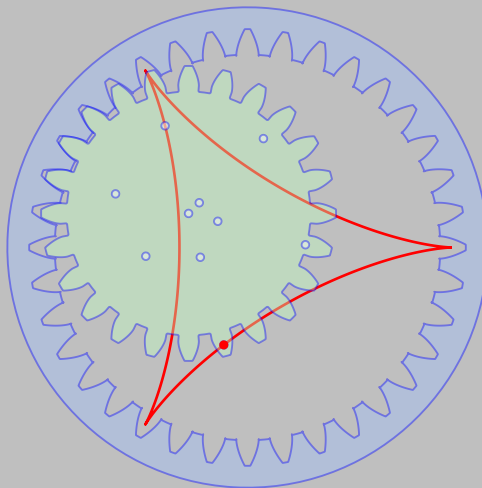


PSTricks

pst-spirograph v.0.40

A PSTricks package for drawing spirograph curves

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1 Introduction

pst-spirograph is a package to simulate the operation of a spirograph. A spirograph is a geometric drawing toy that produces mathematical roulette curves that are technically known as hypotrochoids and epitrochoids. The mathematician Bruno Abakanowicz invented the spirograph between 1881 and 1900.¹ It was used to calculate an area delimited by curves. A hypotrochoid is generated by a fixed point on a circle rolling inside a fixed circle.² It consists of a small toothed wheel rotating inside or outside a ring gear. The weighing tile wheel has nine drilled holes numbered from 0–8, through these small holes the tip of a pen or pencil can be put. This causes the small wheel to rotate one or more laps around the crown and draws a hypocycloid.

The wheel can also turn off a first fixed gear, it is thus possible to draw epicycloids. The command is written as

```
\psSpirograph [Options] (x,y)
```

and can optionally be followed by the coordinates of the point where you wish to place the Spirograph: `\psSpirograph [Options] (x,y)` which by default is centered at the origin. The optional parameters, including default values are indicated as following:

1. Z1=20: number of teeth of the wheel 1, the crown;
2. Z2=10: number of teeth of the wheel 2;
3. m=0.5: module of the gear;
4. ap=20: pressure angle in degrees, it must be reduced if the number of teeth crown is large (if the path of the teeth will be incorrect), e.g. take Z1=120;
5. holenummer=0 : active hole number;
6. polarangle=<value>: polar angle in degrees to position the center of the small wheel, a useful parameter for animation.

There are two Boolean values for the organisation of the two circles:

- circles: to draw circles of contact (default is false).
- inner: the gear rotates inside of the crown (true — default) or outside (false).

In the drawing, the color selection wheel and the line of the curve is made with the following setting:

1. color1={rgb}{0.625 0.75 1};
2. color2={rgb}{0.75 1 0.75};
3. curvecolor=red ;
4. curvewidth=1pt: linewidth of the hypocycloid;
5. circlescolor=red .

The origin of the spirograph can be set by the coordinates (x,y) . If the they are missing, $(0,0)$ is assumed. By default, the wheels are not filled with color. The color inside the wheels must be set by the option `fillStyle=solid`.

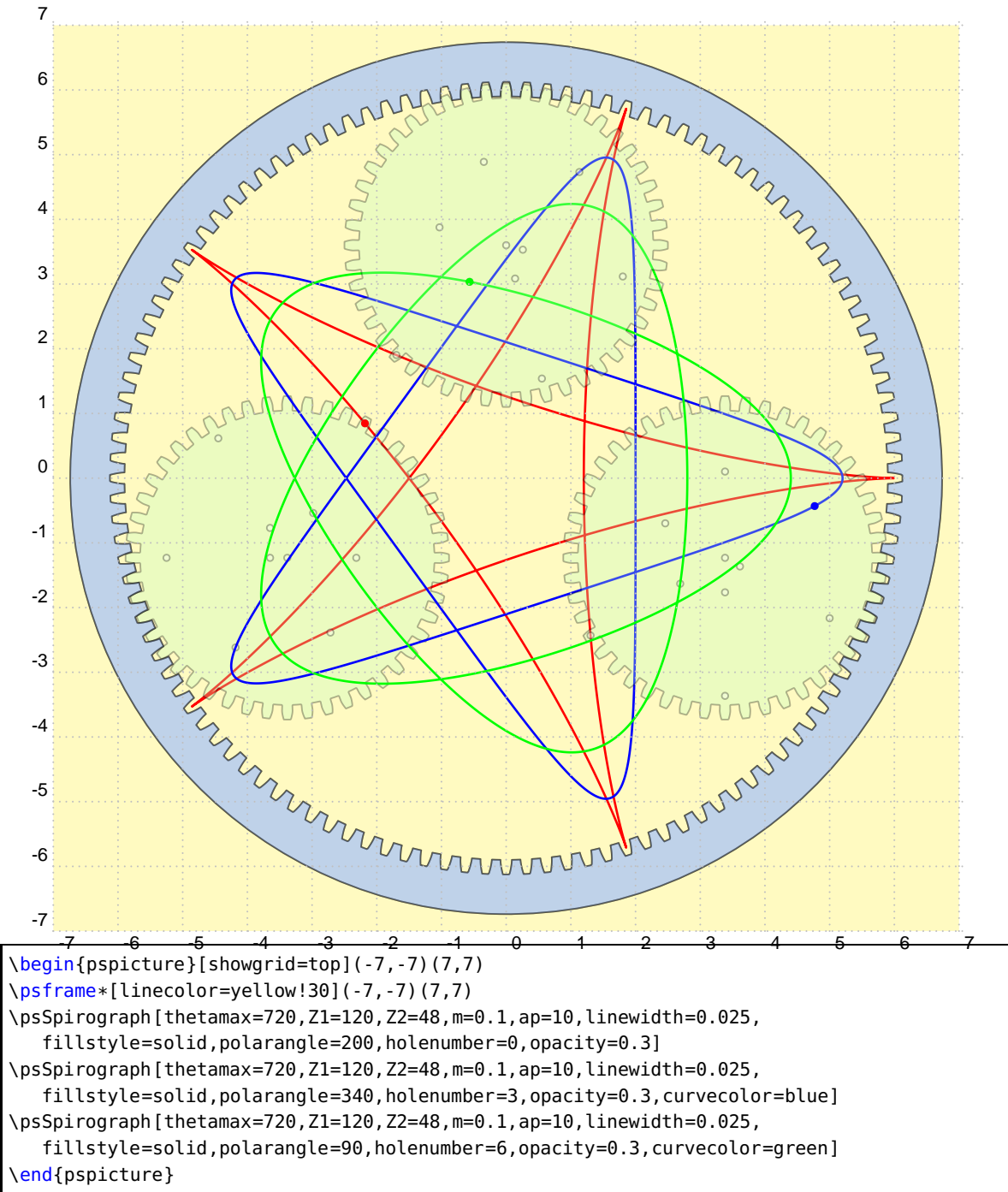
The choice of color and line thickness contour of the wheels is made with usual PSTricks options: `linecolor` and `linewidth`. The transparency of the small wheel is adjusted with the `opacity` option of PSTricks.

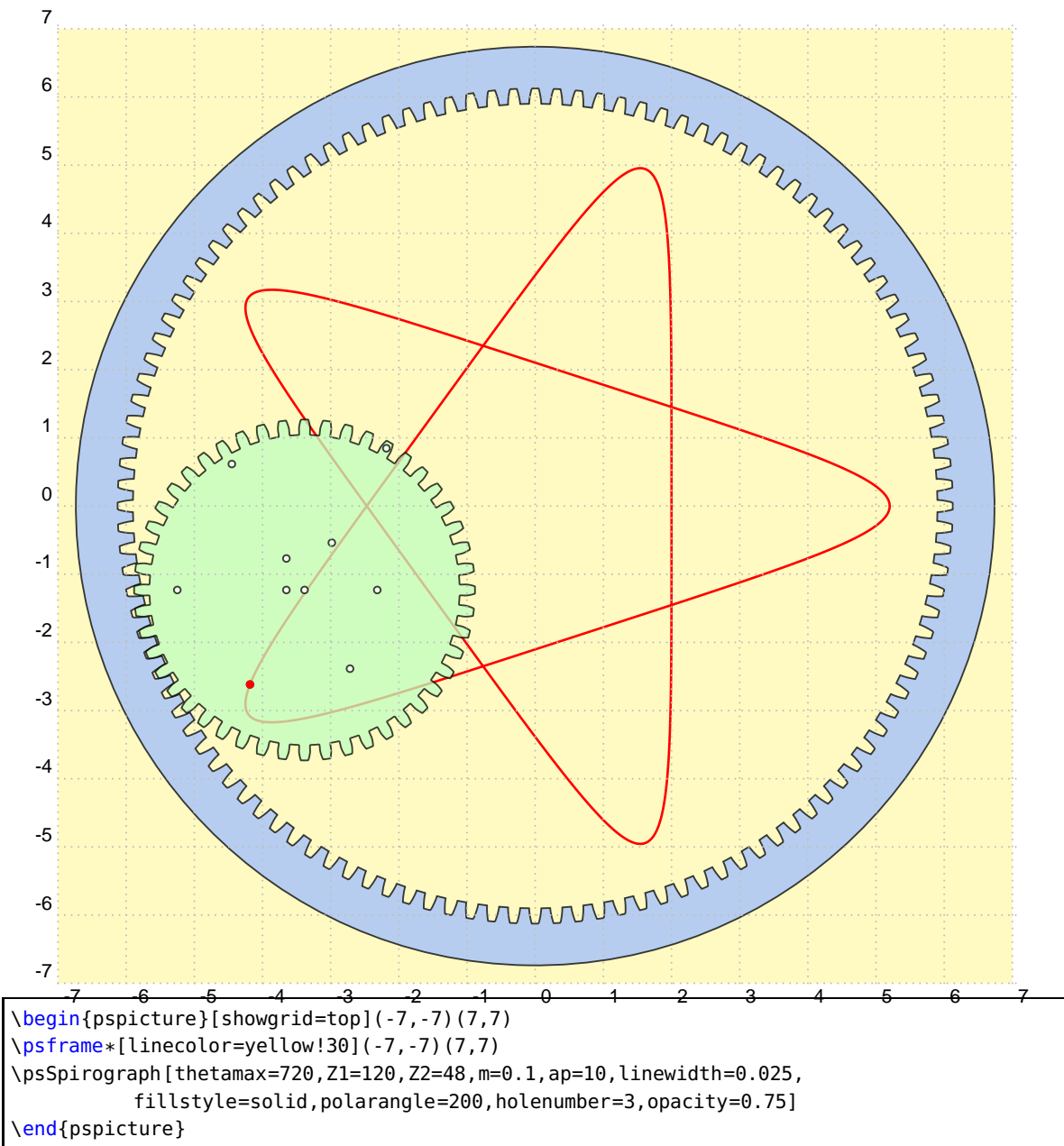
¹ <http://en.wikipedia.org/wiki/Spirograph>

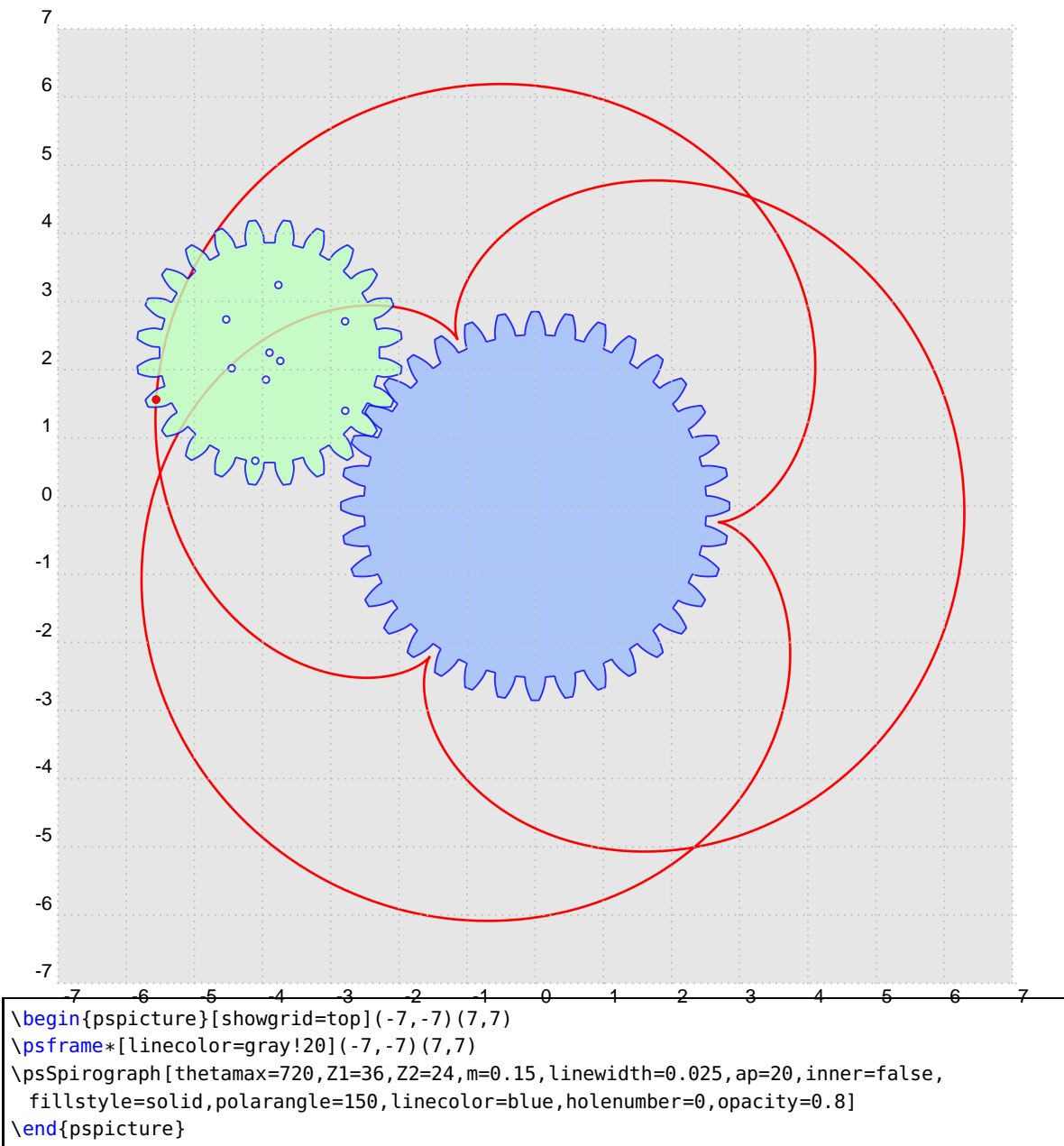
² <http://mathworld.wolfram.com/Spirograph.html>

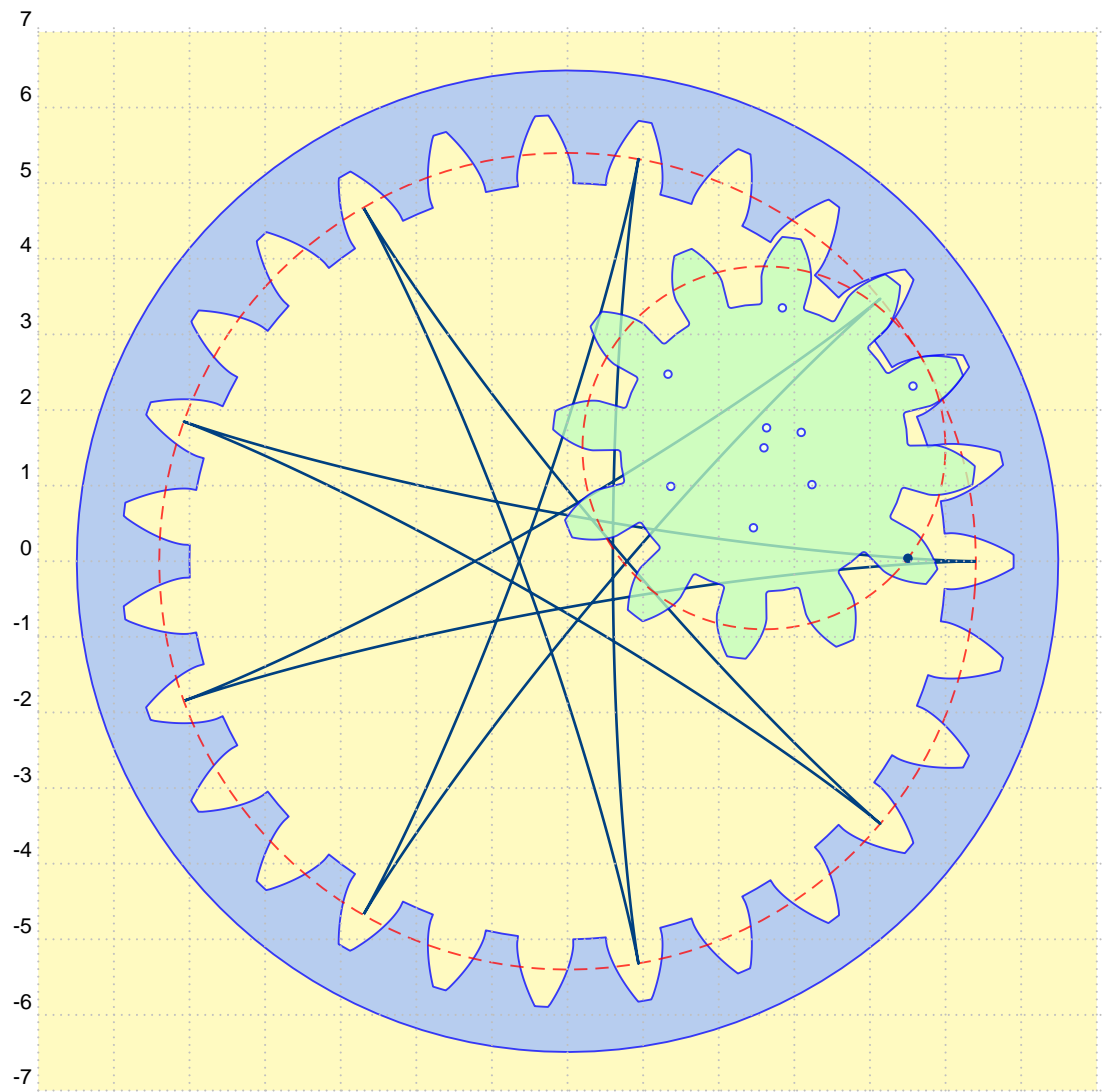
The last parameter is the angle $\text{thetamax}=360$, which represents the rotation in degrees the center of the small wheel around the ring, so it is a parameter to adjust, depending on the planned route of the hypocycloid.

2 Examples





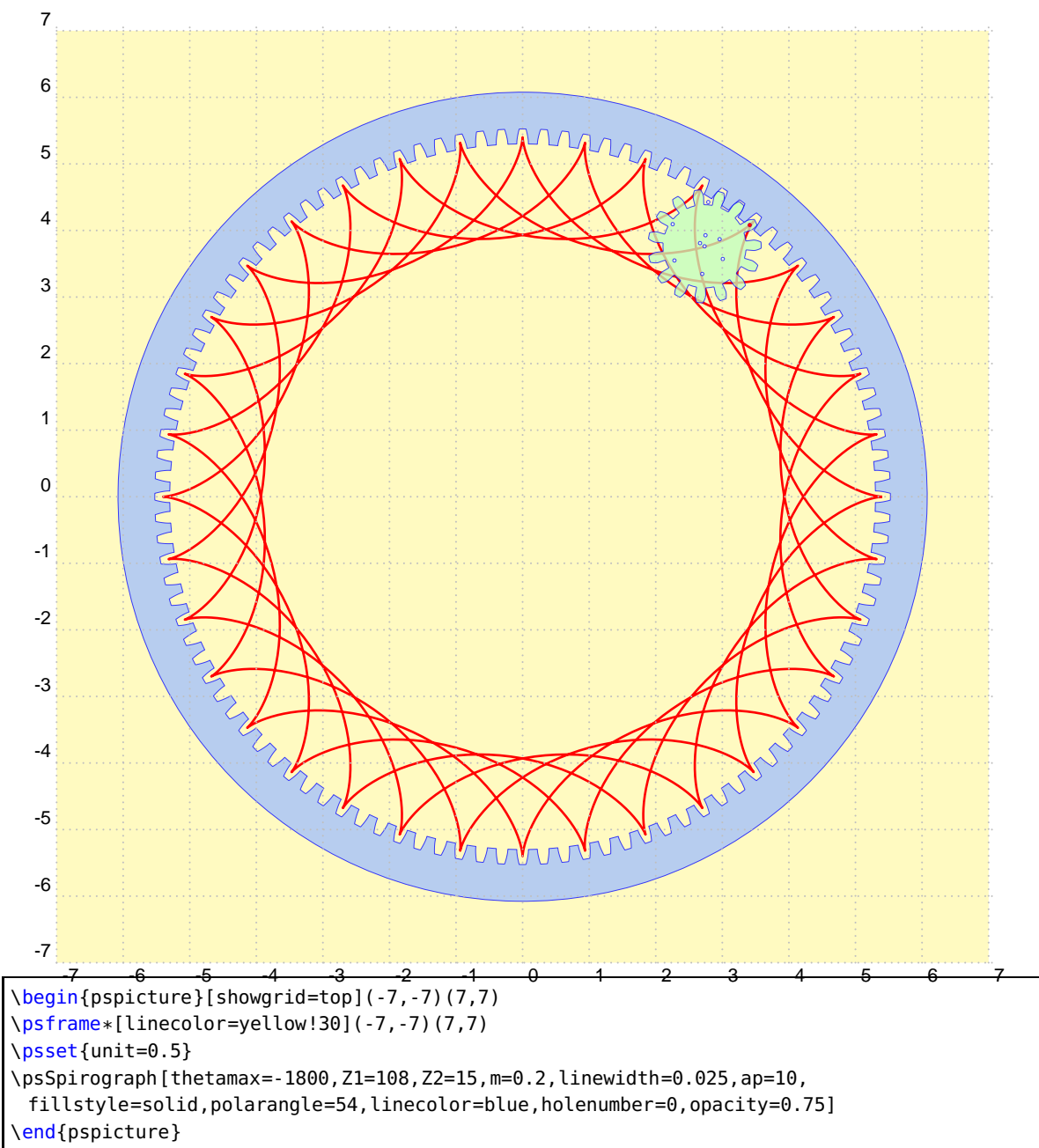


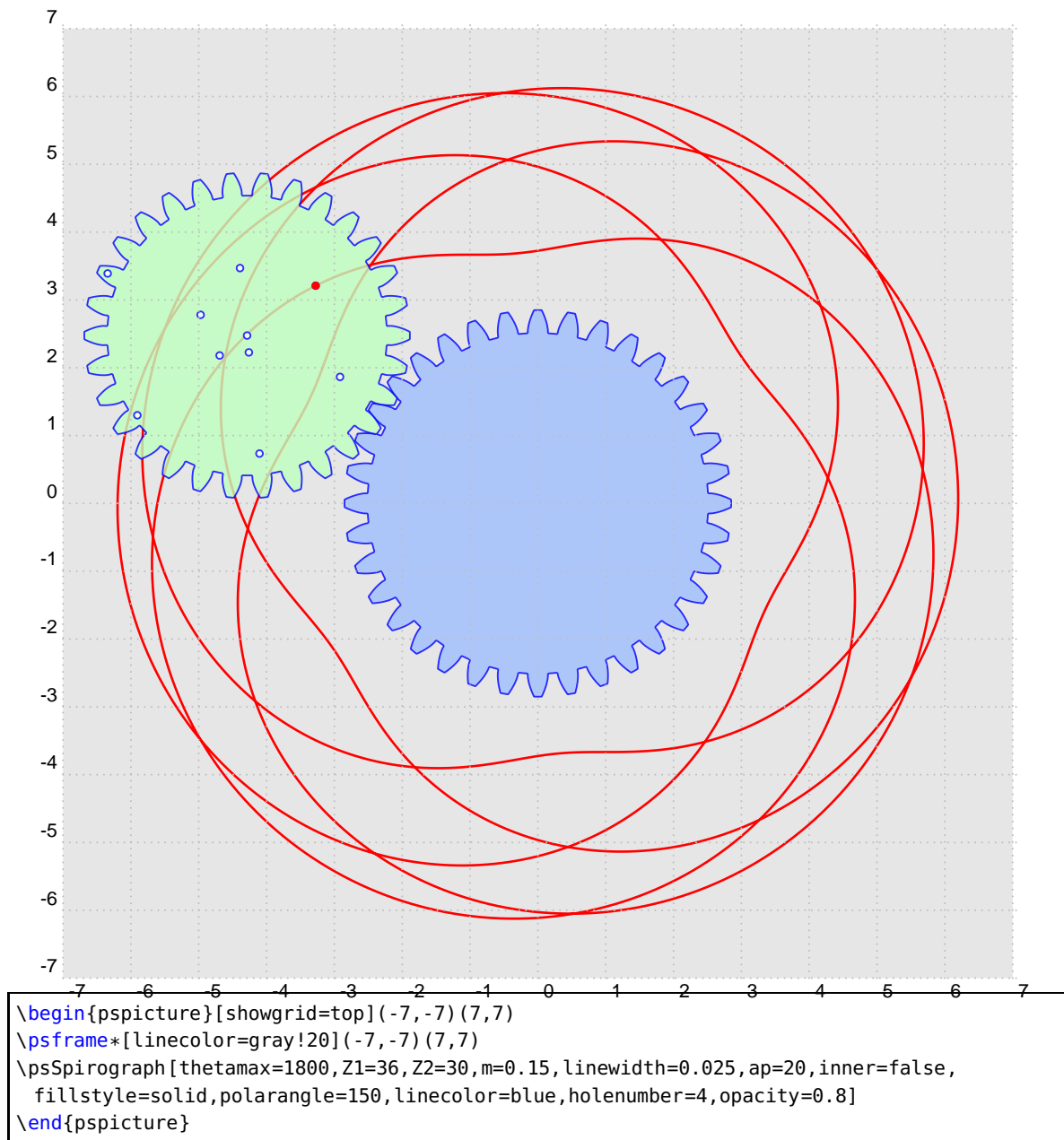


```

\begin{pspicture}[showgrid=top](-7,-7)(7,7)
\psframe*[linecolor=yellow!30](-7,-7)(7,7)
\psSpirograph[thetamax=1440,Z1=27,Z2=12,m=0.4,linewidth=0.025,
  curvecolor={rgb}{0 0.25 0.5}},circles,fillstyle=solid,polarangle=30,
  linecolor=blue,holenumber=0,opacity=0.75]
\end{pspicture}

```





3 Animations

With package animate one can easily create animations:

```
\begin{animateinline}[
  width=0.9\linewidth,
  begin={\begin{pspicture}(-3.5,-3.5)(3.5,3.5)},
  end={\end{pspicture}}},
  palindrome,controls,
  % autoplay
]{5}
\multiframe{100}{rA=0.001+30.000}{%
  \psSpirograph[thetamax=rA,Z1=59,Z2=24,m=0.1,ap=10,curvewidth=1.5pt,
    linewidth=0.025,fillstyle=solid,polarangle=rA,holenumber=5,opacity=0.5](0,0)}
\end{animateinline}
```

There are some more examples in the documentation directory of the package.

4 List of all optional arguments for pst-spirograph

Key	Type	Default
Z1	ordinary	20
Z2	ordinary	10
m	ordinary	0.5
ap	ordinary	20
polarangle	ordinary	0
holenumber	ordinary	1
thetamax	ordinary	360
color1	ordinary	[rgb]{0.625 0.75 1}
color2	ordinary	[rgb]{0.75 1 0.75}
circlescolor	ordinary	red
curvecolor	ordinary	red
curvewidth	ordinary	1pt
inner	boolean	true
circles	boolean	true

References

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- [4] Nikolai G. Kollock. *PostScript richtig eingesetzt: vom Konzept zum praktischen Einsatz*. IWT, Vaterstetten, 1989.
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- [6] Herbert Voß. *PSTricks – Grafik für T_EX und L^AT_EX*. DANTE – lehmanns media, Heidelberg/Berlin, 6 edition, 2010.
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- [8] Herbert Voß. *PSTricks – Graphics for L^AT_EX*. UIT, Cambridge/UK, 1. edition, 2011.
- [9] Timothy Van Zandt. *multido.tex - a loop macro, that supports fixed-point addition*. CTAN:/macros/generic/multido.tex, 1997.
- [10] Timothy Van Zandt and Denis Girou. Inside PSTricks. *TUGboat*, 15:239–246, September 1994.

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