Fig. 1. Circular current loop geometry.

III. CARTESIAN COORDINATES

The field components and their derivatives in Cartesian coordinates are given below. These are easier to use when rotations or translations are needed and obviate the need to transform the basis vectors. The following substitutions are used for simplicity: $\rho^2 \equiv x^2 + y^2$, $r^2 \equiv x^2 + y^2 + z^2$, $\alpha^2 \equiv a^2 + r^2 - 2a\rho$, $\beta^2 \equiv a^2 + r^2 + 2a\rho$, $k^2 \equiv 1 - \alpha^2/\beta^2$, $\gamma \equiv x^2 - y^2$, and $C \equiv \mu_0 I/\pi$. Note that ρ and r are non-negative.
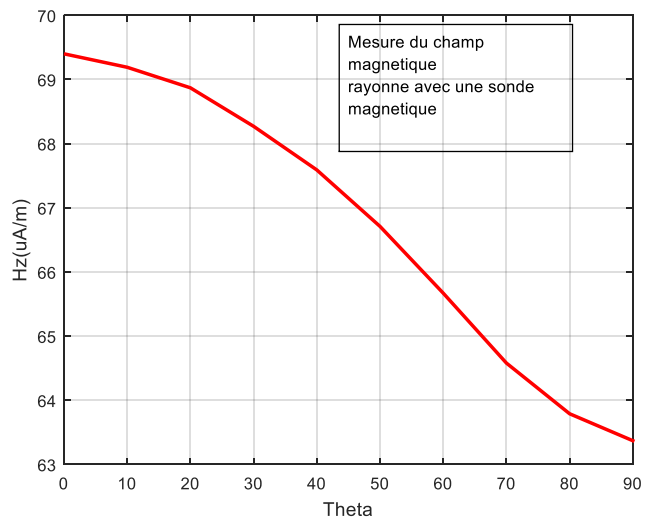
Field Components:

$$B_x = \frac{C\,x\,z}{2\alpha^2\beta\rho^2}\left[(a^2 + r^2)E(k^2) - \alpha^2 K(k^2)\right]$$

$$B_y = \frac{C\,y\,z}{2\alpha^2\beta\rho^2}\left[(a^2 + r^2)E(k^2) - \alpha^2 K(k^2)\right] = \frac{y}{x}B_x$$

$$B_z = \frac{C}{2\alpha^2\beta}\left[(a^2 - r^2)E(k^2) + \alpha^2 K(k^2)\right]$$

....
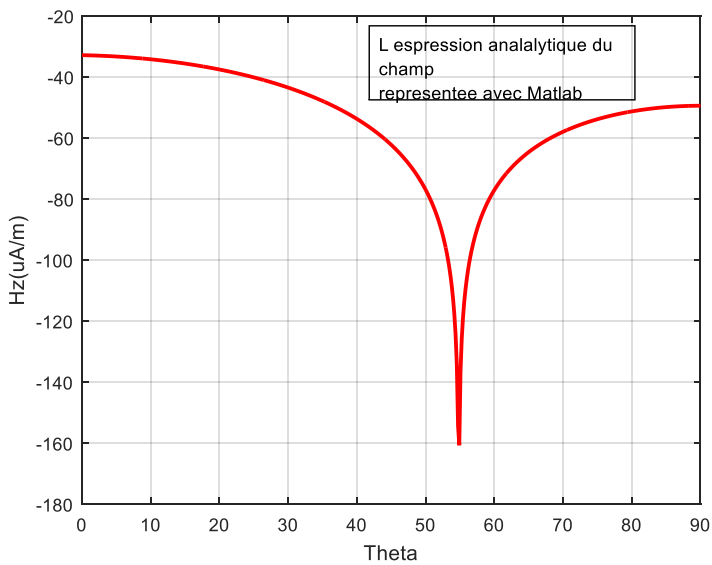
A: Simulation

B: Mesure

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Code Matlab: c est juste l expression analytique de Hz cad Bz/µ representee dans le systeme de coordonnees spheriques car les mesures ont ete aussi fait dans le systeme de coordonnees spheriques

```matlab
%% Ce code trace le champ magnetique rayonne par une boucle de courant
%% il trace Hz cad Bz/mue0
%% en fonction de l angle Theta
%% a=12.25 mm  est le rayon de la boucle de courant
%% r =20 cm est la distance de mesure du champ
%% I=320 mA est le courant qui circule dans la boucle de courant

function Hz=Representation_de_Hz(a,r,I)

pshi=pi/2;

theta_rad=0:(pi/1000):(pi/2);
theta_deg= (theta_rad.*180)./pi;

x=r*sin(theta_rad).*cos(pshi);
y=r*sin(theta_rad).*sin(pshi);


rho1=sqrt(x.^2+y.^2);
rho=rho1.^2;

alpha=a.^2+r.^2-(2*a*rho1);
alpha1=sqrt(alpha);
betha=a.^2+r.^2+(2*a*rho1);
betha1=sqrt(betha);
m=1-(alpha./betha);
k=sqrt(m);
[K,E]=ellipke(m);
C=I/pi;


Hz=(C./2.*alpha.*betha1).*((a^2-r^2).*E+(alpha.*K));

Hz0=abs(Hz);
Hz1=20*log(Hz0/10^-6);


plot(theta_deg,Hz1,'r','linewidth',2);

xlabel('Theta');ylabel('Hz(uA/m)');
grid on;
```