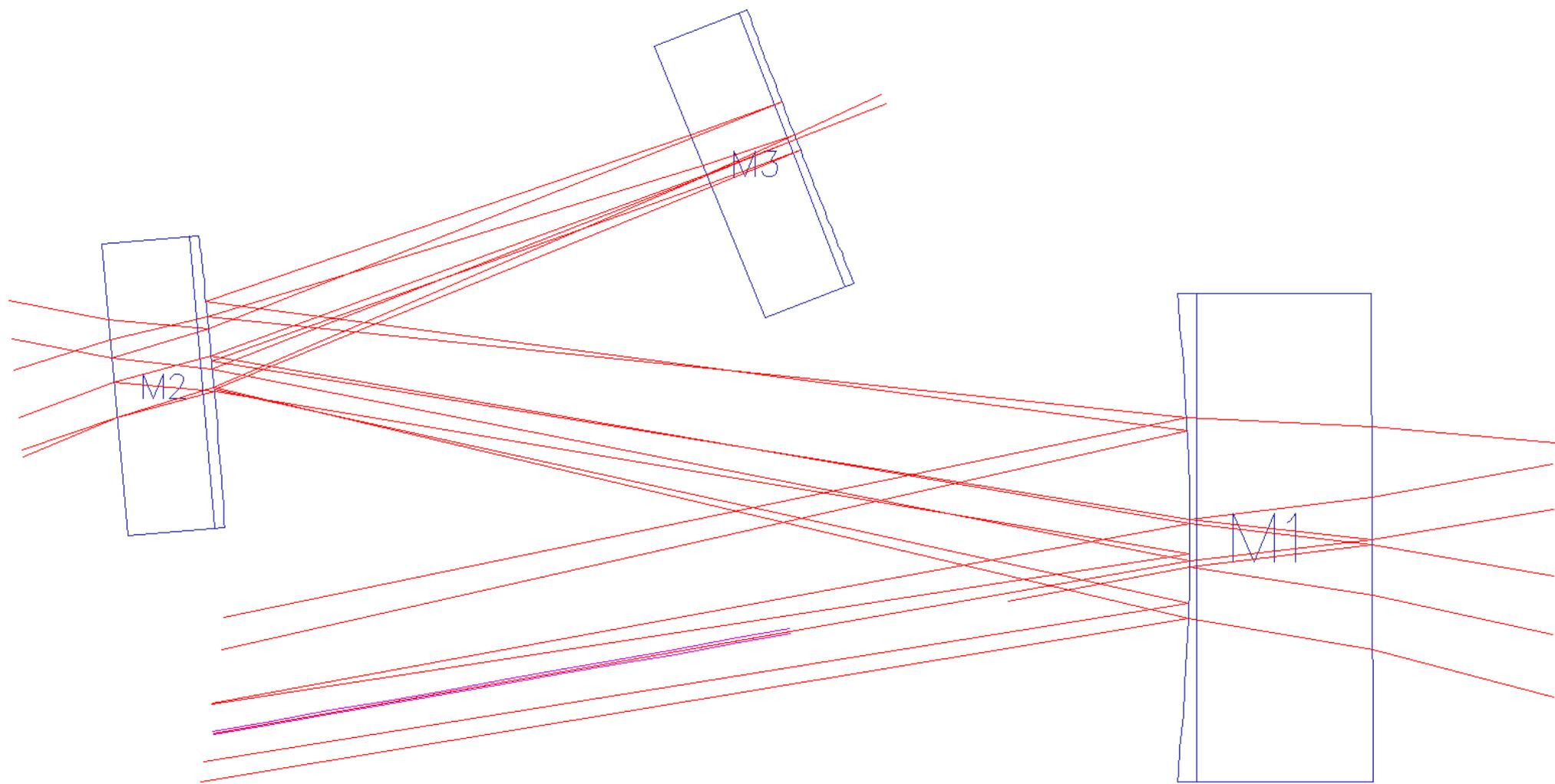


# Useful for the main beam path

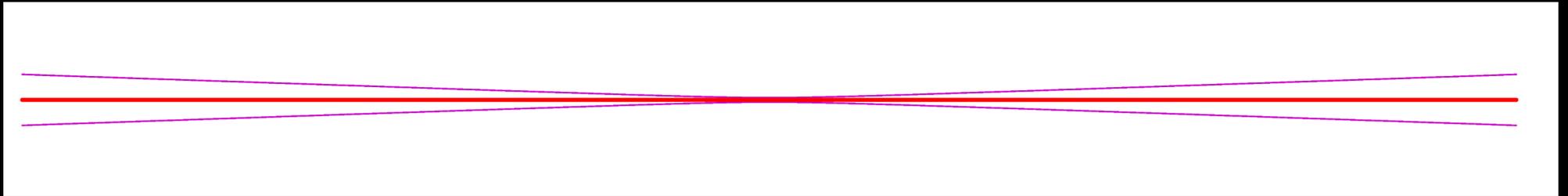






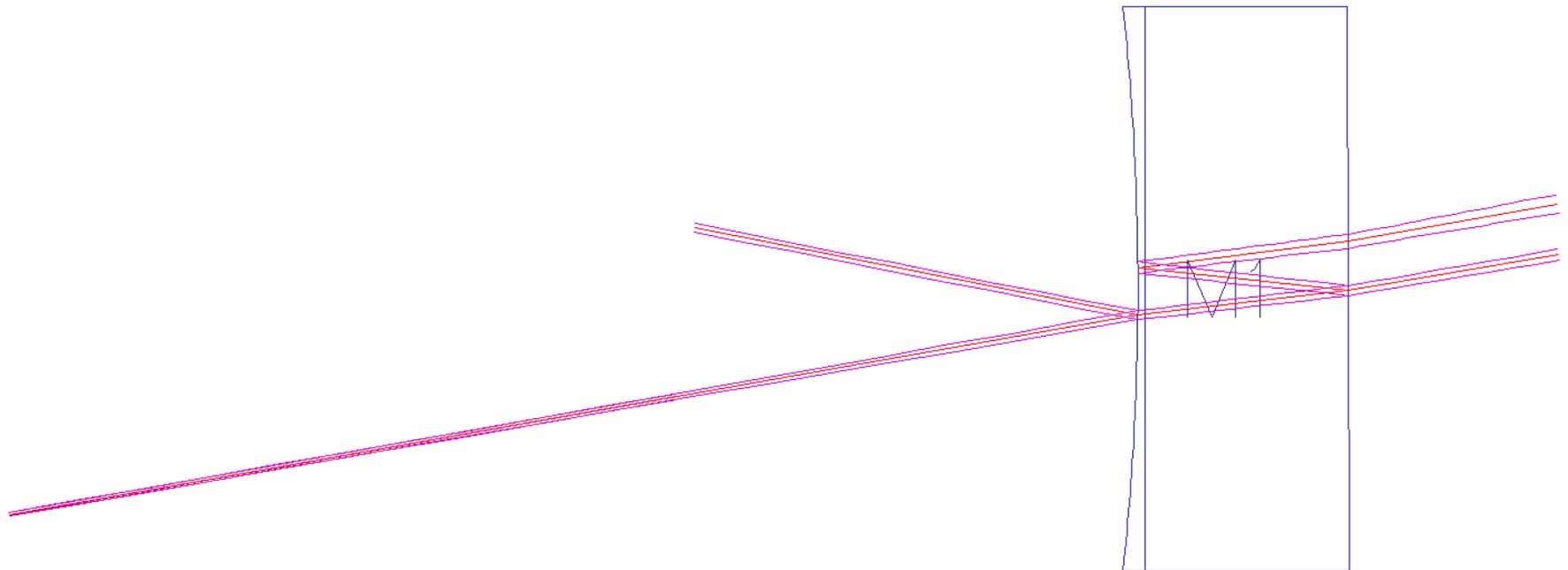


# Gaussian Beam Propagation



# ABCD Matrix

- Reflection
- Refraction



# Astigmatism



Elliptic Beams

# Keeping Track of

- Gouy phase
- Optical distance
- Optical Power

# Define a Gaussian Beam Object

#q-parameter of the beam

```
q0 = gauss.Rw2q(ROC=np.inf, w=0.3*mm)
```

#Create a GaussianBeam object.

```
b1 = beam.GaussianBeam(q0=q0, wl=1064*nm, length=30*cm, P=1.0)
```

#Set the direction angle of the beam to 10deg from the global x-axis.

```
b1.dirAngle = deg2rad(10)
```

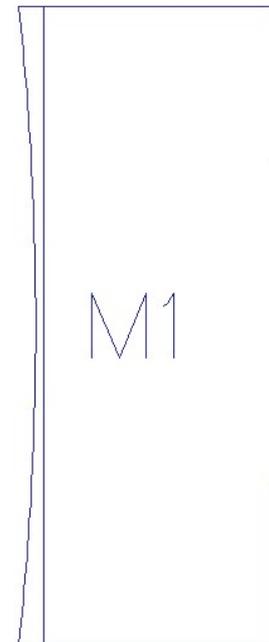
#Set the position of the origin of the beam

```
b1.pos = (0.0, 0.0)
```



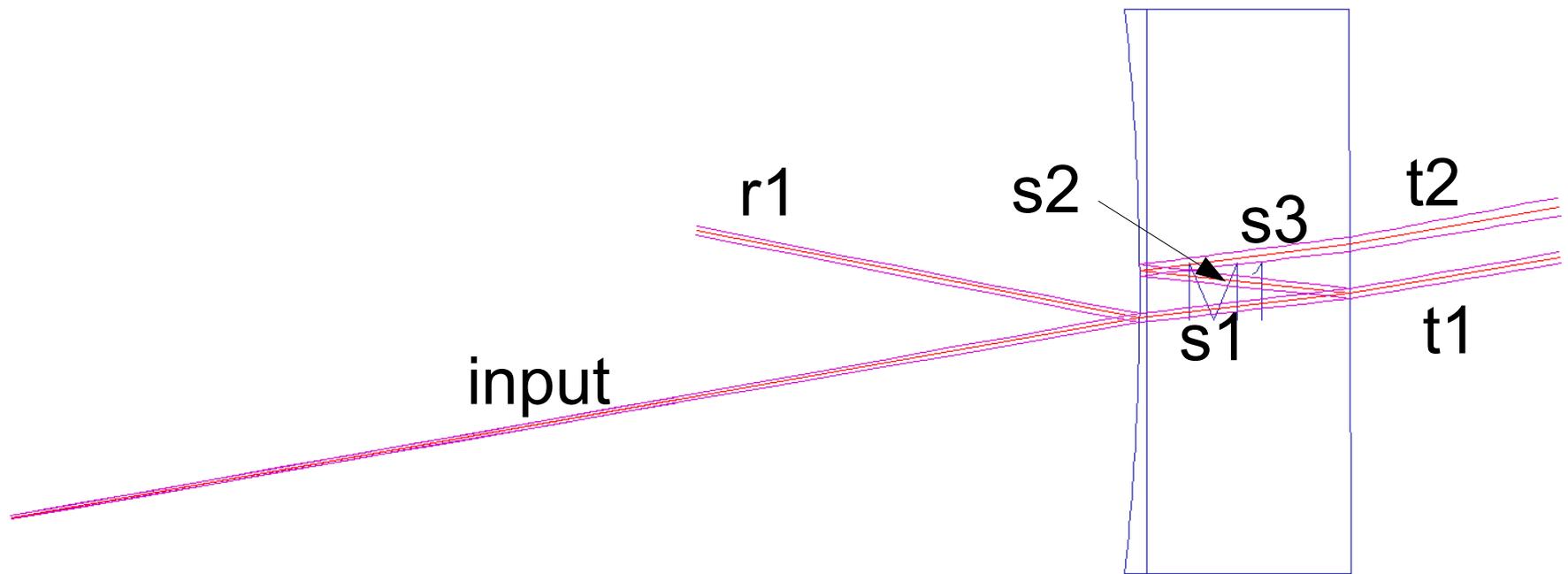
# Define a Mirror Object

```
M1 = opt.Mirror(HRcenter=[50*cm, 10*cm], normAngleHR=pi,  
               diameter=25*cm, thickness=10*cm,  
               wedgeAngle=deg2rad(0.25), inv_ROC_HR=1./(120*cm),  
               inv_ROC_AR=0,  
               Refl_HR=0.9, Trans_HR=1-0.9,  
               Refl_AR=500*ppm, Trans_AR=1-500*ppm,  
               n=1.45, name='M1')
```



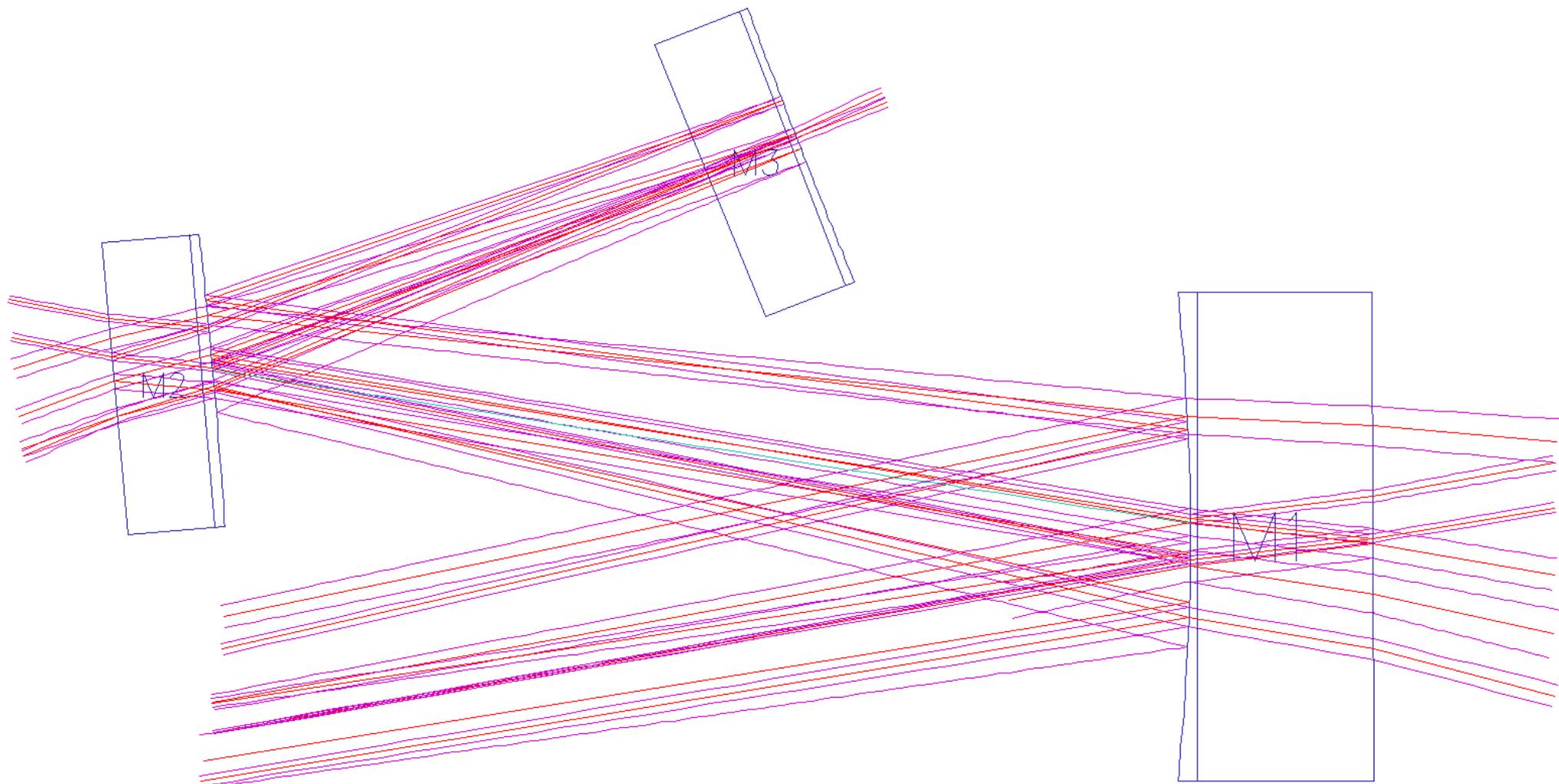
# Hit the Mirror

```
>>>beams1 = M1.hitFromHR(b1, order=2)
>>>beams1
{'input': <gtrace.beam.GaussianBeam at 0x39bab90>,
 'r1': <gtrace.beam.GaussianBeam at 0x39bae30>,
 's1': <gtrace.beam.GaussianBeam at 0x39badd0>,
 's2': <gtrace.beam.GaussianBeam at 0x39baf50>,
 's3': <gtrace.beam.GaussianBeam at 0x39d5050>,
 't1': <gtrace.beam.GaussianBeam at 0x39baef0>,
 't2': <gtrace.beam.GaussianBeam at 0x39bae90>}
```



# Non-Sequential Trace

```
>>>beams = non_seq_trace([M1,M2,M3], b1,  
                          order=30, power_threshold=1e-6)  
  
>>>beams  
<gtrace.beam.GaussianBeam at 0x39d52f0>,  
<gtrace.beam.GaussianBeam at 0x39d5230>,  
<gtrace.beam.GaussianBeam at 0x39d50b0>,  
<gtrace.beam.GaussianBeam at 0x39bad10>,  
<gtrace.beam.GaussianBeam at 0x39d5650>,  
<gtrace.beam.GaussianBeam at 0x39d5590>,  
<gtrace.beam.GaussianBeam at 0x39d5470>,  
<gtrace.beam.GaussianBeam at 0x39d5350>,  
<gtrace.beam.GaussianBeam at 0x39d59b0>,  
<gtrace.beam.GaussianBeam at 0x39d58f0>, ...
```



# DXF Output

**#Create a canvas object**

```
cnv = draw.Canvas()
```

**#Draw all beams**

```
drawAllBeams(cnv, beams, drawWidth=True, sigma=3.0,  
             drawPower=False, drawROC=False, drawGouy=False,  
             drawOptDist=False, layer='main_beam',  
             fontSize=0.01)
```

**#Draw the mirror**

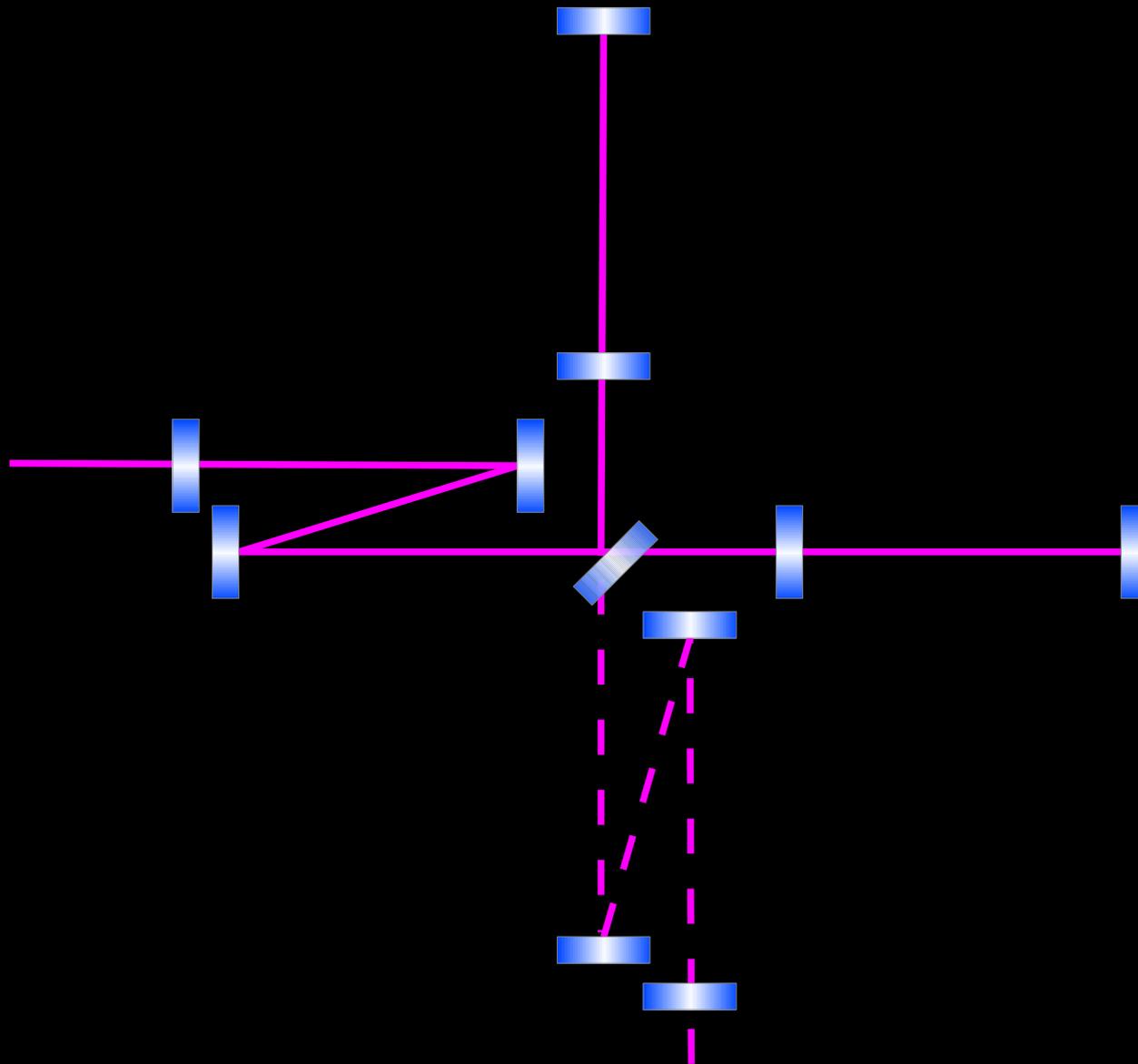
```
drawAllOptics(cnv, [M1,M2,M3])
```

**#Save the result as a DXF file**

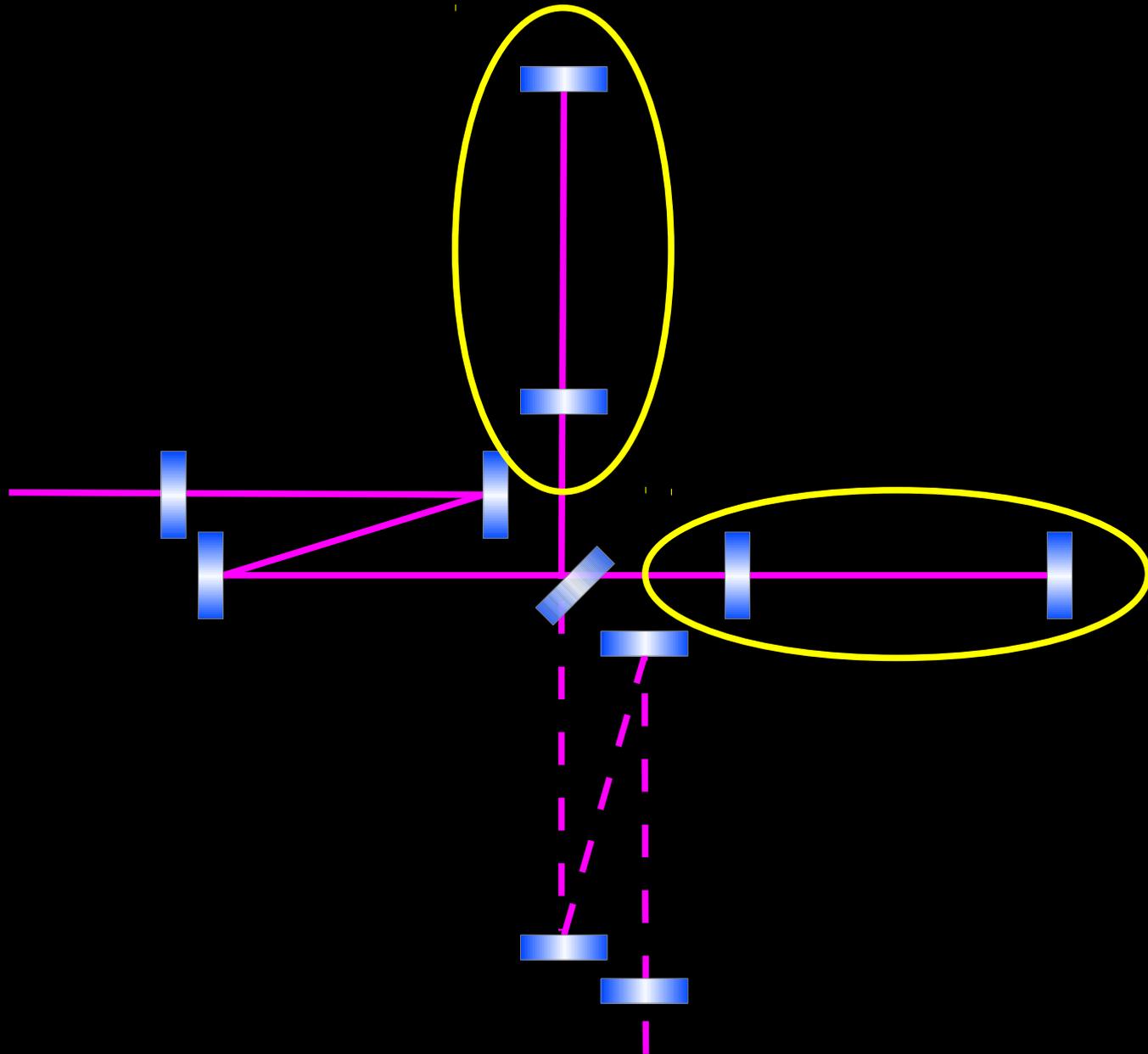
```
renderer.renderDXF(cnv, 'NonSeq.dxf')
```

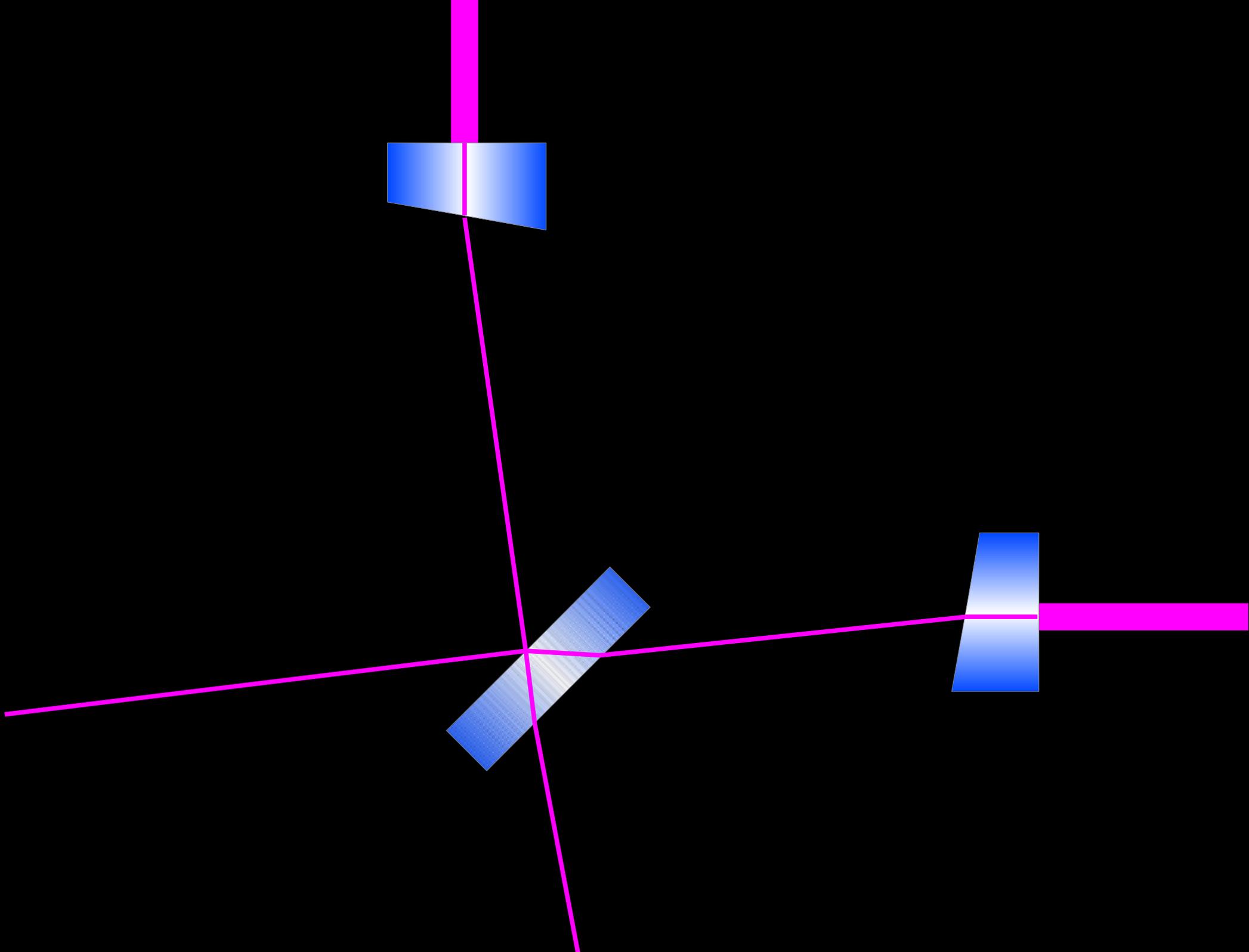
Why did I create this ?

# Many Constraints

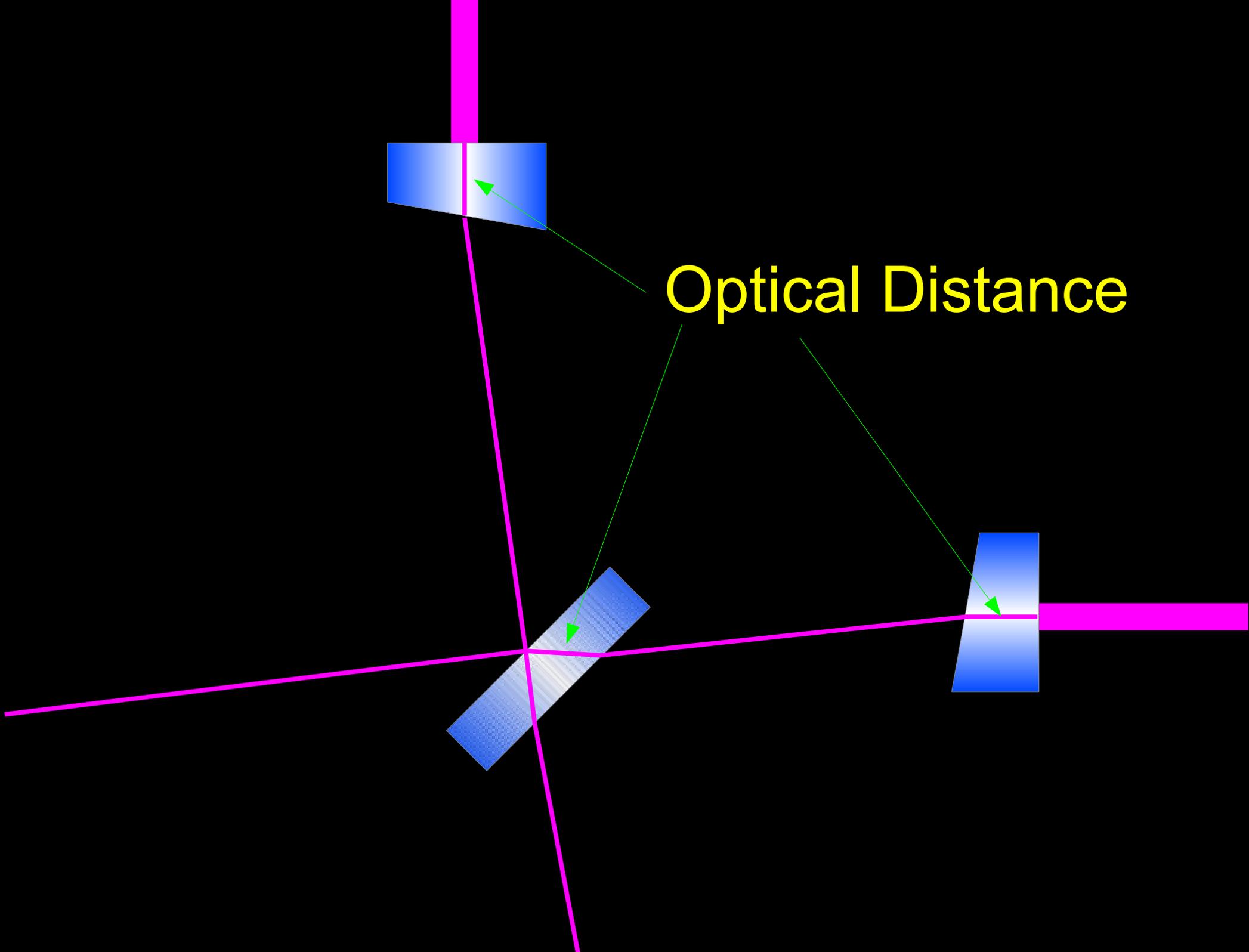


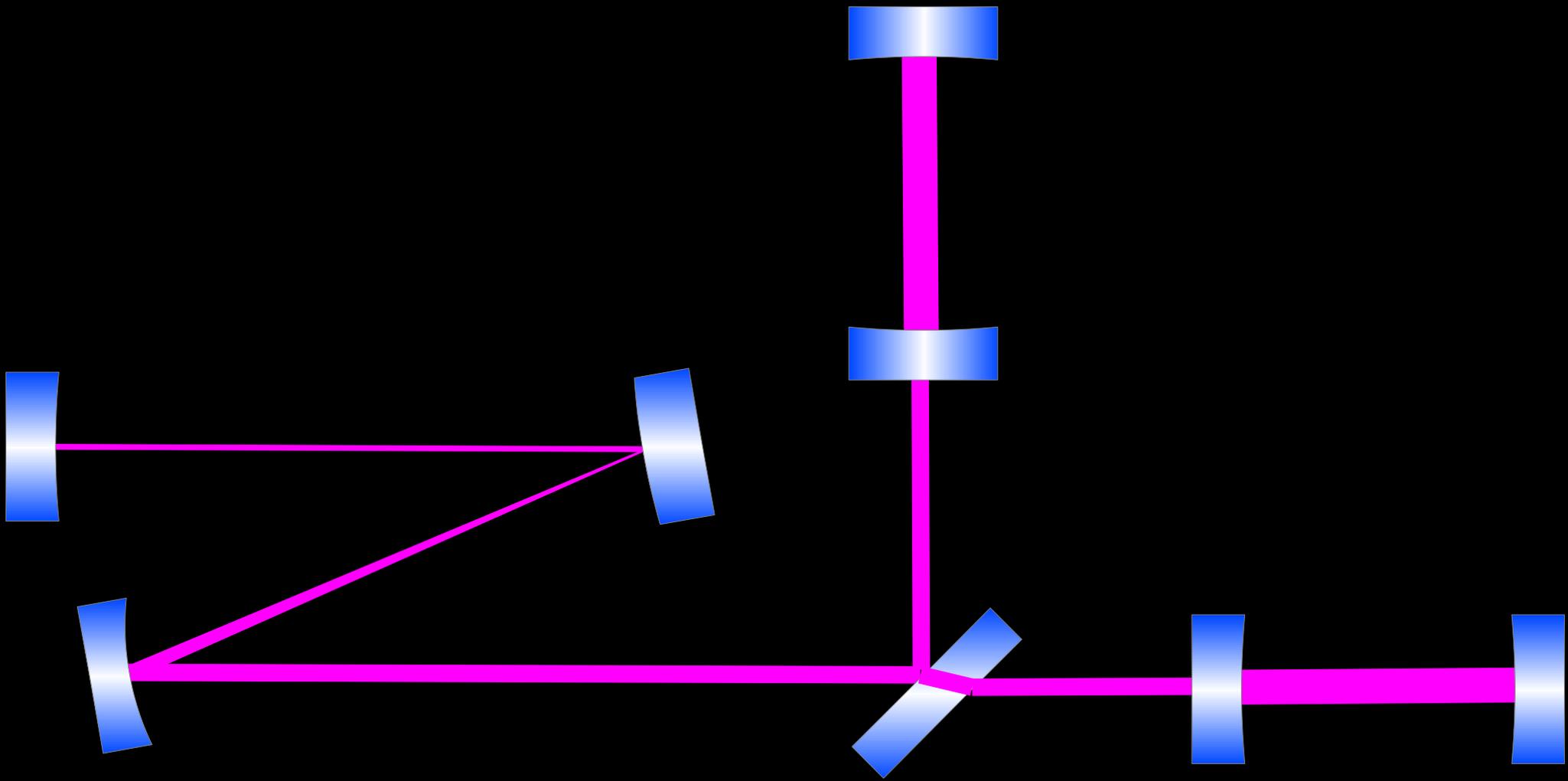
# Many Constraints





Optical Distance

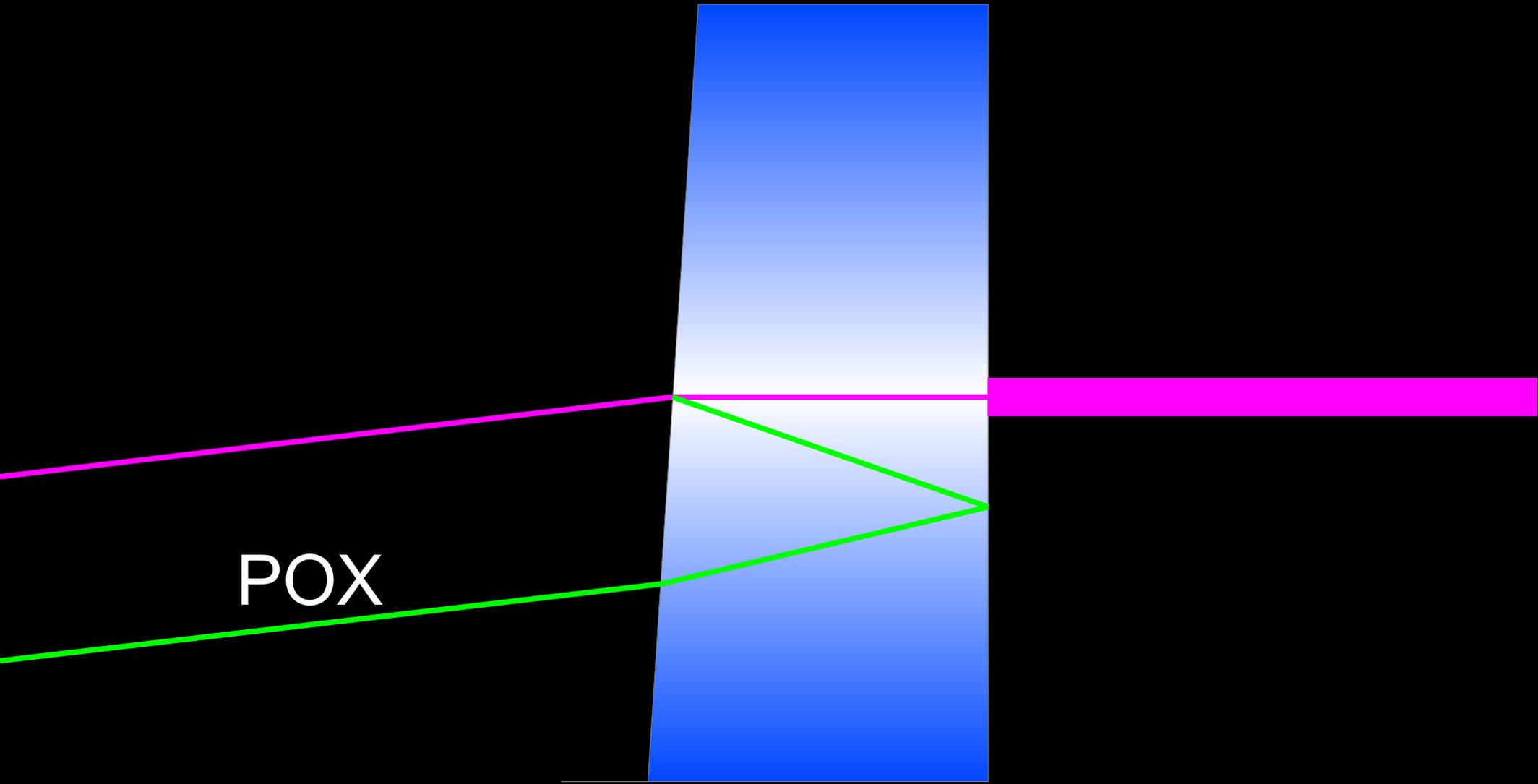


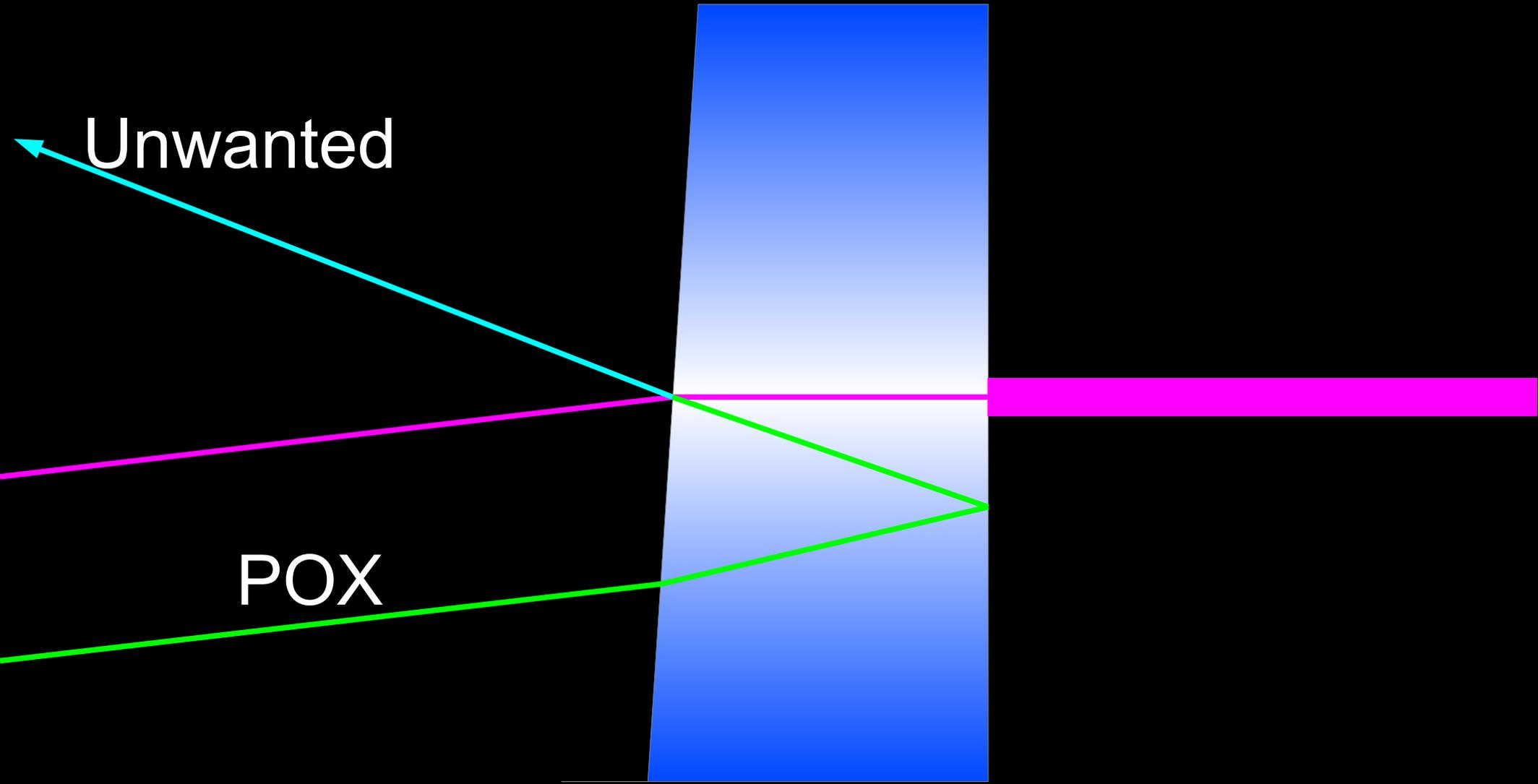


Mode Matching

ROC Error Tolerance

POX





Unwanted

POX

