Tomsk Polytechnic University

DESCRIPTIVE GEOMETRY
ENGINEERING GRAPHICS

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Lecture 5

SURFACES

Plan

1. Conical and Cylindrical Surfaces.
2. Rotation Surfaces.
3. Rotation Surface Cut by a Plane

Conical and Cylindrical Surfaces

The position of a plane on a drawing may be specified in one of the following ways:

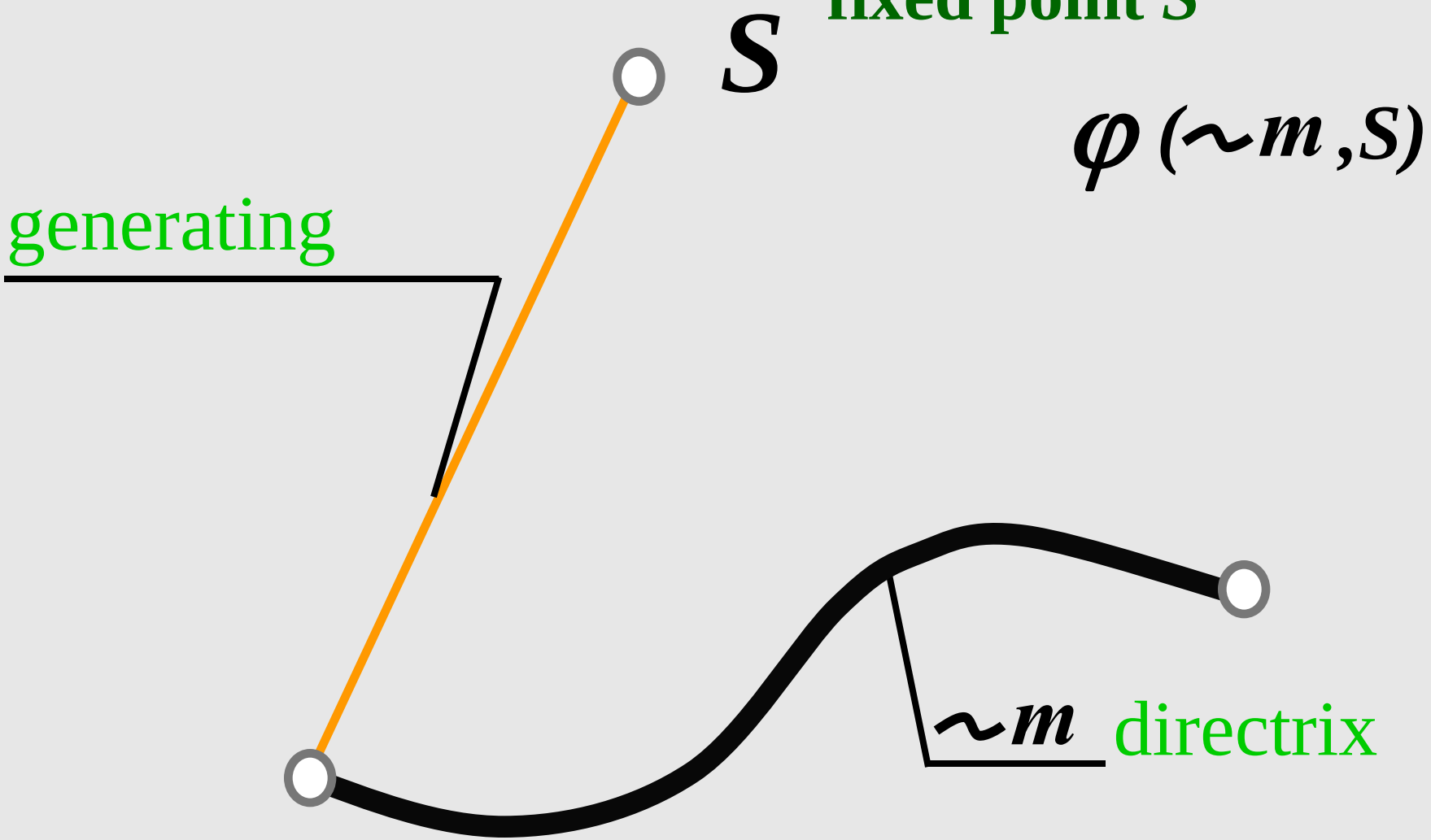
Conical and Cylindrical Surfaces

Conical Surface

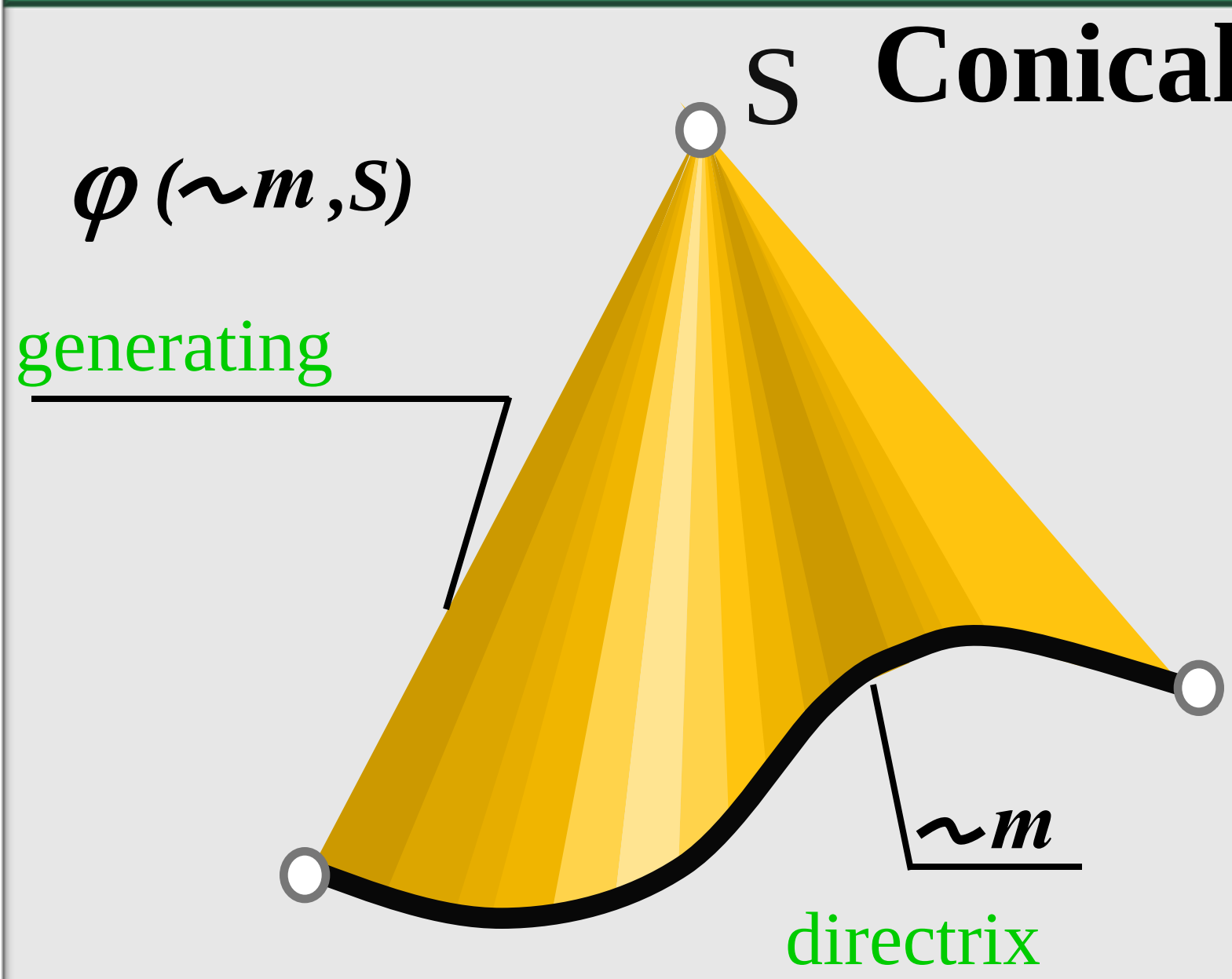
The conical surface is produced by the motion of a linear generating line along a curved directrix.

At that, the generatrix passes some fixed point *S*, referred to as a vertex.

Determinant surface: Directrix and certain fixed point *S*



Conical

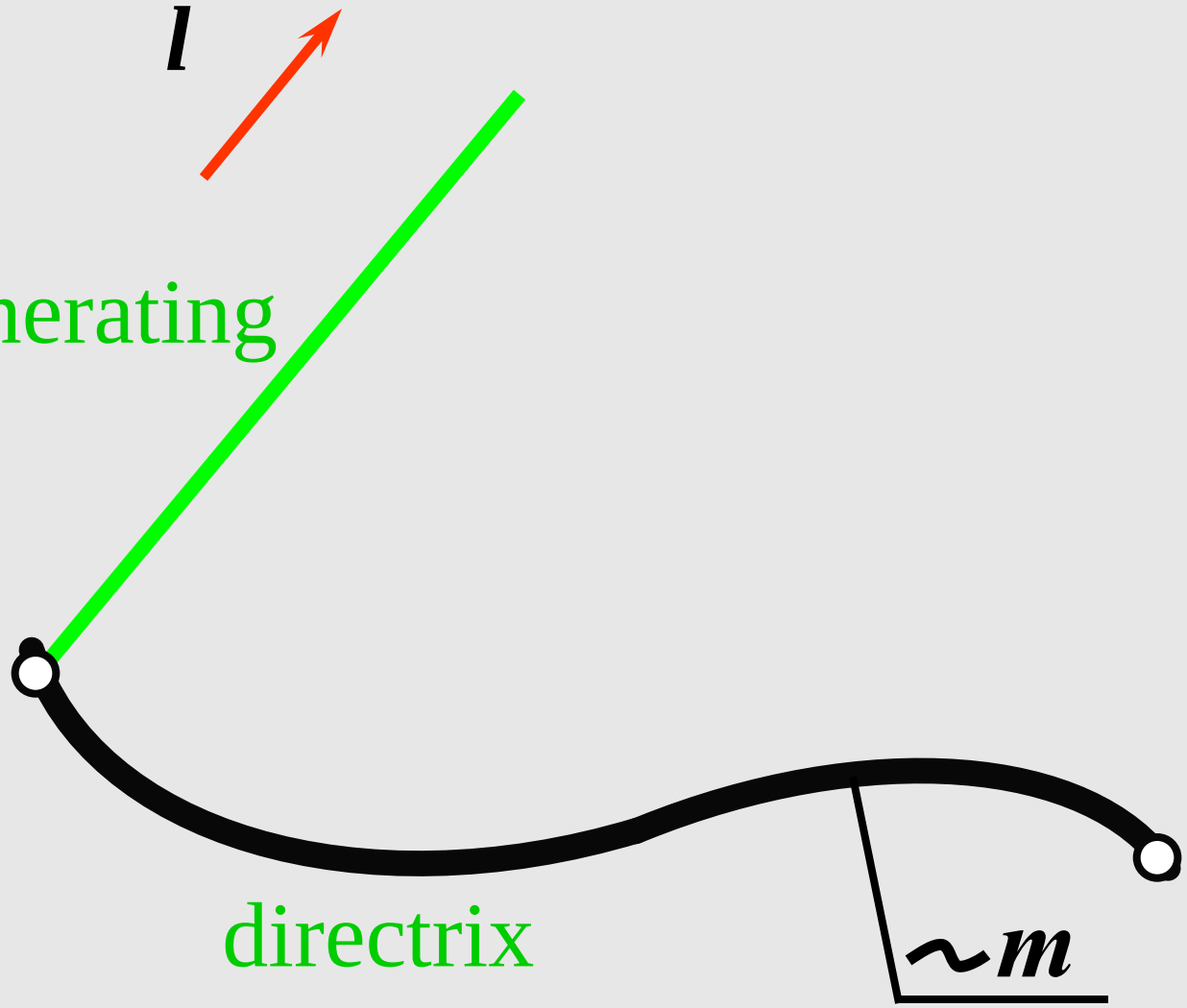


The cylindrical surface

The cylindrical surface is produced by parallel to a given straight line *l* motion of a linear generating line along a curved directrix

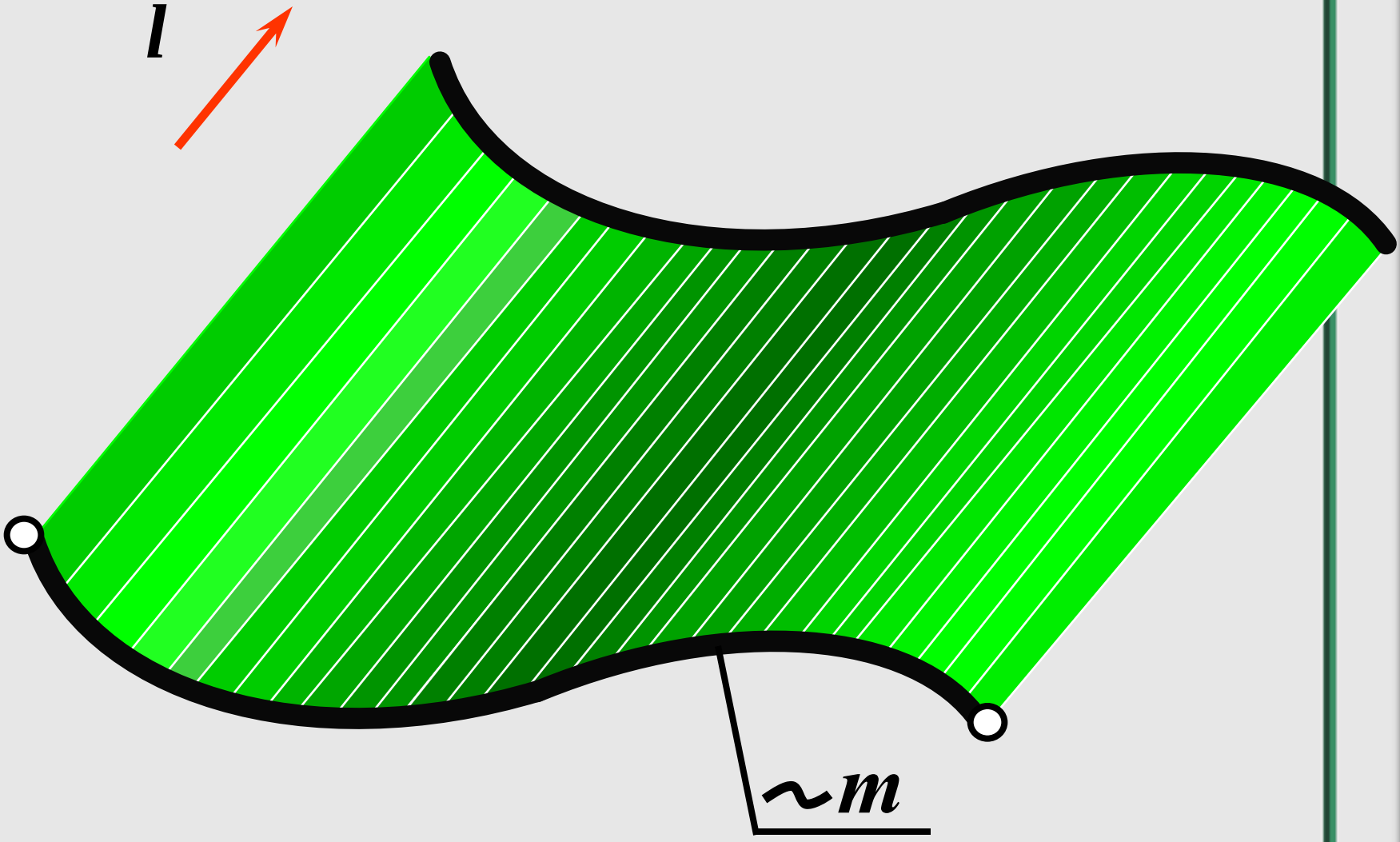
A cylindrical surface is considered to be distinguished if a directrix and a generatrix.

Determinant surface: $\varphi(\sim m, l)$



$\varphi\,(\sim m, l)$

cylindrical



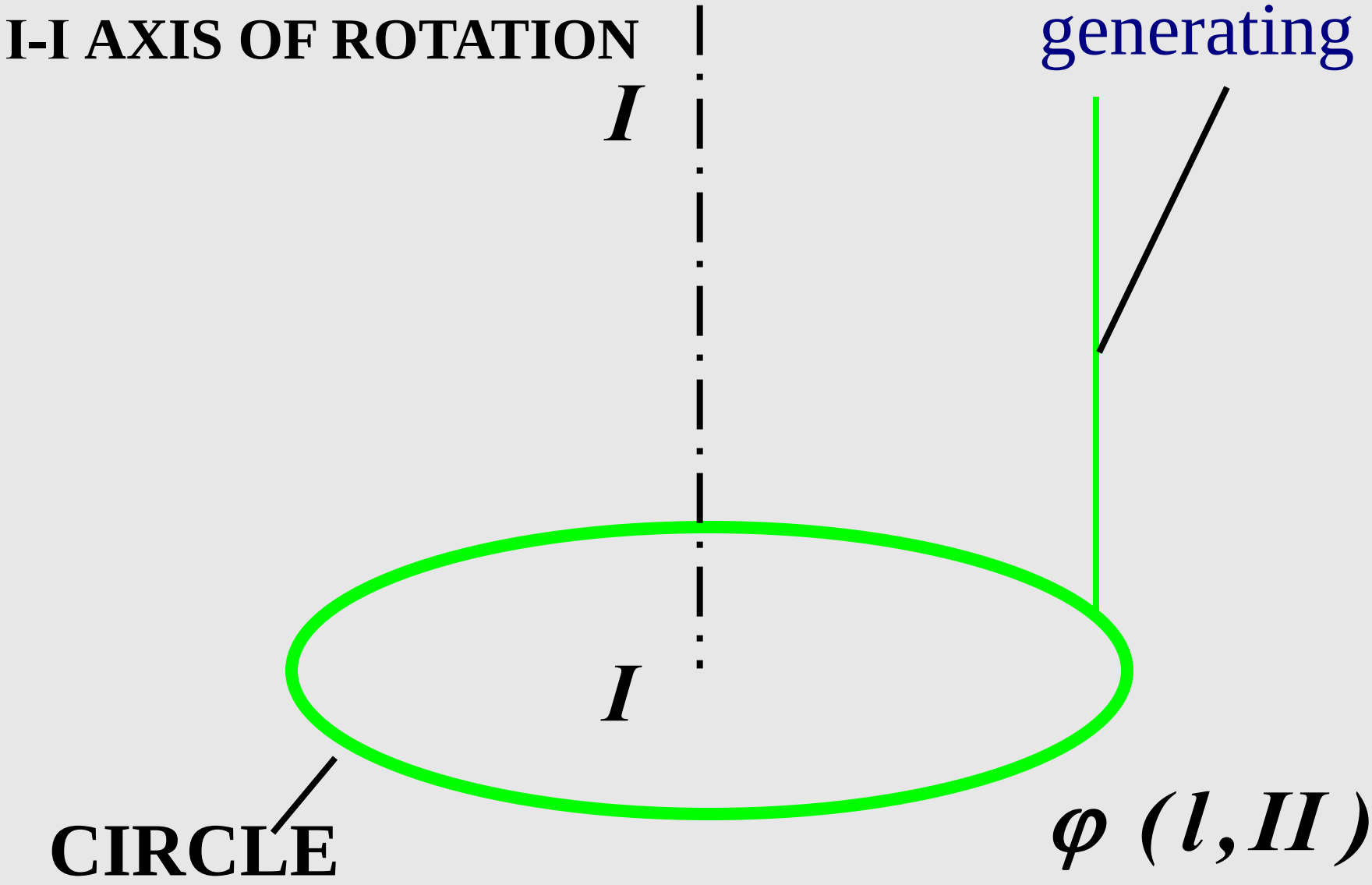
Rotation Surfaces

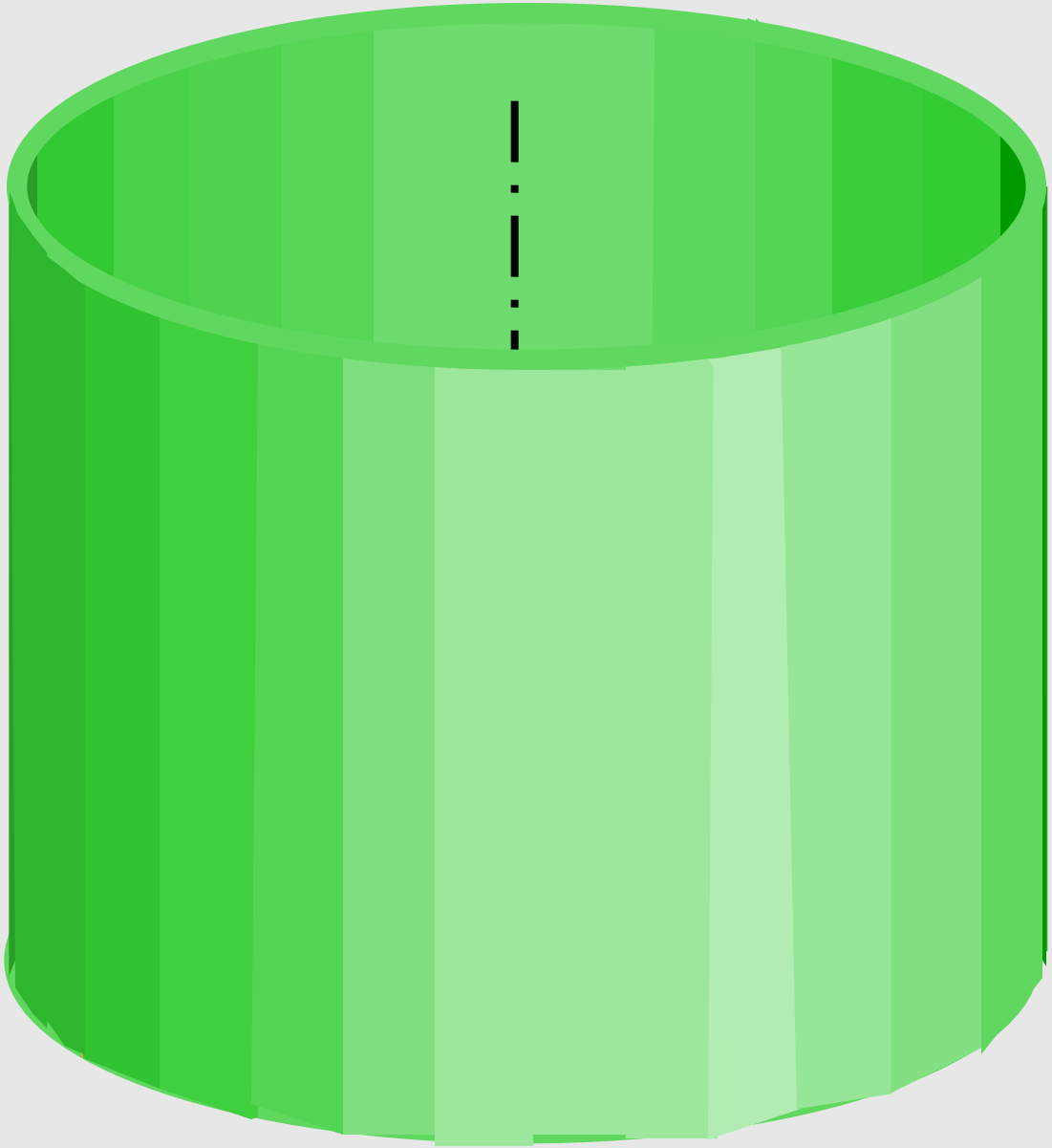
Rotation surface is a surface described by a curve (or a straight line), rotating on its axis

Rotation Surfaces

Cylinder of rotation - this is a surface produced by rotation of the line *L* round the axis *I* parallel to it

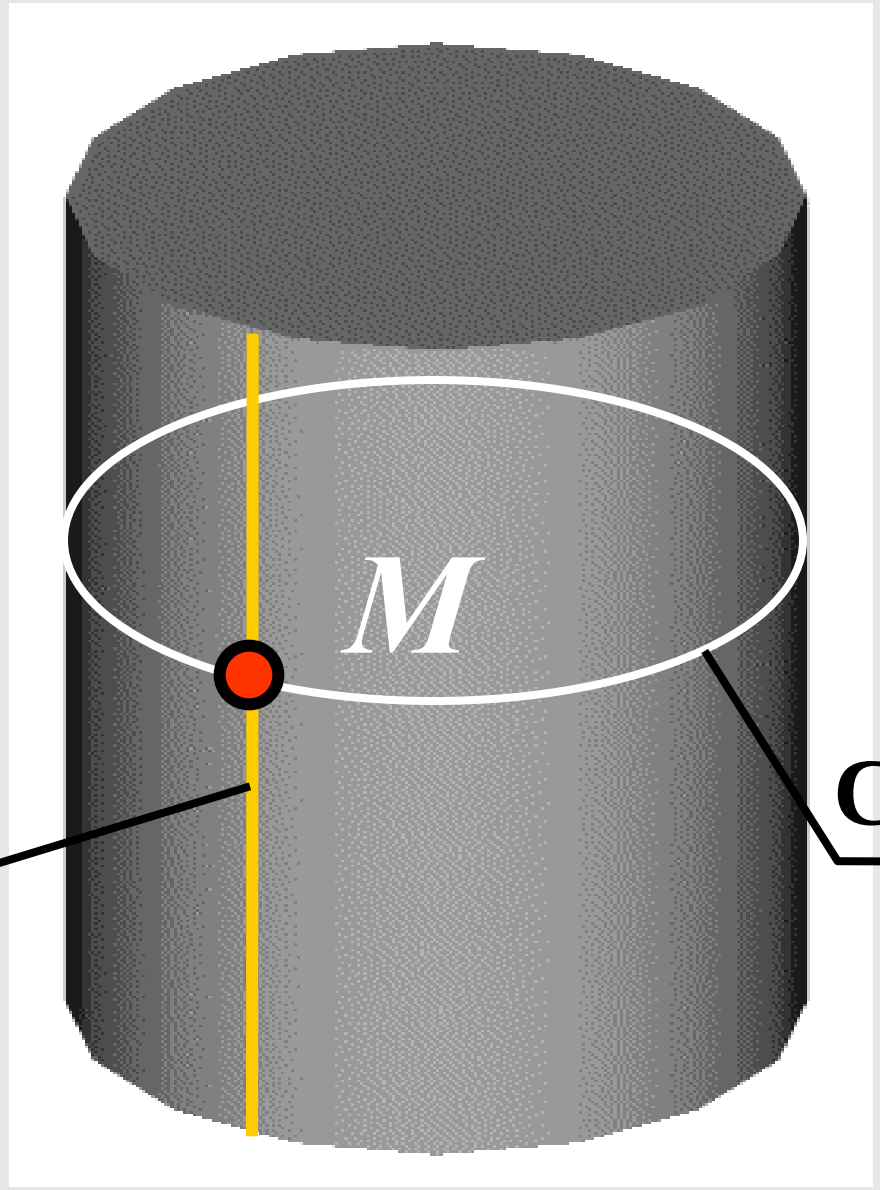
Cylinder of rotation





A Point on the Cylinder of rotation

It is necessary to construct a straight line or a circle which belongs to the cylinder and passes through the set point.

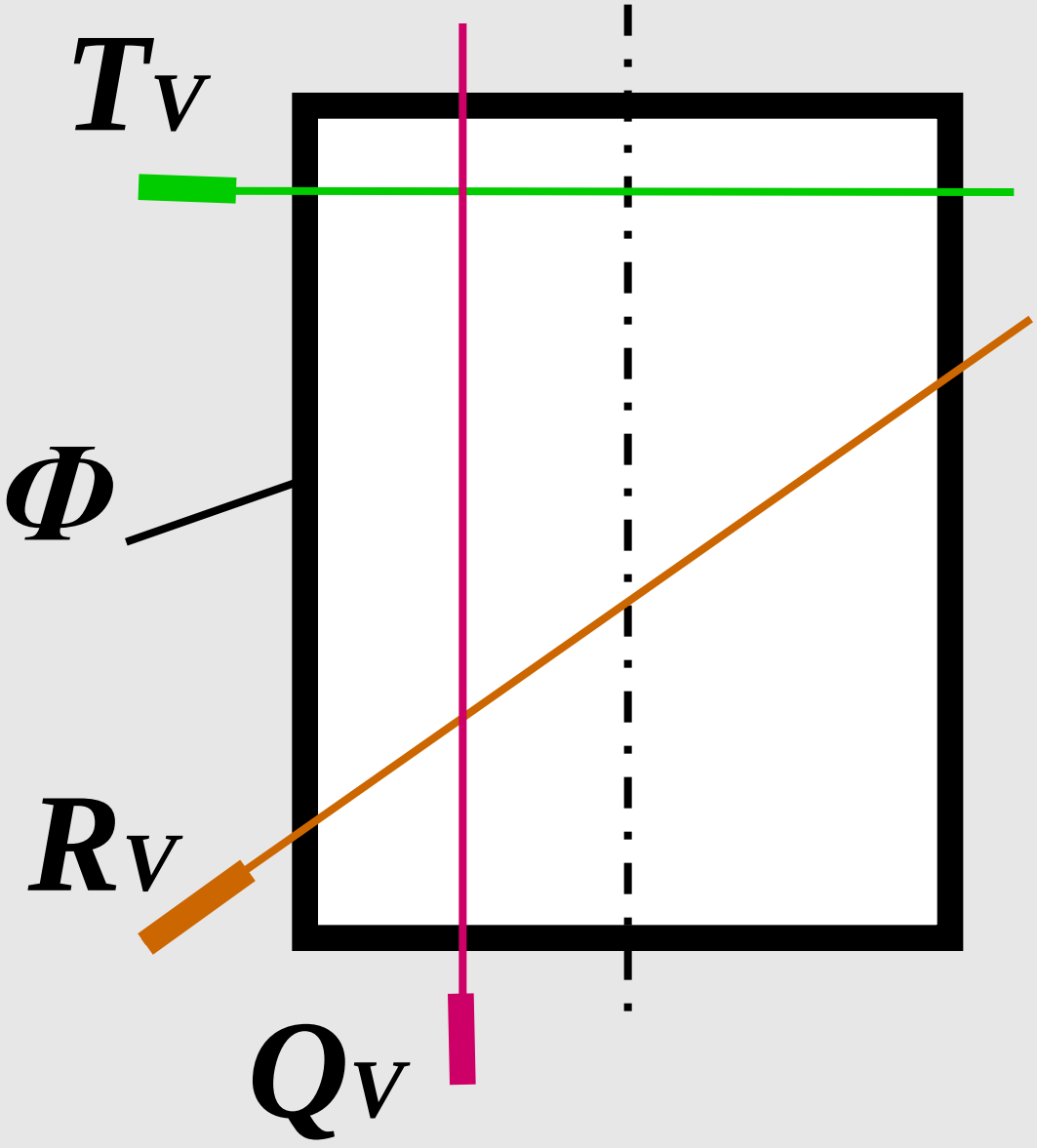

M
generating
CIRCLE

Cylinder of rotation Cut by a Plane

At crossing the cylinder Planes it is possible to receive on a surface

3 types of lines:

- Two straight lines
- Circle
- Ellipse



$Q(Q_V) \cap \Phi =$

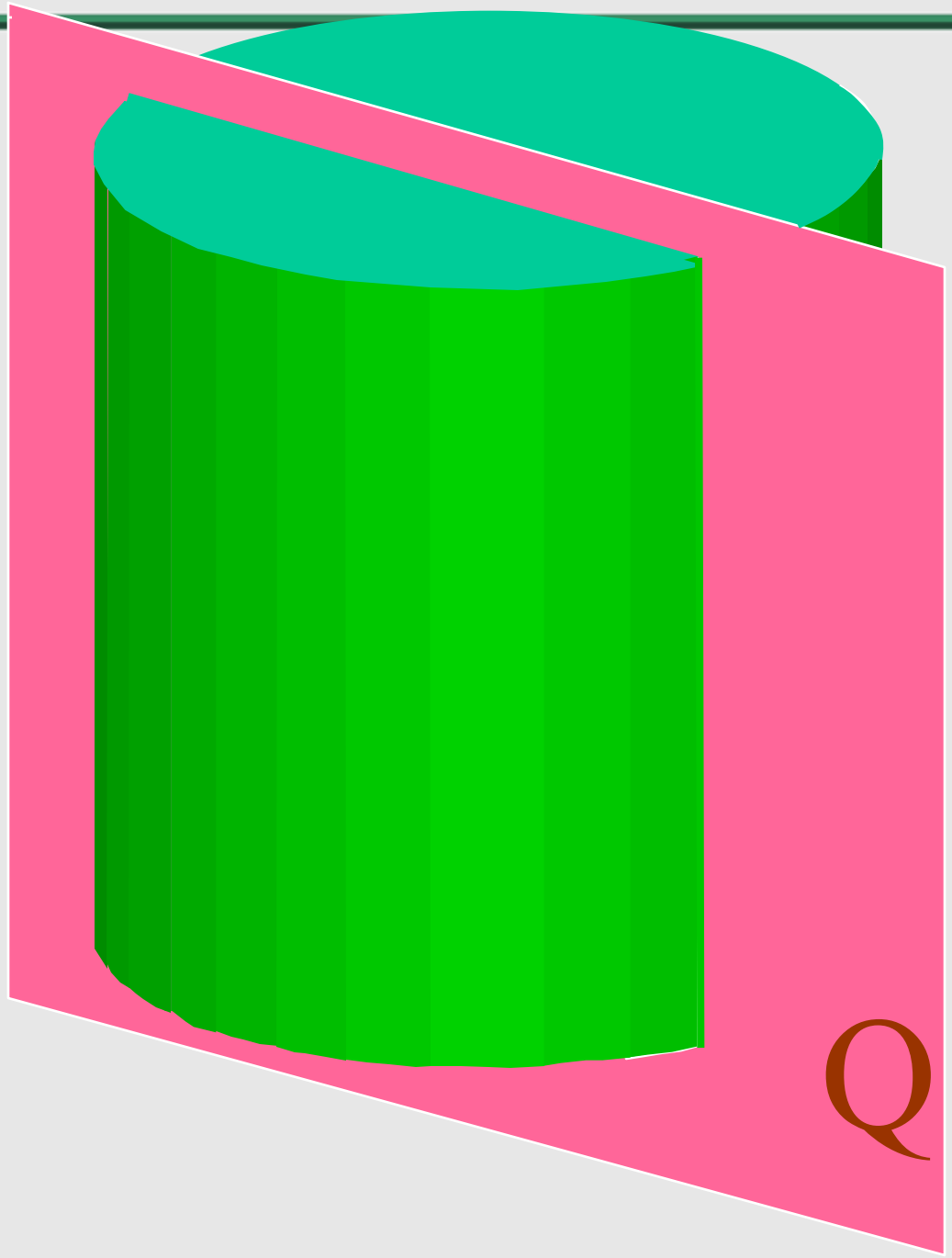
Two straight lines

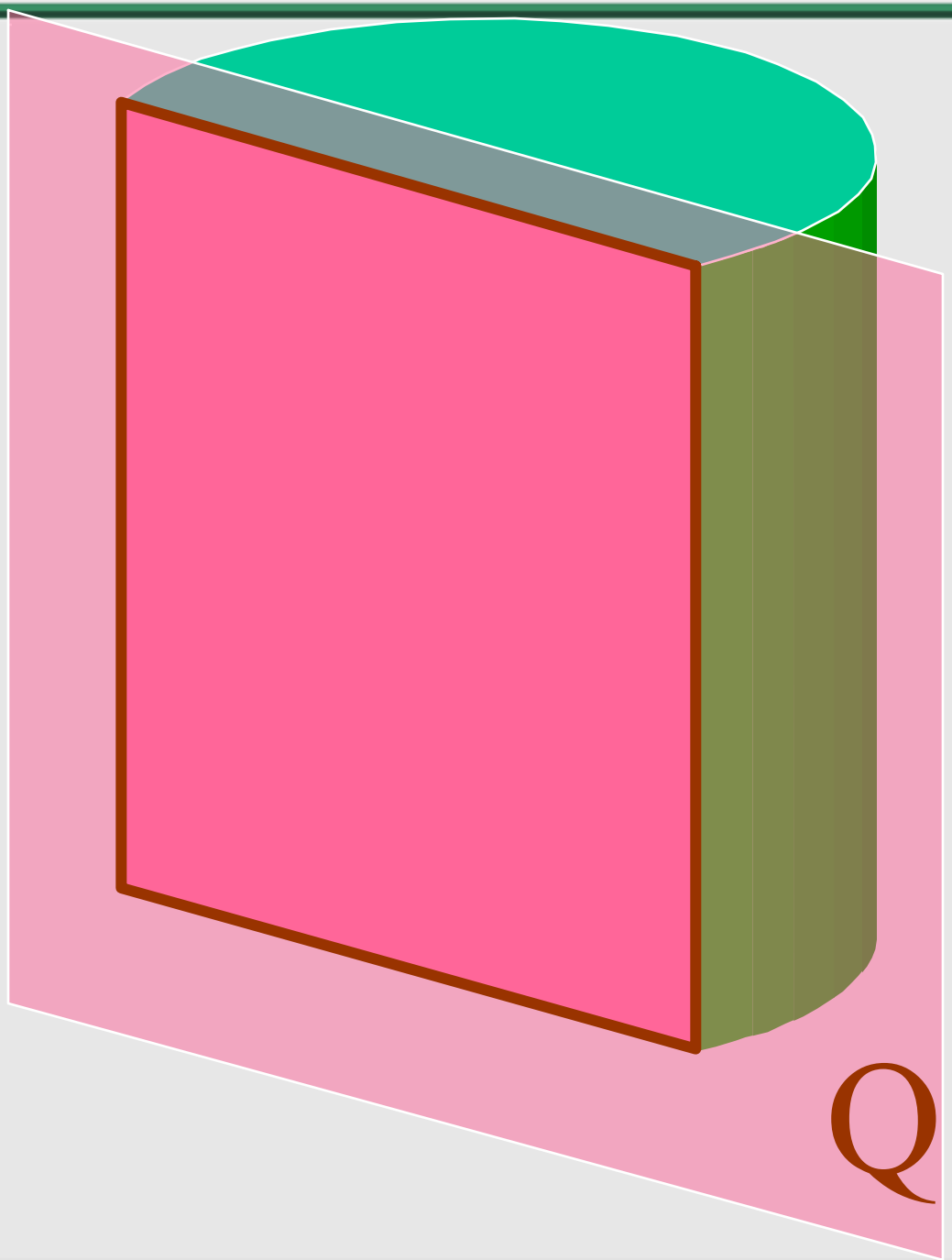
$T(T_V) \cap \Phi =$

Circle

$R(R_V) \cap \Phi =$

Ellipse

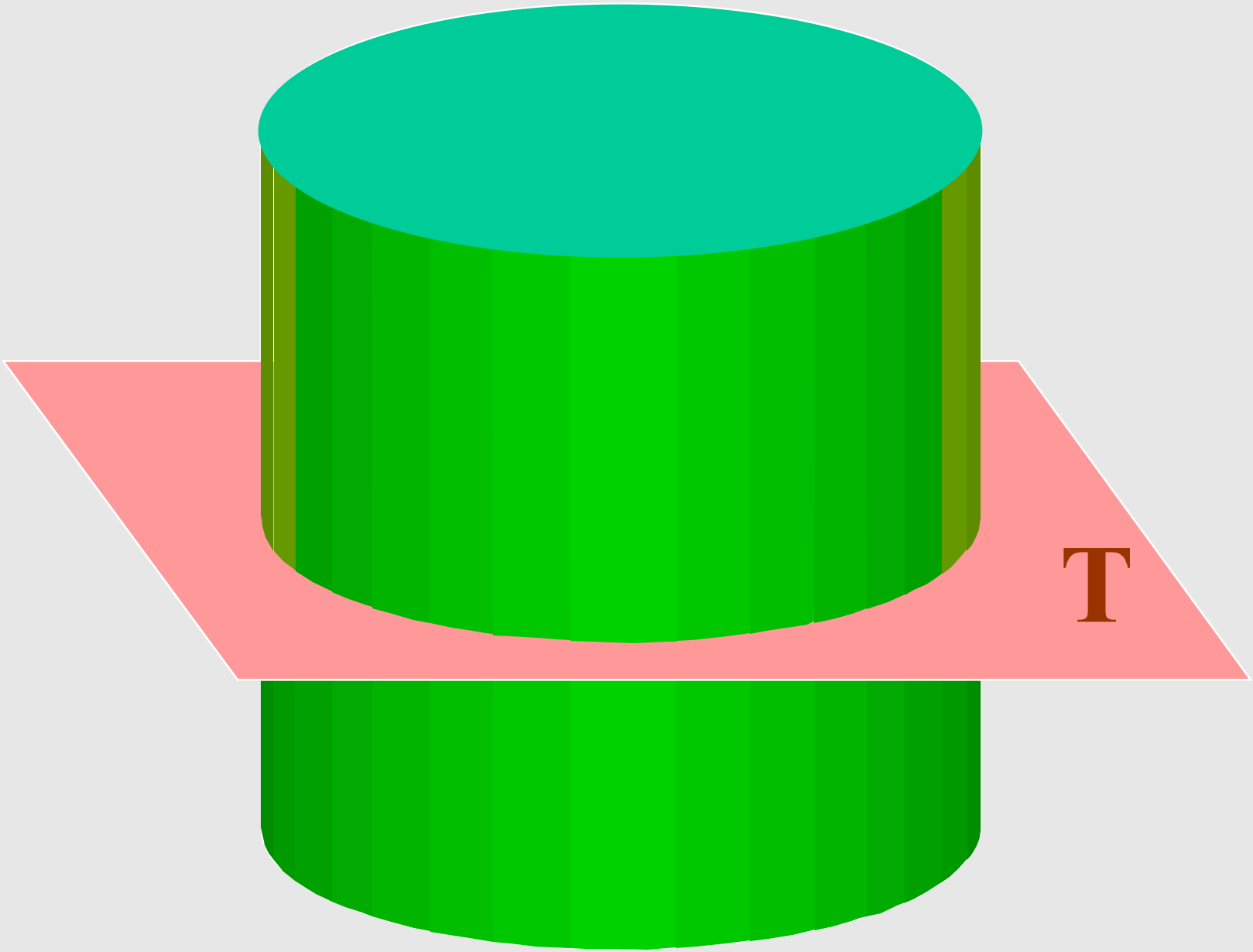

Q



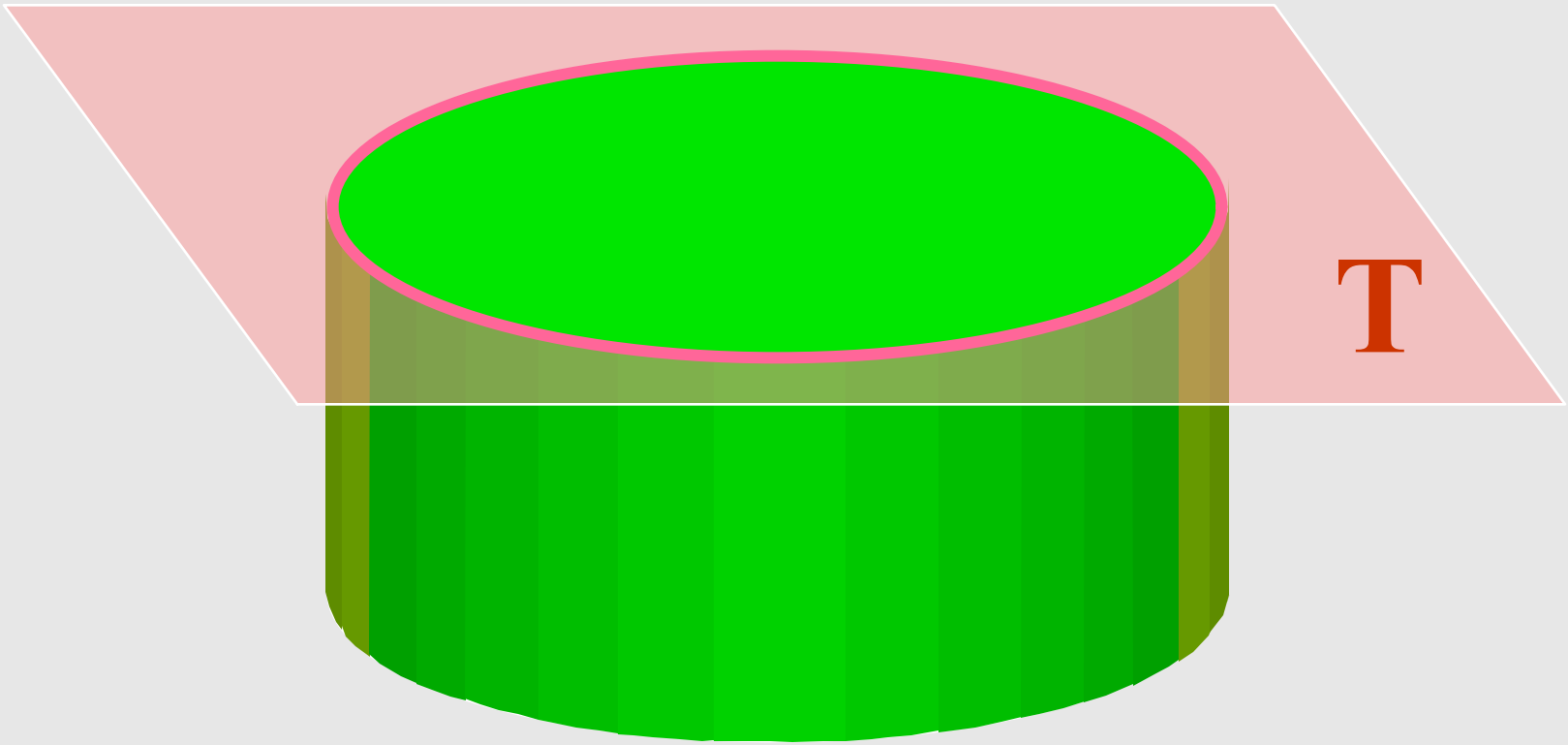
$Q(Q_V) \cap \Phi =$

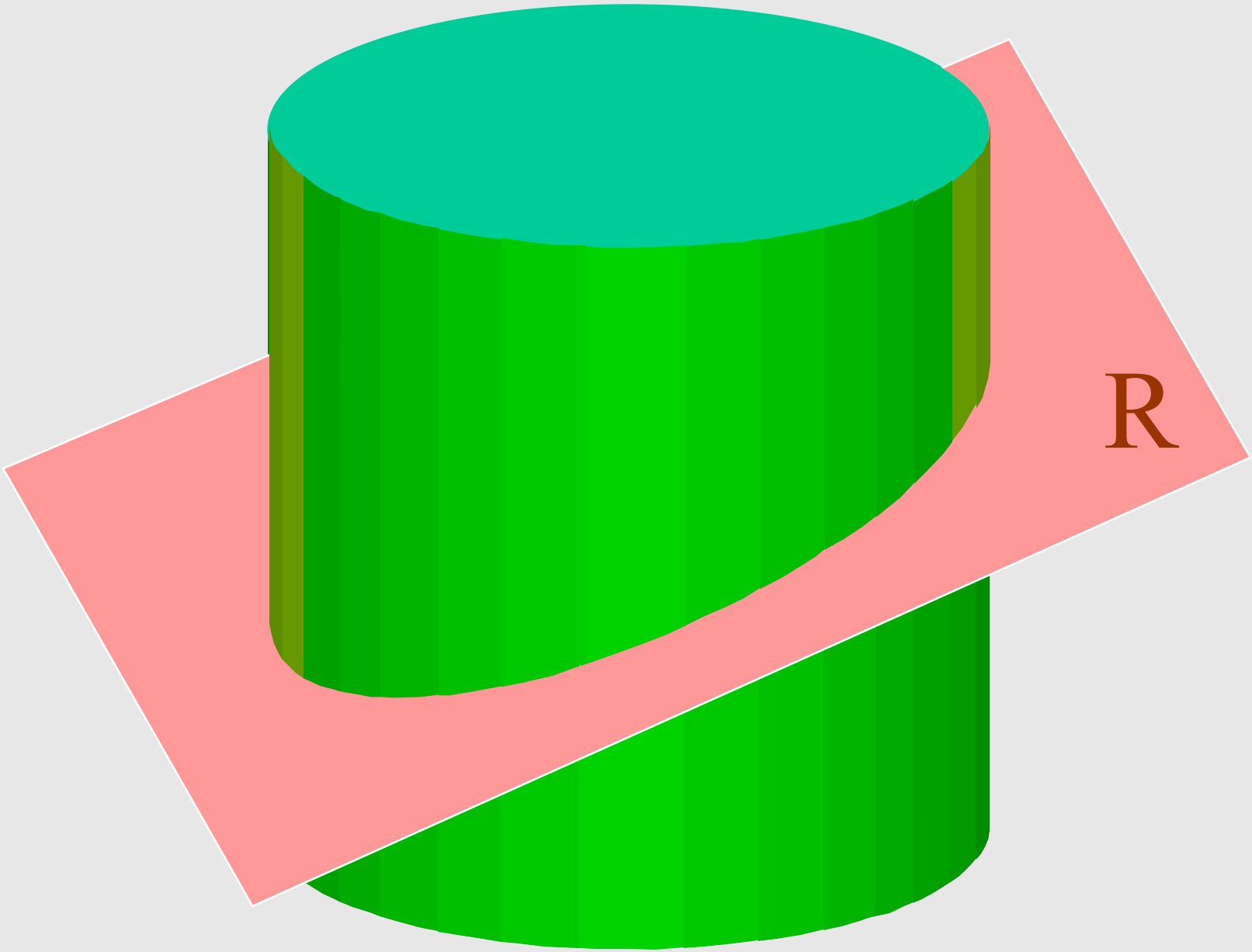
Two straight lines

Section - a rectangular

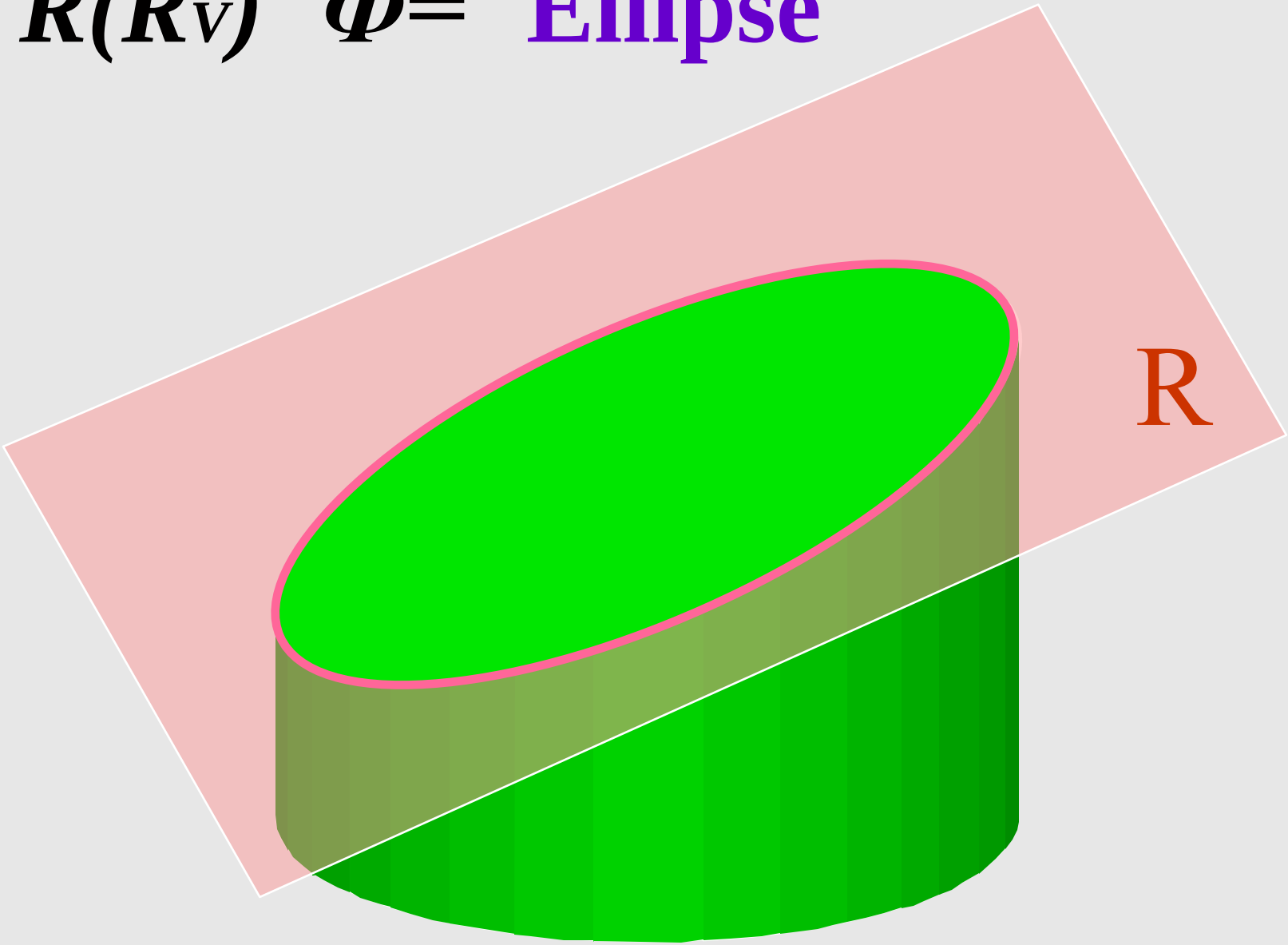

T

$$T(Tv) \cap \Phi = \text{Circle}$$




R

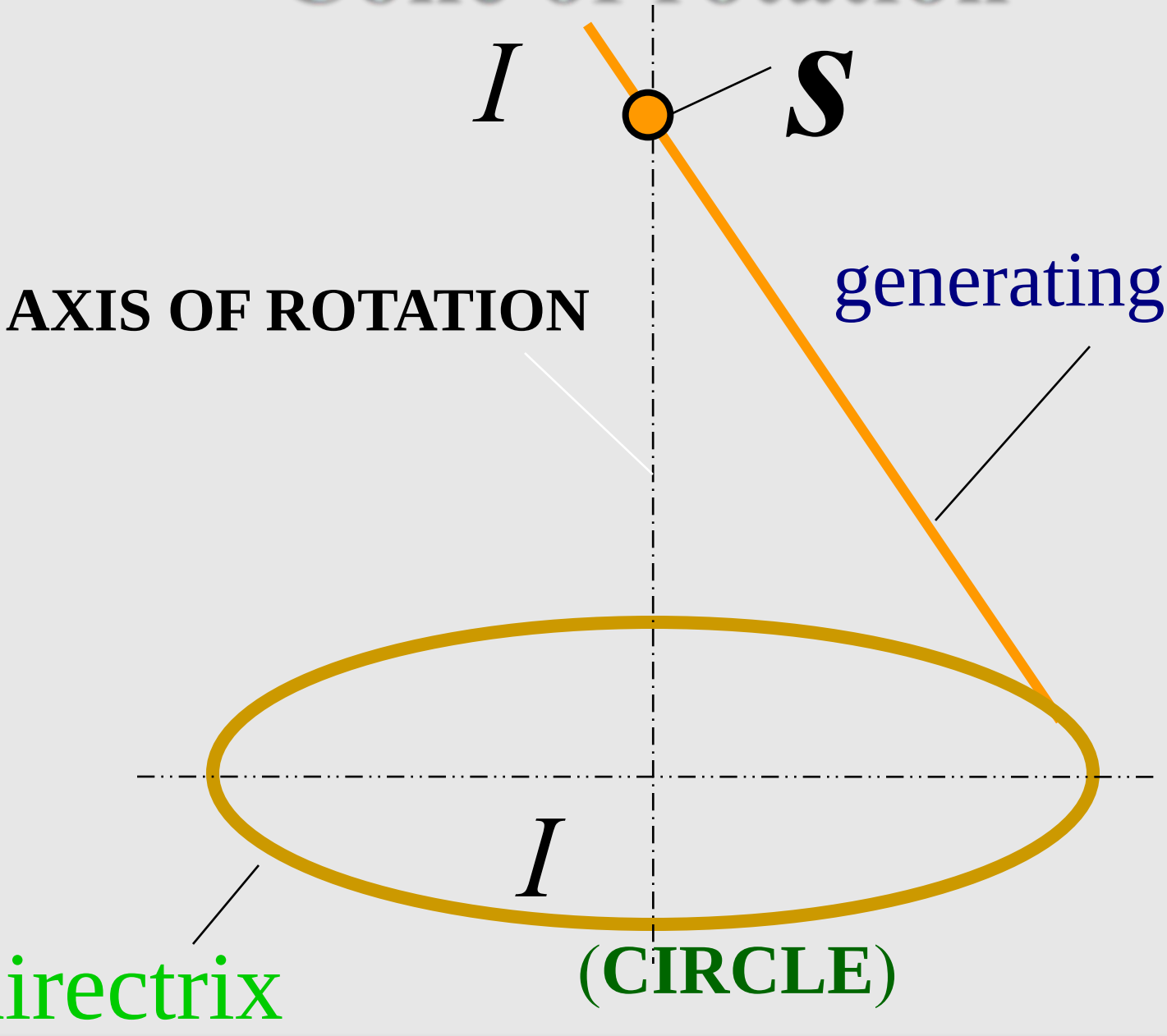
$R(R_V)$ Φ= Ellipse

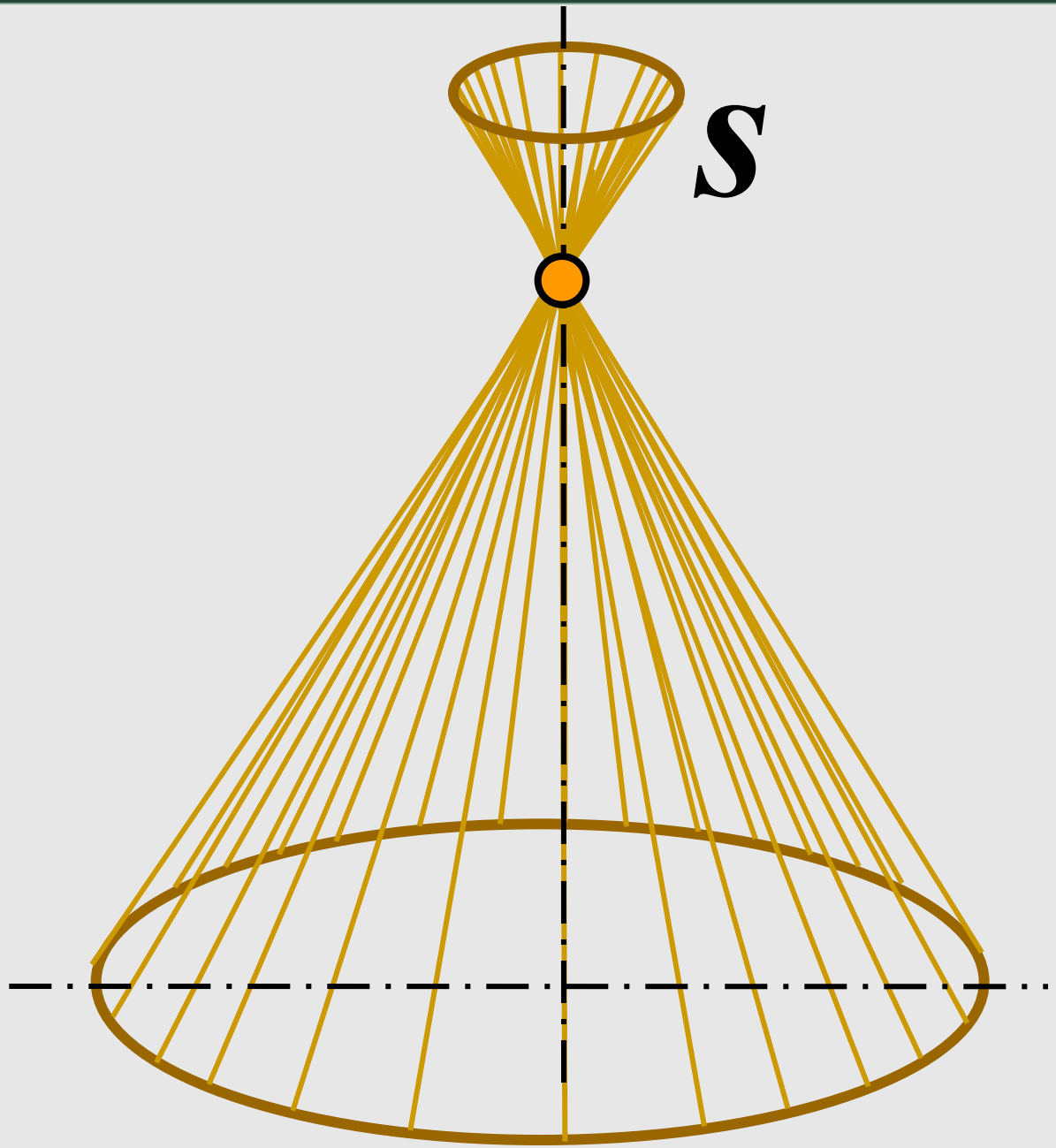


Rotation Surfaces

***Cone* of rotation** - this is a surface produced by rotation of the line *L* round the axis *I* intersecting it

Cone of rotation

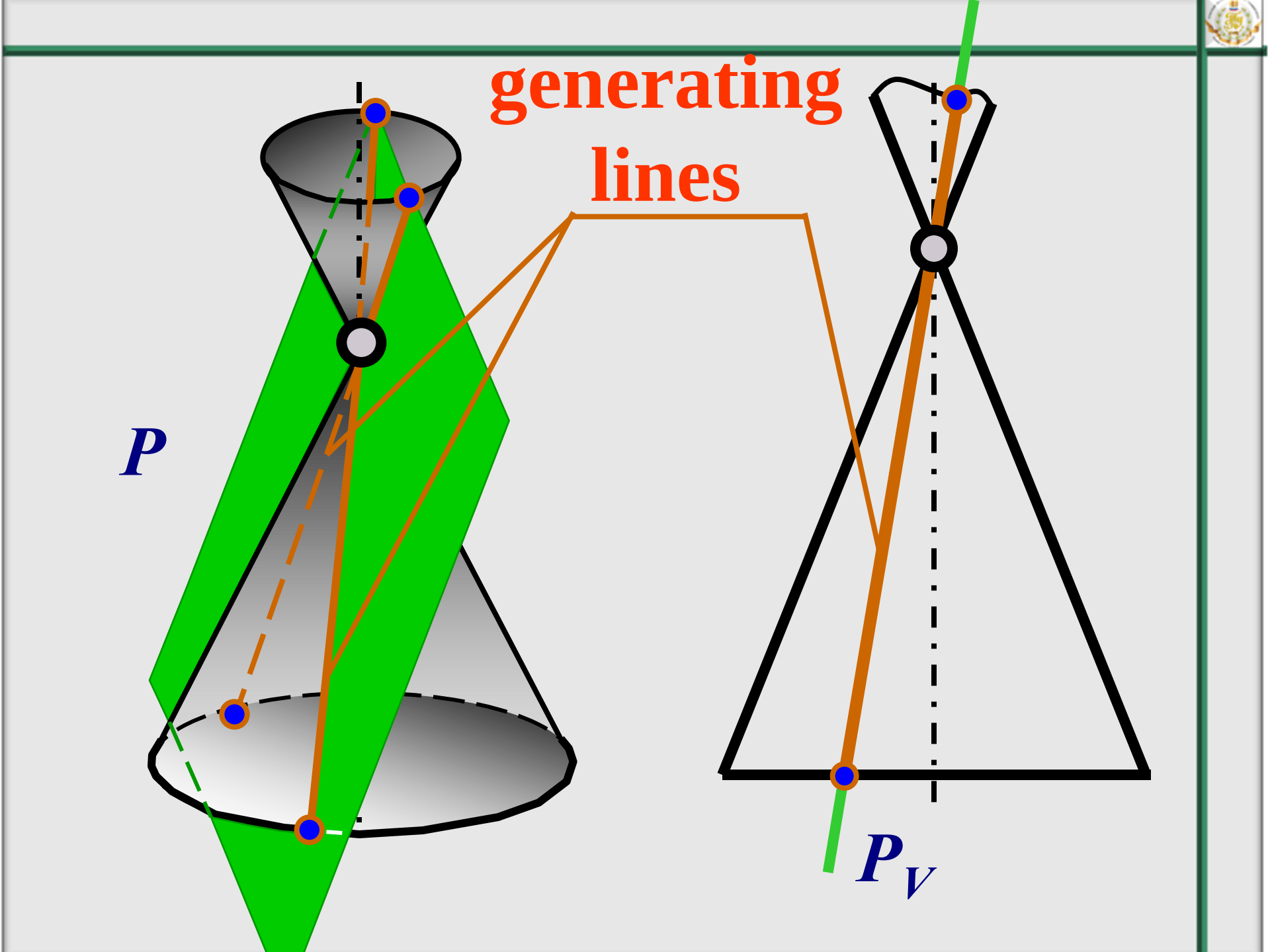


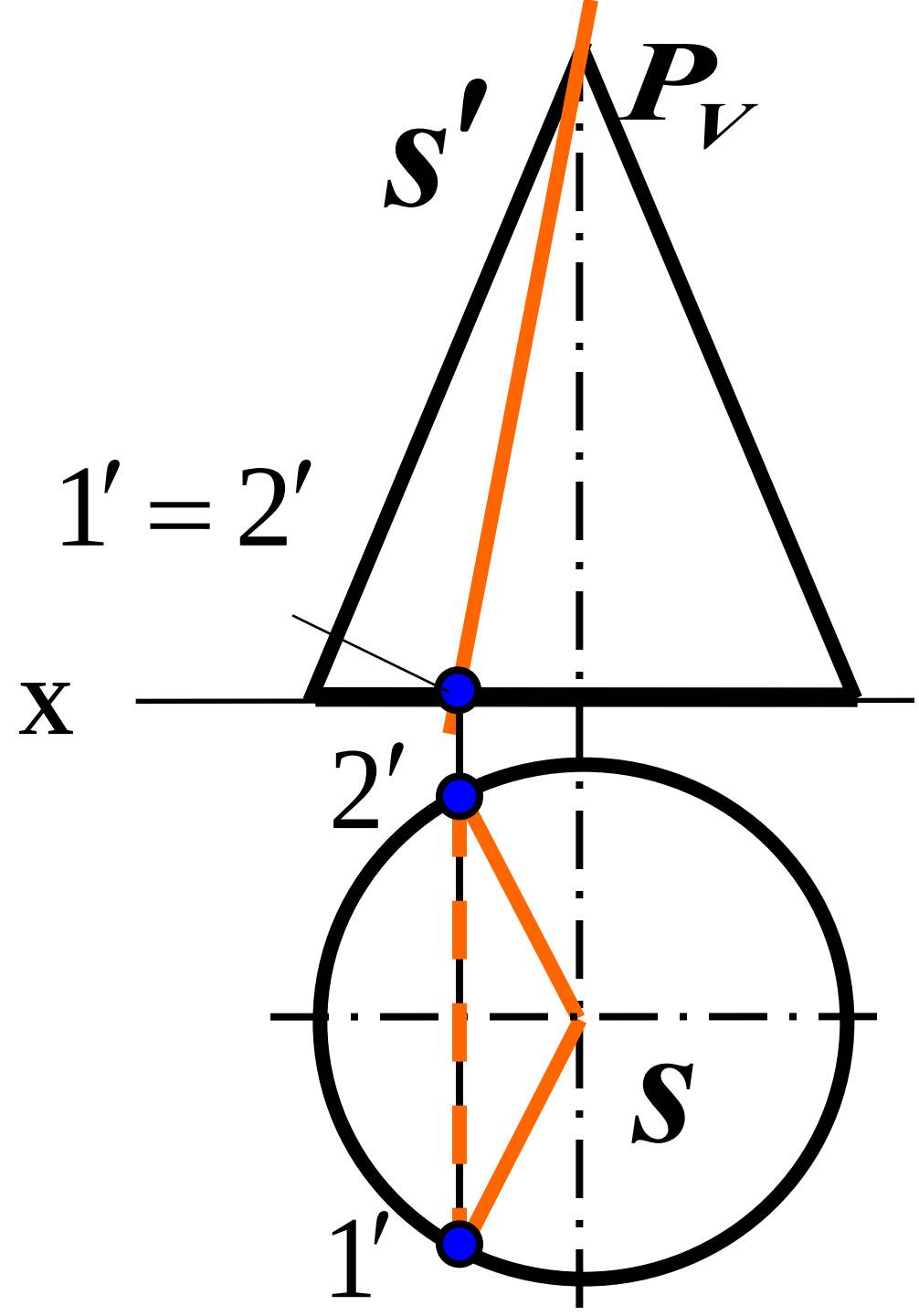

S

Cone of rotation Cut by a Plane

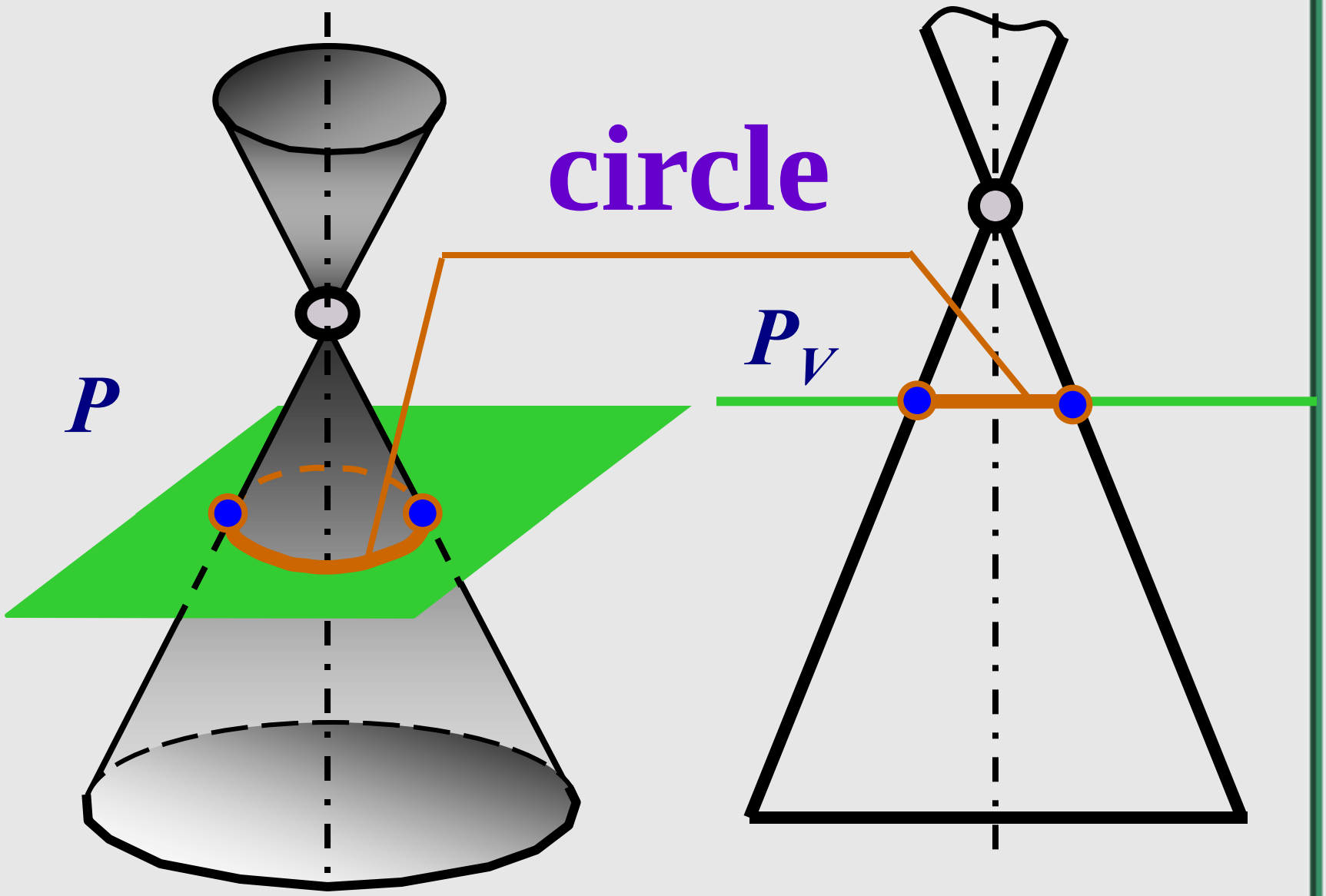
Depending on the direction of a cutting plane, different lines, called the lines of conical sections, may be obtained in the section of a rotation cone.

If a cutting plane passes through a vertex of a cone, we get in its section a pair of generating lines (triangle)


generating
lines
P
P_V

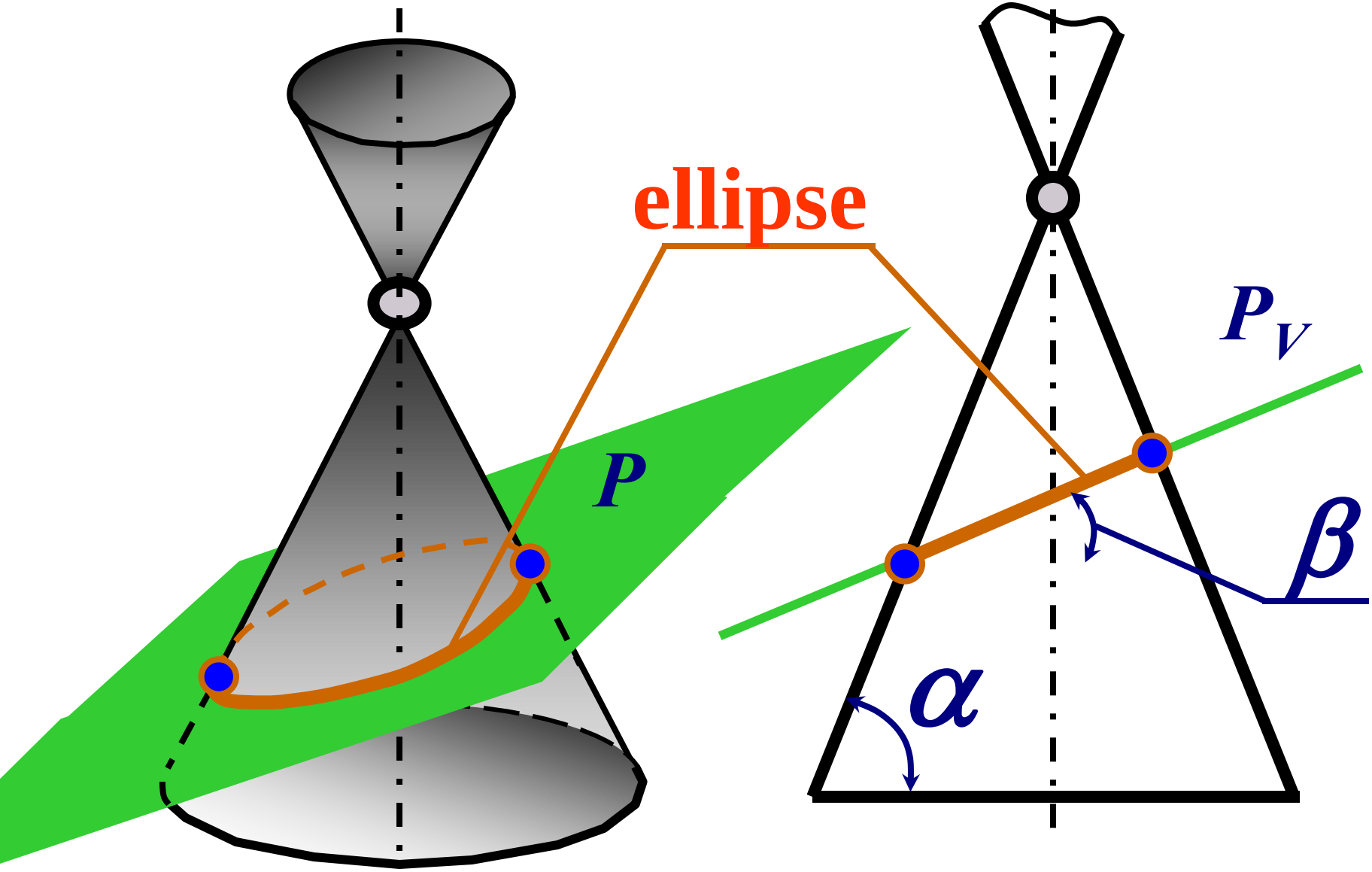

P_V
s'
$1' = 2'$
x
$2'$
s
$1'$

As a result of intersection of a cone with a plane perpendicular to the cone axis, a circle is obtained


circle
P
P_V

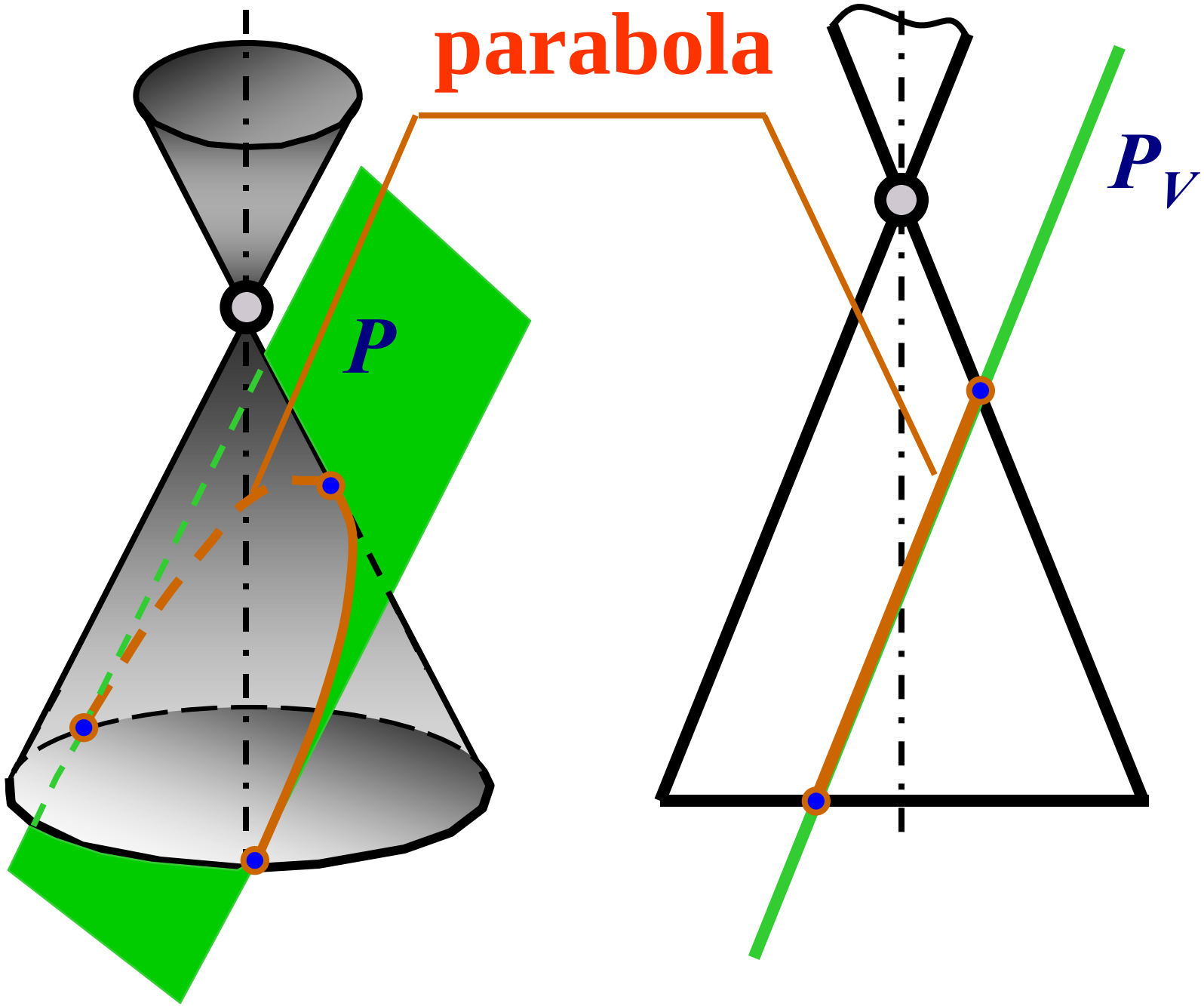
If a cutting plane is inclined to the rotation axis of a cone and does not pass through its vertex, an ellipse

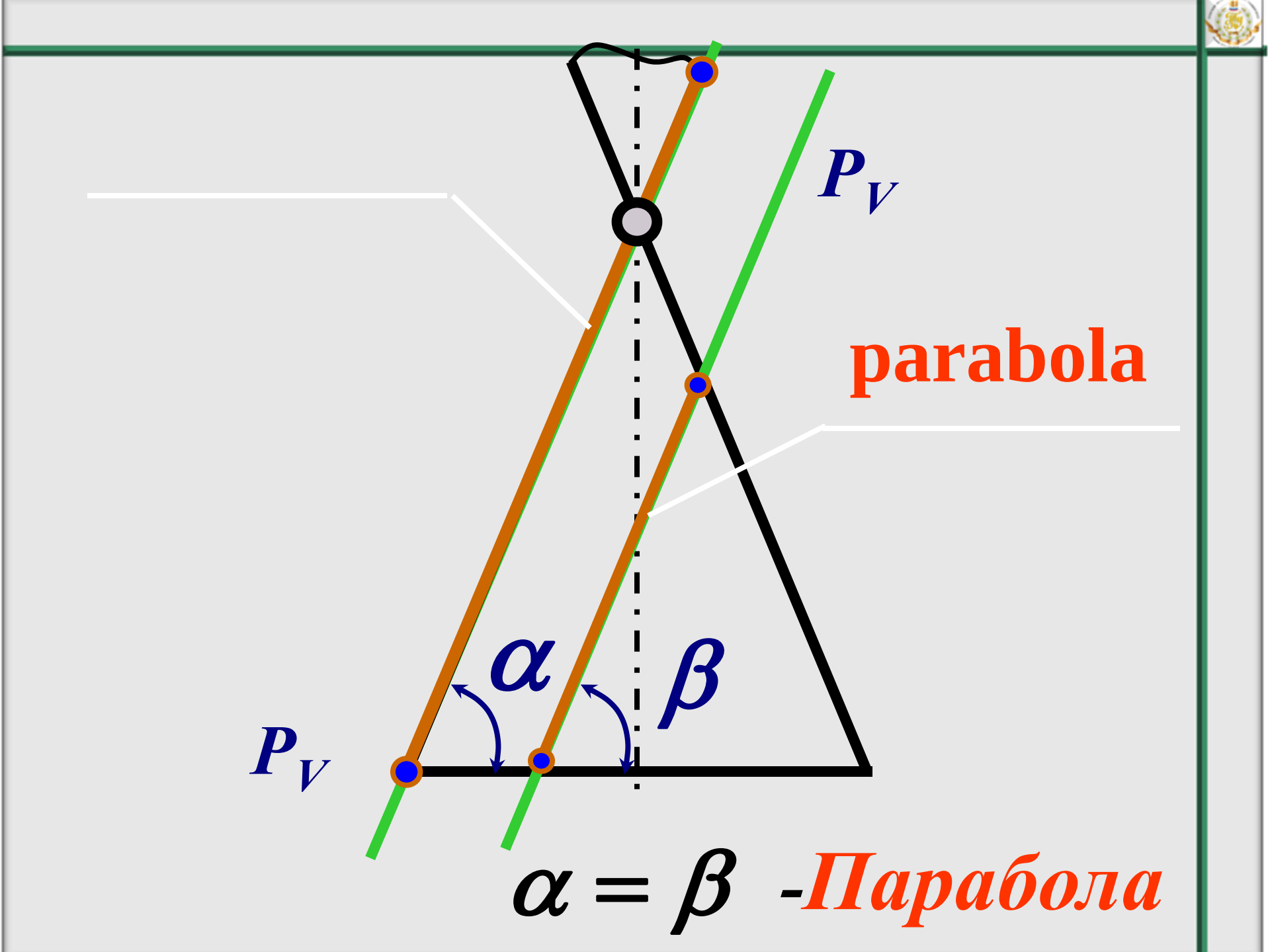
An ellipse is obtained when the inclination angle β is less than the inclination angle α *of the cone generatrix to its base* ($\beta < \alpha$), that is when a plane cuts all generating lines of a given cone



$\alpha > \beta > 0$ - **ellipse**

In case the angles α and β are equal, i.e. a cutting plane is parallel to one of the generatrices of the cone, a **parabola** is obtained in the section.

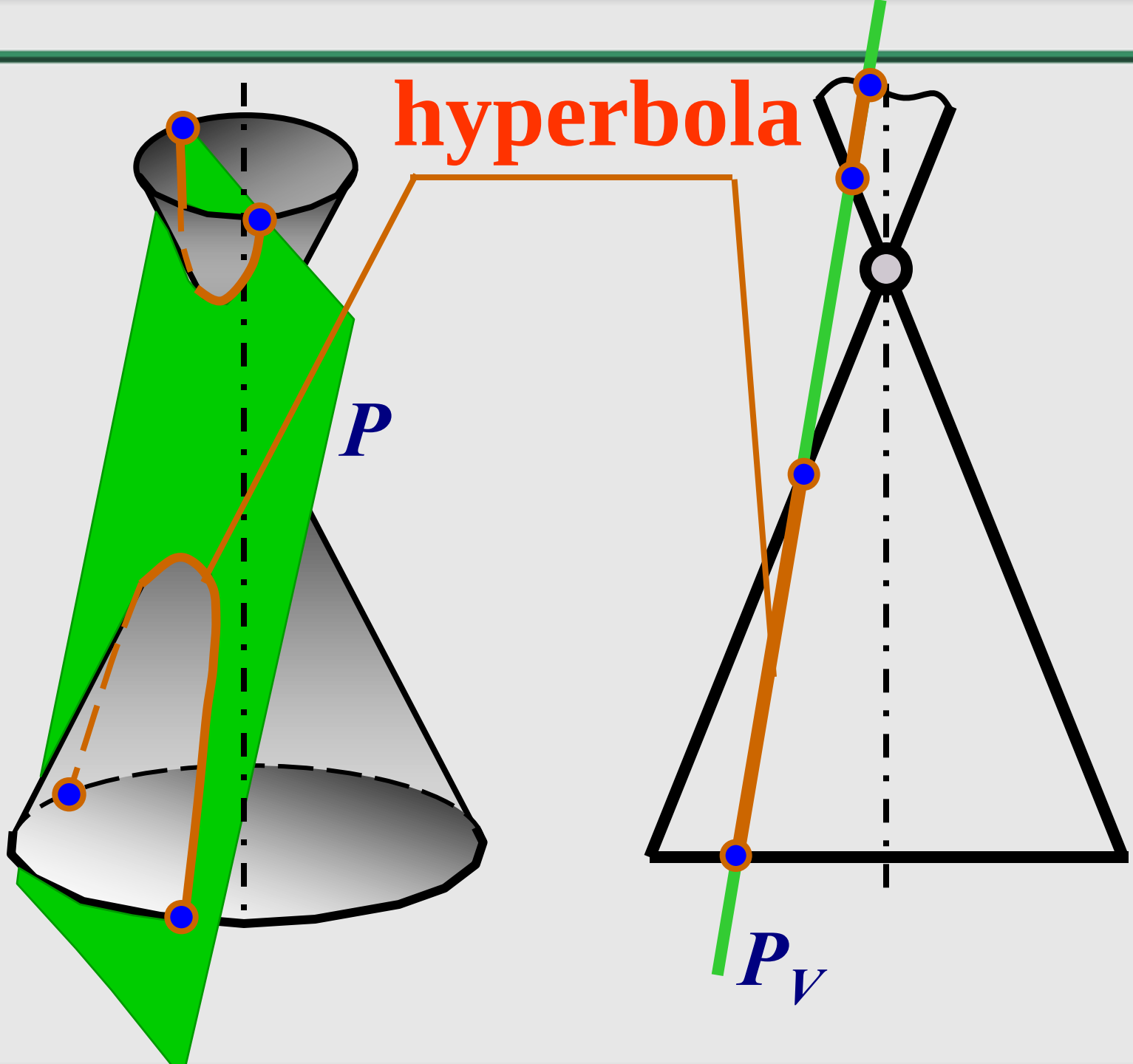

parabola
P
P_V



$\alpha = \beta$ -*Парабола*

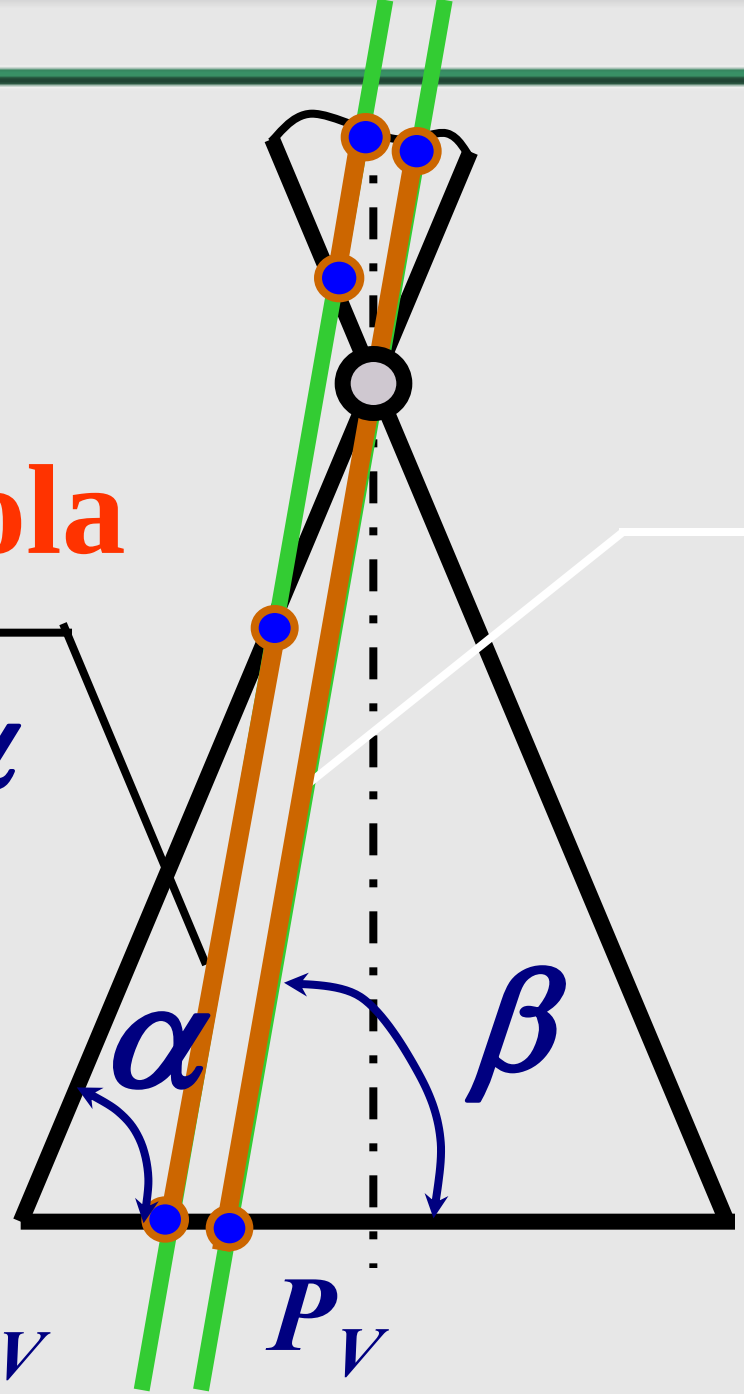
If a cutting plane is inclined at an angle which changes in the following limits - $90° \geqslant \beta > \alpha$, a **hyperbola** is obtained in the section.

The cutting plane here is parallel to **two generating lines** of the cone.


hyperbola
P
P_V

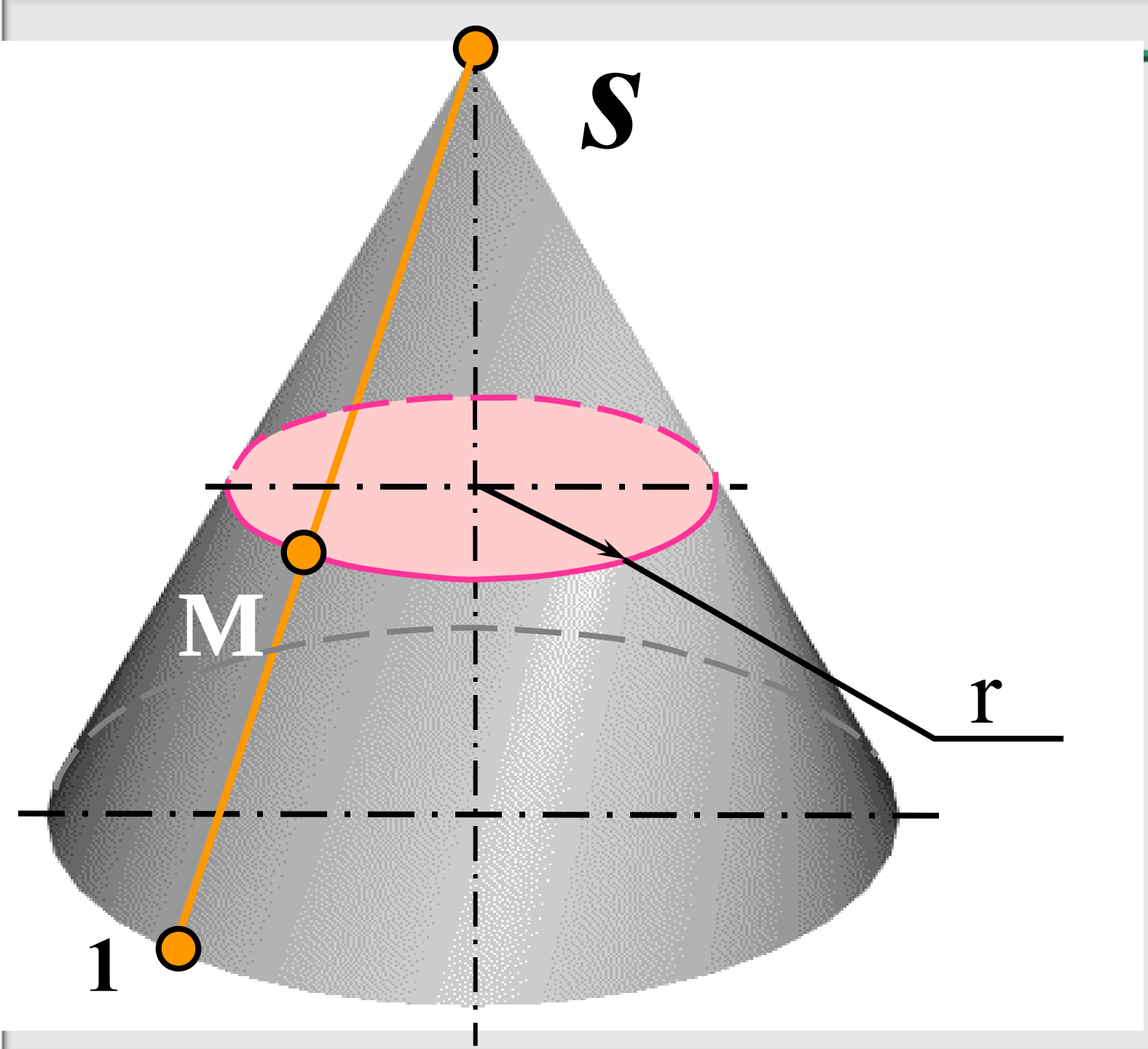
hyperbola

$90^0 \geqslant \beta > \alpha$



A Point on the *Cone* of rotation .

If the point belongs to a surface of a cone it is necessary to construct a circle or forming which belong to a cone

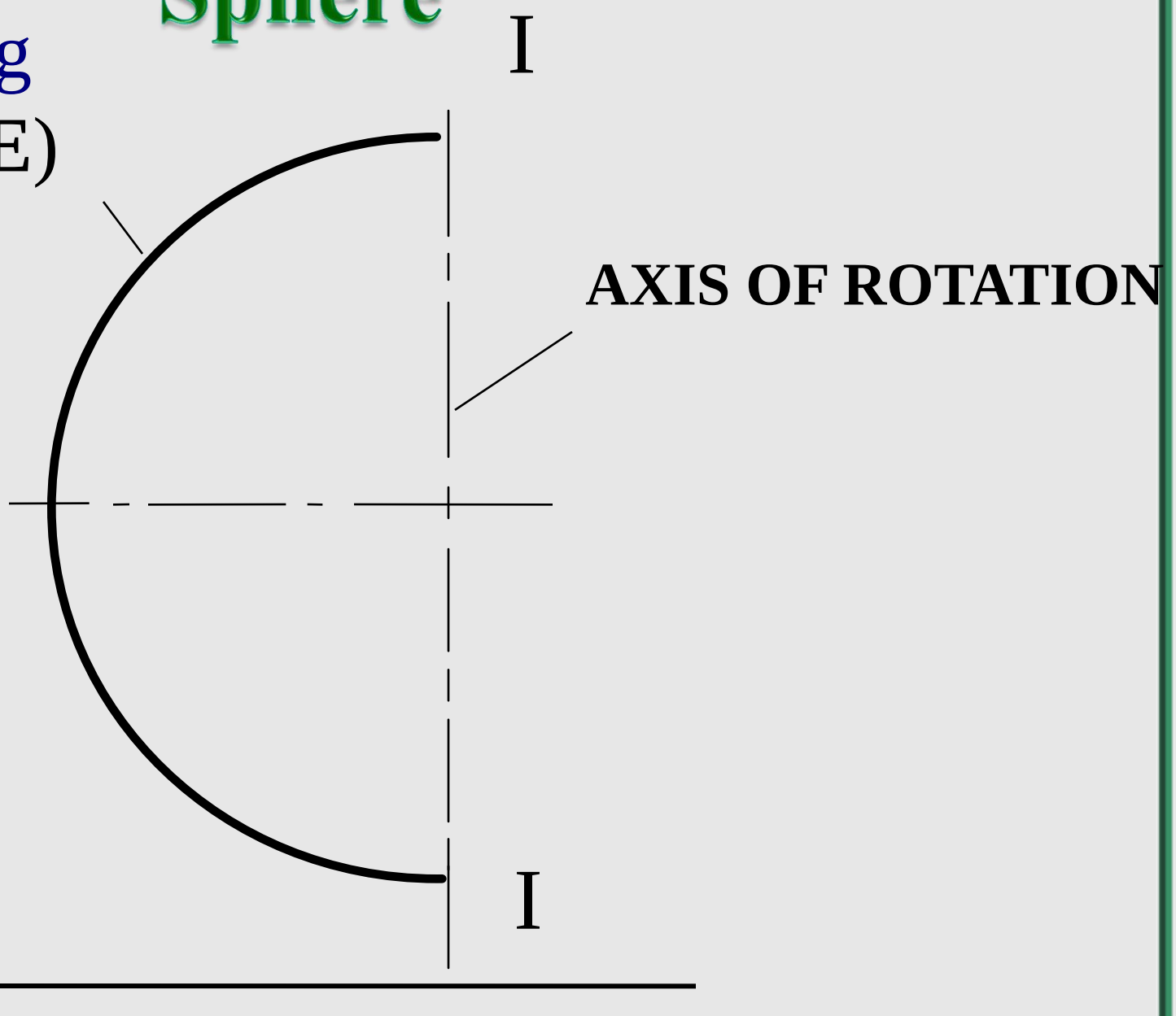

S
M
r
1

Rotation Surfaces

Sphere - this is a surface produced by rotation of a circle round its diameter

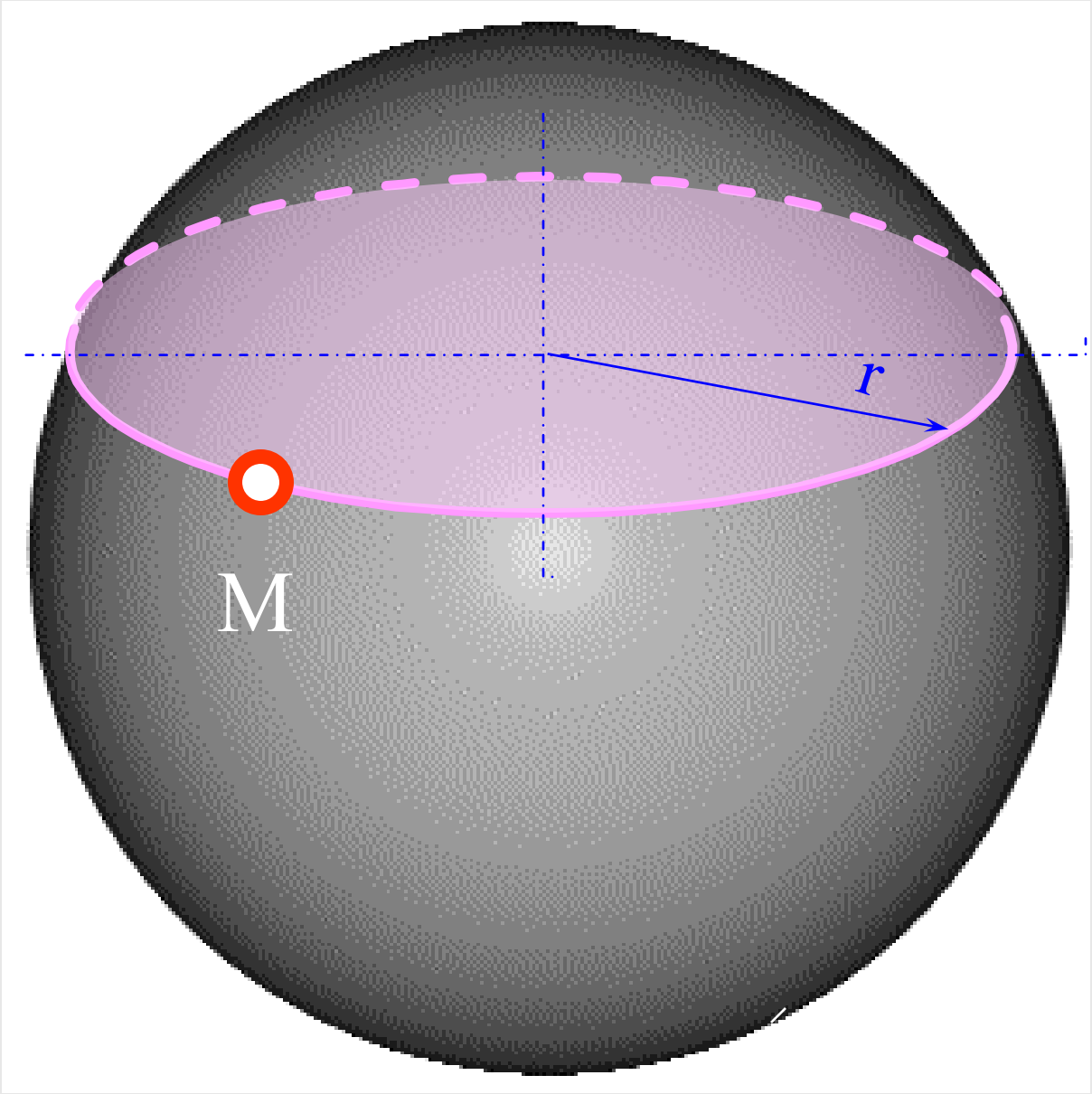
Sphere

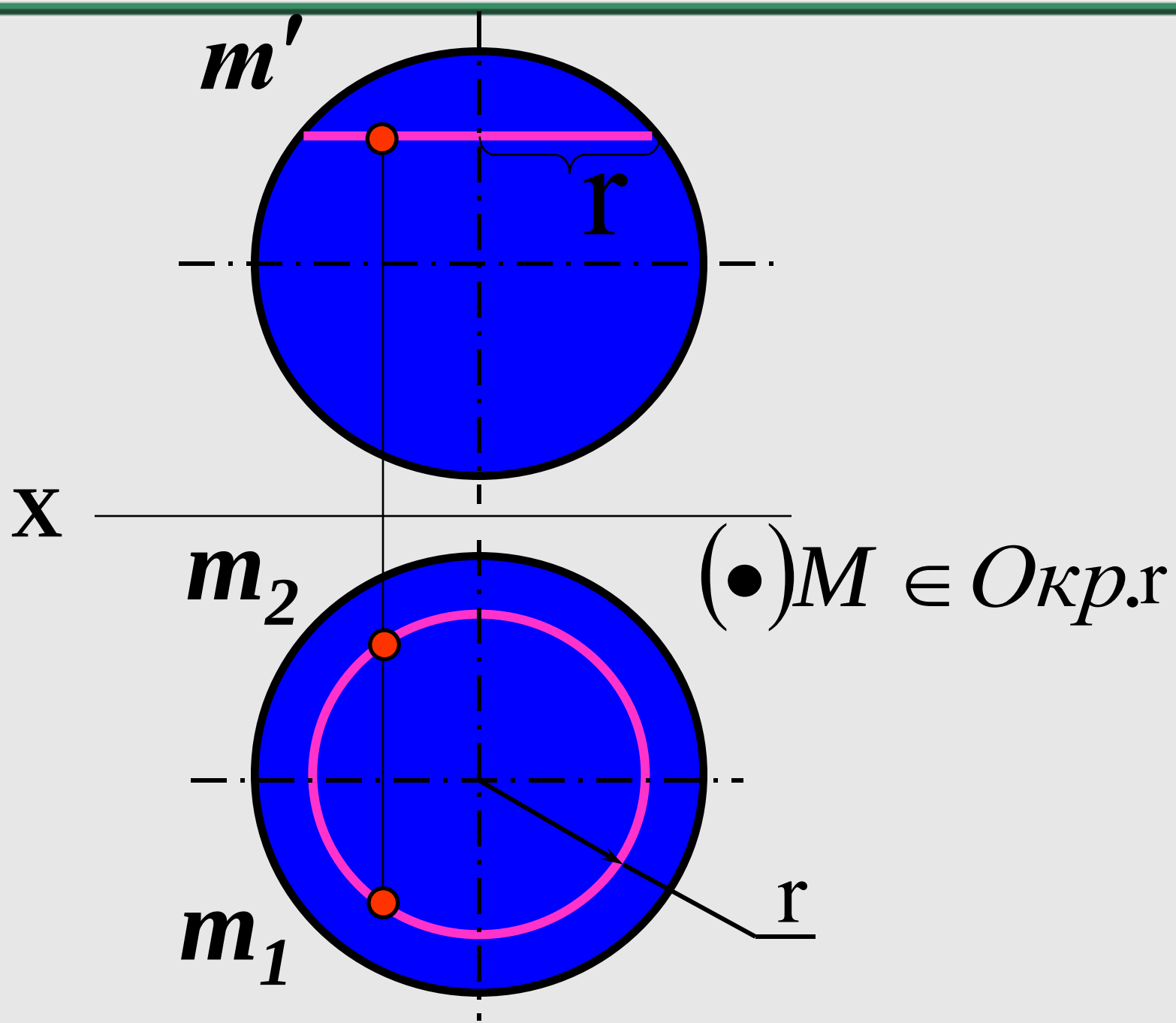
generating
(CIRCLE)



A Point on the Sphere.

If the point belongs to a Sphere then it is necessary to construct a circle which belong to a Sphere


r
M

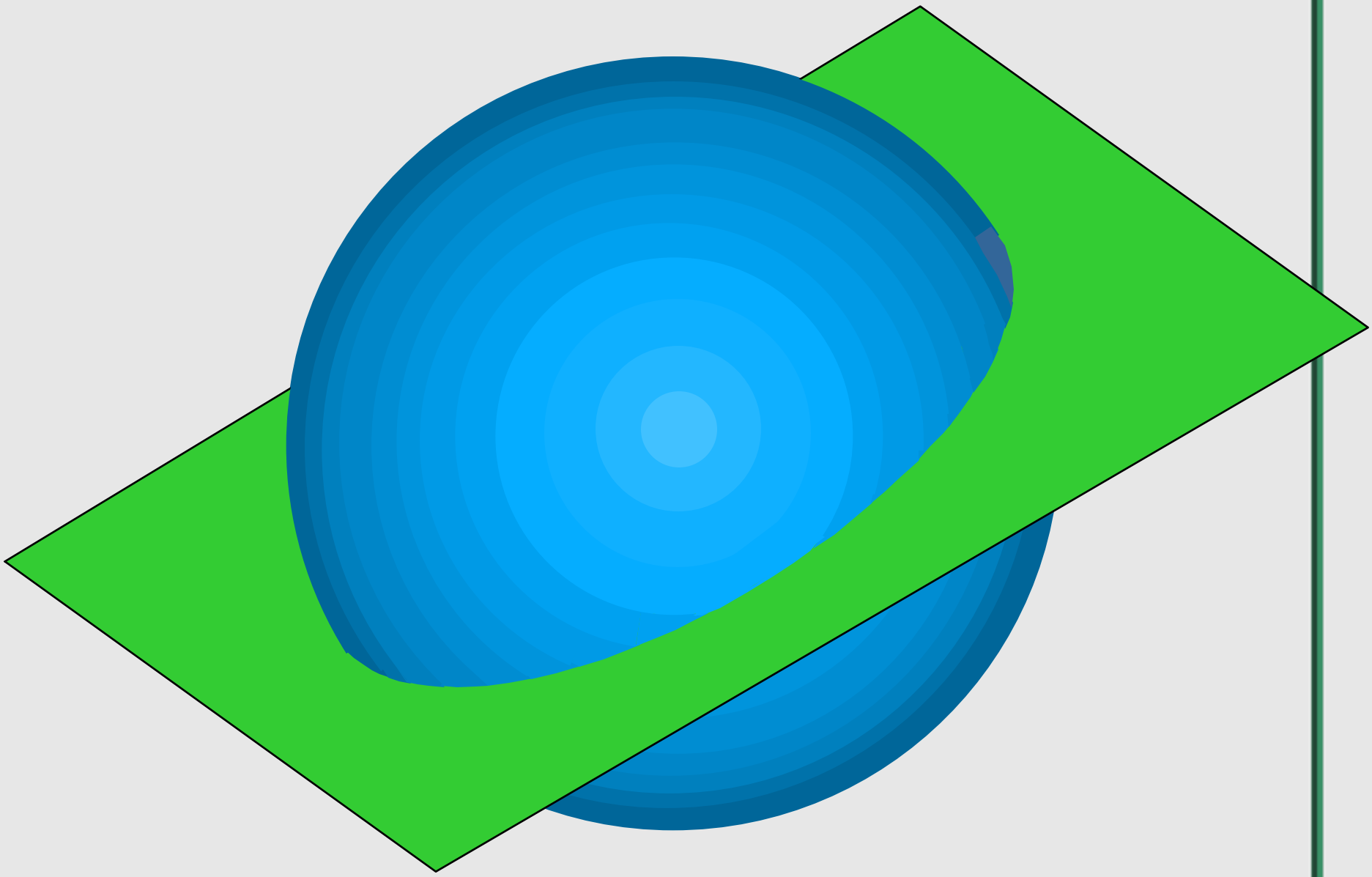
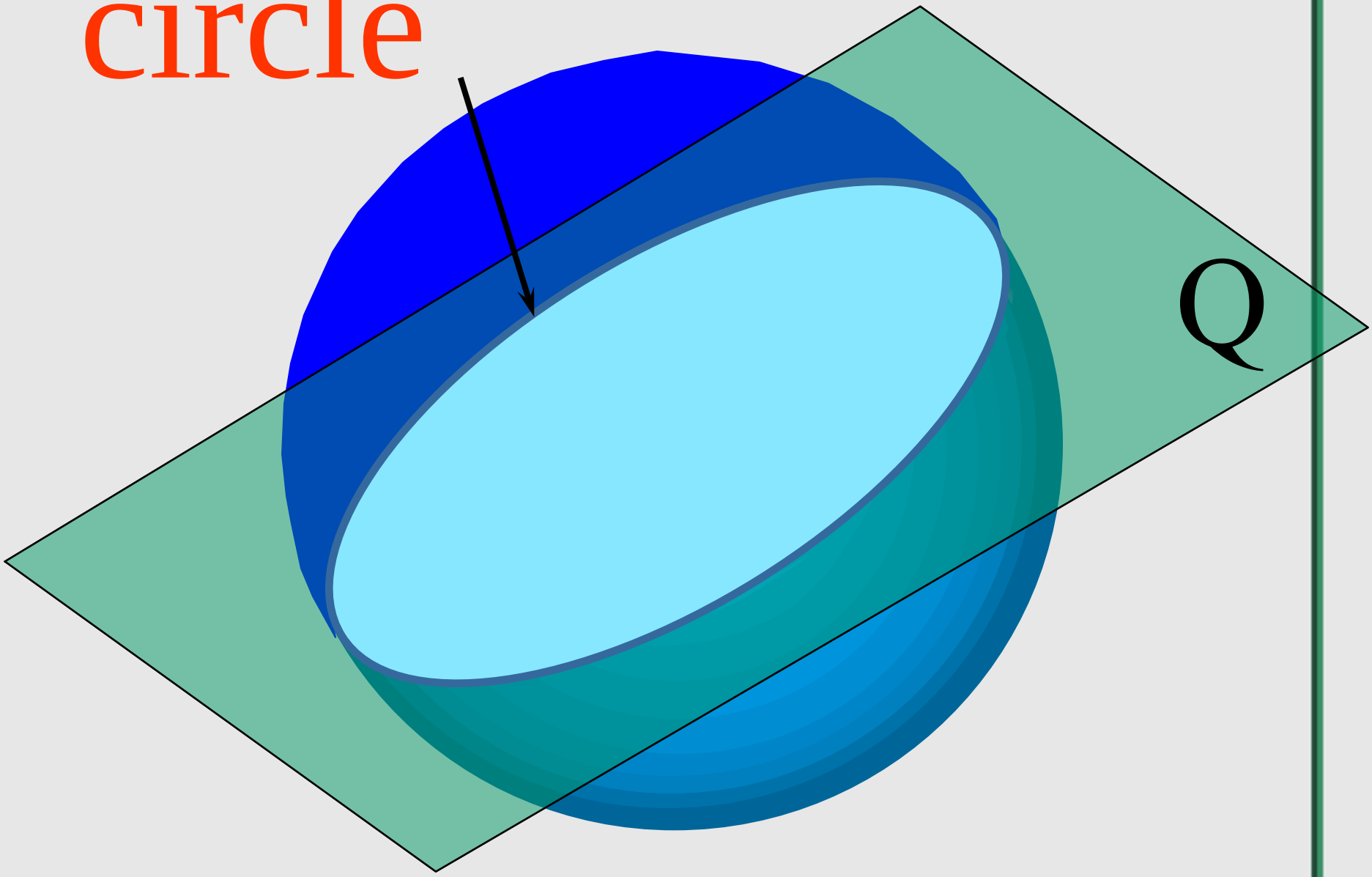

m'
r
X
m2
(•)M ∈ Окр.r
r
m1

Sphere Cut by a Plane

A plane intersects a sphere always in a circle.

This circle may be projected as:

- ***a straight line*** if the cutting plane is perpendicular to the projection plane
- ***a circle*** of radius equal in length to distance from the axis of the sphere rotation to the outline if the cutting plane is parallel to the projection plane
- ***an ellipse*** if the cutting plane is not parallel to the projection plane



circle