

```

n = 8;
NextBulbNormal[c_] [{{x_, y_, z_}, Jz_: {}}] := Block[{r, w, c, s, z, r},

  r =  $\sqrt{x^2 + y^2 + z^2}$ ;
  w =  $\sqrt{x^2 + y^2}$ ;
  c $_{\theta}$  =  $\frac{x}{w}$ ;
  s $_{\theta}$  =  $\frac{y}{w}$ ;
  c $_{\phi}$  =  $\frac{z}{r}$ ;
  s $_{\phi}$  =  $\frac{w}{r}$ ;
  z $_{\theta}$  = (c $_{\theta}$  + i s $_{\theta}$ )n;
  z $_{\phi}$  = (c $_{\phi}$  + i s $_{\phi}$ )n;
  c $_{\underline{\theta}}$  = Re[z $_{\theta}$ ];
  s $_{\underline{\theta}}$  = Im[z $_{\theta}$ ];
  c $_{\underline{\phi}}$  = Re[z $_{\phi}$ ];
  s $_{\underline{\phi}}$  = Im[z $_{\phi}$ ];
  r = rn;
  z = r {c $_{\underline{\theta}}$  s $_{\underline{\phi}}$ , s $_{\underline{\theta}}$  s $_{\underline{\phi}}$ , c $_{\underline{\phi}}$ } + c;

  (*Note early out*)
  If[Jz == {}, Return[{z}]];
  (*Note early out*)

  A =  $\begin{pmatrix} c_{\underline{\theta}} s_{\underline{\phi}} & r s_{\underline{\phi}} & 0 & 0 & r c_{\underline{\theta}} \\ s_{\underline{\theta}} s_{\underline{\phi}} & 0 & r s_{\underline{\phi}} & 0 & r s_{\underline{\theta}} \\ c_{\underline{\phi}} & 0 & 0 & r & 0 \end{pmatrix}$ ;

  M = MatrixPower;

  B =  $\begin{pmatrix} n r^{(n-1)} & 0 & 0 \\ 0 & n M\left[\begin{pmatrix} c_{\theta} & -s_{\theta} \\ s_{\theta} & c_{\theta} \end{pmatrix}, n-1\right] & 0 \\ 0 & 0 & n M\left[\begin{pmatrix} c_{\phi} & -s_{\phi} \\ s_{\phi} & c_{\phi} \end{pmatrix}, n-1\right] \end{pmatrix}$  // ArrayFlatten;

  C =  $\begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & -\frac{x}{w^2} & \frac{1}{w} & 0 & 0 \\ 0 & -\frac{y}{w^2} & 0 & \frac{1}{w} & 0 \\ -\frac{z}{r^2} & 0 & 0 & 0 & \frac{1}{r} \\ -\frac{w}{r^2} & \frac{1}{r} & 0 & 0 & 0 \end{pmatrix}$ ;

  D =  $\begin{pmatrix} \frac{x}{r} & \frac{y}{r} & \frac{z}{r} \\ \frac{x}{w} & \frac{y}{w} & 0 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$ ;

  Jz = A.B.C.D.Jz + IdentityMatrix[3];
  {z, Jz}

]

MandelBulbNormal[c_] :=
Nest[NextBulbNormal[c], N@c, IdentityMatrix[3]], recursionLevel] /. {z_., Jz_} -> z.Jz //
Normalize

recursionLevel = 2;
MandelBulb[c_] := Norm@Nest[NextBulbNormal[N@c], N@c, recursionLevel]

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