Evaluation of integrals for a cylindrical field distribution of finite and infinite length.

```
ClearAll[i, iu]
i = Integrate[{1, u} (u^2 + a^2)^(-3/2), u, Assumptions → (a > 0)];
iu[x_] = i /. u → x;
Limit[iu[z] - iu[-z] , z → Infinity, Direction → 1]
Limit[iu[z] - iu[-z] , z → -Infinity, Direction → -1]
```

$$\left\{\frac{2}{a^2}, 0\right\}$$

$$\left\{-\frac{2}{a^2}, 0\right\}$$

```
ClearAll[int1]

int1[p_, phip_, a_] = Integrate[1 / (1 + a^2 - 2 a Cos[phip - p]),
   p, Assumptions → (a ∈ Reals && 0 ≤ p ≤ 2 Pi && 0 ≤ phip ≤ 2 Pi )];
int1[ϕ, θ, r] // TraditionalForm

FullSimplify[int1[2 Pi, phip, r] - int1[0, phip, r], Assumptions → 0 ≤ phip ≤ 2 Pi]
```

$$\frac{2\tan^{-1}\left(\frac{(r+1)\tan\left(\frac{\phi-\theta}{2}\right)}{r-1}\right)}{r^2-1}$$

0

```
ClearAll[ int21, int22, do]
int21[p_, a_] = Integrate[E ^ ( I p) / (1 + a ^ 2 - 2 a Cos[p]),
   p, Assumptions → (a ∈ Reals && 0 ≤ p ≤ 2 Pi)];
int22[p_, a_] = Integrate[E ^ ( 2 I p) / (1 + a ^ 2 - 2 a Cos[p]),
   p, Assumptions → (a ∈ Reals && 0 ≤ p ≤ 2 Pi)];
int21[ϕ, r] // TraditionalForm
int22[ϕ, r] // TraditionalForm

FullSimplify[int21[2 Pi - theta, r] - int21[-theta, r], 0 ≤ theta ≤ 2 Pi]
FullSimplify[int22[2 Pi - theta, r] - int22[-theta, r], 0 ≤ theta ≤ 2 Pi]
```

$$\frac{i\left(r^2 \log\left(-r + e^{i\phi}\right) - \log\left(1 - r\, e^{i\phi}\right)\right)}{r\left(r^2 - 1\right)}$$

$$\frac{i\left(r^4 \log\left(-r + e^{i\phi}\right) + \left(r^2 - 1\right) r\, e^{i\phi} - \log\left(1 - r\, e^{i\phi}\right)\right)}{r^2\left(r^2 - 1\right)}$$

```
0
0
```