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In[ ]:= polFig[A_, sc_, {x_, y_, z_}] := Block[{S1, S2, S3,  $\chi$ ,  $\psi$ },
  S1 = Abs[A[[1]]]^2 - Abs[A[[2]]]^2;
  S2 = 2 Re[Conjugate[A[[2]]] A[[1]]];
  S3 = -2 Im[Conjugate[A[[2]]] A[[1]]];
   $\psi$  = If[S1 == 0 && S2 == 0, 0, ArcTan[S1, S2] / 2];
   $\chi$  = ArcTan[ $\sqrt{S1^2 + S2^2}$ , S3] / 2;
  {Which[ $\chi$  < 0, EdgeForm[Red],  $\chi$  > 0, EdgeForm[Green],  $\chi$  == 0, EdgeForm[Blue]],
   circCylfor2D[{x, y, z}, sc, Tan[Abs[ $\chi$ ]],  $\psi$ ]
   (*Rotate[Circle[{0,0}], {sc, sc Tan[Abs[ $\chi$ ]]},  $\psi$ ]*)
  ]
circCylfor2D[centre_ : {0, 0, 0}, radius_ : 1, rydrx_ : 1, angle_ :=
  {FaceForm[], Translate[Rotate[Scale[Cylinder[{0, 0, 0}, {0, 0, 0.00001}], radius],
    {1, rydrx, 1}], angle, {0, 0, 1}], centre]}
paraField[x_, y_] :=  $\sqrt{\frac{1}{\pi}}$  Exp[-(x^2 + y^2)] ( $\{1, i\} + \sqrt{2} (x + i y)^2 \{1, -i\}$ )
In[ ]:= focFig[bfp_, {rayx_, rayy_}, sphereR_, coordz_, ptfz_, lengthf_, lblrayz_] :=
  Block[{polPaxF, paraxSlice, axes, beam, ray,
    lens, ptfocf, ptpxf, normRay, fptz, theta, coneZ},
    normRay = Norm[{rayx, rayy}];
    theta = ArcSin[normRay / sphereR]; phi = ArcTan[rayx, rayy];
    fptz = sphereR Cos[theta];
    coneZ = sphereR Cos[ArcSin[1 / sphereR]];
    axes = Show[Graphics3D[{Arrowheads[.025], Thickness[0.0015],
      Arrow[{0, 0, bfp}, {0, 0, .8}], Arrow[{0, 0, coordz}, {1.6, 0, coordz}],
      Arrow[{0, 0, coordz}, {0, 1.4, coordz}], Text["x", {1.55, -0.13, coordz}],
      Text["y", {0.24, 1.27, coordz}], Text["z", {0, 0.13, 0.7}]}], ParametricPlot3D[
      {Cos[f], Sin[f], coordz}, {f, 0, 2  $\pi$ }, PlotStyle -> {{Dashed, Black}}]];
    polPaxF = Graphics3D[{EdgeForm[Thickness[0.0015]],
      Table[Table[polFig[paraField[1.7 r Cos[f], 1.7 r Sin[f]], 0.06,
        {r Cos[f], r Sin[f], bfp}], {f, 0, 2  $\pi$ ,  $\pi/2 / (10 r + 1)$ }, {r, 0, 0.95, 0.2}]}]];
    paraxSlice = Graphics3D[{Lighting -> {"Ambient", White},
      First@DensityPlot[Norm[paraField[1.7 x, 1.7 y]], {x, -1, 1}, {y, -1, 1},
        ColorFunction -> GrayLevel, RegionFunction -> Function[{x, y, z}, x^2 + y^2 <= 1],
        Frame -> False] /. {x_?AtomQ, y_?AtomQ} -> {x, y, bfp}]}]];
    beam = Graphics3D[{Opacity[.2], EdgeForm[Directive[Transparent]],
      Red // Glow, Cylinder[{0, 0, bfp + 0.01}, {0, 0, -coneZ}],
      Cone[{0, 0, -coneZ}, {0, 0, 0}]}]];
    ray = Show[Graphics3D[{Arrowheads[.025], Thickness[0.0015],
      Red, Arrowheads[{0, 0.025, 0.025, 0.025, 0}],
      Arrow[{rayx, rayy, bfp}, {rayx, rayy, -fptz}, {0, 0, 0}],
      Red, Text[" $\theta$ ", {0, 0.1, -1.2 lblrayz}]}], ParametricPlot3D[
      lblrayz {Cos[ArcTan[rayx, rayy]] Sin[t], Sin[ArcTan[rayx, rayy]] Sin[t], -Cos[t]},
      {t, 0, ArcSin[normRay / sphereR]}, PlotStyle -> {Red, Thickness[0.001]}]];
    lens = SphericalPlot3D[sphereR, { $\theta$ ,  $\pi$  - ArcSin[1.05 / sphereR],  $\pi$ }, { $\phi$ , 0, 2  $\pi$ },
      PlotStyle -> Directive[ColorData["DeepSeaColors"] [0.85], Opacity[.7]], Mesh -> 6,
      MeshStyle -> Dashed, Boxed -> False, Axes -> False, Lighting -> {"Ambient", White}];
    ptpxf = Show[ParametricPlot3D[{0.3 Cos[f], 0.3 Sin[f], coordz},
      {f, 0, ArcTan[rayx, rayy]}, PlotStyle -> {Black, Thickness[0.001]}] /.
      Line[x_] -> {Arrowheads[{0.01}], Arrow[x]}, Graphics3D[{Text[" $\phi$ ",
        {0.5 Cos[ArcTan[rayx, rayy] / 2], 0.38 Sin[ArcTan[rayx, rayy] / 2], coordz}],
      Line[{0, 0, coordz}, {rayx, rayy, coordz}], Thickness[0.002],

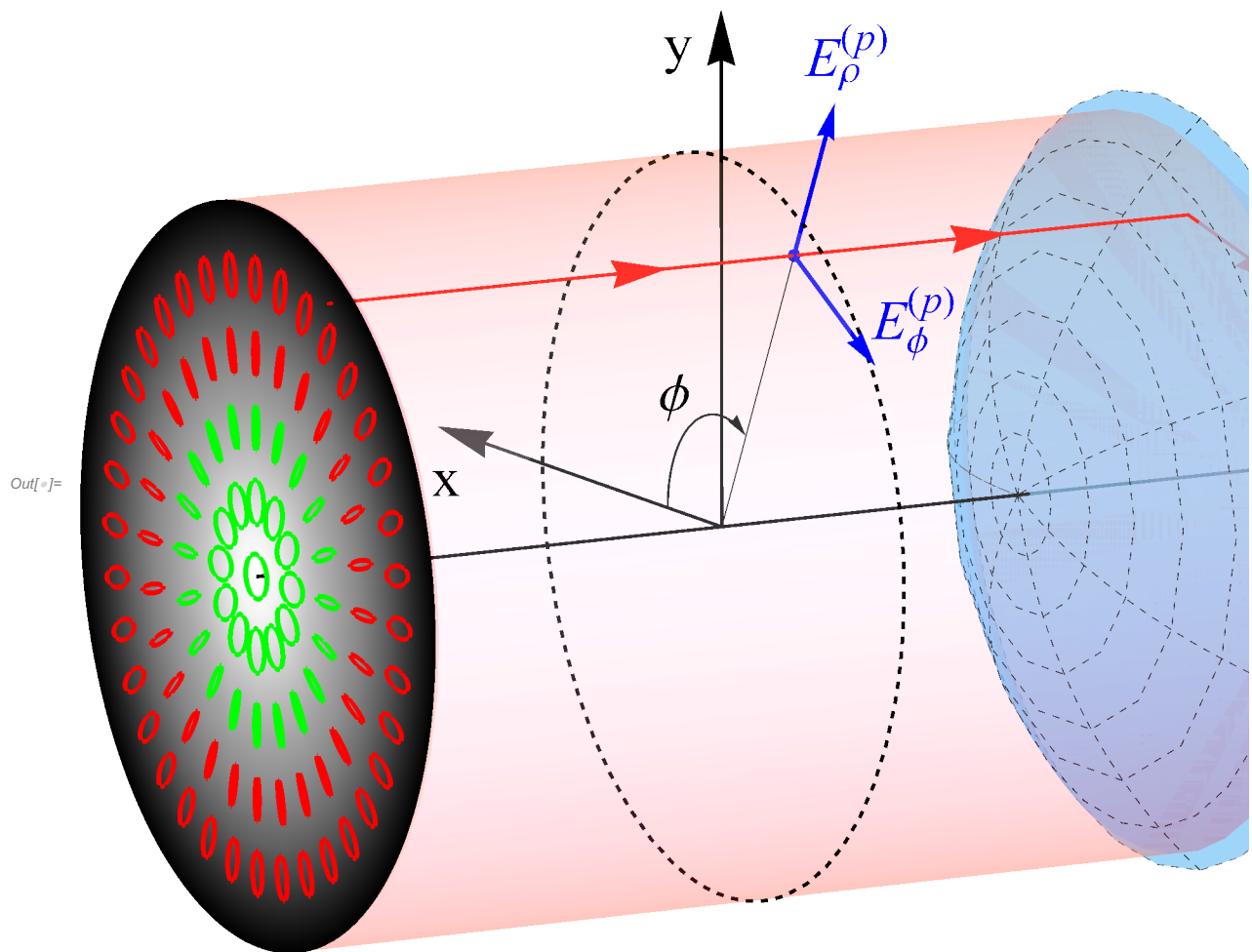
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Arrowheads[0.016], Blue, PointSize[.006], Point[{rayx, rayy, coordz}],
Text[" $E_{\phi}^{(p)}$ ", {rayx, rayy, coordz} + 1.3 lengthf {-rayy - .1, rayx + .3, 0} / normRay],
Text[" $E_{\rho}^{(p)}$ ", {rayx, rayy, coordz} + 1.3 lengthf {rayx, rayy, 0} / normRay], Arrow[
  {{rayx, rayy, coordz}, {rayx, rayy, coordz} + lengthf {rayx, rayy, 0} / normRay}],
Arrow[{{rayx, rayy, coordz}, {rayx, rayy, coordz} +
  lengthf {-rayy, rayx, 0} / normRay}]]];
ptfocf = Graphics3D[{Thickness[0.002], Arrowheads[0.016], Blue, PointSize[.006],
  Point[ptfz {Cos[phi] Tan[theta], Sin[phi] Tan[theta], -1}],
  Arrow[{ptfz {Cos[phi] Tan[theta], Sin[phi] Tan[theta], -1},
    ptfz {Cos[phi] Tan[theta], Sin[phi] Tan[theta], -1} +
    lengthf {Cos[theta] rayx, Cos[theta] rayy, 0} / normRay}],
  Arrow[{ptfz {Cos[phi] Tan[theta], Sin[phi] Tan[theta], -1},
    ptfz {Cos[phi] Tan[theta], Sin[phi] Tan[theta], -1} +
    lengthf {0, 0, normRay Sin[theta]} / normRay}],
  Arrow[{ptfz {Cos[phi] Tan[theta], Sin[phi] Tan[theta], -1},
    ptfz {Cos[phi] Tan[theta], Sin[phi] Tan[theta], -1} +
    lengthf {-rayy, rayx, 0} / normRay}], Dashed,
  Line[{ptfz {Cos[phi] Tan[theta], Sin[phi] Tan[theta], -1},
    ptfz {Cos[phi] Tan[theta], Sin[phi] Tan[theta], -1} +
    lengthf {Cos[theta] rayx, Cos[theta] rayy, normRay Sin[theta]} / normRay}],
  Line[{ptfz {Cos[phi] Tan[theta], Sin[phi] Tan[theta], -1} +
    lengthf {Cos[theta] rayx, Cos[theta] rayy, 0} / normRay,
    ptfz {Cos[phi] Tan[theta], Sin[phi] Tan[theta], -1} +
    lengthf {Cos[theta] rayx, Cos[theta] rayy, normRay Sin[theta]} / normRay}],
  Line[{ptfz {Cos[phi] Tan[theta], Sin[phi] Tan[theta], -1} +
    lengthf {0, 0, normRay Sin[theta]} / normRay,
    ptfz {Cos[phi] Tan[theta], Sin[phi] Tan[theta], -1} +
    lengthf {Cos[theta] rayx, Cos[theta] rayy, normRay Sin[theta]} / normRay}]]
, Text[" $E_{\phi}^{(f)}$ ", ptfz {Cos[phi] Tan[theta], Sin[phi] Tan[theta], -1} +
  1.3 lengthf {Cos[theta] rayx, Cos[theta] rayy + .1, 0} / normRay],
Text[" $E_z^{(f)}$ ", ptfz {Cos[phi] Tan[theta], Sin[phi] Tan[theta], -1} +
  1.3 lengthf {0, -.15, normRay Sin[theta]} / normRay],
Text[" $E_{\phi}^{(f)}$ ", ptfz {Cos[phi] Tan[theta], Sin[phi] Tan[theta], -1} +
  1.3 lengthf {-rayy, rayx, 0} / normRay}]]];
Show[{axes, lens, beam, ray, ptfocf, ptpxf,
  polPaxF, paraxSlice}, Boxed -> False,
  ViewVertical -> {0, 1, 0}, ViewPoint -> {-18, 4, -10}, ImageSize -> 900,
  Method -> {"ShrinkWrap" -> True}, BaseStyle -> {FontFamily -> "Times", FontSize -> 30}]
]

In[ ]:= bfp = -3.8; rayx = -.4; rayy = .8; coordz = -2.4; sphereR = 1.5;
lblrayz = 0.3;
ptfz = 0.;
lengthf = .5;
figFocusing =
  Grid[{{focFig[bfp, {rayx, rayy}], sphereR, coordz, ptfz, lengthf, lblrayz}]]]

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In[ ]:= SetDirectory[
  "/Users/rodrigo/GoogleDrive/Investigacion/Skyrmion/Skyrmion-Shared/figures/"
]
Out[ ]:= /Users/rodrigo/GoogleDrive/Investigacion/Skyrmion/Skyrmion-Shared/figures

In[ ]:= Export["figFocusing.pdf", figFocusing]
Out[ ]:= figFocusing.pdf

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