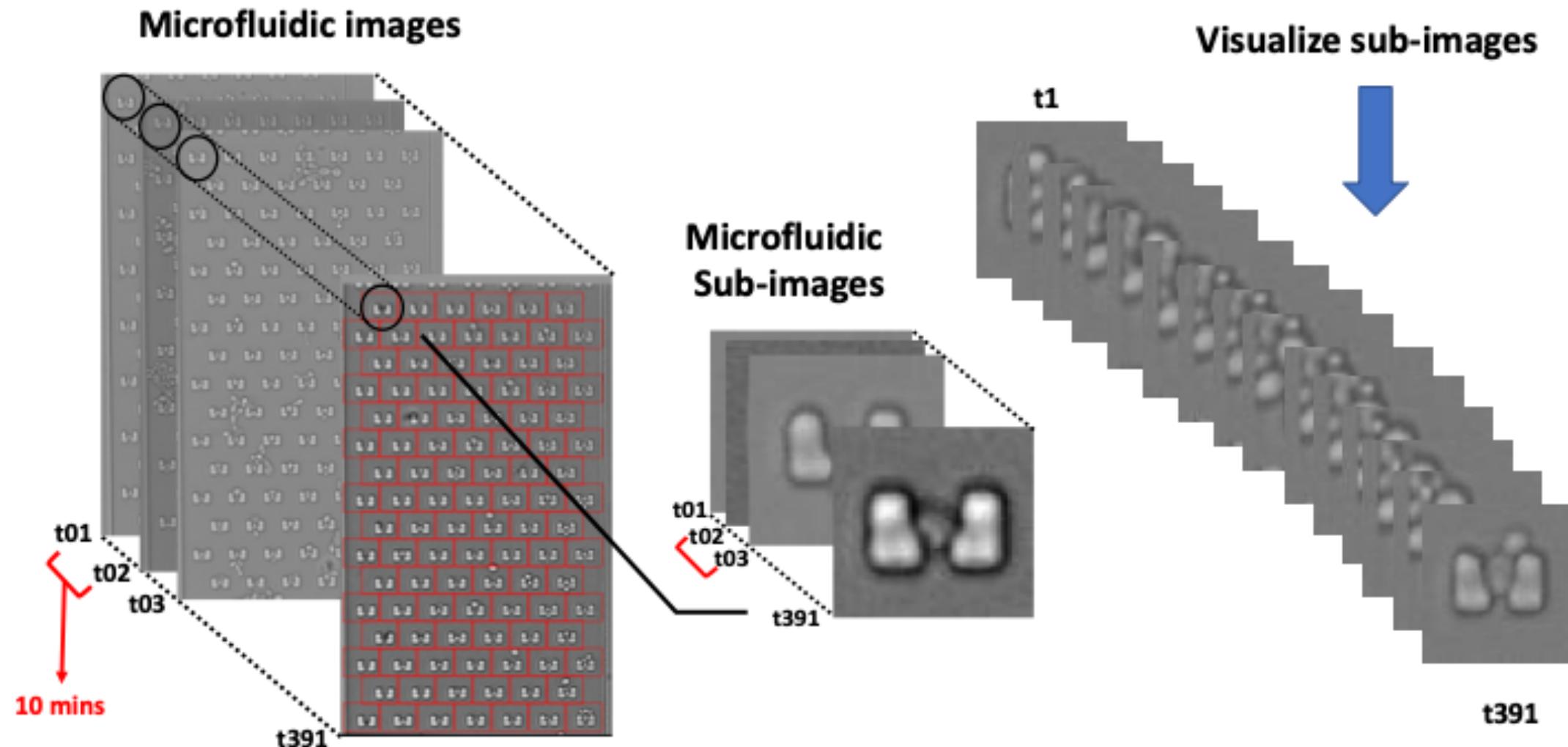


μ Polar

R - Package Visualization Tools for Time-lapse
Microscopic Images

Time-Lapse Images



Calculating Distance

Image with
Reference point
(no-cell)

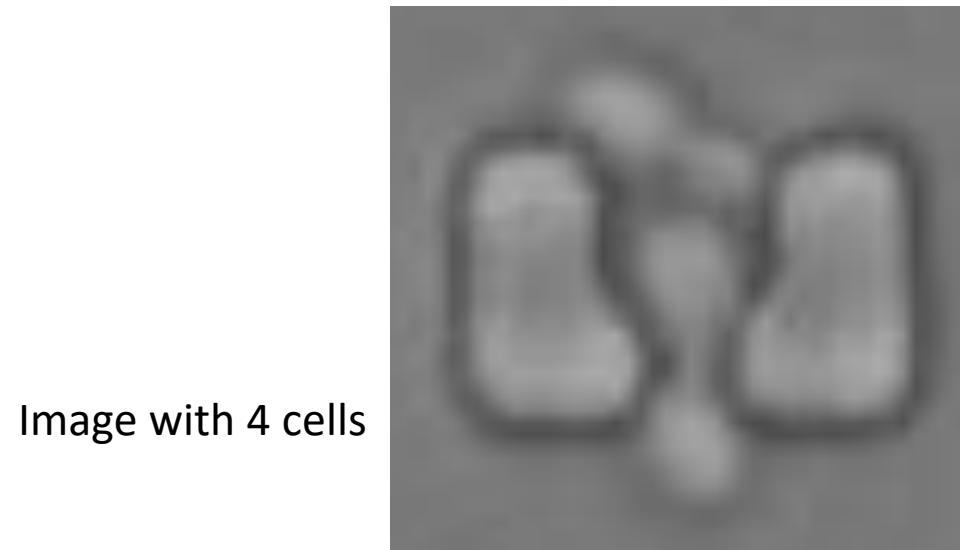
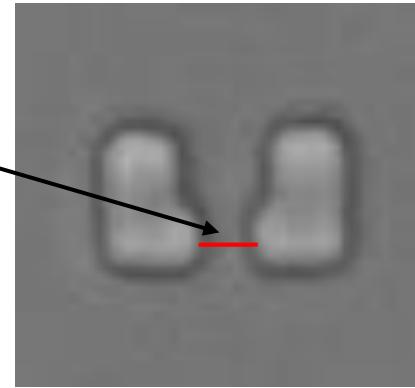
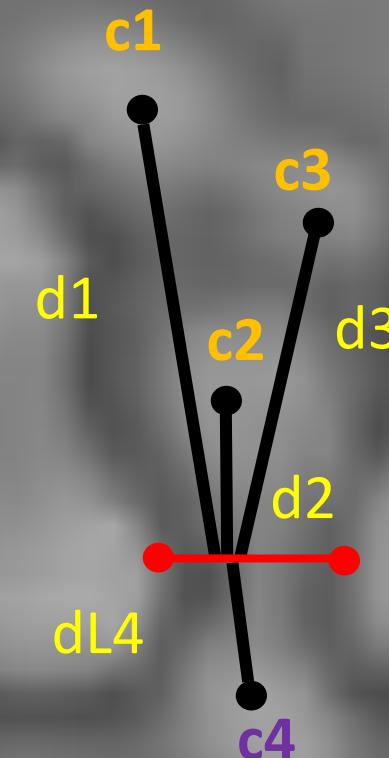


Image with 4 cells

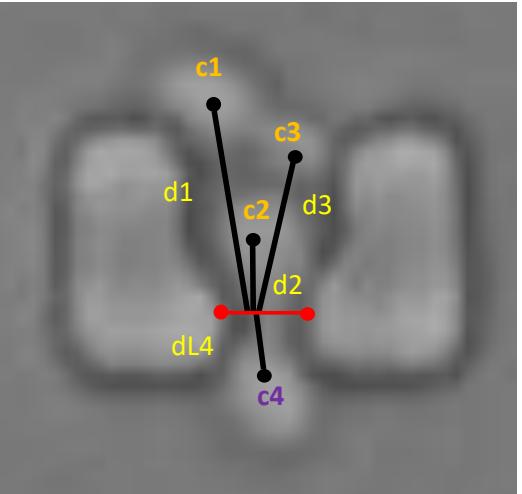
Image with cell distance from reference point



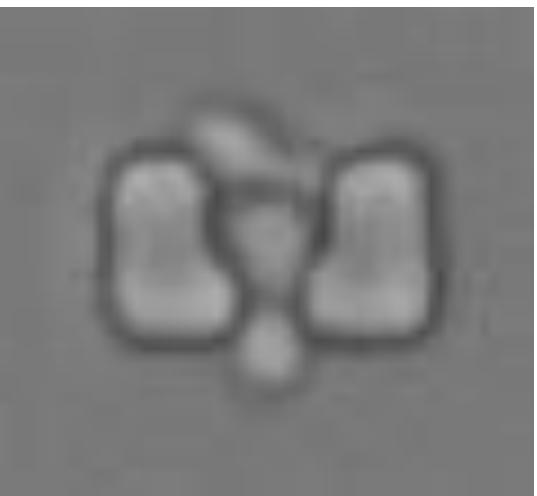
Creating Dataset

Trap Images

Time-point 1



Time-point 2



trap_num	time_num	total_objs	obj_X	obj_Y	area	dist	cell
1	1	4	x1	y1	a1	d1	c1
	1	4	x2	y2	a2	d2	c2
	1	4	x3	y3	a3	d3	c3
	1	4	x4	y4	a4	d4	c4
1	2	3	x1	y1	a1	d1	c1
	2	3	x2	y2	a2	d2	c2
	2	3	x3	y3	a3	d3	c3

Data is in time domain

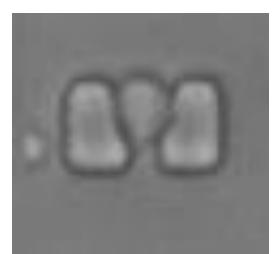
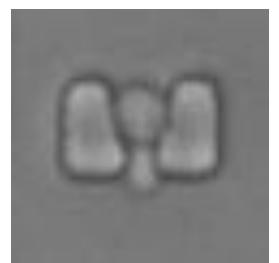
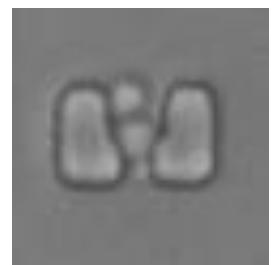
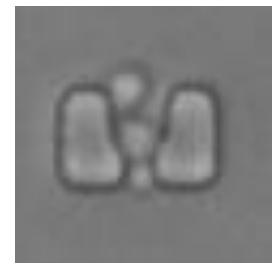
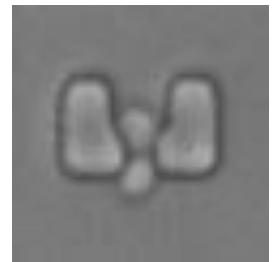
The correlation for time series observations with observations with previous time steps, called lags

- **Autocorrelation function (ACF).** At lag k , this is the correlation between series values that are k intervals apart.

$$\hat{\rho}_k = \frac{\sum_{t=k+1}^T (r_t - \bar{r})(r_{t-k} - \bar{r})}{\sum_{t=1}^T (r_t - \bar{r})^2}$$

- **Partial autocorrelation function (PACF).** At lag k , this is the correlation between series values that are k intervals apart, accounting for the values of the intervals between.

A plot of the autocorrelation of a time series by lag is called the **AutoCorrelation Function**, or the acronym ACF.



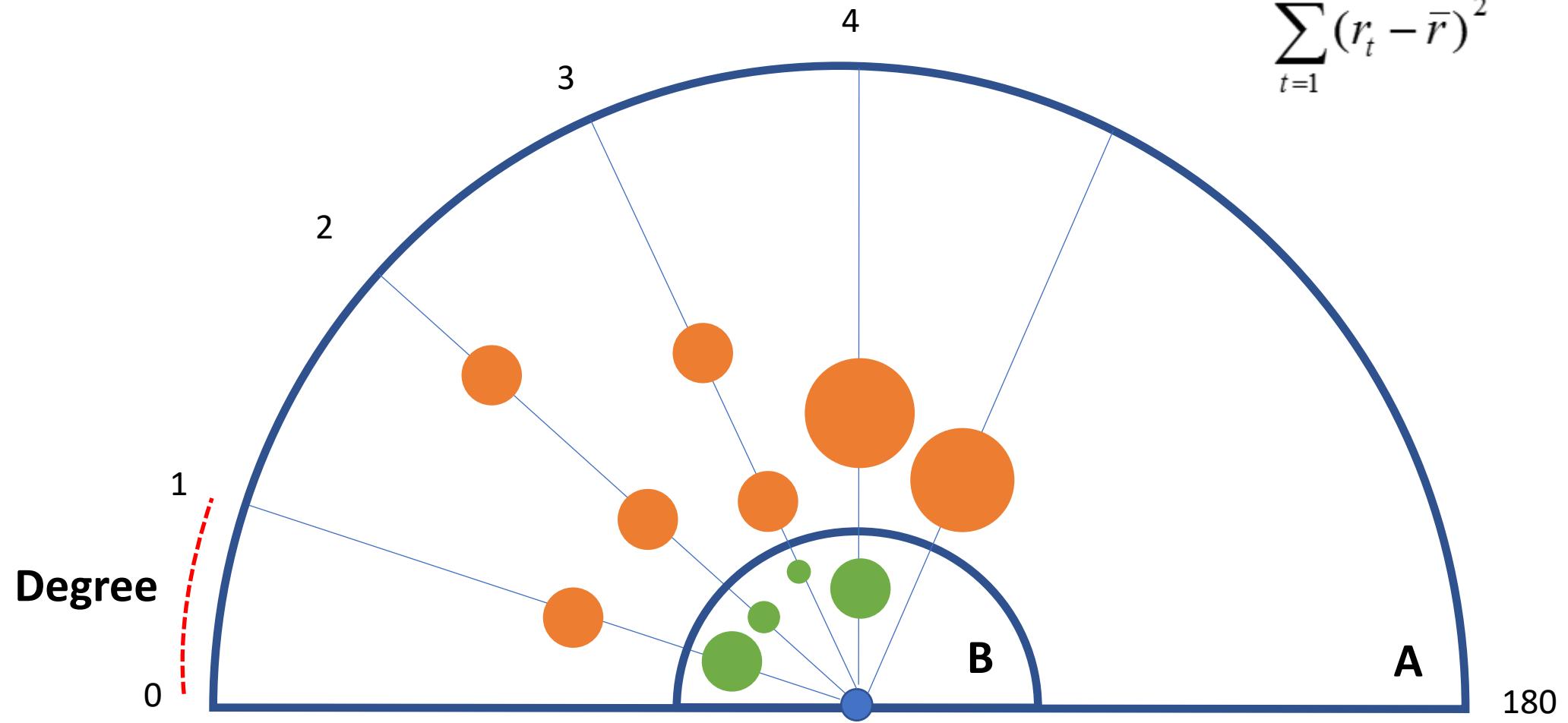
Cells Distance on uPolar (180°)

Data is in time domain

Covert Cartesian coordinate to Polar coordinate

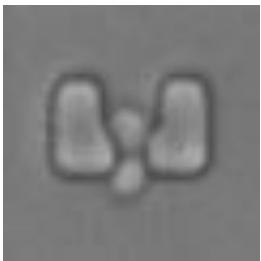
$$\text{Degree} = 180 / 391 = 0.46$$

$$\hat{\rho}_k = \frac{\sum_{t=k+1}^T (r_t - \bar{r})(r_{t-k} - \bar{r})}{\sum_{t=1}^T (r_t - \bar{r})^2}$$

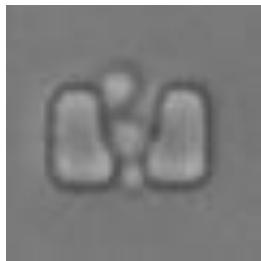


Cells Distance on uPolar (360⁰)

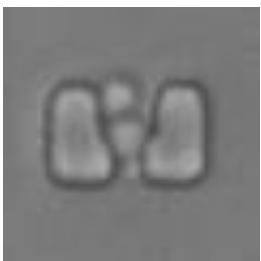
Time-point 01



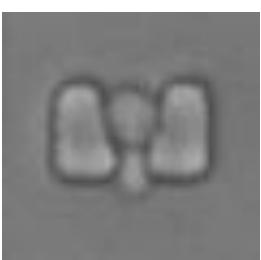
Time-point 02



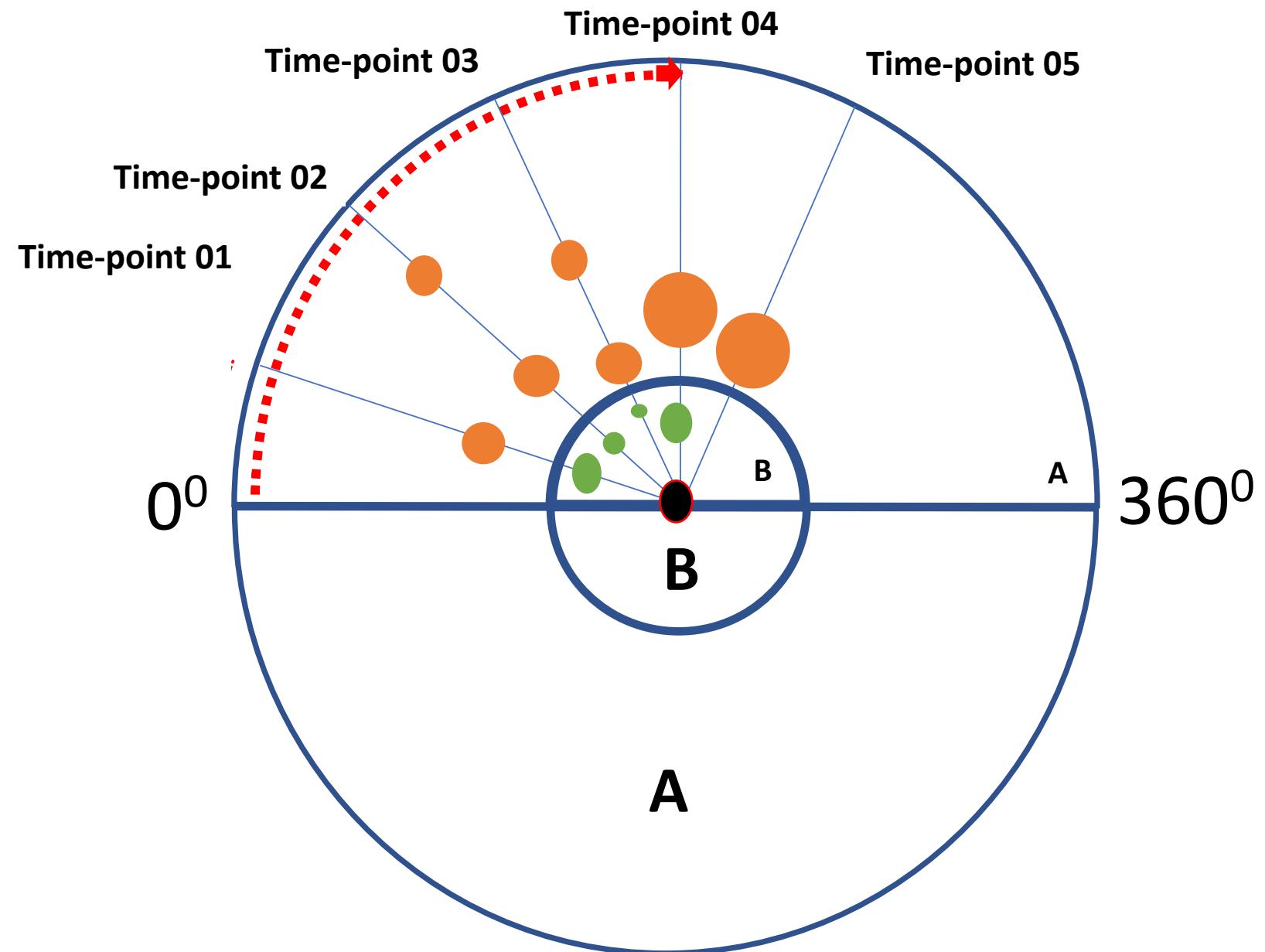
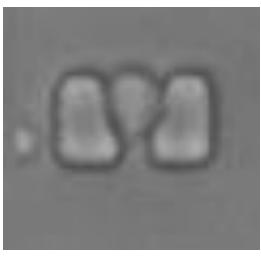
Time-point 03



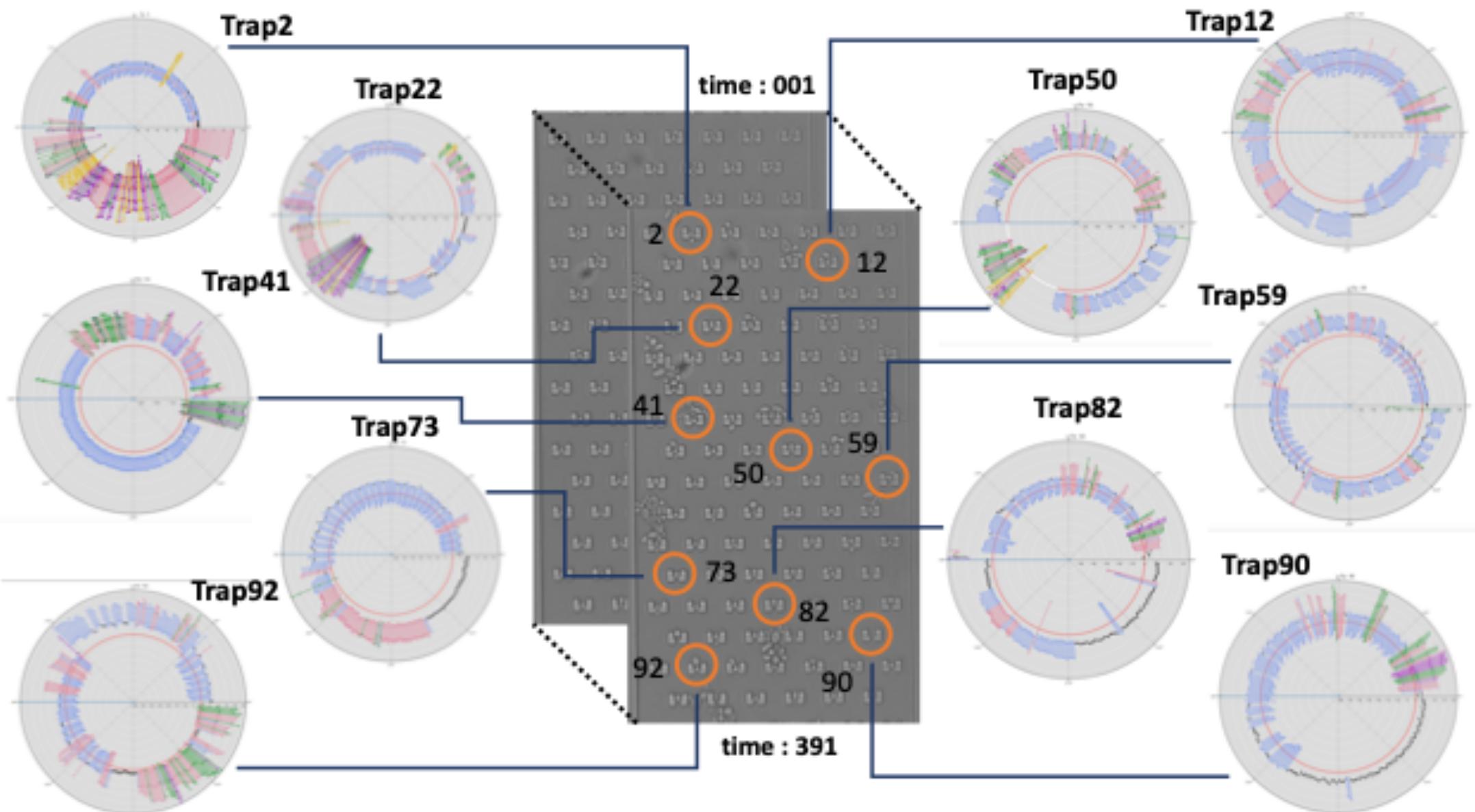
Time-point 04



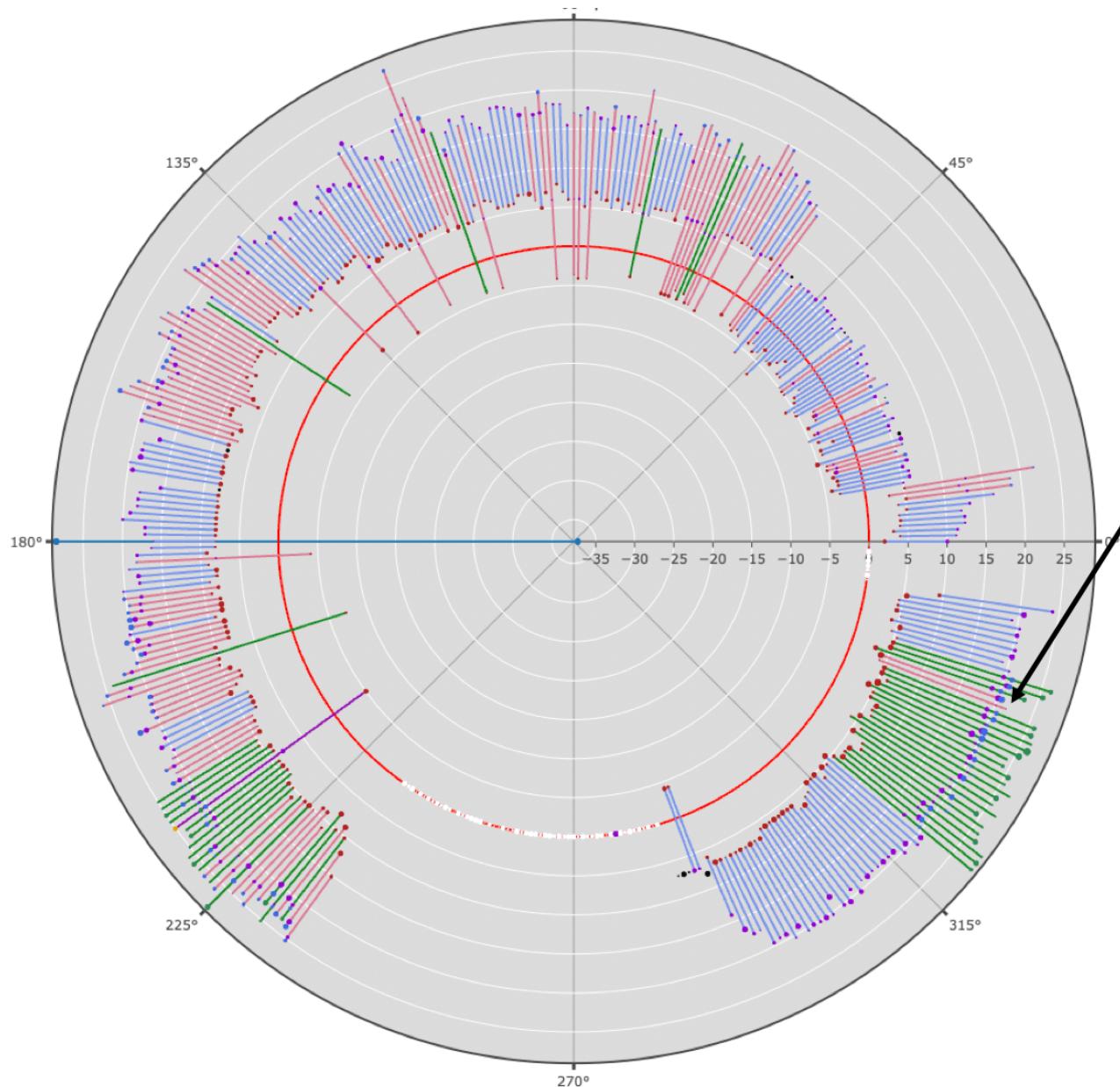
Time-point 05



uPolar Visualization tool (R package)



Basic Color Codes for uPolar



mμPlot Info

- Time-Point = 371
- Number of Cells = 3

Color Representation

- White = No cell (on red line)
 - Black = 1 Cell
 - Green = 2 Cells
 - Light-Brown = 3 Cells
 - Blue = 4 Cells
 - Orange = 5 Cells
 - Sky-blue > 5 Cells
 - Red = reference point
-
- Star = RLS

uPolar Examples

Trap 01

Trap 02

Trap 10

Trap 20

Trap 50

Trap 60

Trap 80

Trap 104

01

10

60

20

80

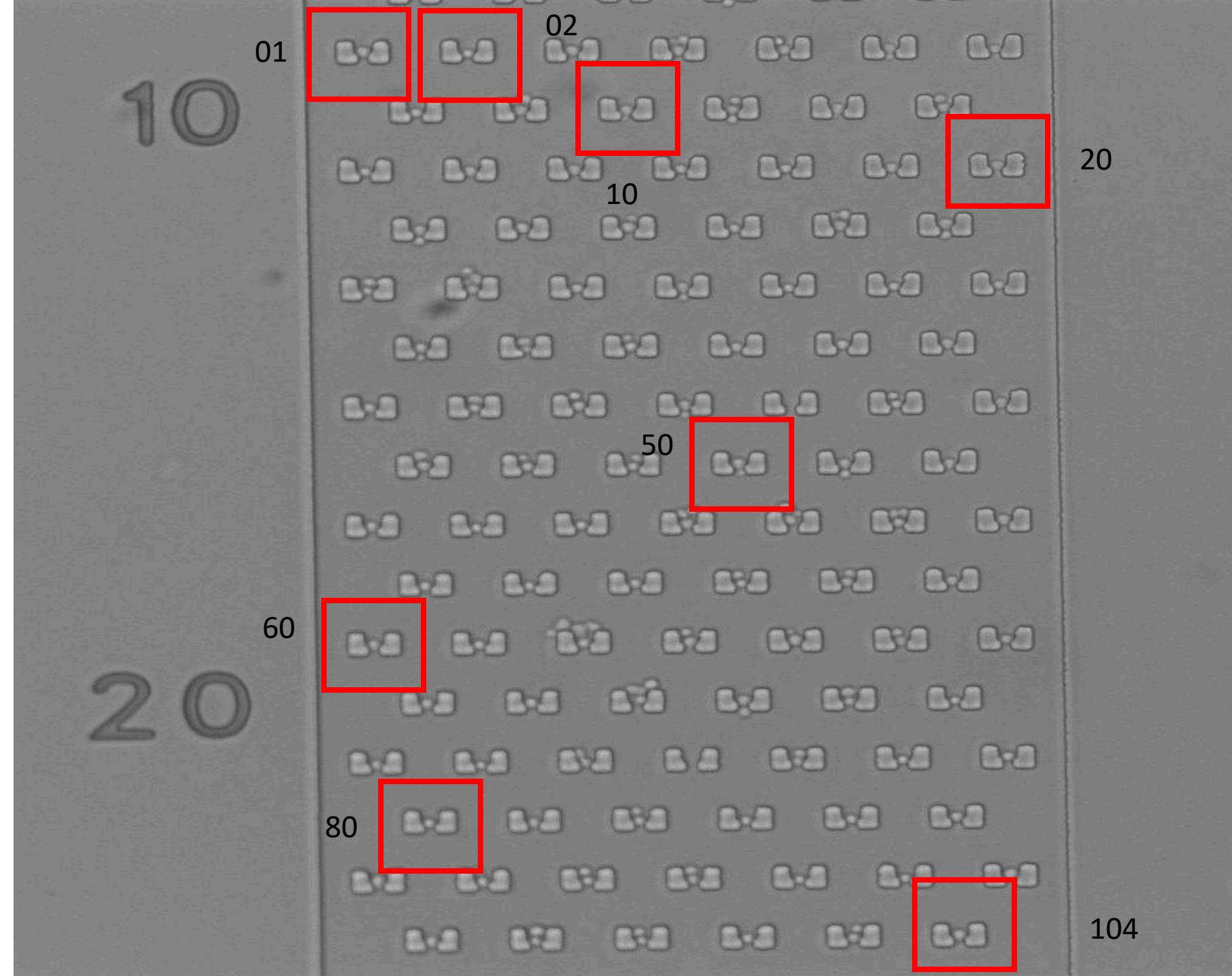
02

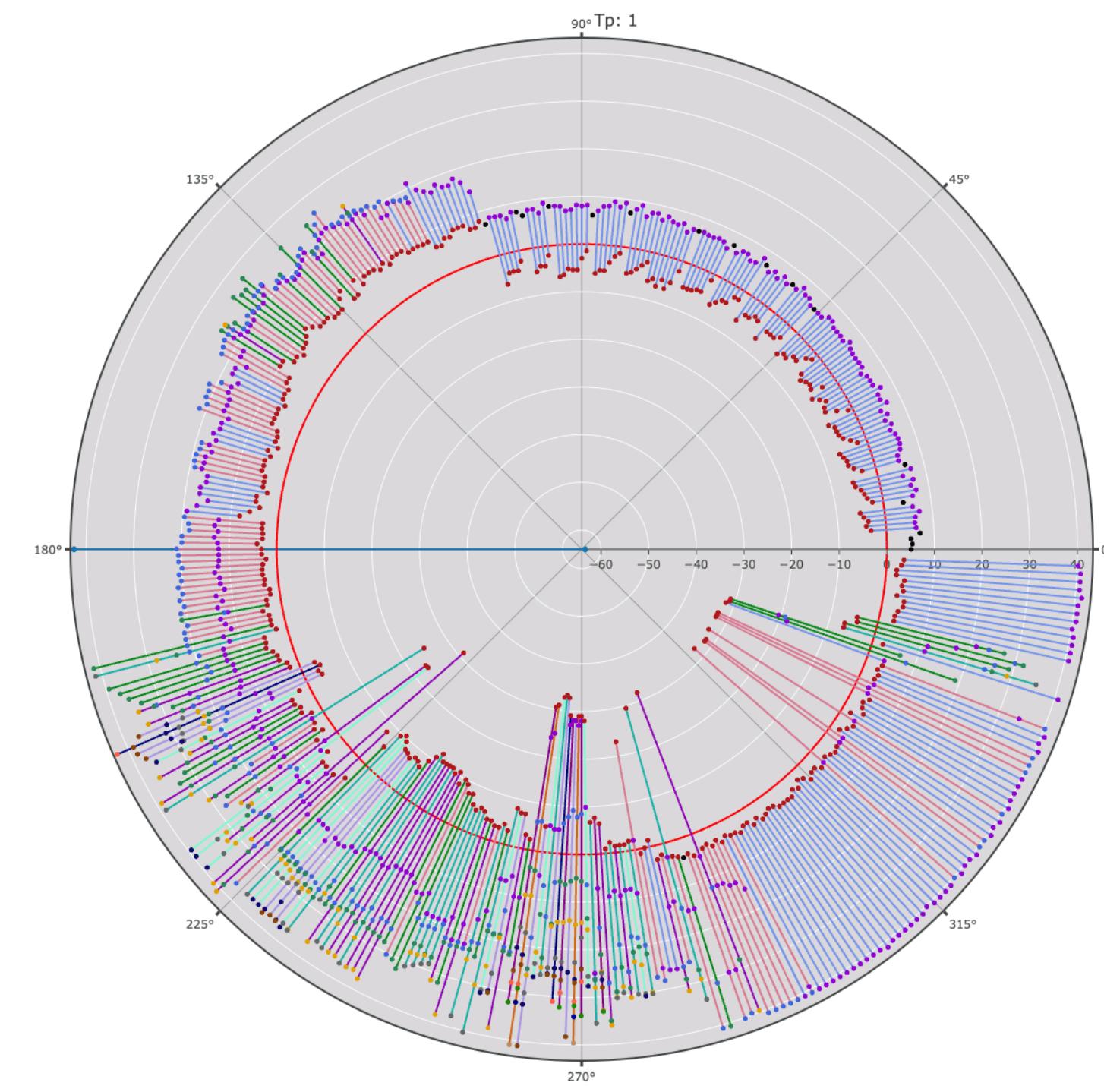
10

50

104

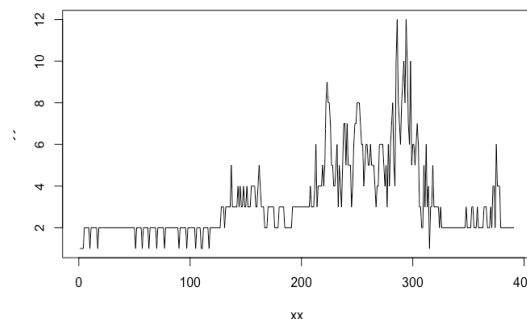
20



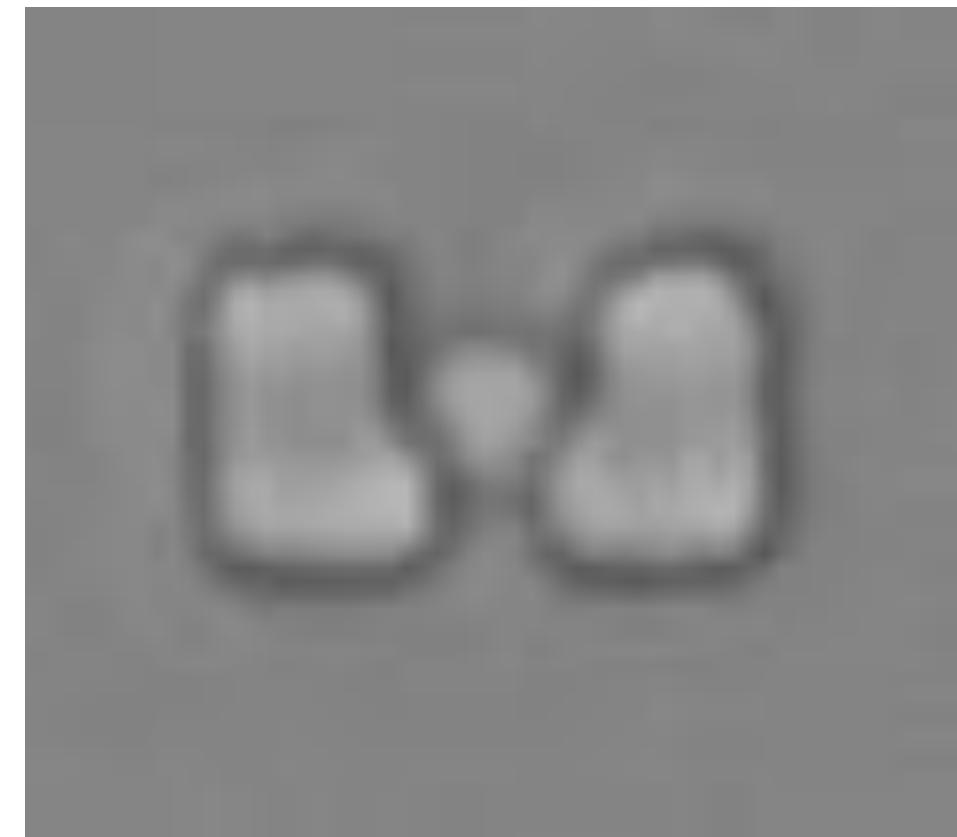


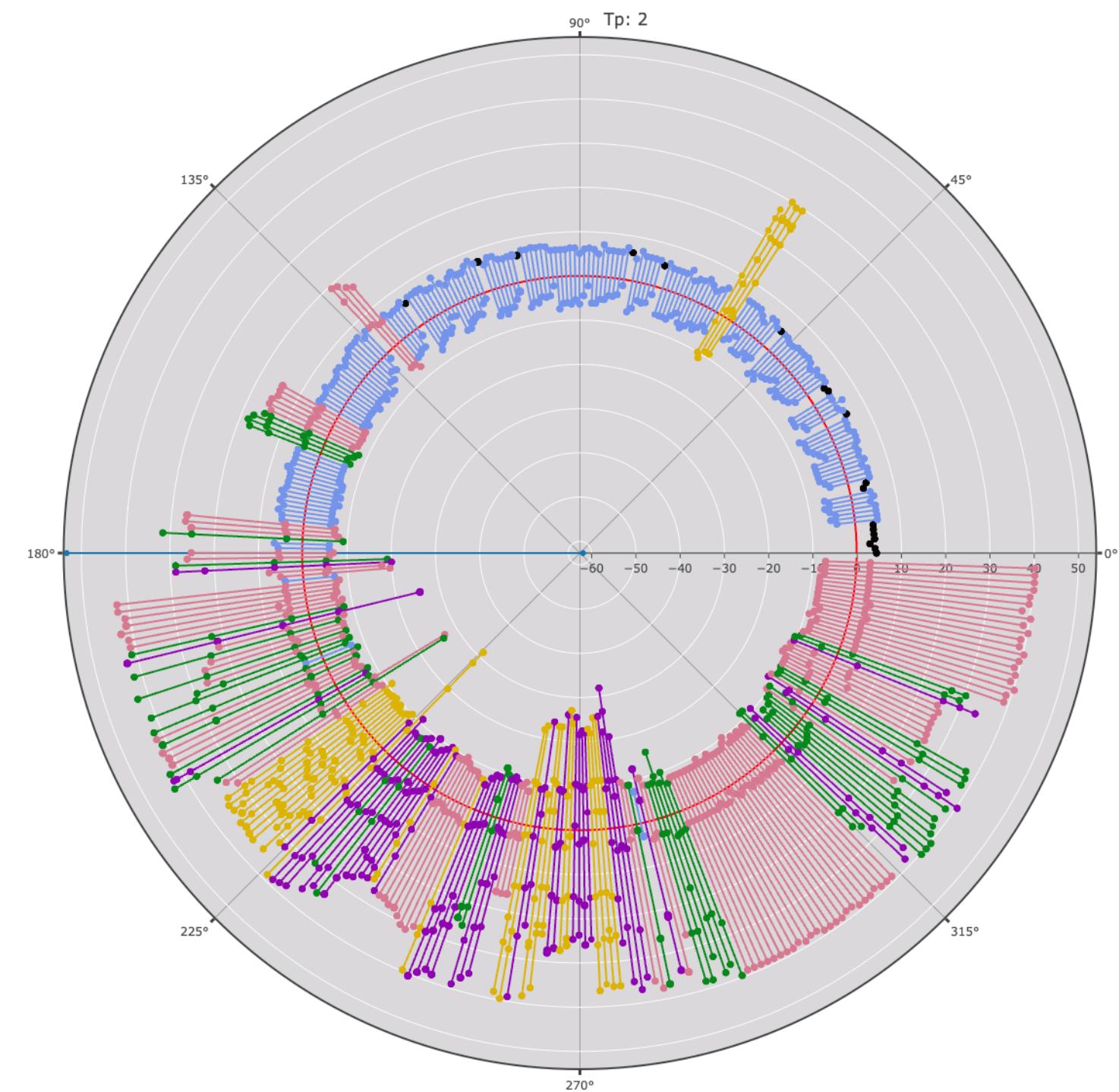
Polar Visualization ← BC8 Trap 01

Total Cells



↓ Time-lapsed Images

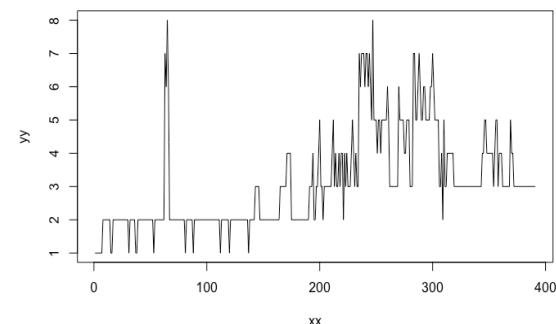




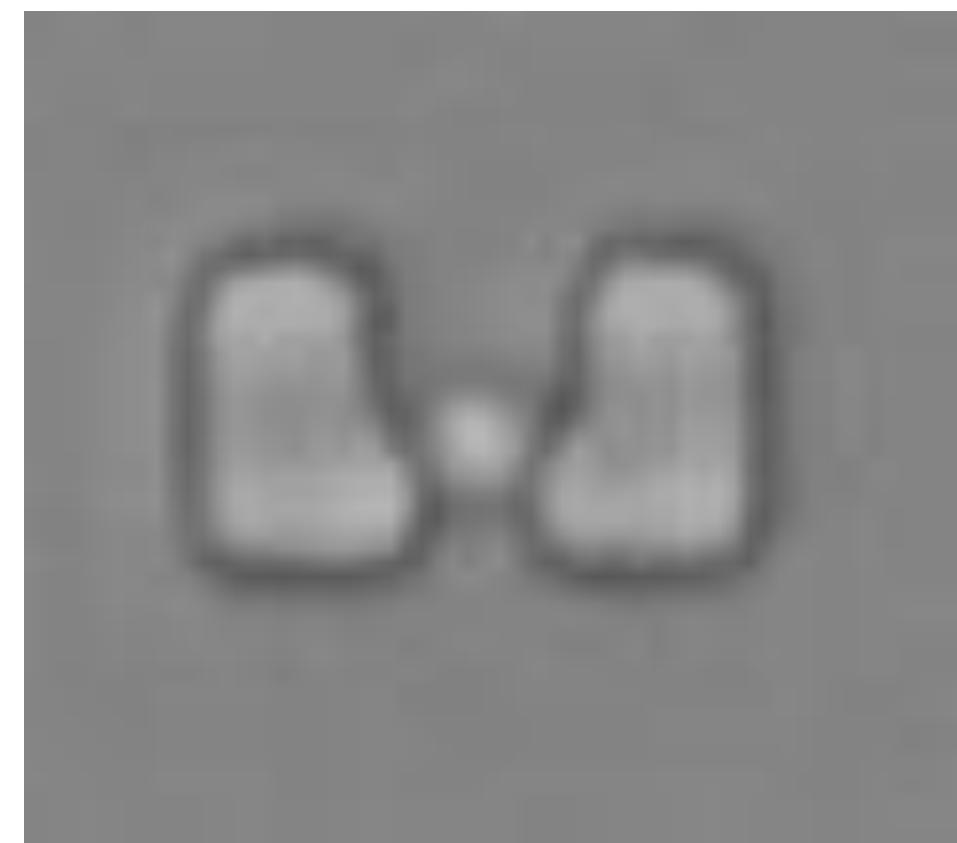
Polar Visualization

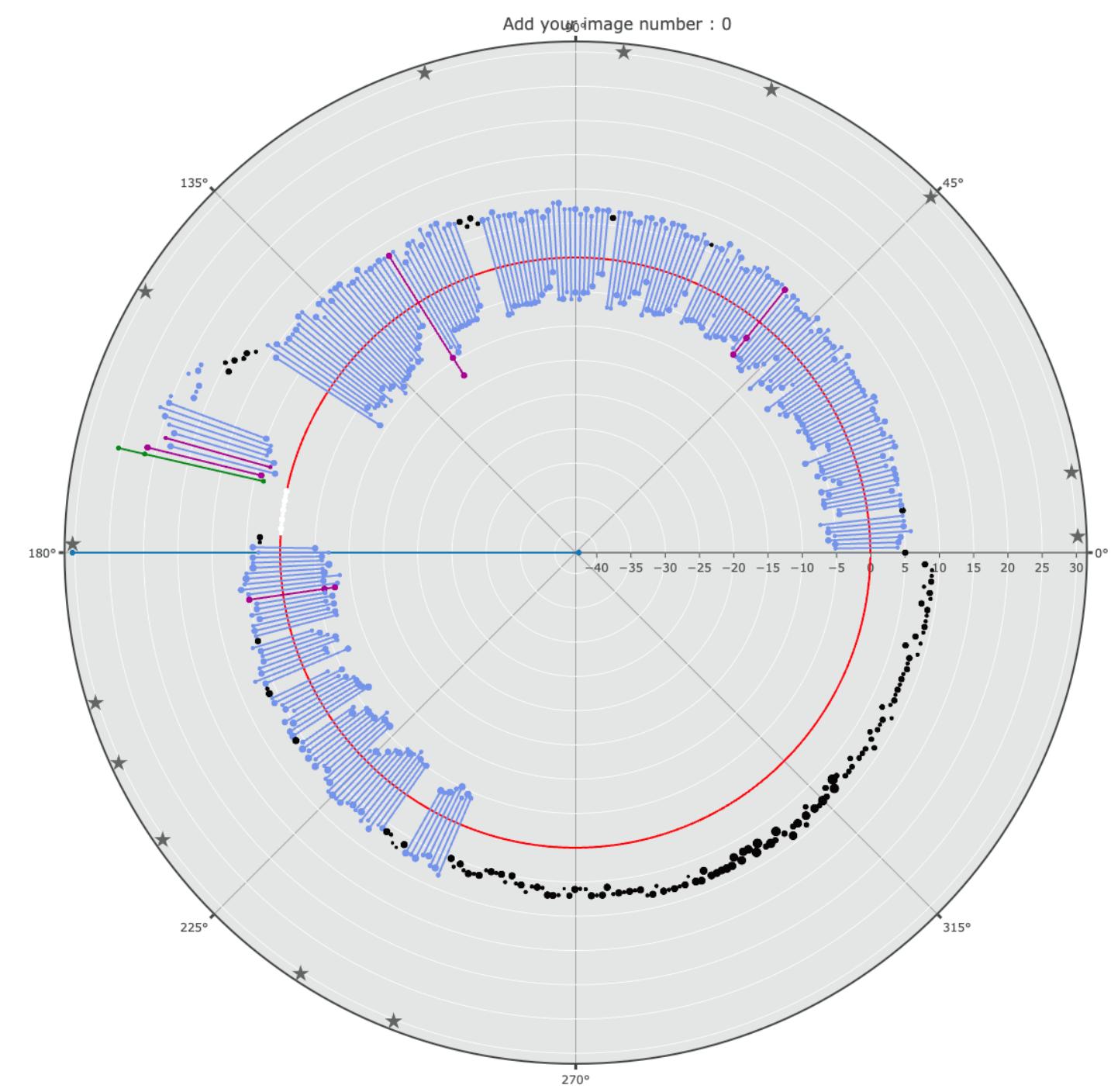
BC8 Trap 02

Total Cells

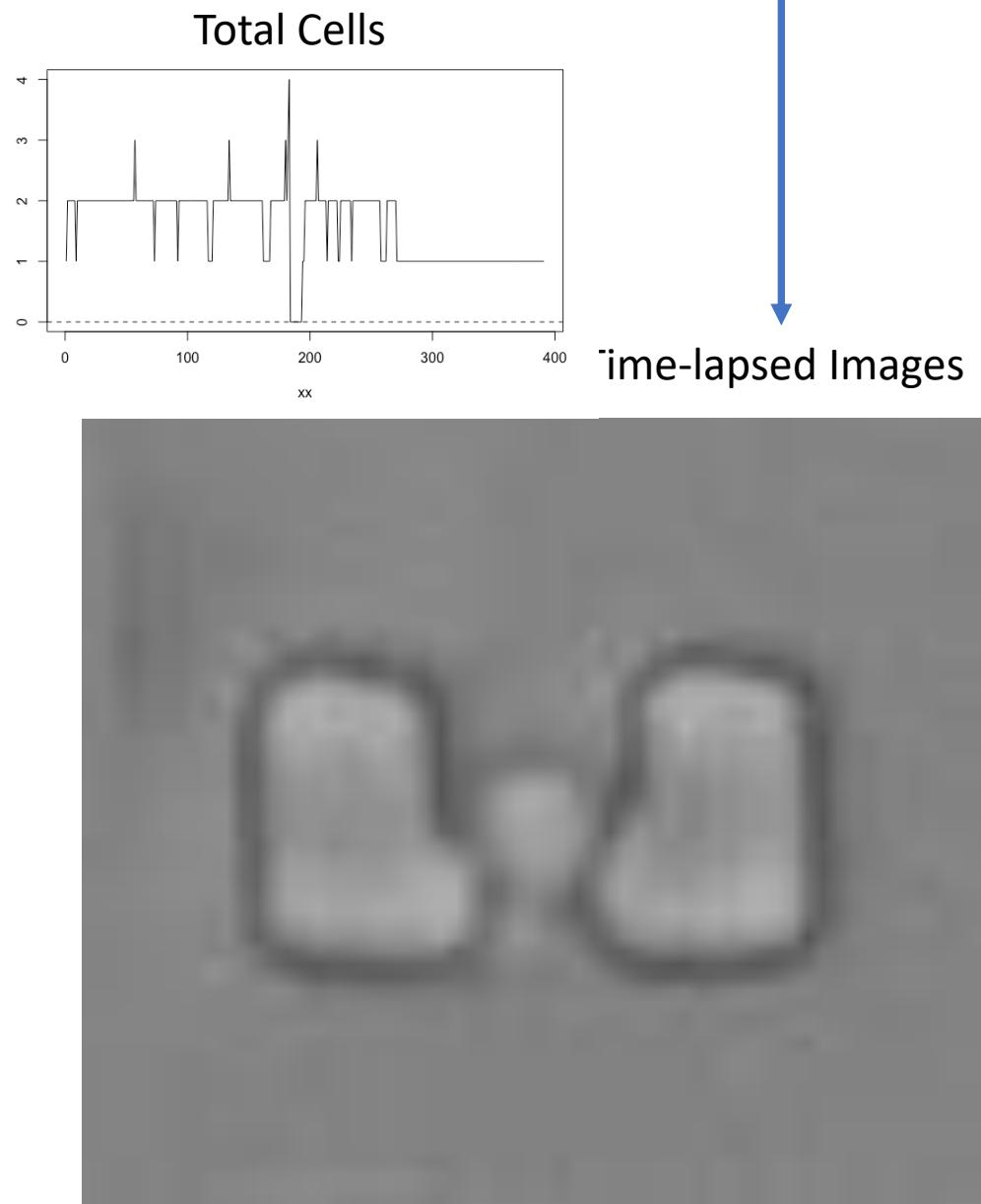


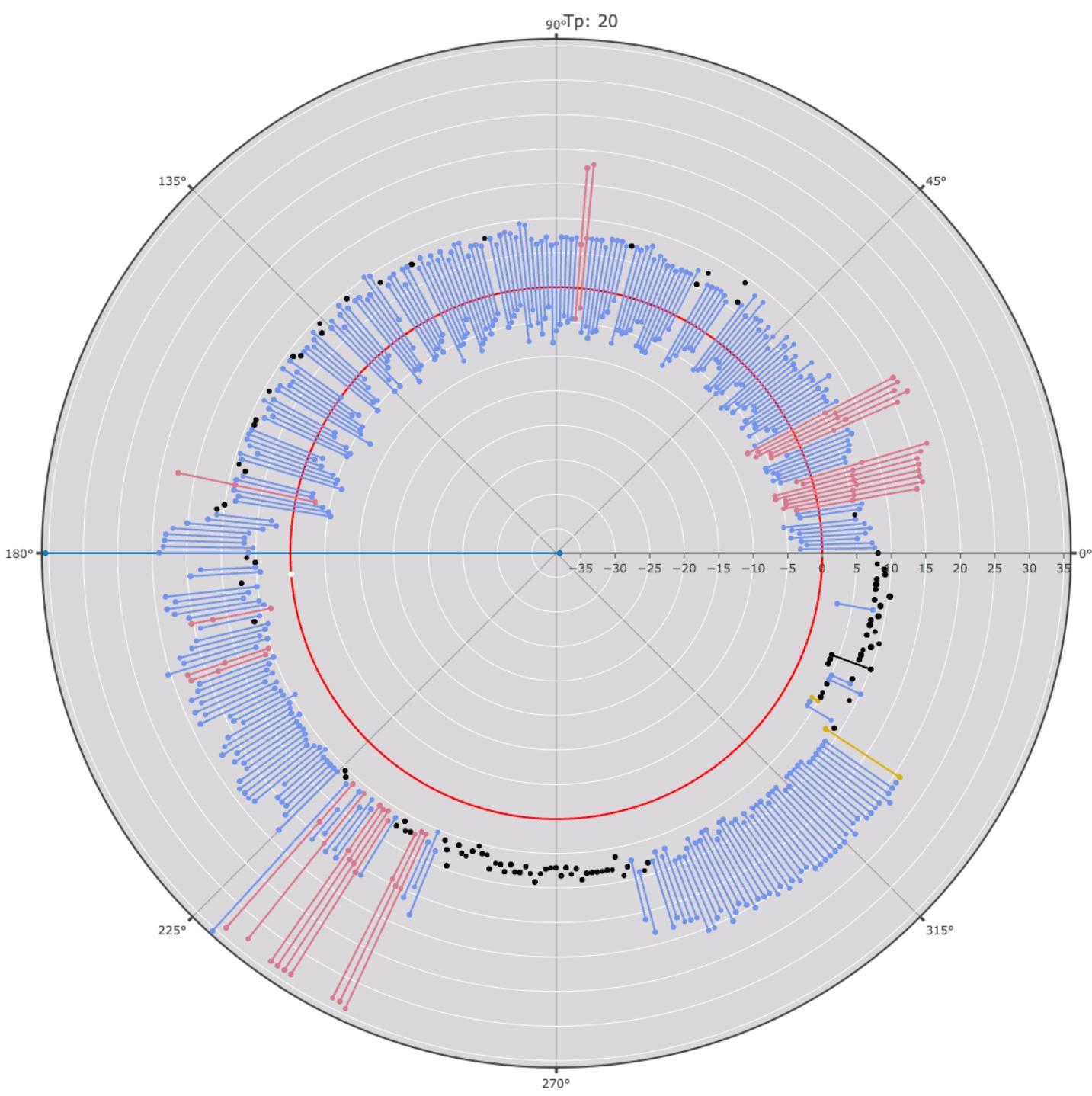
Time-lapsed Images





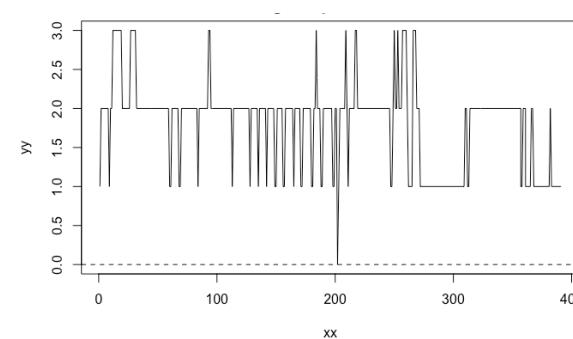
Polar Visualization ← BC8 Trap 10



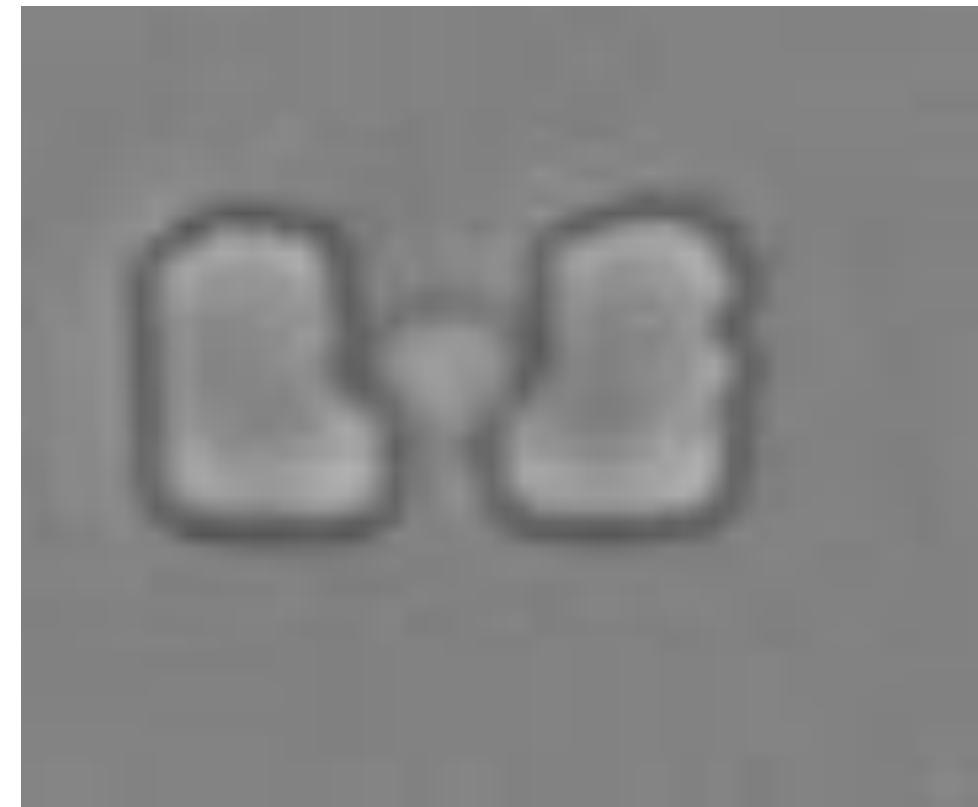


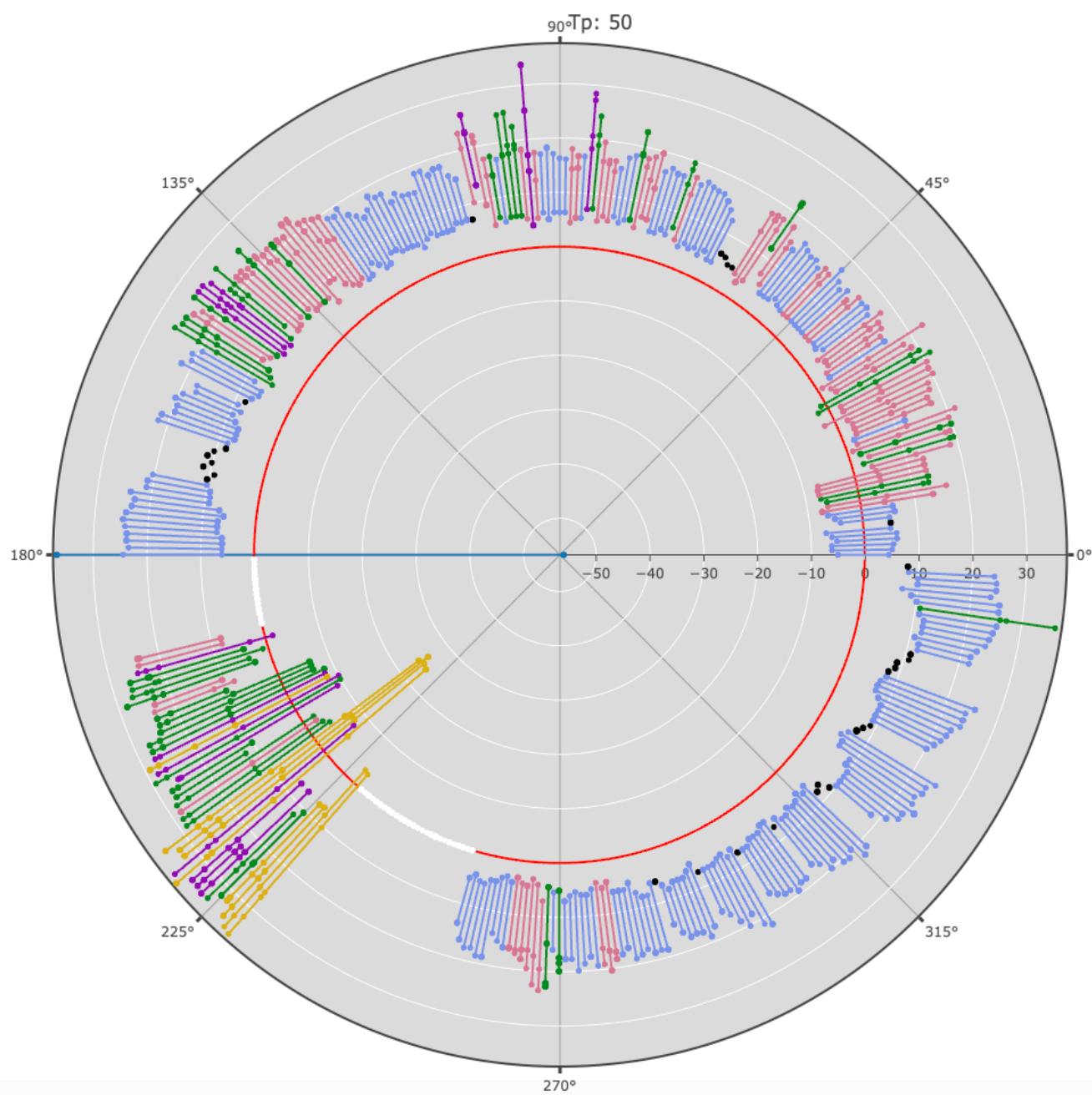
Polar Visualization ← BC8 Trap 20

Total Cells

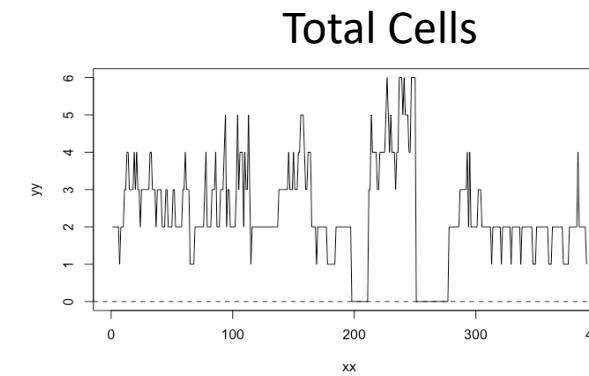


Time-lapsed Images



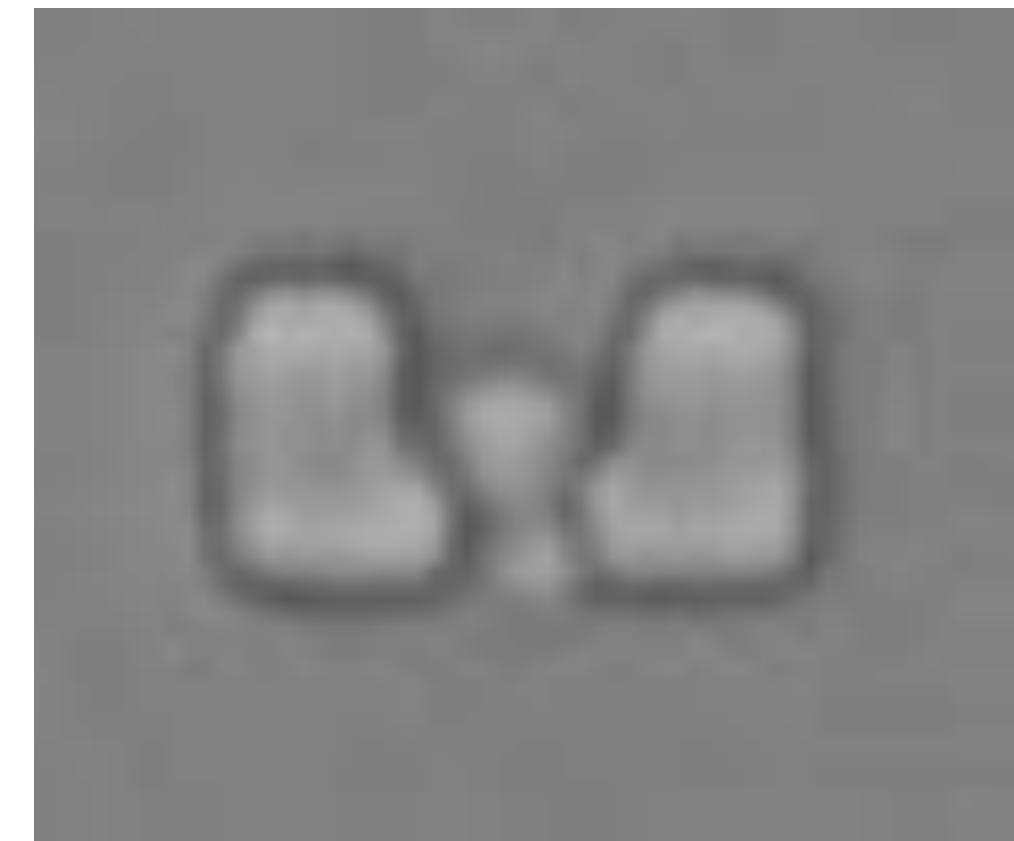


Polar Visualization ← BC8 Trap 50

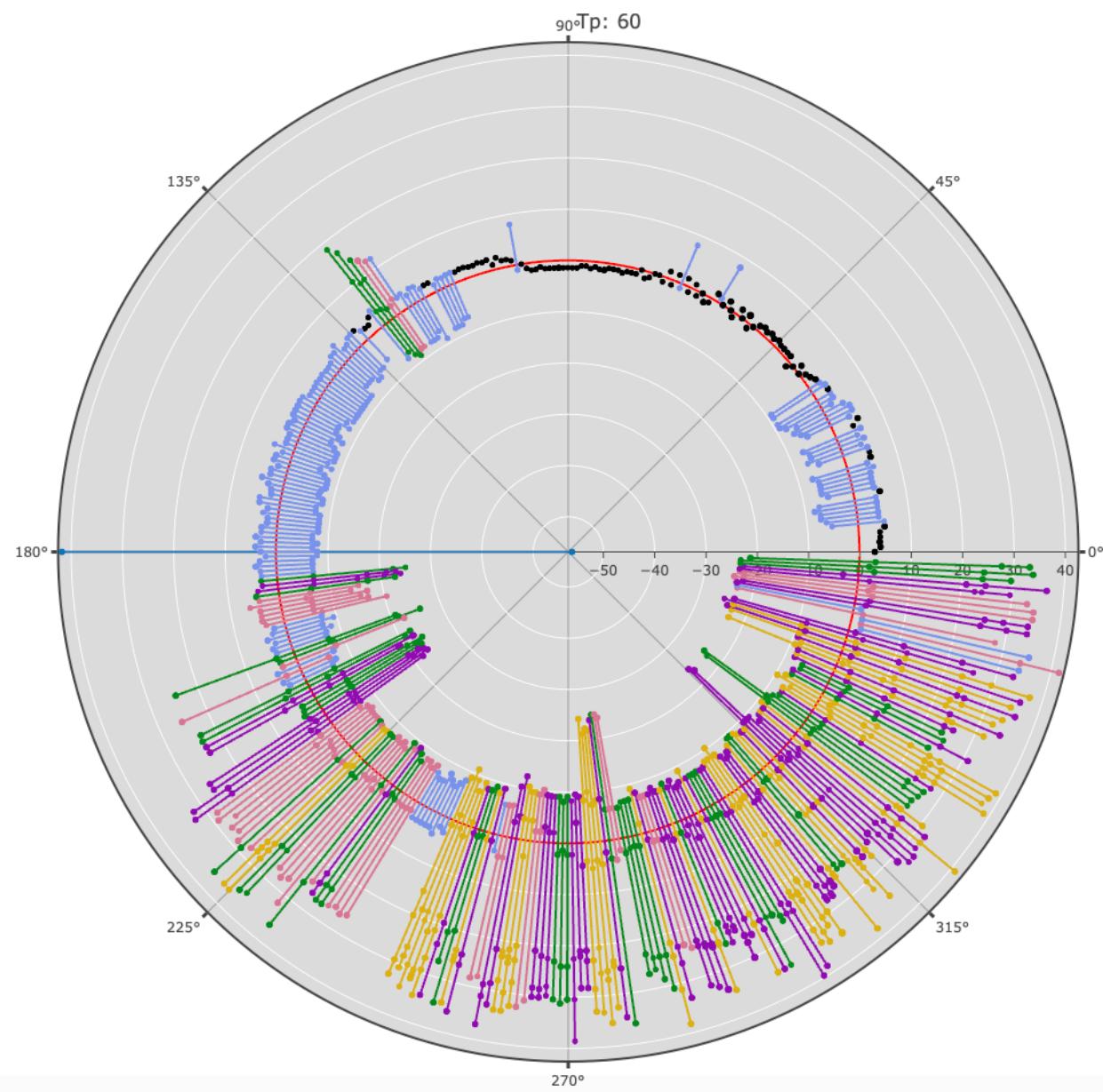


Total Cells

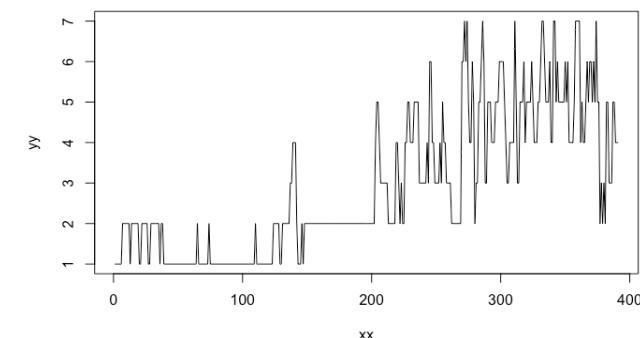
Time-lapsed Images



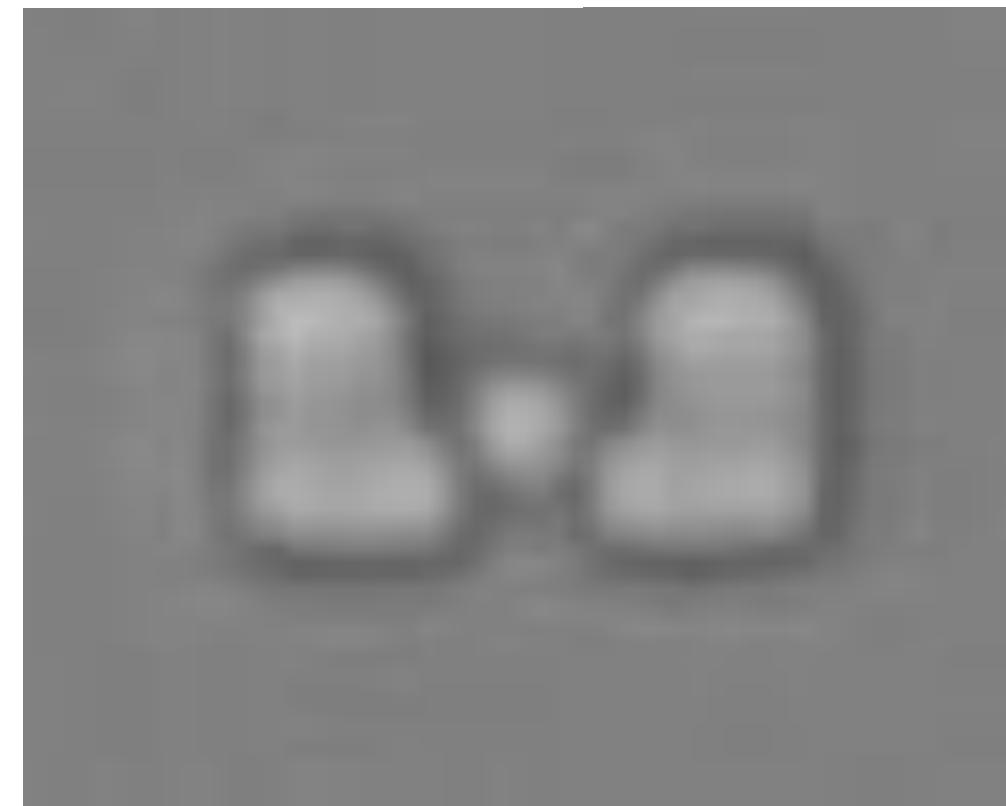
Polar Visualization ← BC8 Trap 60



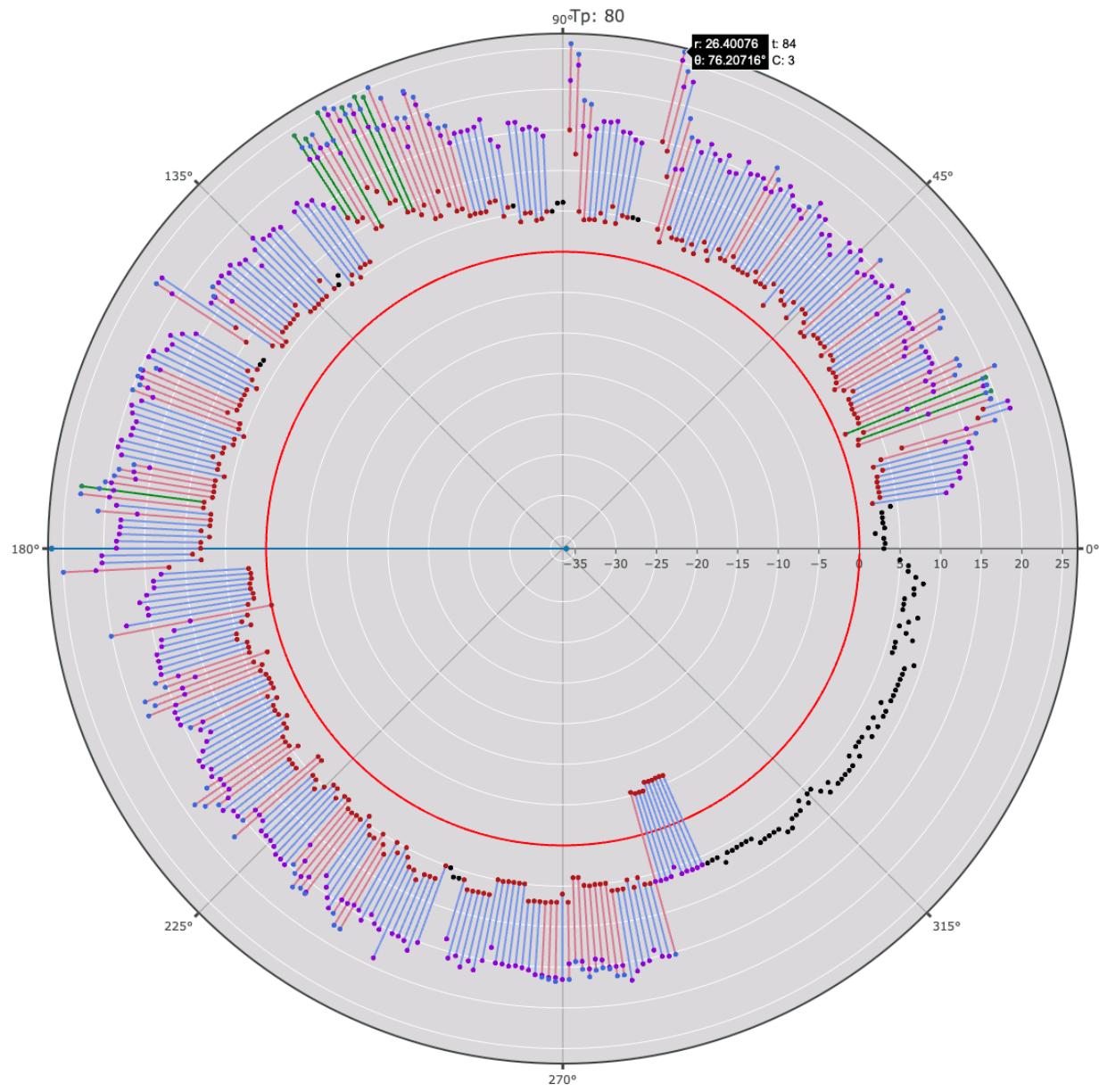
Total Cells



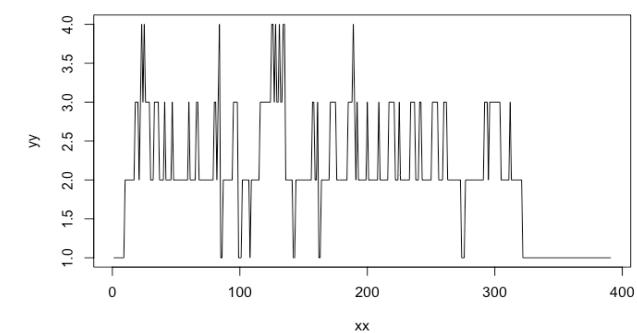
Time-lapsed Images



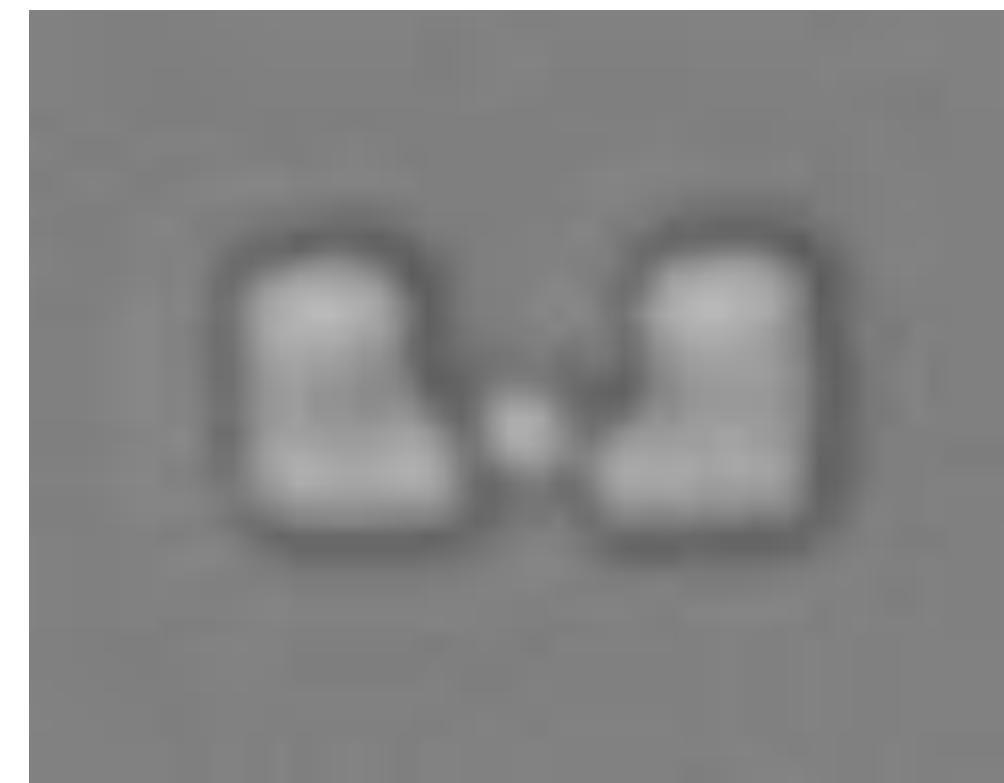
Polar Visualization ← BC8 Trap 80



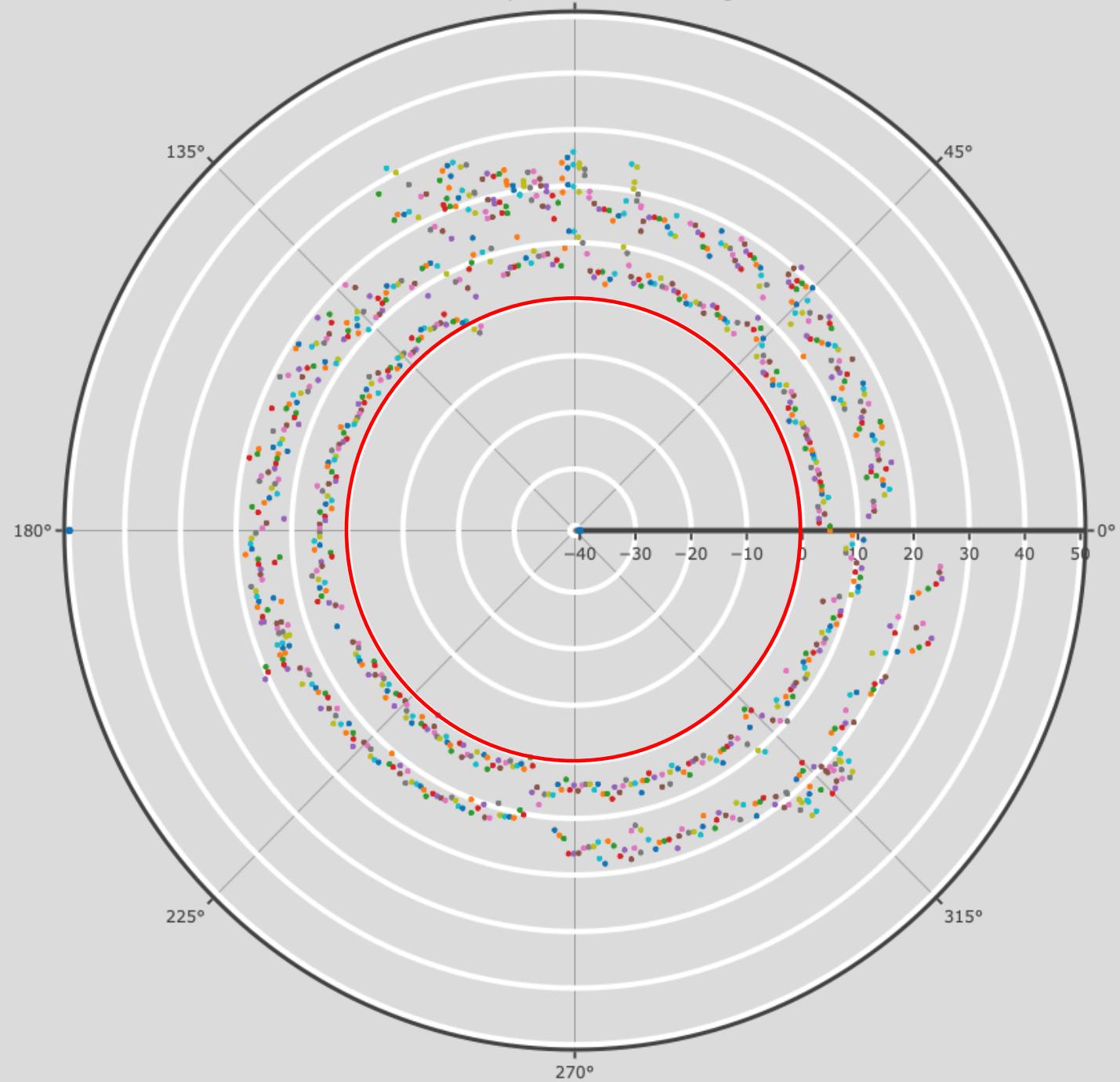
Total Cells



Time-lapsed Images

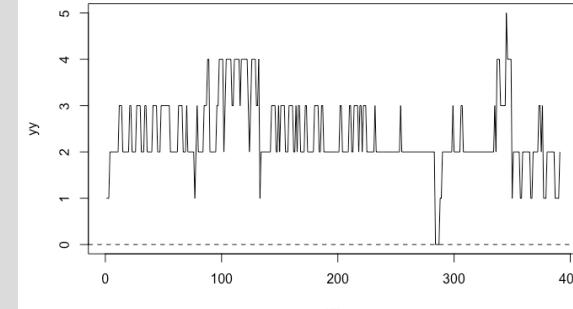


Beacon 8 - Trap 104 Cells Tracking

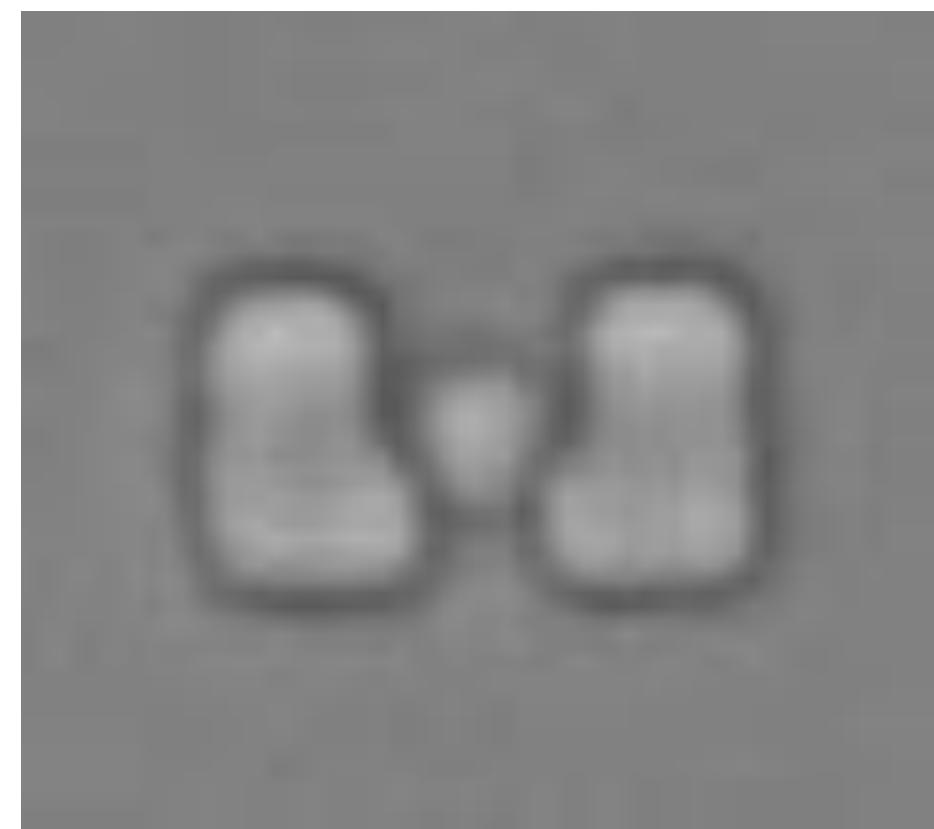


Polar Visualization ← BC8 Trap 104

Total Cells



Time-lapsed Images



Thank you

<https://github.com/merang/uPolar>