Simulation for “Symmetric Derivation of the Singlet Correlations within a Quaternionic 3-sphere”.

http://dx.doi.org/10.13140/RG.2.2.15725.46565

Created by Fred Diether Apr. 2022. With 3D Vectors!

In[81]:=
```
<< "clifford.m"
w = 0; t = 0; u = 0;
m = 20000;
plotpc = Table[{0, 0}, m];
I3 = Pseudoscalar[3];
```

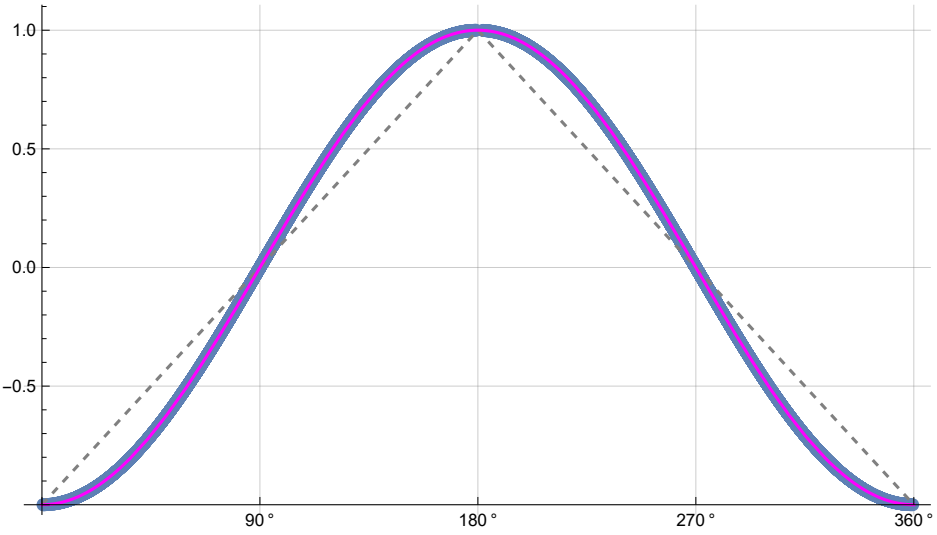
In[86]:=
```
Do[aa = RandomPoint[Sphere[]];
 a = ({e[1], e[2], e[3]}).aa;  (*convert to GA*)
 bb = RandomPoint[Sphere[]];
 b = ({e[1], e[2], e[3]}).bb;  (*convert to GA*)
 ss = RandomPoint[Sphere[]]; (*Singlet spin vector*)
 s = ({e[1], e[2], e[3]}).ss;  (*convert to GA*)
 Da = InnerProduct[I3, a];  (*detector bivector*)
 Db = InnerProduct[I3, b];
 Ls1 = InnerProduct[I3, s];  (*spin bivector to A*)
 Ls2 = -Ls1;  (*spin bivector to B, conservation of angular momentum*)
 ga = GeometricProduct[Da, Ls1];  (*particle - detector interaction*)
 gb = GeometricProduct[Ls2, Db];  (*particle - detector interaction*)
 ag = GeometricProduct[Ls1, Da];  (*particle - detector interaction*)
 bg = GeometricProduct[Db, Ls2];  (*particle - detector interaction*)
 A = Sign[Re[ga]];  (*A detection full polarization*)
 B = Sign[Re[gb]];  (*B detection full polarization*)
 pc = 0;
 pc = 1/2 (GeometricProduct[ga, gb] + GeometricProduct[ag, bg]);  (*product calculation*)
 w = w + pc;
 t = t + A;
 u = u + B;
 ϕA = ArcTan[aa[[2]], aa[[1]]];
 ϕB = ArcTan[bb[[1]], bb[[2]]];
 If[ϕA * ϕB > 0, angle = ArcCos[aa.bb] / Degree, angle = (-ArcCos[aa.bb]) / Degree + 360];
 plotpc[[l]] = {angle, Re[pc]}, {l, m}]
```

In[87]:=
```
mean = Expand[N[w / m]]; (*shows the vanishing of cross products*)
aveA = N[t / m];
aveB = N[u / m];
Print[" <A> = ", aveA, "  <B> = ", aveB];
Print["Cross products vanish, mean = ", mean];
simulation = ListPlot[plotpc, PlotMarkers → {Automatic, Small}, AspectRatio → 9 / 16,
   Ticks → {{{90, 90 °}, {180, 180 °}, {0, 0 °}, {270, 270 °}, {360, 360 °}}, Automatic},
   GridLines → Automatic, AxesOrigin → {0, -1.0}];
negcos = Plot[-Cos[x Degree], {x, 0, 360}, PlotStyle → {Magenta}];
p1 = Plot[-1 + 2 x1 Degree / π, {x1, 0, 180}, PlotStyle → {Gray, Dashed}];
p2 = Plot[3 - 2 x2 Degree / π, {x2, 180, 360}, PlotStyle → {Gray, Dashed}];
Show[simulation, p1, p2, negcos ]
```

```
 <A> = 0.0166  <B> = 0.0053
```

```
Cross products vanish, mean = 0.00139093 + 0.00158746 e1. e2. - 0.00163252 e1. e3. + 0.00193806 e2. e3.
```

Out[96]=



Blue is correlation data, magenta is the negative cosine curve for an exact match.