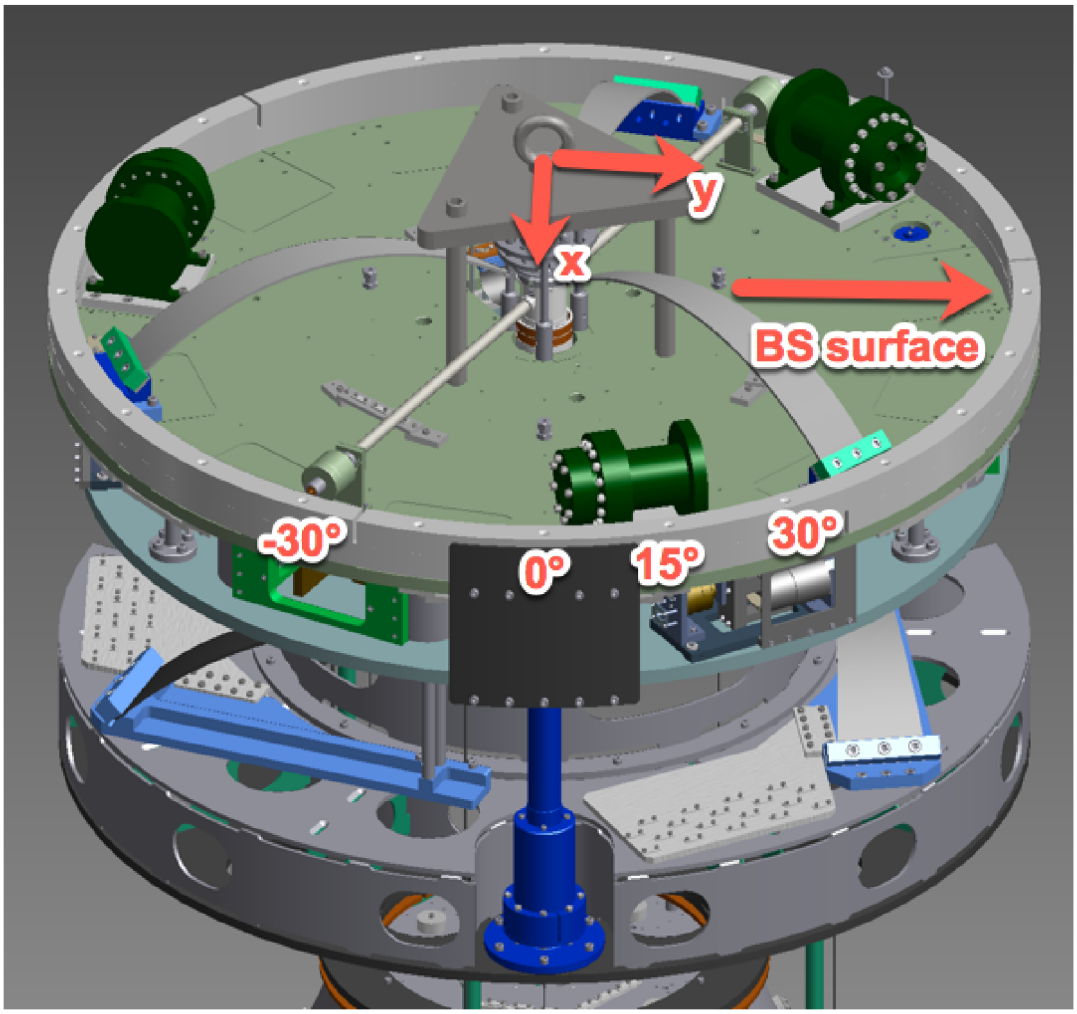
T1707205-v2 - PI Matrix Calc - BS Final Hang 9/21/2017

The calculation assumes the BS Final Hang arrangement with L (longitudinal) = -X (global, on the AF) = y (this calculation) and T (transverse) = -Y = -x.



- **Graphics/geometry stuff**

```
vals = {
    R -> 715 / 1000, (* PI radius *)
    Sradius -> Sqrt[123.346^2 + 459.968^2] / 1000, (* 3D CAD *)
    Gradius -> 602.6 / 1000, (* 3D CAD *)
    Lradius -> Sqrt[131.764^2 + 579.648^2] / 1000, (* 3D CAD *)
    l -> 200 / 1000, (* For graphics *)
    origin -> 0°
   };
```

```
Lradius /. vals
```

```
0.594435
```

Angular locations of the various items

```
Gangles = 15 ° + {0 °, 120 °, 240 °}
```

$$\{15\,^\circ, 135\,^\circ, 255\,^\circ\}$$

```
Langles = 30 ° + {0 °, 120 °, 240 °}
```

$$\{30\,^\circ, 150\,^\circ, 270\,^\circ\}$$

```
Sangles = -30 ° + {0 °, 120 °, 240 °}
```

$$\{-30\,^\circ, 90\,^\circ, 210\,^\circ\}$$

Positions of the various items as vectors

```
Spositions = Sradius * Table[RotationMatrix[Sangles[[i]]].{1, 0}, {i, 1, 3}]
```

$$\left\{\left\{\frac{\sqrt{3}\ \text{Sradius}}{2}, -\frac{\text{Sradius}}{2}\right\}, \{0, \text{Sradius}\}, \left\{-\frac{\sqrt{3}\ \text{Sradius}}{2}, -\frac{\text{Sradius}}{2}\right\}\right\}$$

```
Gpositions = Gradius * Table[RotationMatrix[Gangles[[i]]].{1, 0}, {i, 1, 3}]
```

$$\left\{\left\{\frac{\left(1+\sqrt{3}\right)\ \text{Gradius}}{2\sqrt{2}}, \frac{\left(-1+\sqrt{3}\right)\ \text{Gradius}}{2\sqrt{2}}\right\},\right.$$
$$\left.\left\{-\frac{\text{Gradius}}{\sqrt{2}}, \frac{\text{Gradius}}{\sqrt{2}}\right\}, \left\{-\frac{\left(-1+\sqrt{3}\right)\ \text{Gradius}}{2\sqrt{2}}, -\frac{\left(1+\sqrt{3}\right)\ \text{Gradius}}{2\sqrt{2}}\right\}\right\}$$

```
Lpositions = Lradius * Table[RotationMatrix[Langles[[i]]].{1, 0}, {i, 1, 3}]
```

$$\left\{\left\{\frac{\sqrt{3}\ \text{Lradius}}{2}, \frac{\text{Lradius}}{2}\right\}, \left\{-\frac{\sqrt{3}\ \text{Lradius}}{2}, \frac{\text{Lradius}}{2}\right\}, \{0, -\text{Lradius}\}\right\}$$

Orientations of the various items as unit vectors

```
Svectors = Table[RotationMatrix[Sangles[[i]]].{0, 1}, {i, 1, 3}]
```

$$\left\{\left\{\frac{1}{2}, \frac{\sqrt{3}}{2}\right\}, \{-1, 0\}, \left\{\frac{1}{2}, -\frac{\sqrt{3}}{2}\right\}\right\}$$

```
Gvectors = Table[RotationMatrix[Gangles[[i]]].{0, 1}, {i, 1, 3}]
```

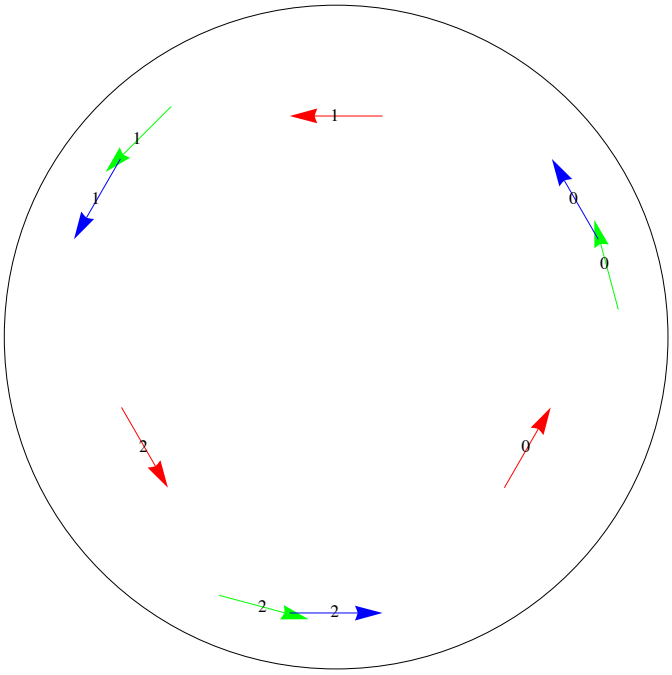
$$\left\{\left\{-\frac{-1+\sqrt{3}}{2\sqrt{2}}, \frac{1+\sqrt{3}}{2\sqrt{2}}\right\}, \left\{-\frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}}\right\}, \left\{\frac{1+\sqrt{3}}{2\sqrt{2}}, -\frac{-1+\sqrt{3}}{2\sqrt{2}}\right\}\right\}$$

```
Lvectors = Table[RotationMatrix[Langles[[i]]].{0, 1}, {i, 1, 3}]
```

$$\left\{\left\{-\frac{1}{2}, \frac{\sqrt{3}}{2}\right\}, \left\{-\frac{1}{2}, -\frac{\sqrt{3}}{2}\right\}, \{1, 0\}\right\}$$

■ Diagram

```
Graphics[{
   Circle[{0, 0}, R],
   Red,
   Sequence[Table[Arrow[{Spositions[[i]] - Svectors[[i]] * l / 2,
       Spositions[[i]] + Svectors[[i]] * l / 2}], {i, 1, 3}
    ]],
   Black, Sequence[Table[Text[i - 1, Spositions[[i]]], {i, 1, 3}]],
   Green,
   Sequence[Table[Arrow[{Gpositions[[i]] - Gvectors[[i]] * l / 2,
       Gpositions[[i]] + Gvectors[[i]] * l / 2}], {i, 1, 3}
    ]],
   Black, Sequence[Table[Text[i - 1, Gpositions[[i]]], {i, 1, 3}]],
   Blue,
   Sequence[Table[Arrow[{Lpositions[[i]] - Lvectors[[i]] * l / 2,
       Lpositions[[i]] + Lvectors[[i]] * l / 2}], {i, 1, 3}
    ]],
   Black, Sequence[Table[Text[i - 1, Lpositions[[i]]], {i, 1, 3}]]
  }] /. vals
```




```
(LVDTfromLTY = {
    Table[Lvectors[[i]].{1, 0}, {i, 1, 3}],
    Table[Lvectors[[i]].{0, 1}, {i, 1, 3}],
    Table[Lvectors[[i]].Lvectors[[i]] * Lradius, {i, 1, 3}]
   }) // TableForm
```

$-\frac{1}{2}$	$-\frac{1}{2}$	1
$\frac{\sqrt{3}}{2}$	$-\frac{\sqrt{3}}{2}$	0
Lradius	Lradius	Lradius

```
LVDTfromLTY /. vals // N // TableForm
```

-0.5	-0.5	1.
0.866025	-0.866025	0.
0.594435	0.594435	0.594435

```
(LTYfromLVDT = Inverse[LVDTfromLTY]) // TableForm
```

$-\frac{1}{3}$	$\frac{1}{\sqrt{3}}$	$\frac{1}{3\,\text{Lradius}}$
$-\frac{1}{3}$	$-\frac{1}{\sqrt{3}}$	$\frac{1}{3\,\text{Lradius}}$
$\frac{2}{3}$	0	$\frac{1}{3\,\text{Lradius}}$

```
Transpose[LTYfromLVDT] /. vals // N // TableForm
```

-0.333333	-0.333333	0.666667
0.57735	-0.57735	0.
0.560756	0.560756	0.560756

```
LTYfromLVDT /. vals // N // TableForm
```

-0.333333	0.57735	0.560756
-0.333333	-0.57735	0.560756
0.666667	0.	0.560756