OPEN RAY TRACER EXAMPLES

Ray tracing for a microscope condenser described in the United States patent nr 3,743,386 from July 1973.

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(*we load the OpenRayTracer package*)Needs["OpenRayTracer`"]
```

Virtual bench setup

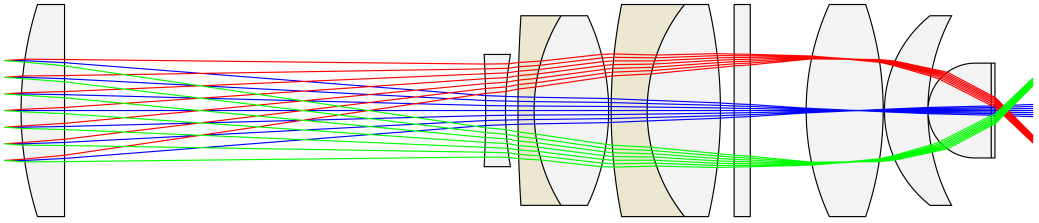
```
bench = With[{f = 150, glassI = "s-tih18", glassII = "n-bk7", glassIII = "n-bk7",
    glassIV = "h-k51", glassV = "h-k51", glassVI = "n-bk7", glassVII = "sfn4",
    glassVIII = "n-bk7", glassIX = "s-tih18", glassX = "s-tih18", glassXI = "n-bak2"},
  With[{lensDiameterVerySmall = 2 * 0.038 f, lensDiameterMedium = 2 * 0.076 f,
    lensDiameterSmall = 2 * 0.045 f, lensDiameter = 2 * 0.085 f}, With[
    {R1 = -∞, R2 = ∞, R3 = 0.038 f, R4 = 0.161 f, R5 = 0.097 f, R6 = -0.263 f, R7 = 0.203 f,
     R8 = -∞, R9 = ∞, R10 = -0.38 f, R11 = 0.135 f, R12 = 0.432 f, R13 = -0.178 f,
     R14 = 0.144 f, R15 = 1.212 f, R16 = 0.258 f, R17 = -0.816 f, R18 = -∞, R19 = 0.28 f,
     t1 = 0.003 f, t2 = 0.051 f, t3 = 0.035 f, t4 = 0.062 f, t5 = 0.013 f, t6 = 0.059 f,
     t7 = 0.029 f, t8 = 0.06 f, t9 = 0.013 f, t10 = 0.016 f, t11 = 0.035 f},
    With[{S7 = 0.339 f, S6 = 0.01 f, S5 = 0.002 f, S4 = 0.011 f,
      S3 = 0.045 f, S2 = 0.001 f, S1 = 0},
     With[{vertexXI = 0, vertexX = t11 + S7, vertexVIIIPlusIX = t11 + S7 + t10 + S6,
       vertexVIPlusVII = t11 + S7 + t10 + S6 + t9 + t8 + S5,
       vertexV = t11 + S7 + t10 + S6 + t9 + t8 + S5 + t7 + t6 + S4},
      With[{vertexIV = vertexV + t5 + S3, vertexIII = vertexV + t5 + S3 + t4 + S2,
        vertexII = vertexV + t5 + S3 + t4 + S2 + t3 + S1,
        vertexI = vertexV + t5 + S3 + t4 + S2 + t3 + S1 + t2},
       With[{screenPosition = vertexI + 5}, With[{plateI =
           createSphericalLens[vertexI, R2, R1, t1, lensDiameterVerySmall, glassI],
          lensII = createSphericalLens[vertexII, R3, R2, t2,
            lensDiameterVerySmall, glassII],
          lensIII = createSphericalLens[vertexIII, R5, R4, t3,
            lensDiameterMedium, glassIII],
          lensIV = createSphericalLens[vertexIV, R7, R6, t4, lensDiameter, glassIV],
          plateV = createSphericalLens[vertexV, R9, R8, t5, lensDiameter, glassV],
          lensVIPlusVII = createCementedSphericalDoubletLens[vertexVIPlusVII,
            R12, R11, R10, t7, t6, lensDiameter, glassVII, glassVI],
          lensVIIIPlusIX = createCementedSphericalDoubletLens[vertexVIIIPlusIX,
            R15, R14, R13, t9, t8, lensDiameterMedium, glassIX, glassVIII],
          lensX = createSphericalLens[vertexX, R17, R16, t10,
            lensDiameterSmall, glassX],
          lensXI = createSphericalLens[vertexXI, R19, R18, t11,
            lensDiameter, glassXI]},
         With[{bench = createBench["air", MultipleFanStyle →
               {Directive[Blue], Directive[Red], Directive[Green]}]},

          bench["addOpticalComponents"][lensXI, lensX, lensVIIIPlusIX, lensVIPlusVII,
           plateV, lensIV, lensIII, lensII, plateI, createArbitraryPlanarScreen[
            {screenPosition, 0, 0}, lensDiameter, 1, {-1, 0, 0}, Visible → False]];
          bench]]]]]]]]]
```

2D tracing

```
With[{centerPointAtBeamOrigin = {-2, 0, 0},
  beamDirectionA = {1, 0, 0}, beamDirectionB = {Cos[4 Degree], 0, Sin[4 Degree]},
  beamDirectionC = {Cos[-4 Degree], 0, Sin[-4 Degree]}, beamRadius = 6,
  raySpacings = 2, beamAngularSpacing = 1 Degree, wavelength = 0.5893},
 bench["interactWithMulipleRayBundles3DAndDraw"][{createCollimatedBeam3D[
    wavelength, centerPointAtBeamOrigin, beamDirectionA, beamRadius, raySpacings],
   createCollimatedBeam3D[wavelength, centerPointAtBeamOrigin, beamDirectionB,
    beamRadius, raySpacings], createCollimatedBeam3D[wavelength,
    centerPointAtBeamOrigin, beamDirectionC, beamRadius, raySpacings]},
  {Frame → False, ImageSize → {600, Automatic}, PlotPoints → 120}]]
```

Out[1]=



3D tracing

```
With[{centerPointAtBeamOrigin = {-2, 0, 0},
  beamDirectionA = {1, 0, 0}, beamDirectionB = {Cos[4 Degree], 0, Sin[4 Degree]},
  beamDirectionC = {Cos[-4 Degree], 0, Sin[-4 Degree]}, beamRadius = 6,
  raySpacings = 2, beamAngularSpacing = 1 Degree, fanCount = 1, wavelength = 0.5893},
 bench["interactWithMulipleRayBundles3DAndDraw"][{createCollimatedBeam3D[
    wavelength, centerPointAtBeamOrigin, beamDirectionA, beamRadius, raySpacings],
   createCollimatedBeam3D[wavelength, centerPointAtBeamOrigin, beamDirectionB,
    beamRadius, raySpacings], createCollimatedBeam3D[wavelength,
    centerPointAtBeamOrigin, beamDirectionC, beamRadius, raySpacings]},
  {Frame → False, ImageSize → {600, Automatic}, PlotPoints → 120}]]
```

Out[2]=