The TikZ-planets package

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Contents

I initially created this package to illustrate celestial mechanics for an astronomy course I taught in 2019. It makes it easy to add sketches of solar system objects to illustrate seasons, moon phases,... The commands provided by this package are to be used in a `tikzpicture` environment.

This package is a work in progress and is my first attempt at creating a TikZ package. I would be really happy to receive suggestions on how to improve it.

1.1 Installation

Move the package (.sty file) to a latex search directory (usually `~/texmf/` on a Unix-type system) if you want to be able to use it from any directory. Ask you system administrator if you need help.

1.2 Requirements

Tikz-planets requires the following standard packages to be installed

- xcolor
- pgfkeys
- xstring
- tikz

1.3 Source

This package is available on CTAN.

The source code, along with an issue tracker can be found at `https://framagit.org/Moutmout/tikz-planets.git`.

1.4 License

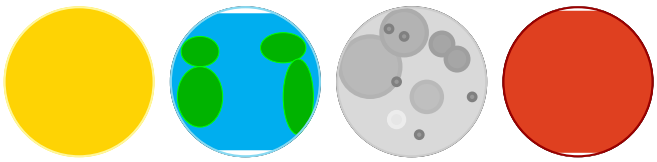
2 Usage

To use the commands provided by this package in a TikZ picture, add the `\usepackage{planets}` command to the header of your document.

2.1 Drawing a planet

Drawing one of the eight solar system planets is rather straightforward: Use `\planet[surface=earth]`, replacing the option `earth` with the name of any planet. Although they are not planets, the `\planet` command can also be used to draw the Sun, the Moon and Pluto, by setting the `surface=<name>` keyword.

```
\planet[surface=sun]
\planet[surface=earth]
\planet[surface=moon]
\planet[surface=mars]
```

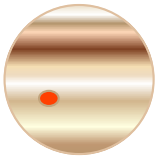


The celestial bodies available in this package are:

- `sun`
- `mercury`
- `venus`
- `earth`
- `moon`
- `mars`
- `jupiter`
- `saturn`
- `uranus`
- `neptune`
- `pluto`

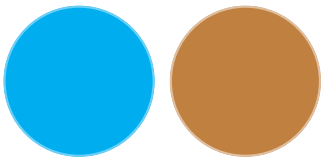
In addition to this list, it is possible to represent Jupiter with a different graphical style. This option was created purely for esthetic reasons and is not (yet) available for any other planets.

```
\planet[surface=shaded jupiter]
```



If you need a planet that isn't in the solar system, you can make a generic one with a solid color surface.

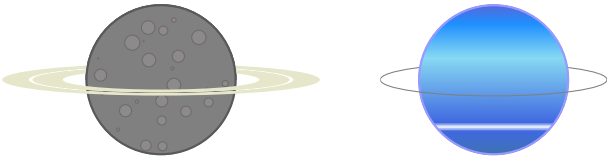
```
\planet
\planet[color=brown]
```



2.2 Rings

The four gas giants in the solar system sport a ring, but only Saturn is shown with a ring by default. A "Saturn-like" set of rings can be drawn around any planet with the `rings` option. A thin ring with a custom radius can be drawn with the `ring=<radius>` option.

```
\planet[surface=mercury, rings]
\planet[surface=neptune, ring=1.5]
```



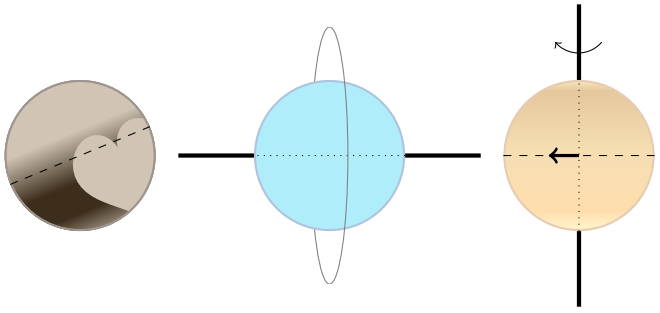
2.3 Rotational characteristics

Most planets rotate around a set axis that can be tilted with respect to the plane of orbit. The rotation axis of the Earth, for instance, is tilted by 23.5 degrees. Uranus spins on its side, with a rotation axis tilted at 90 degrees. This can be illustrated using the `tilt=<angle in degrees>` and the `rotation` options.

The equator and rotational axis of a planet can be shown respectively with the `equator` and `axis` options.

Venus rotates in the opposite direction compared to the other planets in the solar system. This can be illustrated with the `retrograde` option.

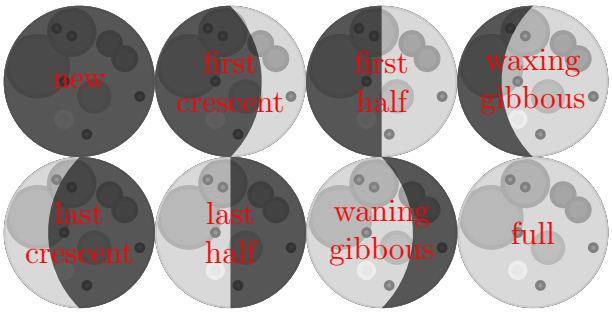
```
\planet[surface=pluto, tilt=22.5, equator]
\planet[surface=uranus, tilt=90, axis,
        ring=1.7]
\planet[surface=venus,
        retrograde, rotation]
```



2.4 Phases

Half of a planet or moon is in the shadow of the Sun. This can be illustrated with the `phase=<name>` keyword, which can take the following values: `new`, `first crescent`,

`first half`, `waxing gibbous`, `full`, `waning gibbous`, `last half` or `last crescent`.

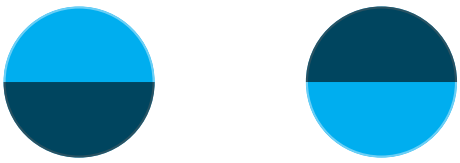


If the phase is specified for a planet with "Saturn-like" rings, then the rings will also be shaded.

```
\planet[surface=saturn,
        phase=first half, tilt=20]
\planet[surface=saturn,
        phase=waxing gibbous, tilt=-20]
```

It is possible to specify a phase such that only the top half or bottom half of the planet is visible.

```
\planet[phase=top half]
\planet[phase=bottom half, centerx=4]
```



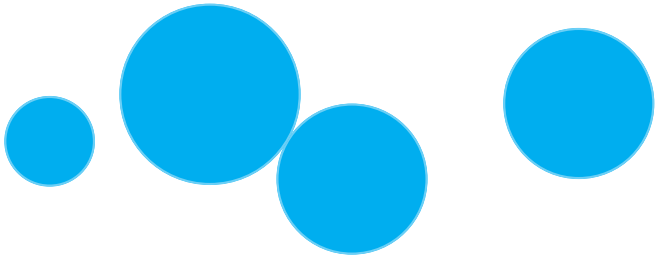
2.5 Size and position

By default, a planet has a radius of 1 and is centered at $(0, 0)$. To draw schematics illustrating celestial mechanics, it is useful to use several `\planet`s in one figure.

The size of the planet is set with the `scale=<planet radius>` keyword. For instance, `scale=2` makes the radius of the planet twice as big.

The position of the center of the planet can be set by specifying the x and y coordinates of the center with the `centerx=<x coordinate>` and/or `centery=<y coordinate>` keywords. Alternatively, the coordinates of the planet's center can be set using the `center={<point>}` keyword. This makes it possible to specify the center of the planet in either cartesian, polar coordinates or named points.

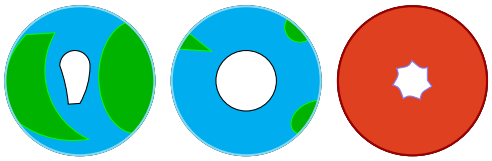
```
\planet[center={(0, 1.5)}, scale=.6]
\planet[centerx=4, centery = 1]
\planet[center={(45 : 3)}, scale=1.2]
\node (A) at (7, 2) {};
\planet[center={A}]
```



2.6 Polar view of planets

In a diagram, you may want to show a planet seen from one of its poles, like an observer sitting above or below the elliptical plane. This is achieved with the `surface=<surface>` option.

```
\planet[surface=north pole]
\planet[surface=south pole, centerx=2.2]
\planet[surface=mars pole, centerx=4.4]
```



This feature is (currently) only available for the Earth and for Mars.

3 Complete examples

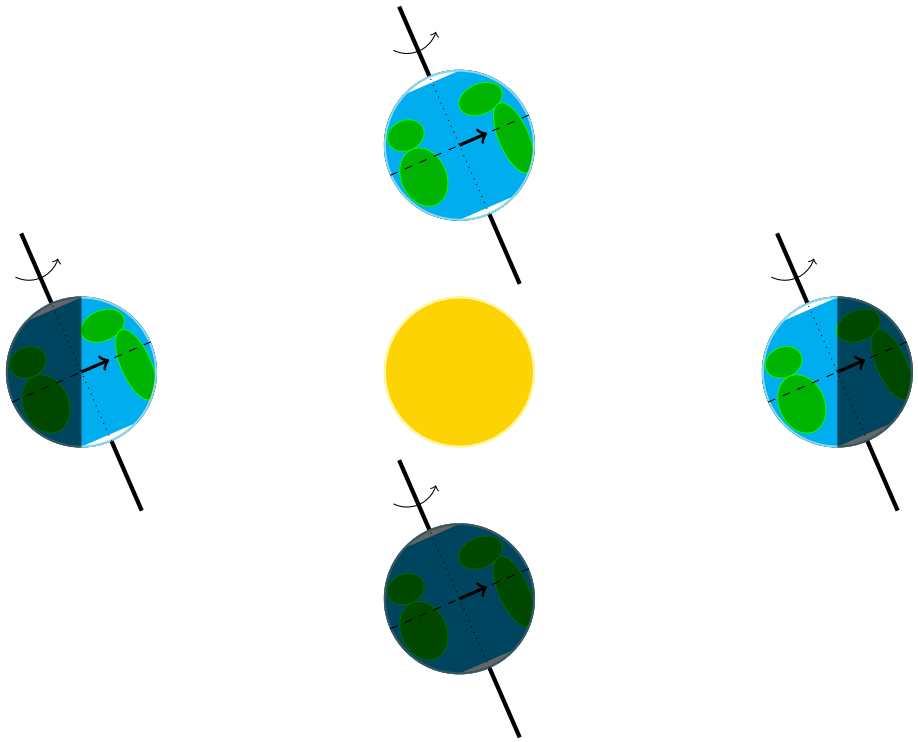
Here are a few examples of what can be done with the TikZ-planets package. More examples can be found at `https://framagit.org/search?utf8=%E2%9C%93&snippets=true&scope=snippet_titles&repository_ref=&search=tikz-planets`.

3.1 The seasons

Season's are caused by the tilt of Earth's axis. This is why summer in the northern hemisphere happens at the same time as winter in the southern hemisphere.

```
\planet[surface=sun]

\planet[surface=earth, phase = first half, rotation, tilt=23.5, centerx=-5]
\planet[surface=earth, phase = last half, rotation, tilt=23.5, centerx=5]
\planet[surface=earth, phase = new, rotation, tilt=23.5, centery=-3]
\planet[surface=earth, phase = full, rotation, tilt=23.5, centery=3]
```



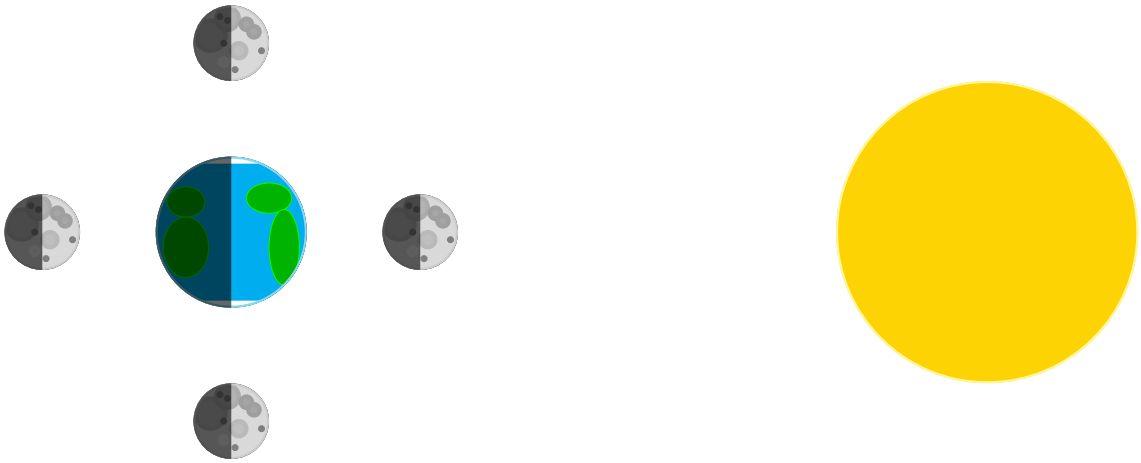
3.2 The phases of the Moon

Half of the Moon is in the shadow of the Sun. Since the Moon goes around the Earth, the shadows on the near-side of the Moon change.

```
\planet[surface=earth, phase=first half]
\planet[surface=sun, centerx=10, scale=2]

\planet[surface=moon, phase=first half, centerx=-2.5, scale=.5]
```

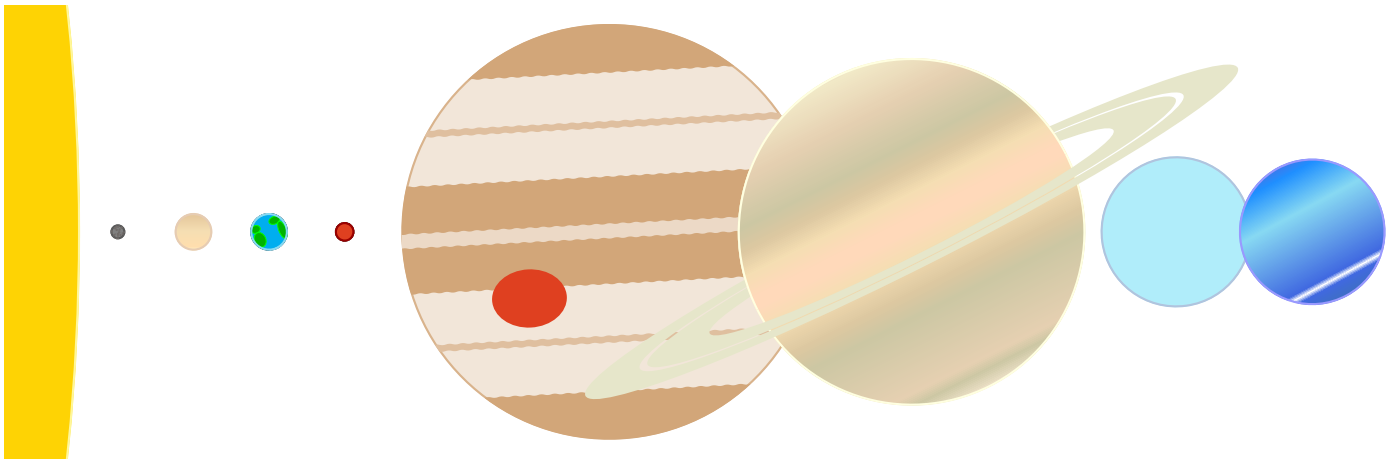
```
\planet[surface=moon, phase=first half, centerx=2.5, scale=.5]
\planet[surface=moon, phase=first half, centery=-2.5, scale=.5]
\planet[surface=moon, phase=first half, centery=2.5, scale=.5]
```



3.3 The solar system

You might have learned "My Violent Evil Monster Just Scared Us Nuts", "My Very Excellent Mother Just Served Us Nachos", or some other mnemonic to remember the order of the eight (or nine if you're old enough) planets in the solar system. The distances in the following sketch are not to scale, but the radii roughly are.

```
\clip (0,-3) rectangle (20, 3);
\planet[surface=sun, scale=28, centerx=-27]
\planet[surface=mercury, centerx=1.5, tilt=0, scale=.1]
\planet[surface=venus, centerx=2.5, tilt=2.6, scale=.25]
\planet[surface=earth, centerx=3.5, tilt=23.5, scale=.25]
\planet[surface=mars, centerx=4.5, tilt=25.2, scale=.13]
\planet[surface=jupiter, centerx=8, tilt=3, scale=2.75]
\planet[surface=saturn, centerx=12, tilt=26.7, scale=2.3]
\planet[surface=uranus, centerx=15.5, tilt=97.8, scale=1]
\planet[surface=neptune, centerx=17.3, tilt=28.3, scale=.97]
```



4 Changelog

4.1 Version 1.0.4 - May 2025

- Fixed bug with `center` keyword.
- Updated documentation for `center` keyword.
- Updated documentation with version number and date.
- Added polar view of Earth and Mars.
- Updated documentation for polar views of planets.
- Documented options surface=shaded jupiter, phase=top half and phase=bottom half.
- Documented the options to show the rotation axis and equator independently.

4.2 Version 1.0.3

- Changed internal command names to avoid clashes with user namespace
- Rotation axis of planets is now show to "go through" the planet, rather than be drawn on top of planet.

4.3 Version 1.0.2

- Made planets and wasysym compatible
- Possibility to use a point to specify the center of a planet (thus use polar coordinates)
- Make a more schematic representation of Jupiter that better fits with the graphical style used for the telluric planets
- A ring system can be added around any planet
- Ensure the radius of a planet is exactly 1 by default
- Thin rings can be drawn with any radius
- Draw the phase before rings to avoid having a strange shadow on the rings
- Rings typically are in the equatorial plane of their planet: make rings tilt with axial tilt
- Use solid color rather than shading for rings so that they have the same appearance when tilted
- Added Pluto
- Added shading to the rings for each phase
- Fixed documentation typos

4.4 Version 1.0.1

- Crescent and gibbous phases
- Added Mercury, Venus, Jupiter, Saturn, Uranus and Neptune surfaces
- Rotation can now be retrograde
- Color used no longer depends on x11names