

```

r0 = {x0, y0, z0};
r[1] = {x, W/2 - t*W, T/2};
r[2] = {x, -W/2, T/2 - t*T};
r[3] = {x, -W/2 + t*W, -T/2};
r[4] = {x, W/2, -T/2 + t*T};
rt = Table[D[r[i], t], {i, 1, 4}]
{{0, -W, 0}, {0, 0, -T}, {0, W, 0}, {0, 0, T} }

B = Sum[Cross[rt[[i]], (r[i] - r0)] / ((r[i] - r0). (r[i] - r0))^(3/2), {i, 1, 4}]
{ -T W
----- - T Y0
((x - x0)^2 + (-W/2 - Y0)^2 + (T/2 - t T - z0)^2)^3/2 + -T W
----- + T Y0
((x - x0)^2 + (W/2 - Y0)^2 + (-T/2 + t T - z0)^2)^3/2 +
----- - W z0
((x - x0)^2 + (-W/2 + t W - Y0)^2 + (-T/2 - z0)^2)^3/2 + -T W
----- + W z0
((x - x0)^2 + (W/2 - t W - Y0)^2 + (T/2 - z0)^2)^3/2 ,
----- - T x + T x0
((x - x0)^2 + (-W/2 - Y0)^2 + (T/2 - t T - z0)^2)^3/2 + T x - T x0
----- - W x + W x0
((x - x0)^2 + (-W/2 + t W - Y0)^2 + (-T/2 - z0)^2)^3/2 + W x - W x0
((x - x0)^2 + (W/2 - t W - Y0)^2 + (T/2 - z0)^2)^3/2 }
Integrate[Integrate[1/(p^2 + u^2 + v^2)^3/2, u], v]
ArcTan[u v / p Sqrt[p^2 + u^2 + v^2]] /
p
Integrate[Integrate[v / (p^2 + u^2 + v^2)^3/2, u], v]
-ArcTanh[Sqrt[p^2 + u^2 + v^2] / u]
ArcTan[u v / p Sqrt[p^2 + u^2 + v^2]] /
I1[p_, u_, v_] := -
I2[p_, u_, v_] := -ArcTanh[Sqrt[p^2 + u^2 + v^2] / u]

```

```
(W / 2 + y0) * I1[W / 2 + y0, t * T + z0 - T / 2, x - x0]

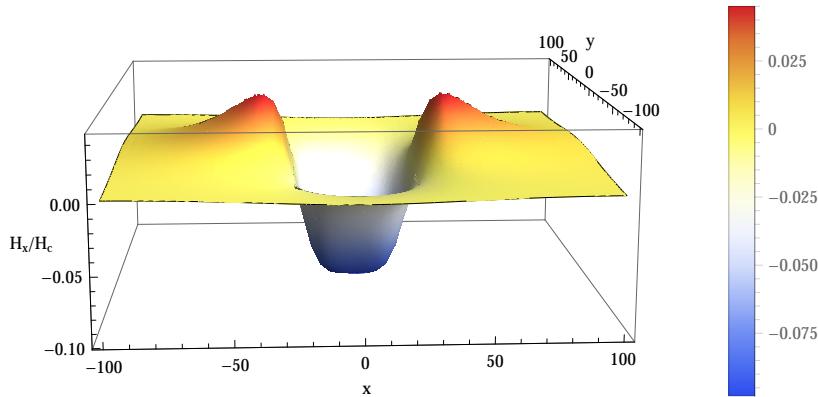
ArcTan[
$$\frac{(x - x0) \left(-\frac{T}{2} + t T + z0\right)}{\left(\frac{W}{2} + y0\right) \sqrt{(x - x0)^2 + \left(\frac{W}{2} + y0\right)^2 + \left(-\frac{T}{2} + t T + z0\right)^2}}$$
]

Bx4[x_, t_, x0_, y0_, z0_, W_, T_] := -(W / 2 + y0) * I1[W / 2 + y0, t * T + z0 - T / 2, x - x0] +
(y0 - W / 2) * I1[y0 - W / 2, t * T - z0 - T / 2, x - x0] -
(z0 + T / 2) * I1[z0 + T / 2, t * W - y0 - W / 2, x - x0] +
(z0 - T / 2) * I1[z0 - T / 2, t * W + y0 - W / 2, x - x0]

Bx2[x_, x0_, y0_, z0_, W_, T_] := Bx4[x, 1, x0, y0, z0, W, T] - Bx4[x, 0, x0, y0, z0, W, T]

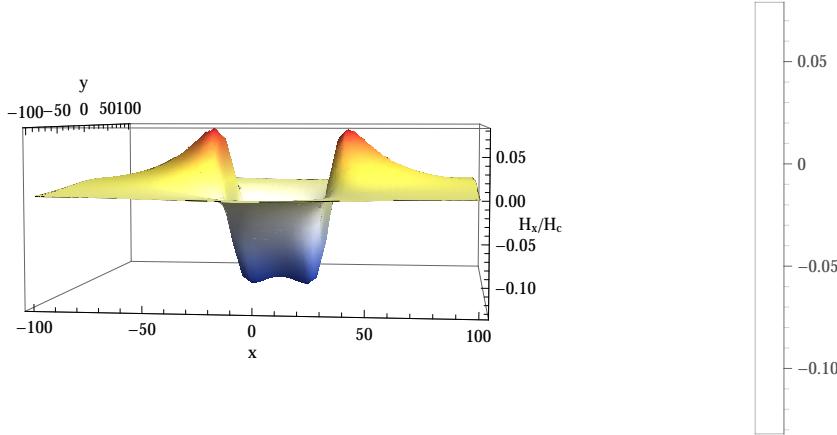
Bx[x0_, y0_, z0_, W_, T_, L_] :=
(Bx2[L / 2, x0, y0, z0, W, T] - Bx2[-L / 2, x0, y0, z0, W, T]) / (4 * Pi)

Plot3D[-Bx[x, y, 20, 50, 20, 50], {x, -100, 100}, {y, -100, 100},
Mesh → None, ColorFunction → "TemperatureMap", PlotLegends → Automatic,
AxesLabel → {"x", "y", "Hx/Hc"}, PlotRange → All, PlotPoints → 50, Exclusions → None]
```



```
BxA[x0_, y0_, z0_, W_, T_, L_] :=
(Bx2[L / 2, x0, y0, z0, W, T] - Bx2[-L / 2, x0, y0, z0, W, T]) / (4 * Pi)
```

```
Plot3D[-Bx[x, y, 15, 50, 20, 50], {x, -100, 100}, {y, -100, 100},
Mesh → None, ColorFunction → "TemperatureMap", PlotLegends → Automatic,
AxesLabel → {"x", "y", "Hx/Hc"}, PlotRange → All, PlotPoints → 50, Exclusions → None]
```



Bx4[x, t, x0, y0, z0, w, T]

$$\begin{aligned} & \text{ArcTan}\left[\frac{(x-x_0) \left(-\frac{T}{2}+t T-z_0\right)}{\left(-\frac{w}{2}+y_0\right) \sqrt{(x-x_0)^2+\left(-\frac{w}{2}+y_0\right)^2+\left(-\frac{T}{2}+t T-z_0\right)^2}}\right]+ \\ & \text{ArcTan}\left[\frac{(x-x_0) \left(-\frac{w}{2}+t W+y_0\right)}{\left(-\frac{T}{2}+z_0\right) \sqrt{(x-x_0)^2+\left(-\frac{w}{2}+t W+y_0\right)^2+\left(-\frac{T}{2}+z_0\right)^2}}\right]- \\ & \text{ArcTan}\left[\frac{(x-x_0) \left(-\frac{w}{2}+t W-y_0\right)}{\left(\frac{T}{2}+z_0\right) \sqrt{(x-x_0)^2+\left(-\frac{w}{2}+t W-y_0\right)^2+\left(\frac{T}{2}+z_0\right)^2}}\right]+ \\ & \left(-\frac{w}{2}-y_0\right) \text{ArcTan}\left[\frac{\frac{(x-x_0) \left(-\frac{T}{2}+t T+z_0\right)}{\left(\frac{w}{2}+y_0\right) \sqrt{(x-x_0)^2+\left(\frac{w}{2}+y_0\right)^2+\left(-\frac{T}{2}+t T+z_0\right)^2}}}{\frac{w}{2}+y_0}\right] \end{aligned}$$

Bx[x0_, y0_, z0_, w_, T_, L_]

$$\frac{1}{4 \pi} \left(\text{ArcTan}\left[\frac{\left(-\frac{L_-}{2}-x_{0-}\right) \left(-\frac{T_-}{2}-z_{0-}\right)}{\left(-\frac{w_-}{2}+y_{0-}\right) \sqrt{\left(-\frac{L_-}{2}-x_{0-}\right)^2+\left(-\frac{w_-}{2}+y_{0-}\right)^2+\left(-\frac{T_-}{2}-z_{0-}\right)^2}}\right]- \right)$$

$$\begin{aligned}
& \text{ArcTan} \left[\frac{\left(\frac{L_-}{2} - x0_- \right) \left(-\frac{T_-}{2} - z0_- \right)}{\left(-\frac{W_-}{2} + y0_- \right) \sqrt{\left(\frac{L_-}{2} - x0_- \right)^2 + \left(-\frac{W_-}{2} + y0_- \right)^2 + \left(-\frac{T_-}{2} - z0_- \right)^2}} \right] - \\
& \text{ArcTan} \left[\frac{\left(-\frac{L_-}{2} - x0_- \right) \left(\frac{T_-}{2} - z0_- \right)}{\left(-\frac{W_-}{2} + y0_- \right) \sqrt{\left(-\frac{L_-}{2} - x0_- \right)^2 + \left(-\frac{W_-}{2} + y0_- \right)^2 + \left(\frac{T_-}{2} - z0_- \right)^2}} \right] + \\
& \text{ArcTan} \left[\frac{\left(\frac{L_-}{2} - x0_- \right) \left(\frac{T_-}{2} - z0_- \right)}{\left(-\frac{W_-}{2} + y0_- \right) \sqrt{\left(\frac{L_-}{2} - x0_- \right)^2 + \left(-\frac{W_-}{2} + y0_- \right)^2 + \left(\frac{T_-}{2} - z0_- \right)^2}} \right] + \\
& \text{ArcTan} \left[\frac{\left(-\frac{L_-}{2} - x0_- \right) \left(-\frac{W_-}{2} + y0_- \right)}{\left(-\frac{T_-}{2} + z0_- \right) \sqrt{\left(-\frac{L_-}{2} - x0_- \right)^2 + \left(-\frac{W_-}{2} + y0_- \right)^2 + \left(-\frac{T_-}{2} + z0_- \right)^2}} \right] - \\
& \text{ArcTan} \left[\frac{\left(\frac{L_-}{2} - x0_- \right) \left(-\frac{W_-}{2} + y0_- \right)}{\left(-\frac{T_-}{2} + z0_- \right) \sqrt{\left(\frac{L_-}{2} - x0_- \right)^2 + \left(-\frac{W_-}{2} + y0_- \right)^2 + \left(-\frac{T_-}{2} + z0_- \right)^2}} \right] - \\
& \text{ArcTan} \left[\frac{\left(-\frac{L_-}{2} - x0_- \right) \left(\frac{W_-}{2} + y0_- \right)}{\left(-\frac{T_-}{2} + z0_- \right) \sqrt{\left(-\frac{L_-}{2} - x0_- \right)^2 + \left(\frac{W_-}{2} + y0_- \right)^2 + \left(-\frac{T_-}{2} + z0_- \right)^2}} \right] + \\
& \text{ArcTan} \left[\frac{\left(\frac{L_-}{2} - x0_- \right) \left(\frac{W_-}{2} + y0_- \right)}{\left(-\frac{T_-}{2} + z0_- \right) \sqrt{\left(\frac{L_-}{2} - x0_- \right)^2 + \left(\frac{W_-}{2} + y0_- \right)^2 + \left(-\frac{T_-}{2} + z0_- \right)^2}} \right] - \\
& \text{ArcTan} \left[\frac{\left(-\frac{L_-}{2} - x0_- \right) \left(-\frac{W_-}{2} - y0_- \right)}{\left(\frac{T_-}{2} + z0_- \right) \sqrt{\left(-\frac{L_-}{2} - x0_- \right)^2 + \left(-\frac{W_-}{2} - y0_- \right)^2 + \left(\frac{T_-}{2} + z0_- \right)^2}} \right] + \\
& \text{ArcTan} \left[\frac{\left(\frac{L_-}{2} - x0_- \right) \left(-\frac{W_-}{2} - y0_- \right)}{\left(\frac{T_-}{2} + z0_- \right) \sqrt{\left(\frac{L_-}{2} - x0_- \right)^2 + \left(-\frac{W_-}{2} - y0_- \right)^2 + \left(\frac{T_-}{2} + z0_- \right)^2}} \right] -
\end{aligned}$$

$$\begin{aligned}
& \text{ArcTan} \left[\frac{\left(\frac{L_-}{2} - x0_- \right) \left(\frac{W_-}{2} - y0_- \right)}{\left(\frac{T_-}{2} + z0_- \right) \sqrt{\left(\frac{L_-}{2} - x0_- \right)^2 + \left(\frac{W_-}{2} - y0_- \right)^2 + \left(\frac{T_-}{2} + z0_- \right)^2}} \right] + \\
& \frac{\text{ArcTan} \left[\frac{\left(-\frac{L_-}{2} - x0_- \right) \left(-\frac{T_-}{2} + z0_- \right)}{\left(\frac{W_-}{2} + y0_- \right) \sqrt{\left(-\frac{L_-}{2} - x0_- \right)^2 + \left(\frac{W_-}{2} + y0_- \right)^2 + \left(-\frac{T_-}{2} + z0_- \right)^2}} \right] \left(-\frac{W_-}{2} - y0_- \right)}{\frac{W_-}{2} + y0_-} - \\
& \frac{\text{ArcTan} \left[\frac{\left(\frac{L_-}{2} - x0_- \right) \left(-\frac{T_-}{2} + z0_- \right)}{\left(\frac{W_-}{2} + y0_- \right) \sqrt{\left(\frac{L_-}{2} - x0_- \right)^2 + \left(\frac{W_-}{2} + y0_- \right)^2 + \left(-\frac{T_-}{2} + z0_- \right)^2}} \right] \left(-\frac{W_-}{2} - y0_- \right)}{\frac{W_-}{2} + y0_-} - \\
& \frac{\text{ArcTan} \left[\frac{\left(-\frac{L_-}{2} - x0_- \right) \left(\frac{T_-}{2} + z0_- \right)}{\left(\frac{W_-}{2} + y0_- \right) \sqrt{\left(-\frac{L_-}{2} - x0_- \right)^2 + \left(\frac{W_-}{2} + y0_- \right)^2 + \left(\frac{T_-}{2} + z0_- \right)^2}} \right] \left(-\frac{W_-}{2} - y0_- \right)}{\frac{W_-}{2} + y0_-} + \\
& \frac{\text{ArcTan} \left[\frac{\left(\frac{L_-}{2} - x0_- \right) \left(\frac{T_-}{2} + z0_- \right)}{\left(\frac{W_-}{2} + y0_- \right) \sqrt{\left(\frac{L_-}{2} - x0_- \right)^2 + \left(\frac{W_-}{2} + y0_- \right)^2 + \left(\frac{T_-}{2} + z0_- \right)^2}} \right] \left(-\frac{W_-}{2} - y0_- \right)}{\frac{W_-}{2} + y0_-} \Bigg]
\end{aligned}$$

```

I3[p_, u_, v_] := Integrate[Integrate[Log[p u v], u], v]

I3[p, u, v]
- 2 u v + u v Log[p u v]

I3[p_, u_, v_] := Integrate[Integrate[Log[u v], u], v]

By4[x_, t_, x0_, y0_, z0_, w_, T_] := -(W/2 + y0) * I3[W/2 + y0, t * T + z0 - T/2, x - x0] +
(y0 - W/2) * I3[y0 - W/2, t * T - z0 - T/2, x - x0] -
(z0 + T/2) * I3[z0 + T/2, t * W - y0 - W/2, x - x0] +
(z0 - T/2) * I3[z0 - T/2, t * W + y0 - W/2, x - x0]

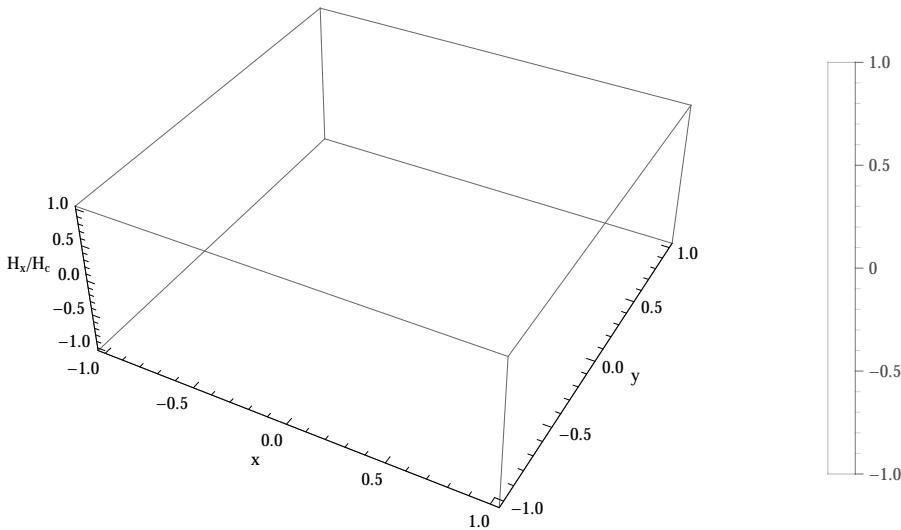
By2[x_, x0_, y0_, z0_, w_, T_] := By4[x, 1, x0, y0, z0, w, T] - By4[x, 0, x0, y0, z0, w, T]

By[x0_, y0_, z0_, w_, T_, L_] :=
(By2[x0, x0, T/2, z0, w, T] - By2[x0, x0, T/2, z0, w, T]) / (4 * Pi)

By[x0_, y0_, z0_, w_, T_, L_]
0

```

```
Plot3D[-By[x, y, 15, 50, 20, 50], {x, -100, 100}, {y, -100, 100},
Mesh → None, ColorFunction → "TemperatureMap", PlotLegends → Automatic,
AxesLabel → {"x", "y", "Hx/Hc"}, PlotRange → All, PlotPoints → 50, Exclusions → None]
```



Sum

```
By1[x0_, y0_, z0_, w_, t_, l_] :=
```

$$\frac{1}{4} \pi \sum \left[\log \left(\frac{t}{2} + z_0 \right) + \sqrt{\left(\frac{l}{2} + x_0 \right)^2 + \left(\frac{w}{2} + y_0 \right)^2 + \left(\frac{t}{2} + z_0 \right)^2}, \{i, 1, 16\} \right]$$

```
By1[x0_, y0_, z0_, w_, t_, l_]
```

$$\frac{1}{4} \pi \left(16 \log \left[\frac{t}{2} + z_0 \right] + 16 \sqrt{\left(\frac{l}{2} + x_0 \right)^2 + \left(\frac{w}{2} + y_0 \right)^2 + \left(\frac{t}{2} + z_0 \right)^2} \right)$$

$$((r[i] - r0) \cdot (r[i] - r0))^{\frac{3}{2}}$$

```
By5[x0_, y0_, z0_, w_, t_, l_] :=
```

$$\frac{1}{4} \pi \sum [\log \left(\frac{t}{2} + z_0 \right) + ((r[i] - r0) \cdot (r[i] - r0))^{\frac{3}{2}}, \{i, 1, 16\}]$$

```
By5[x0_, y0_, z0_, w_, t_, l_]
```

```
By1A[x0_, y0_, z0_, w_, t_, l_] :=
```

$$\frac{1}{4} \text{Pi} \left(\text{Log}[(t/2 + z0)] + \sqrt{\left(\frac{l}{2} + x0\right)^2 + \left(\frac{w}{2} + y0\right)^2 + \left(\frac{t}{2} + z0\right)^2} + \right.$$

$$\text{Log}[(t/2 - z0)] + \sqrt{\left(\frac{l}{2} + x0\right)^2 + \left(\frac{w}{2} + y0\right)^2 + \left(\frac{t}{2} - z0\right)^2} +$$

$$\left. \text{Log}[(t/2 + z0)] + \sqrt{\left(-\frac{l}{2} + x0\right)^2 + \left(\frac{w}{2} - y0\right)^2 + \left(\frac{t}{2} + z0\right)^2} + \right.$$

$$\left. \text{Log}[(t/2 - z0)] + \sqrt{\left(\frac{l}{2} - x0\right)^2 + \left(\frac{w}{2} + y0\right)^2 + \left(\frac{t}{2} + z0\right)^2} \right)$$

```
Plot3D[-By1A[x, y, 15, 50, 20, 50], {x, -100, 100}, {y, -100, 100},
Mesh → None, ColorFunction → "TemperatureMap", PlotLegends → Automatic,
AxesLabel → {"x", "y", "Hx/Hc"}, PlotRange → All, PlotPoints → 50, Exclusions → None]
```

