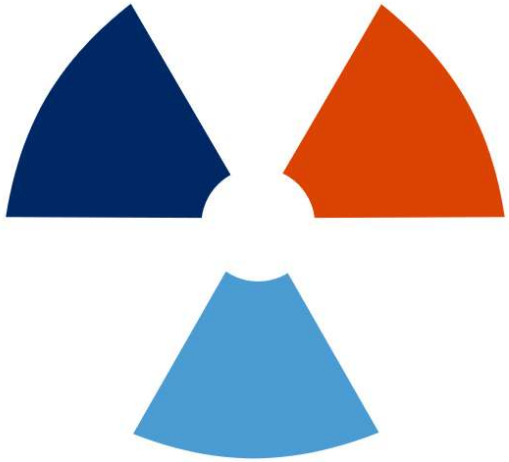

CAUG 4: MCMP Geometry Fundamentals

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Welcome to Session 4!

- Questions from Session 3
- RSICC Application Status
- Simple geometry - Recap
  - Cylinder surfaces
  - Truncated cone Surfaces
  - Introduction to nested surfaces
- Advance volume construction
  - Nested Surfaces
  - Integrated Surfaces
    - Just focusing on sphere for now

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Table 3-8. Macrobody Rectangular Parallelepiped (RPP)

Input Parameter	Description
x_{min} x_{max}	Termini of box sides normal to the x-axis.
y_{min} y_{max}	Termini of box sides normal to the y-axis.
z_{min} z_{max}	Termini of box sides normal to the z-axis.

Table 3-4. MCNP6 Surface Cards

Mnemonic	Type	Description	Equation	Card Entries
P	Plane	General	$Ax + By + Cz - D = 0$	A B C D
PX		Normal to x-axis	$x - D = 0$	D
PY		Normal to y-axis	$y - D = 0$	D
PZ		Normal to z-axis	$z - D = 0$	D
SO	Sphere	Centered at Origin	$x^2 + y^2 + z^2 - R^2 = 0$	R
S		General	$(x-\bar{x})^2 + (y-\bar{y})^2 + (z-\bar{z})^2 - R^2 = 0$	$\bar{x}$ $\bar{y}$ $\bar{z}$ R
SX		Centered on x-axis	$(x-\bar{x})^2 + y^2 + z^2 - R^2 = 0$	$\bar{x}$ R
SY		Centered on y-axis	$x^2 + (y-\bar{y})^2 + z^2 - R^2 = 0$	$\bar{y}$ R
SZ		Centered on z-axis	$x^2 + y^2 + (z-\bar{z})^2 - R^2 = 0$	$\bar{z}$ R

C/X	Cylinder	Parallel to x-axis	$(y-\bar{y})^2+(z-\bar{z})^2-R^2=0$	$\bar{y}$ $\bar{z}$ R
C/Y		Parallel to y-axis	$(x-\bar{x})^2+(z-\bar{z})^2-R^2=0$	$\bar{x}$ $\bar{z}$ R
C/Z		Parallel to z-axis	$(x-\bar{x})^2+(y-\bar{y})^2-R^2=0$	$\bar{x}$ $\bar{y}$ R
CX		On x-axis	$y^2+z^2-R^2=0$	R
CY		On y-axis	$x^2+z^2-R^2=0$	R
CZ		On z-axis	$x^2+y^2-R^2=0$	R

3.2.2.4.4 RCC—RIGHT CIRCULAR CYLINDER

Form: RCC v_x v_y v_z h_x h_y h_z r

Table 3-10. Macrobody Right Circular Cylinder (RCC)

Input Parameter	Description
v_x v_y v_z	The x,y,z coordinates at the center of the base for the right circular cylinder.
h_x h_y h_z	Right circular cylinder axis vector, which provides both the orientation and the height of the cylinder.
r	Radius of right circular cylinder.

Example:

```
RCC     0 -5 0    0 10 0    4
```

This input specification represents a 10-cm-high can about the y-axis with its base plane at y=-5 and having a radius of 4 cm.

3.2.2.4.7 TRC—TRUNCATED RIGHT-ANGLE CONE

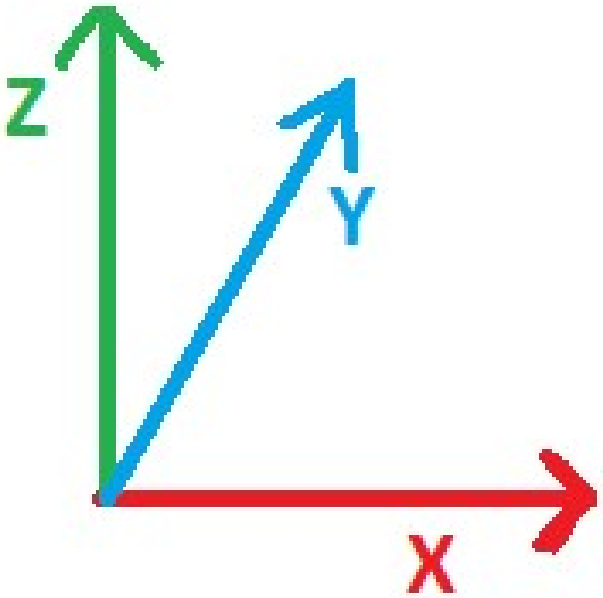
Form: TRC v_x v_y v_z h_x h_y h_z r_1 r_2

Table 3-13. Macrobody Truncated Right-Angle Cone (TRC)

Input Parameter	Description
v_x v_y v_z	The x,y,z coordinates of the cone bottom.
h_x h_y h_z	Cone axis height vector.
r_1	Radius of lower cone base.
r_2	Radius of upper cone base, where $r_1>r_2$.

Example:

```
TRC     -5 0 0   10 0 0   4   2
```


Z
Y
X

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Nested Volumes

- Change outside world!
- Nested sphere
- Nested rectangular
  - Nested rectangular using macrobody

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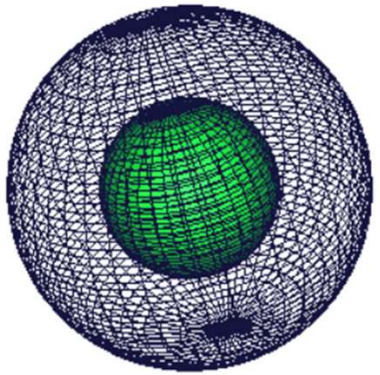

```
Nested Spheres
C Cells
99 0  1       imp:p=1  $ outside world
10 0  -1 2     imp:p=1  $ sphere at origin radius 10
20 0  -2       imp:p=1  $ sphere at origin radius 5

C Surfaces
1 SO  10
2 SO   5
```

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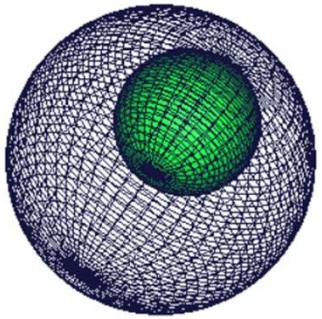
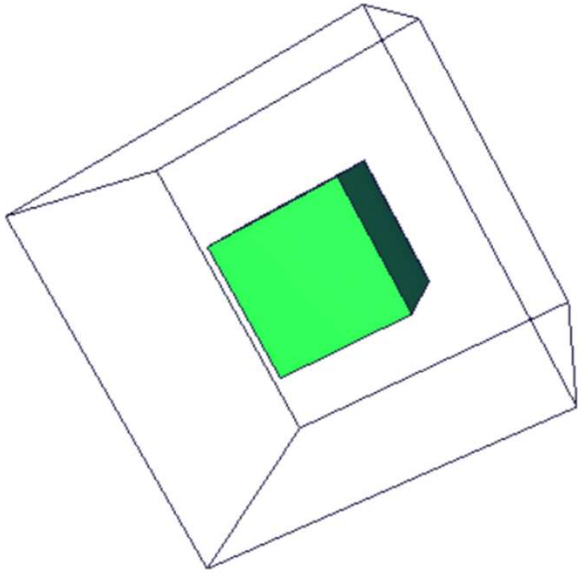


```
Nested Spheres
C Cells
99 0  1       imp:p=1  $ outside world
10 0  -1 2     imp:p=1  $ sphere at origin radius 10
20 0  -2       imp:p=1  $ sphere offset inside with radius 5

C Surfaces
1 SO  10
2 S 1 2 3   5
```

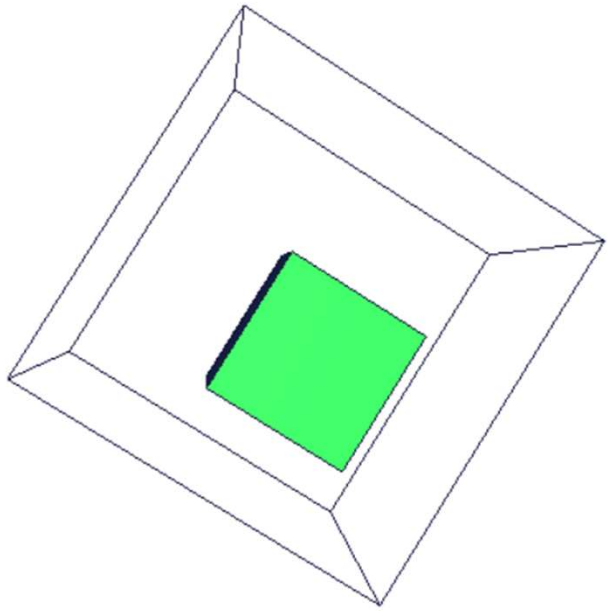
```
Nested Cubes
C Cells
99 0  1       imp:p=1  $ outside world
10 0  -1 2     imp:p=1  $ 10x10x10 cube
20 0  -2       imp:p=1  $ 4x4x4 cube

C Surfaces
1 RPP -5 5  -5 5  -5 5
2 RPP -2 2  -2 2  -2 2
```



```
Offset Nested Cubes
C Cells
99 0  1       imp:p=1  $ outside world
10 0  -1 2     imp:p=1  $ 10x10x10 cube
20 0  -2       imp:p=1  $ 4x4x4 cube

C Surfaces
1 RPP -5 5  -5 5  -5 5
2 RPP -3 1  -3 1  -3 1
```



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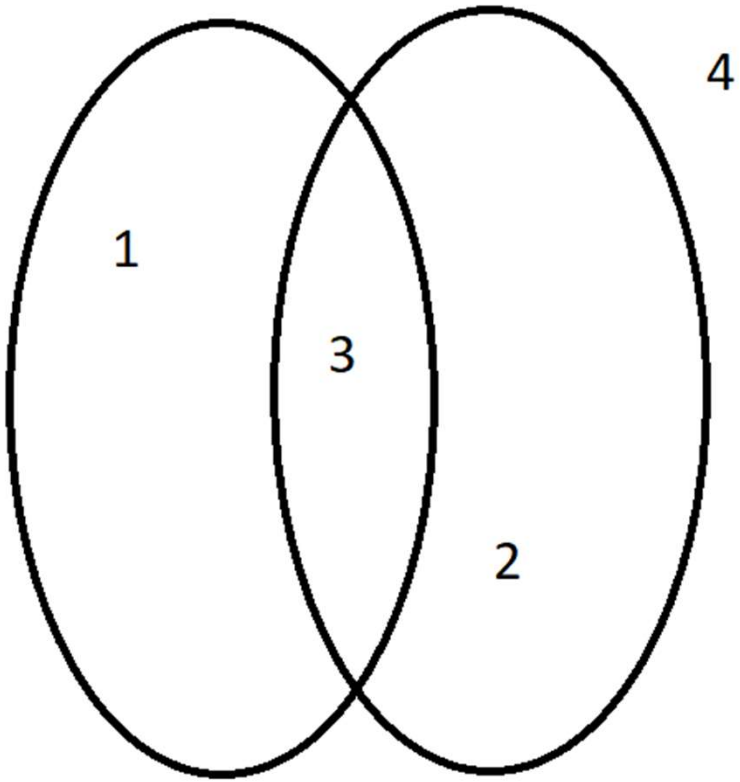
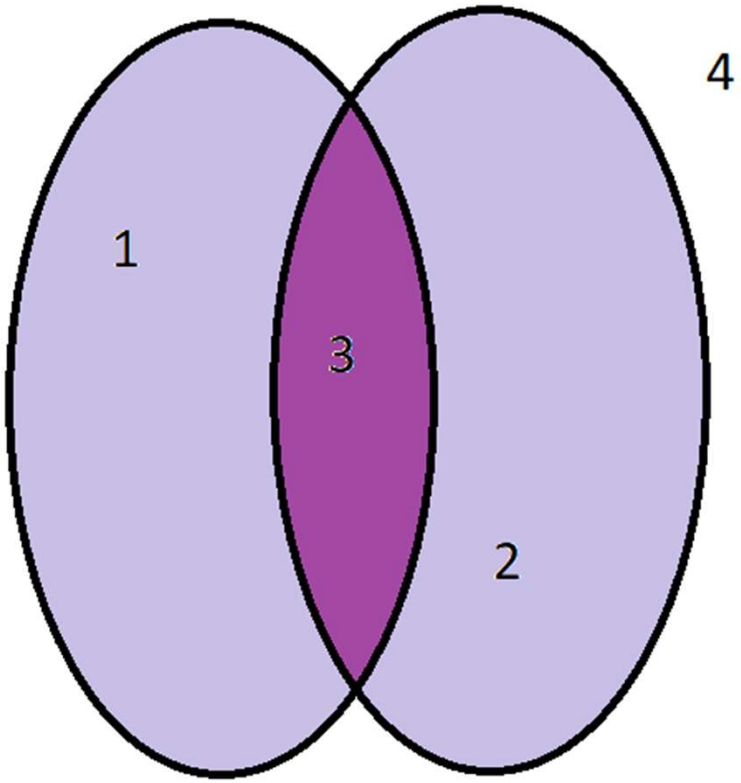
Overlapping Volumes - sphere

- Add surfaces
- Change outside world!

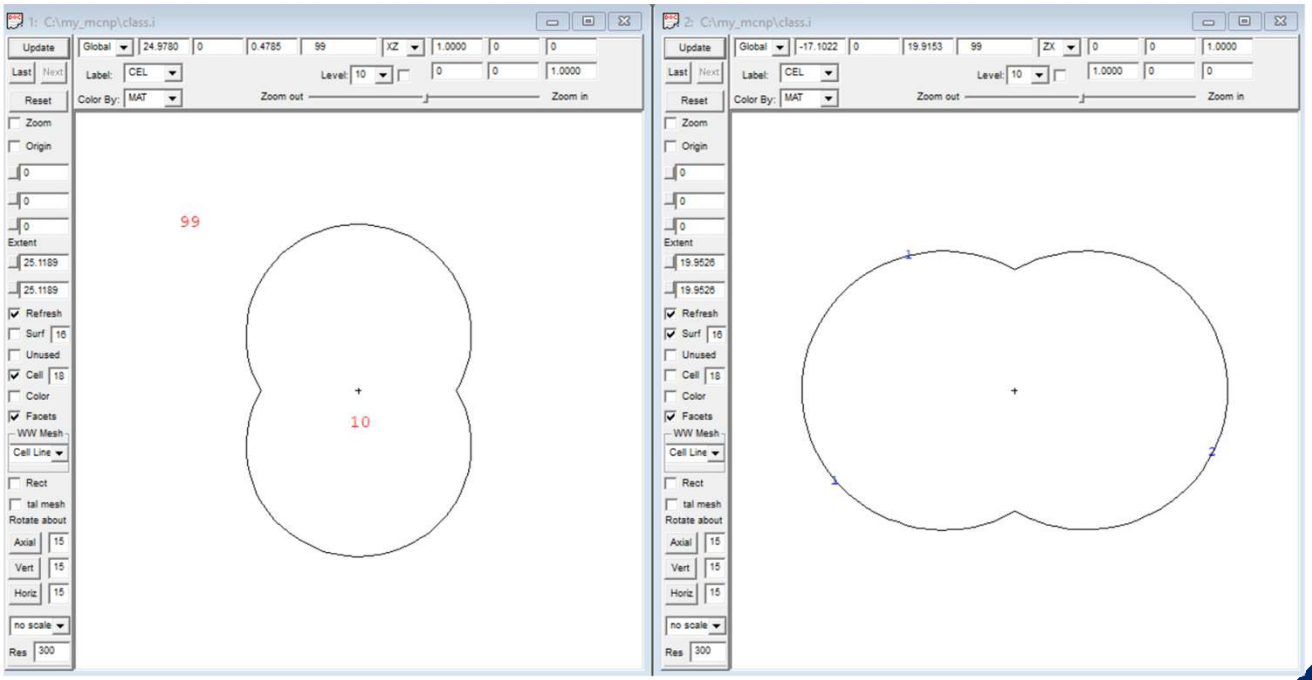

4
1
3
2


4
1
3
2

Spheres and the union

```
C Cells
99 0  1 2       imp:p=1  $ outside world
10 0 -1:-2      imp:p=1  $

C Surfaces
1 S 0 0 -5   10
2 S 0 0  5   10
```



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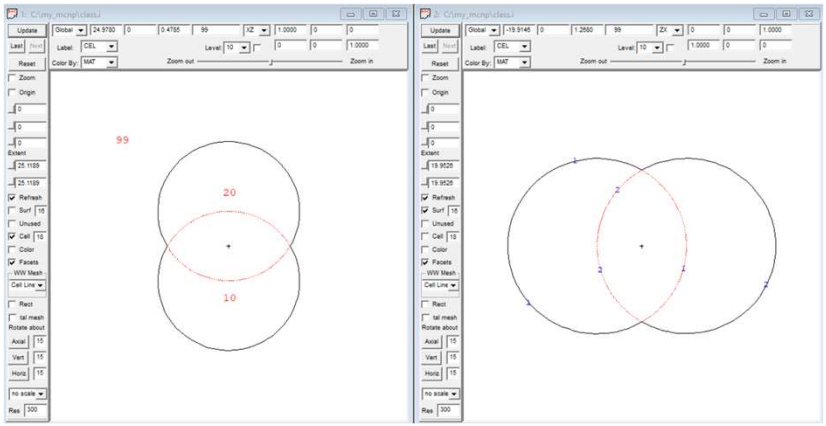
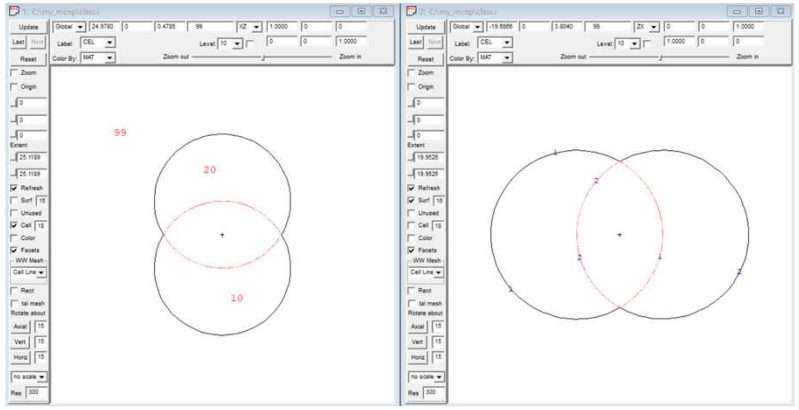
```
Spheres and the union
C Cells
99 0  1 2      imp:p=1  $ outside world
10 0 -1        imp:p=1  $
20 0 -2        imp:p=1  $

C Surfaces
1 S 0 0 -5  10
2 S 0 0  5  10
```



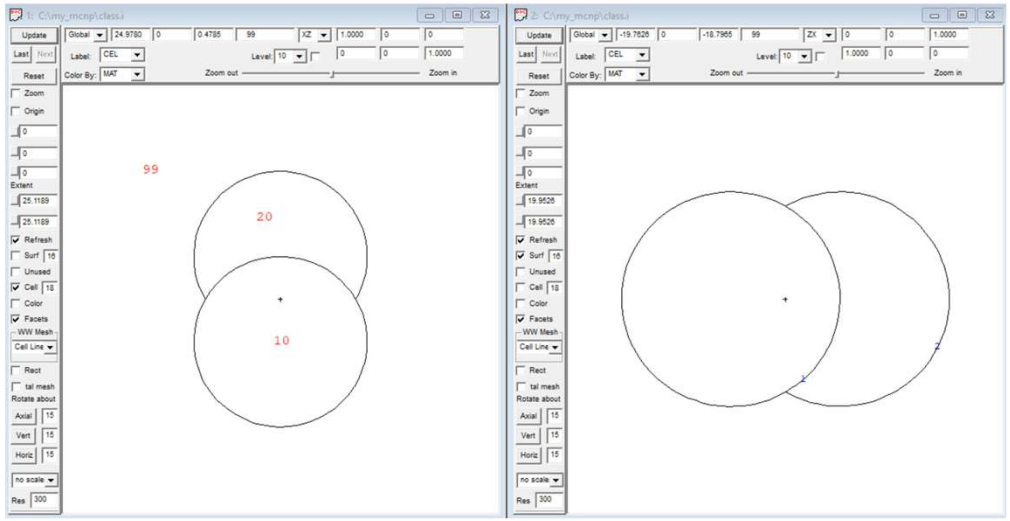
- This geometry has the error of defining the central union twice; both inside surface 1, and inside surface 2. There is a need to differentiate that space.

- This geometry still has the error of defining the central union; but now, it has not been defined at all.

```
Spheres and the union
C Cells
99 0  1 2      imp:p=1  $ outside world
10 0 -1  2     imp:p=1  $
20 0 -2  1     imp:p=1  $

C Surfaces
1 S 0 0 -5  10
2 S 0 0  5  10
```

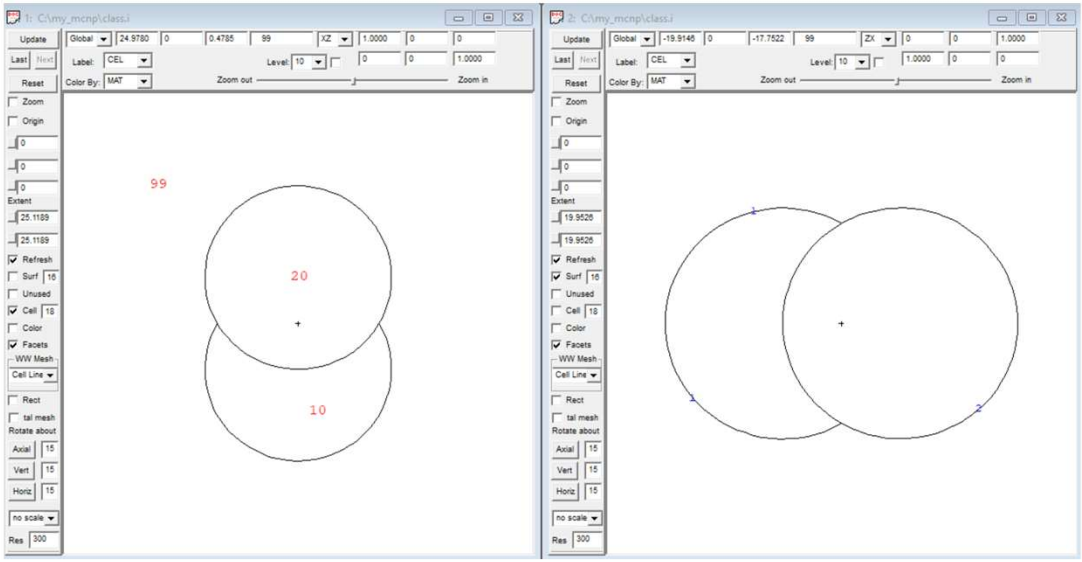


```
Spheres and the union
C Cells
99 0  1 2       imp:p=1  $ outside world
10 0 -1         imp:p=1  $
20 0 -2  1      imp:p=1  $

C Surfaces
1 S 0 0 -5  10
2 S 0 0  5  10
```

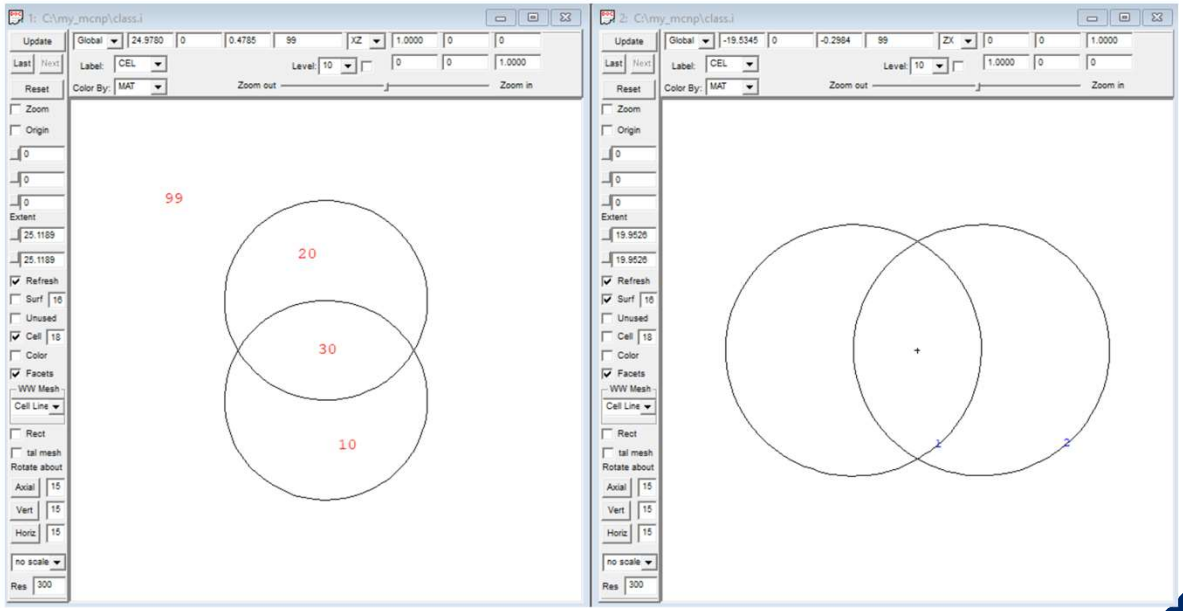


Spheres and the union

```
C Cells
99 0  1 2       imp:p=1  $ outside world
10 0 -1  2      imp:p=1  $
20 0 -2         imp:p=1  $

C Surfaces
1 S 0 0 -5  10
2 S 0 0  5  10
```



```
Spheres and the union
C Cells
99 0  1 2      imp:p=1  $ outside world
10 0 -1 2      imp:p=1
20 0 -2 1      imp:p=1
30 0 -2 -1     imp:p=1

C Surfaces
1 S 0 0 -5   10
2 S 0 0  5   10
```



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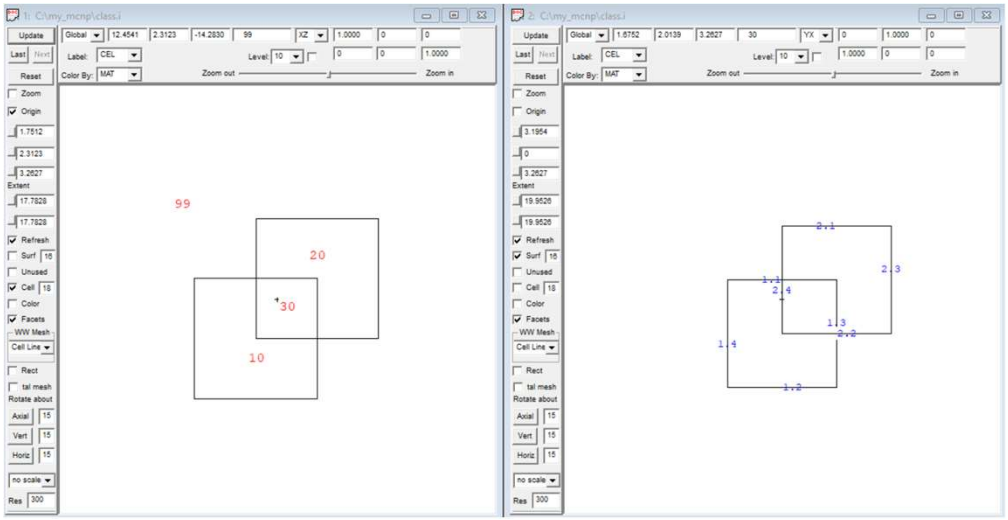
Integrated Cubes

- All the cell relationships are the same as for spheres, but the surface definitions will be different.




```
Cubes and the union
C Cells
99 0  1 2      imp:p=1  $ outside world
10 0 -1 2      imp:p=1
20 0 -2 1      imp:p=1
30 0 -2 -1     imp:p=1

C Surfaces
1 RPP -5 5   -5 5   -5 5
2 RPP  0 10   0 10   0 10
```