Integrals for Line charge problem. $\theta = 0, \pi/2, \pi$ are special cases, and have to be evaluated separately. Also has a plot linechargeFig1.eps, and some plots (not in the book) of the integrands.

```
<< peeters` ;
peeters`setGitDir[ "../project/figures/GAelectrodynamics" ]

ClearAll[t, u, f]
$Assumptions = t ∈ Reals ;
f[u_, t_] = (E^(I t) - u) ((u^2 + 1 - 2 u Cos[t])^(-3 / 2));
f[u, θ] // TraditionalForm
ii = Integrate[ f[u, t], u] // FullSimplify;
ii // TraditionalForm
di = D[ii, u] // FullSimplify // TraditionalForm

iir = Integrate[ f[u, Pi / 2], u] // FullSimplify;
iir // TraditionalForm
dir = D[iir, u] // FullSimplify // TraditionalForm
```

$$\frac{-u + e^{i\theta}}{\left(u^2 - 2u\cos(\theta) + 1\right)^{3/2}}$$

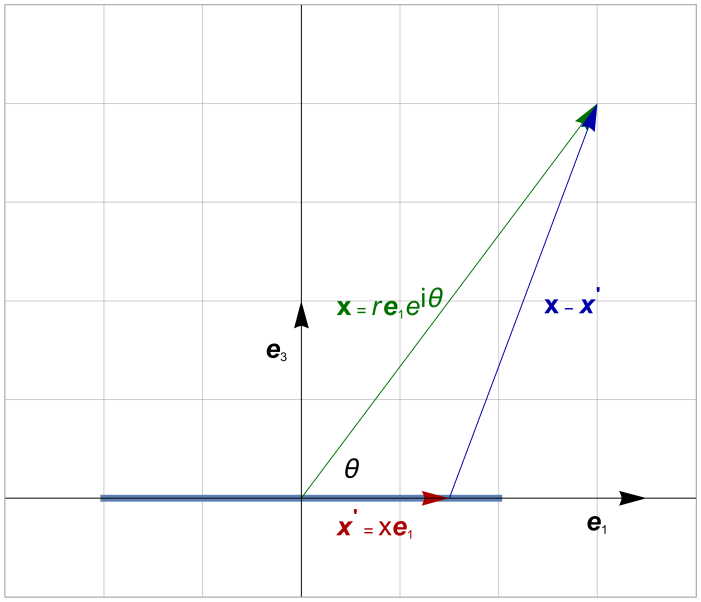
$$-\frac{2 e^{2it}\sqrt{-2u\cos(t) + u^2 + 1}}{\left(-1 + e^{2it}\right)\left(-1 + e^{it}u\right)}$$

$$\frac{e^{it}}{\left(1 - e^{it}u\right)\sqrt{-2u\cos(t) + u^2 + 1}}$$

$$\frac{1 + iu}{\sqrt{u^2 + 1}}$$

$$-\frac{1}{(u + i)\sqrt{u^2 + 1}}$$

```
ClearAll[x, xp, o]
o = {0, 0};
x = {3, 4};
xp = {1.5, 0};
e2 = {0, 1};
e1 = {1, 0};
bold = Style[ #, Bold] &;
sz = 14;
fs = Style[ #, FontSize → sz] &;
tsub[t_, s_] := Subscript[bold[t] // fs, s];
esub := tsub[e, #] &;
vsub := tsub[v, #] &;
midpoint[p_] := (p[[1]] + p[[2]]) / 2 ;
midtext[p_, sh_, text_] := Text[text, midpoint[p] + sh]
p1 = Show[
  ParametricPlot[{x, 0}, {x, -2, 2},
   PlotStyle → Thickness[0.01], GridLines → Automatic,
   Ticks → None,
   PlotRange → {{-3, 4}, {-1, 5}}
  ],
  Graphics[ {
    Green // Darker // Darker,
    midtext[{o, x}, -0.6 e1,
     Row[{ "x" // bold // fs, " = ", r // fs, esub[1], (e // fs) ^ ("iθ" // fs)}]],
    Arrow[{o, x}],
    Red // Darker,
    midtext[{o, xp}, -e2 / 4,
     Row[{ "x'" // bold // fs, " = ", "x" // fs, esub[1]}]],
    Arrow[{o, xp}],
    Black,
    Text["θ" // fs, 0.5 (e1 + 0.6 e2)],
    Arrow[{e2, 2 e2}],
    midtext[{e2, 2 e2}, -0.25 e1, esub[3]],
    Arrow[{2.5 e1, 3.5 e1}],
    midtext[{2.5 e1, 3.5 e1}, -0.25 e2, esub[1]],
    Blue // Darker,
    Arrow[{xp, x}],
    midtext[{xp, x}, 0.5 e1, Row[{ "x" // bold // fs, " - ", "x'" // bold // fs}]]
   }]
 ]
```




```
peeters`exportForLatex["linechargeFig1", p1]
```

```
{linechargeFig1.eps, linechargeFig1pn.png}
```

```
ClearAll[f, g, t]
f[u_] := (1 + I u) / Sqrt[1 + u^2];
g[u_, t_] := (1 - u E^(-I t)) Sqrt[1 + u^2 - 2 u Cos[t]] / (1 + u^2) / Sin[2 t];

Plot[ f[u] // Re, {u, -5, 5}]
Plot[((g[u, #] // Re) &/@ {0.0001, 0.001, 0.01}) // Evaluate, {u, -5, 5}]
```