MA Z X SYMBOL

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MaZX`

# ZXObject

NEW IN 13.2

ZXObject [{$v_1$, $v_2$, …}, {$e_1$, $e_2$, …}]
is an object containing the data of a ZX diagram.

## Details and Options

- Graph [*obj*] display ZXObject obj in a graph form. ZXLayers [Graph [*obj*]] finds the layers of the graph form of *obj*.
- ZXDiagram [*obj*, $expr_1$, $expr_2$, …] add new ZX expressions $expr_1$, $expr_2$, … to the already existing ZXObject *obj*.
- Join [$obj_1$, $obj_2$, …] combines ZXObjects $obj_1$, $obj_2$, ….
- ExpressionFor [*obj*] converts *obj* to the corresponding operator expression.
- Matrix [*obj*] converts *obj* to the corresponding matrix.
- Basis [*obj*] returns the computational basis associated with ZXObject *obj*.

## Examples (1)

```
In[1]:= Needs["MaZX`"]
```

### Basic Examples (1)

ZXDiagram returns the ZXObject.

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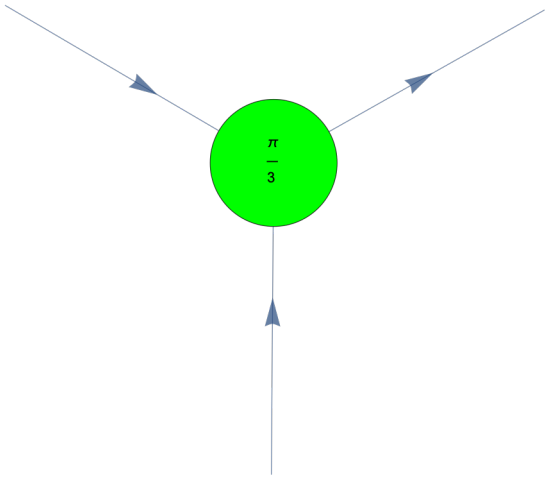
```
In[1]:= obj = ZXDiagram[{{i1, i2} -> Z[1][Pi/3] -> o}, GraphLayout -> "SpringElectricalEmbedding"]
```

Out[1]=




The object is displayed in a graph form as above. However, it stores the data.

```
In[2]:= InputForm[obj]
```

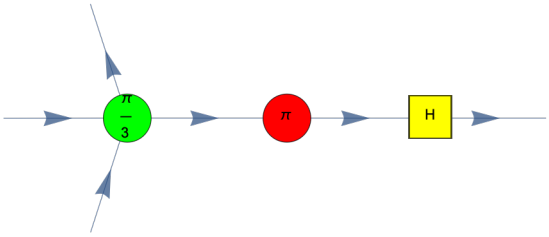
Out[2]//InputForm=

```
ZXObject[{i1, i2, o, Z[1][Pi/3]}, {i1 -> Z[1][Pi/3], i2 -> Z[1][Pi/3], Z[1][Pi/3] -> o},
 GraphLayout -> "SpringElectricalEmbedding"]
```

You can build another ZXObject based on the existing one.

```
In[3]:= new = ZXDiagram[{obj, Z[1] -> X[1][Pi] -> H[1] -> o2}]
```

Out[3]=




Convert the object into an operator expression.

```
In[4]:= op = ExpressionFor[obj]
```

Out[4]= $|0_o\rangle\langle 0_{i1}0_{i2}| + (-1)^{1/3}\,|1_o\rangle\langle 1_{i1}1_{i2}|$

Convert the object into the corresponding matrix representation.

```
In[5]:= mat = Matrix[obj];
        mat // MatrixForm
```

Out[5]//MatrixForm=

$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & e^{\frac{i\pi}{3}} \end{pmatrix}$$

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Of course, the conversion of the object directly into the matrix representation must equal to the matrix representation of the operator expression above.

```
In[6]:= Matrix[obj] - Matrix[op] // Simplify // MatrixForm
```

```
Out[6]//MatrixForm=
```

$$\begin{pmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}$$

Find the bases that are used in the matrix representation.

```
In[7]:= Basis[obj]
```

```
Out[7]= ⟨| In → { |0_i1 0_i2⟩, |0_i1 1_i2⟩, |1_i1 0_i2⟩, |1_i1 1_i2⟩ }, Out → { |0_o⟩, |1_o⟩ } |⟩
```

Find the graph layers in the ZX diagram.

```
In[8]:= ZXLayers[Graph@obj]
```

```
Out[8]= {{i1, i2}, {Z_1(π/3)}, {o}}
```

Find all Z spiders in the ZX diagram.

```
In[9]:= ZSpiders[new]
```

```
Out[9]= {Z_1(π/3)}
```

Find all X spiders in the ZX diagram.

```
In[10]:=
ZSpiders[new]
```

```
Out[10]=
{X_1(π)}
```

Find all spiders, regardless of type Z or X, in the ZX diagram.

```
In[11]:=
ZXSpiders[new]
```

```
Out[11]=
{X_1(π), Z_1(π/3)}
```

Find all Hadamard gates in the ZX diagram.

```
In[12]:=
ZXHadamards[new]
```

```
Out[12]=
{H_1}
```

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## See Also

**ZXDiagram**

Related Guides

- MaZX

Related Links

- R. Duncan, A. Kissinger, S. Perdrix, and J. van de Wetering, Quantum 4, 279 (2020) , "Graph–theoretic Simplification of Quantum Circuits with the ZX–calculus."
- B. Coecke and R. Duncan, New Journal of Physics 13, 043016 (2011) , "Interacting quantum observables: categorical algebra and diagrammatics."

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