

1. Einführung

- 1.1. Was ist Physik?
- 1.2. Physikalische Größen und Einheiten
- 1.3. Messungen, Datenauswertung, Fehler

2. Klassische Mechanik

- 2.1. Kinematik der Massenpunkte
- 2.2. Dynamik der Massenpunkte
- 2.3. Systeme von Massenpunkten
- 2.4. Rotation

3. Gravitation

- 3.1. Gravitationsgesetz
- 3.2. Feld und Potential

3.3. Planetenbahnen: Kepler

3.4. Massenverteilungen

3.5. Dunkle Materie

4. Relativistische Mechanik

4.1. Bezugssysteme und Transformationen

4.2. Spezielle Relativitätstheorie

4.3. Relativistische Kinematik

5. Feste Körper und Flüssigkeiten

5.1. Feste Körper

5.2. Hydrostatik und Hydrodynamik

6. Schwingungen und Wellen

6.1. Schwingungen

6.2. Wellen

Zusammenfassung von v05

Ort $\longleftrightarrow$ Geschwindigkeit $\longleftrightarrow$ Beschleunigung

$\rightarrow$ differenzieren
 $\leftarrow$ integrieren

Weg-Zeit-Gesetz $s(t) = \frac{1}{2}at^2 + v_0t + s_0$

Integrationskonstanten
a) nicht vergessen
b) phys. interpretieren

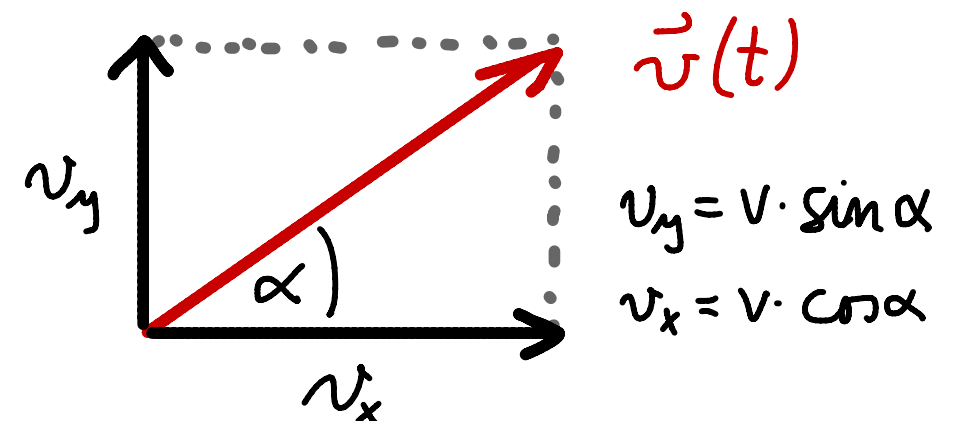
Relativität von Orts- und Geschwindigkeitsmessungen: hängen vom KS ab

Superpositionsprinzip!

Vektorcharakter der phys. Größen

Schräger Wurf

$$\vec{v}(t) = \begin{pmatrix} x(t) \\ y(t) \\ z(t) \end{pmatrix}$$



$\vec{v}(t)$, $\vec{a}(t)$ komp. waise
nach gegeb. Situation; Vorzeichen konsistent!

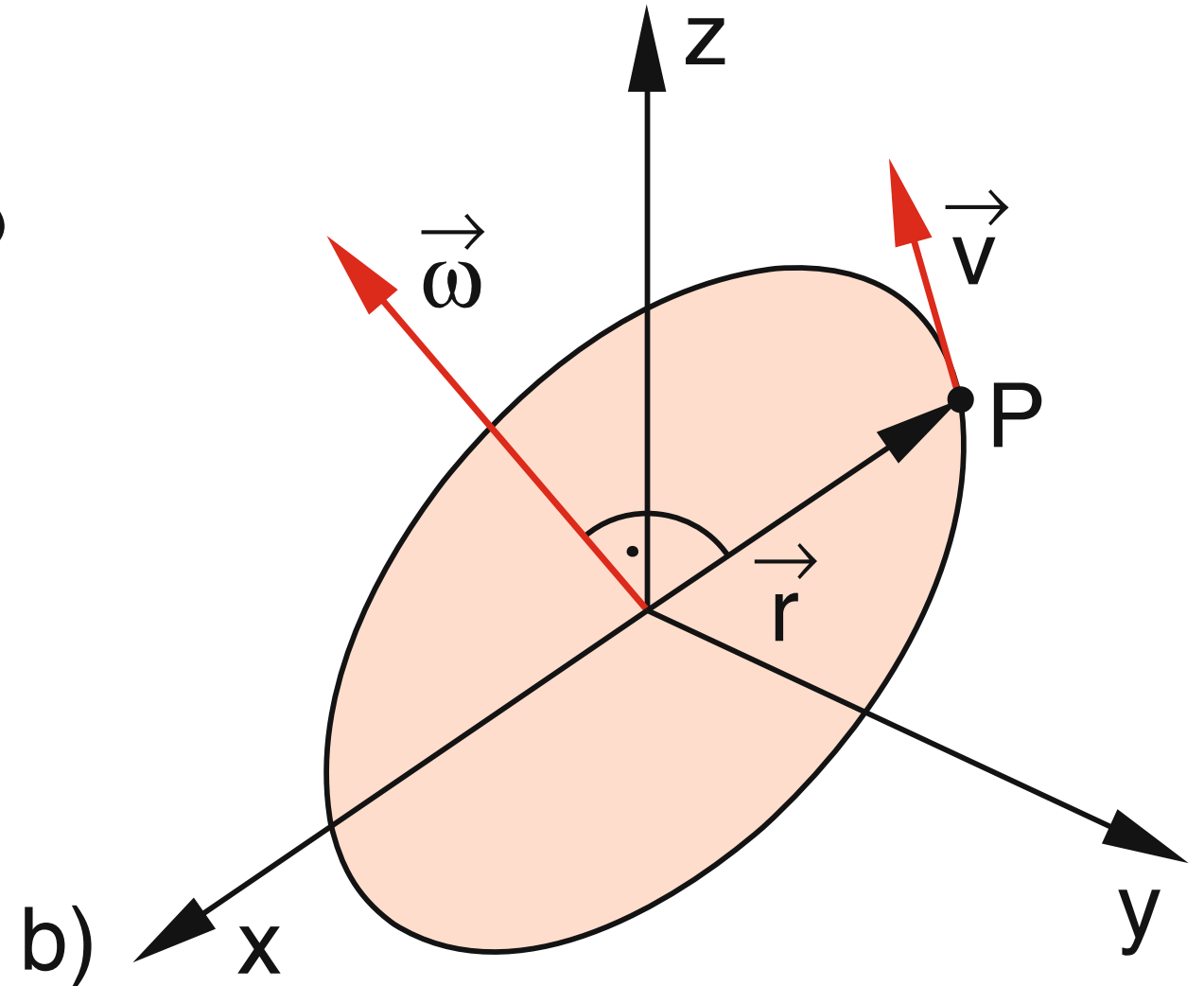
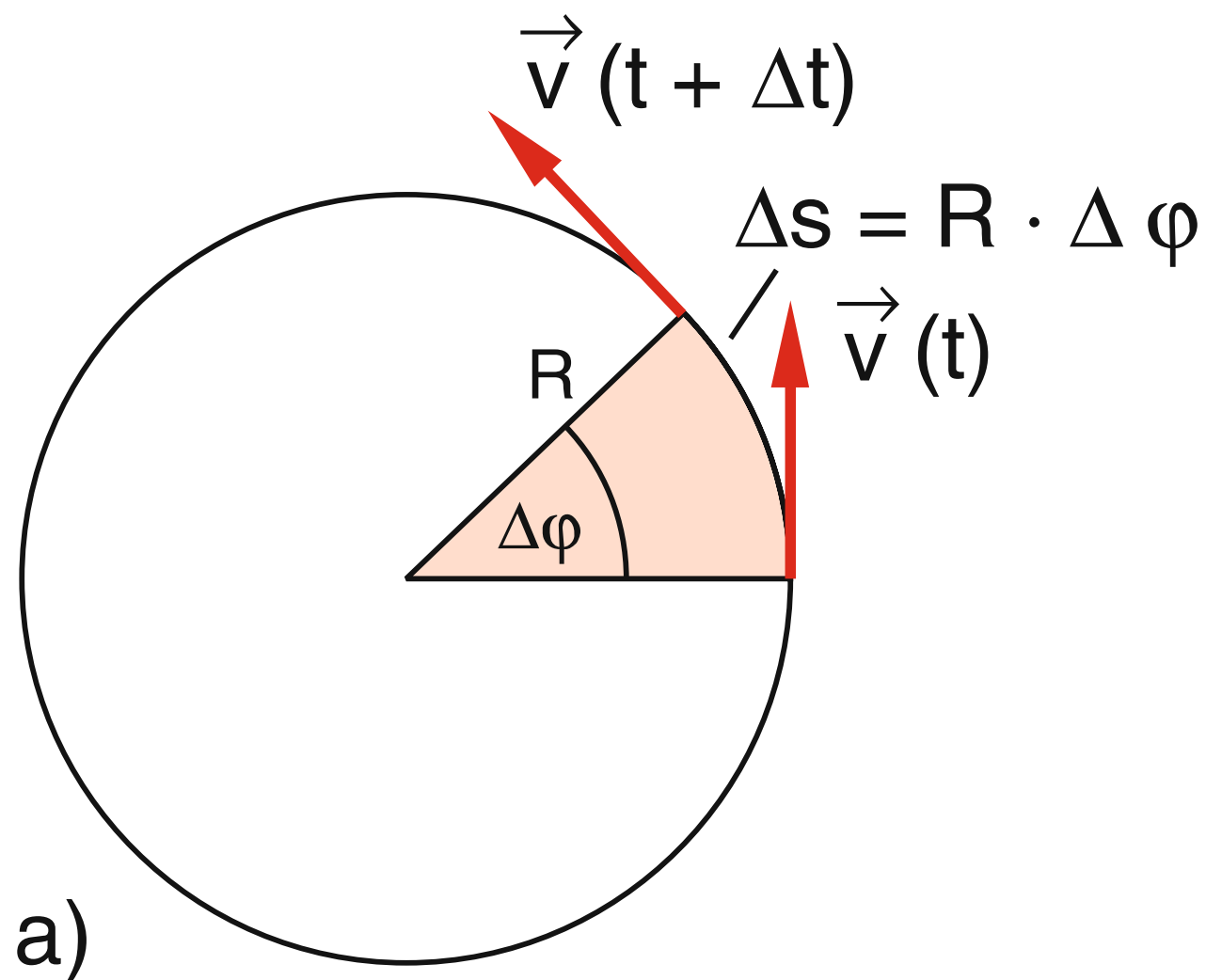


Abb. 2.10. (a) Gleichförmige Kreisbewegung. (b) Zur Definition der Winkelgeschwindigkeit

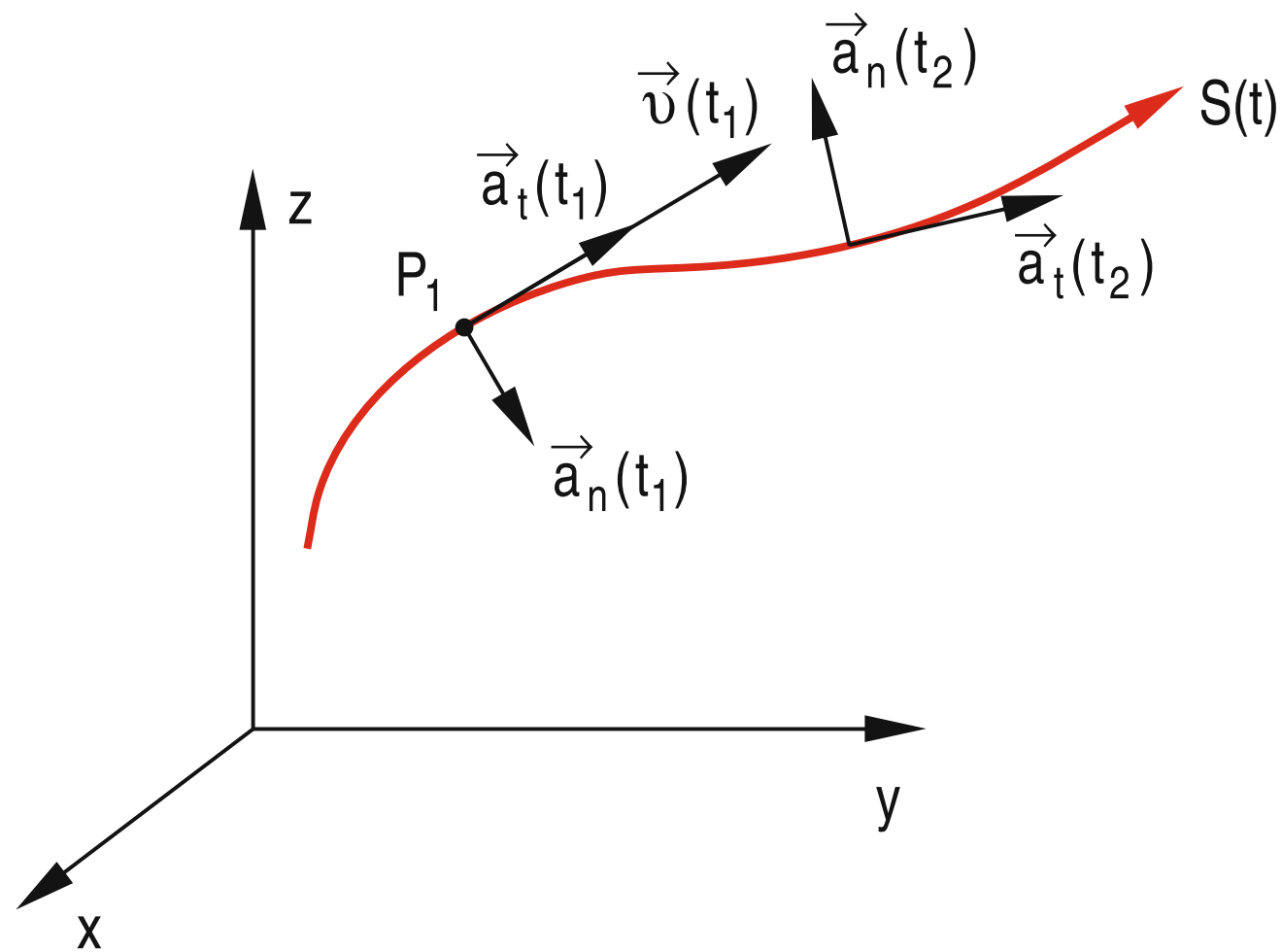


Abb. 2.11. Tangential- und Normalbeschleunigung

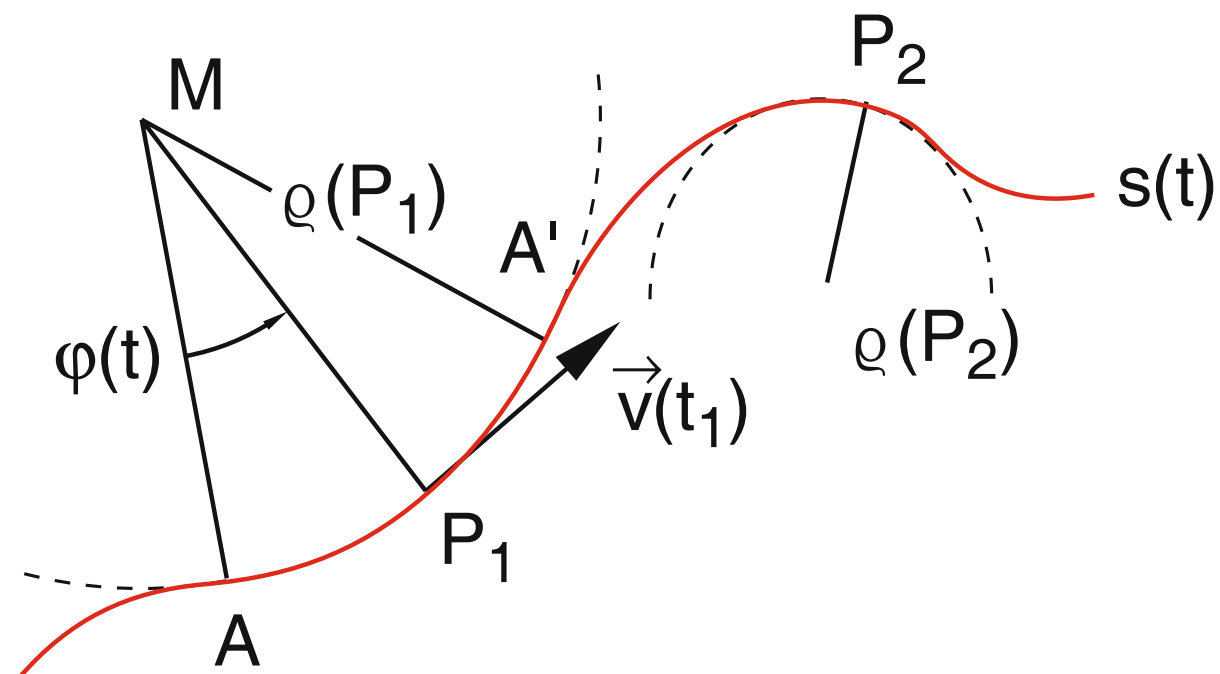
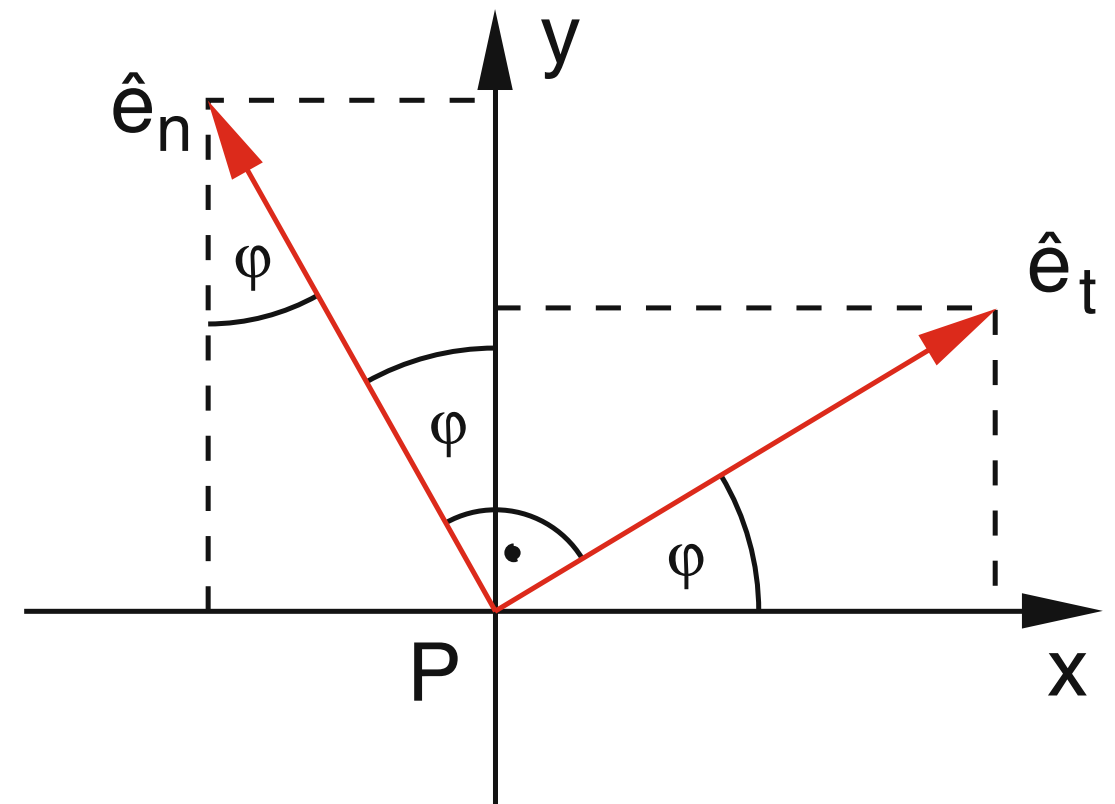
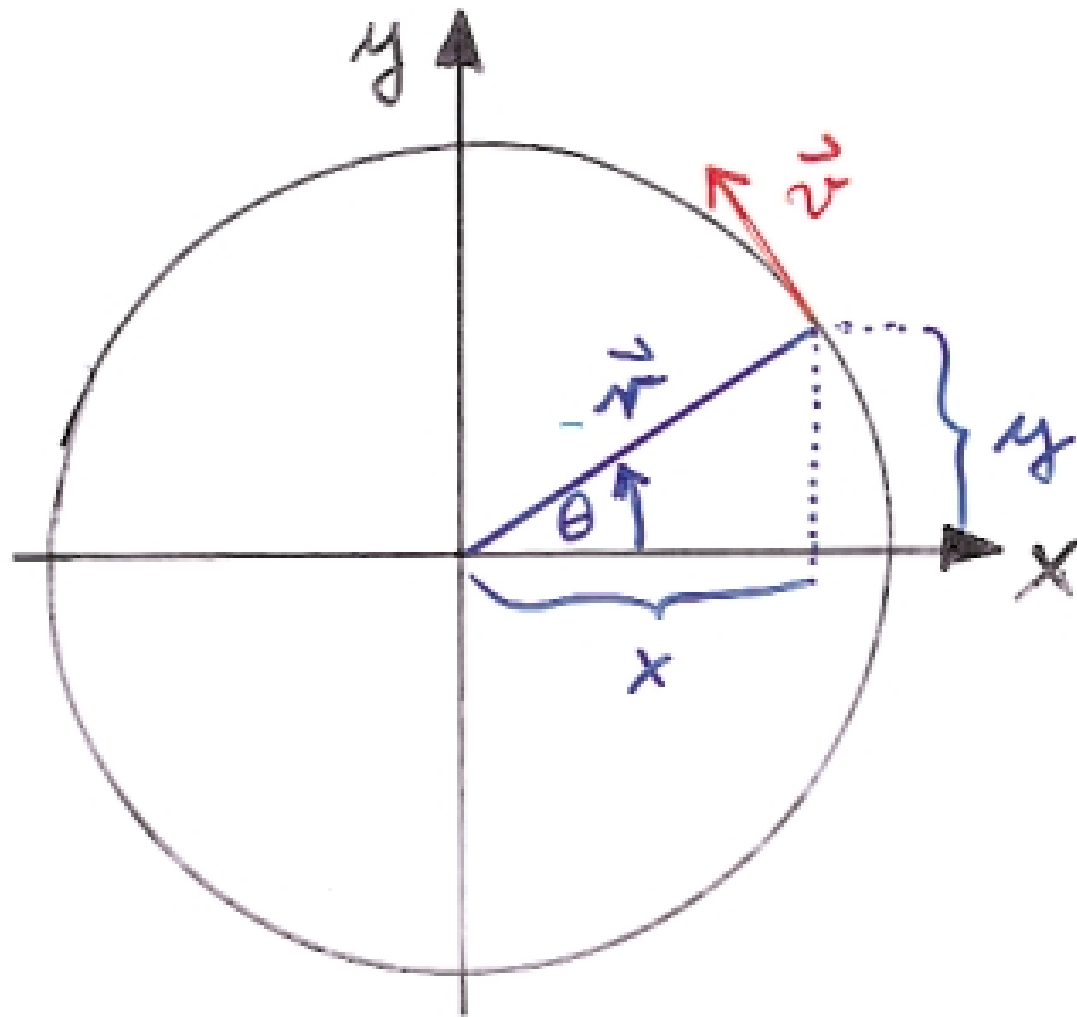


Abb. 2.13. Lokaler Krümmungsradius einer beliebigen krummlinigen Bahnkurve

“Harmonische” Bewegungen, Kreisbewegung



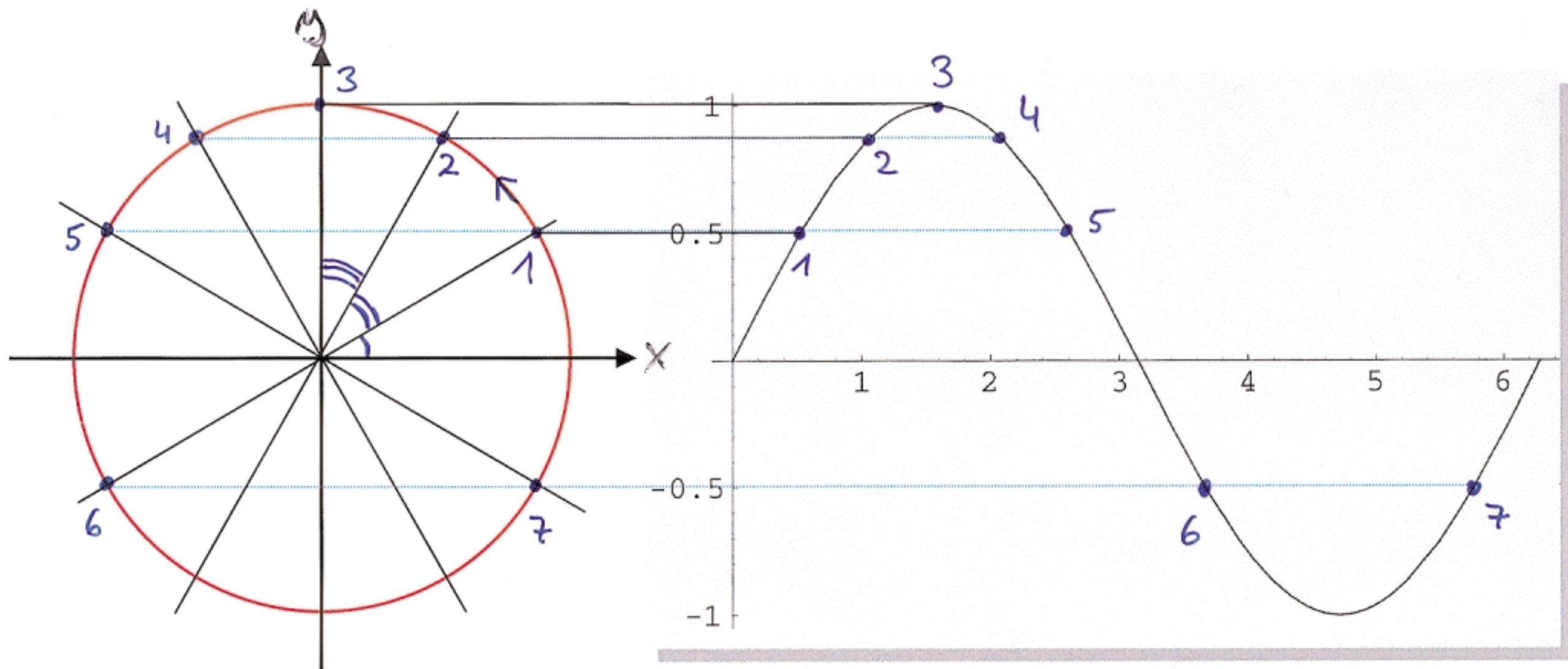
Kreisbeweg. um Koord. urspr.
 $|\vec{v}| = \text{konst.}$

O. B. d. A. $\vec{r}(t) = \begin{pmatrix} x(t) \\ y(t) \end{pmatrix}$

$$r = |\vec{r}| = \sqrt{x^2 + y^2}$$

$$x = r \cdot \cos \theta, \quad y = r \cdot \sin \theta$$

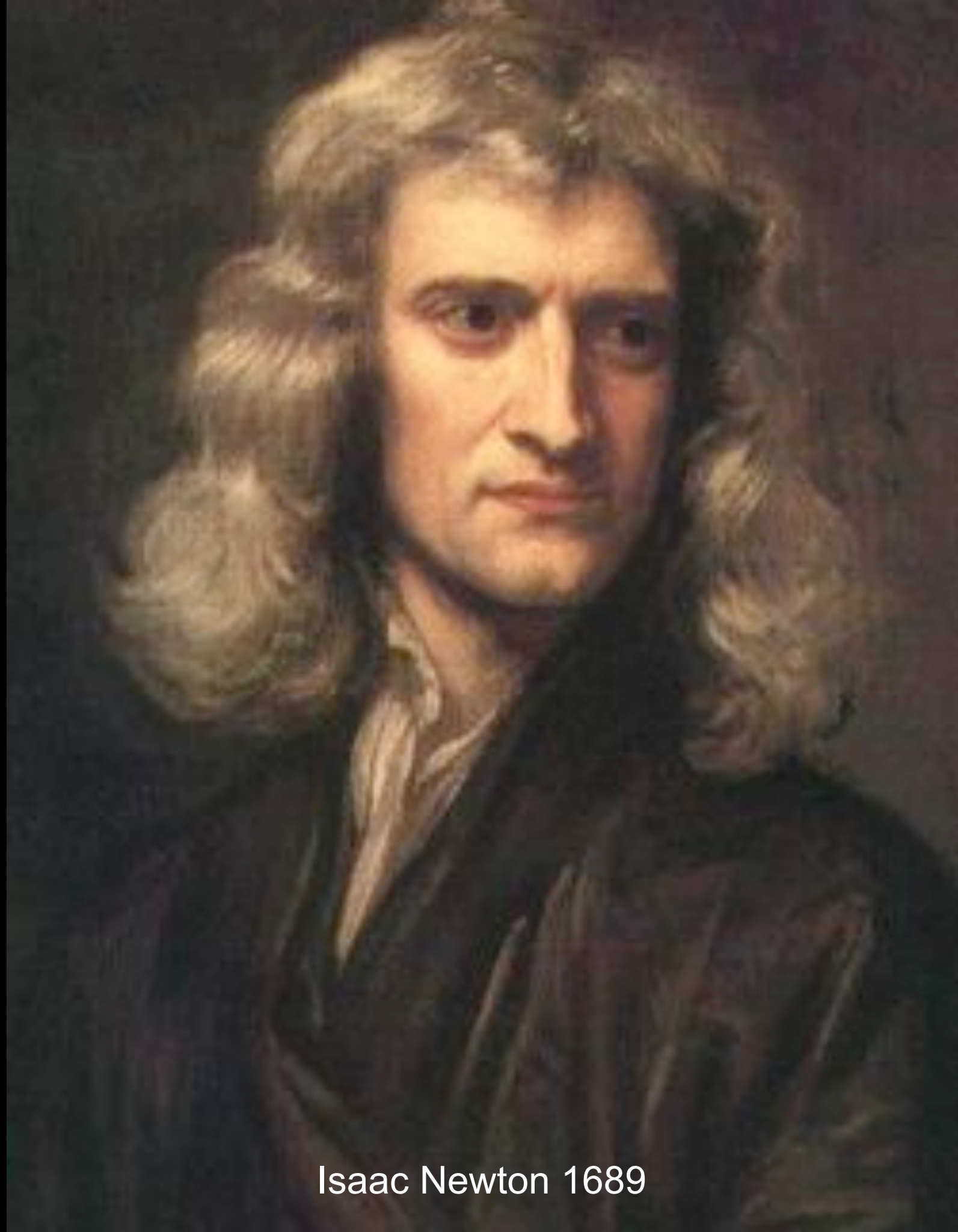
Projektion einer gleichmäßigen
Kreisbewegung: „harmonische Schwingung“



$$\theta(t) = \omega t$$

[hier $r=1$]

$$y(t) = r \cdot \sin \omega t$$



Isaac Newton 1689

LXIX. a. 2

~~App. XVII.~~

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MEMOIRS
OF
S^r ISAAC
NEWTONS
Life.

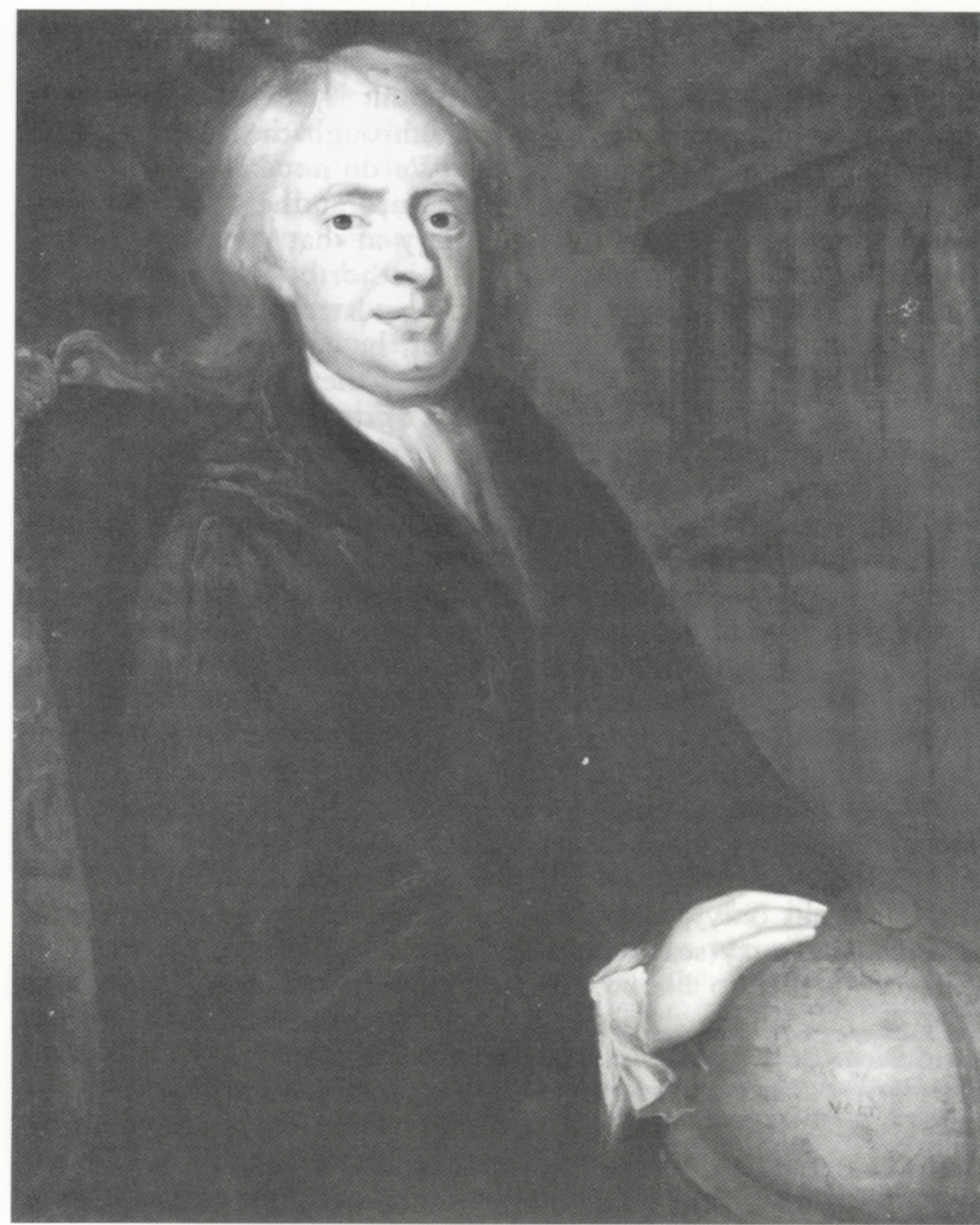
W^m Stukely
1752.

*In magnis, voluisse sat est.
being ^{some} an account, ^{of his family;} chiefly of the junior
part of his life.*

Presented to the Royal Society by Mr. A. H. White. 1936.



Vier Porträts von Newton (1778).



Der greise Newton in einer Darstellung, die William Hogarth zugeschrieben wird.

PHILOSOPHIÆ
NATURALIS
PRINCIPIA
MATHEMATICA.

Autore J. S. NEWTON, Trin. Coll. Cantab. Soc. Matheseos
Professore Lucasiano, & Societatis Regalis Sodali.

IMPRIMATUR.
S. PEPYS, Reg. Soc. PRÆSES.
Julii 5. 1686.

LONDINI,
Jussu Societatis Regiæ ac Typis Josephi Streater. Prostat apud
plures Bibliopolas. Anno MDCLXXXVII.

[12]

AXIOMATA
SIVE
LEGES MOTUS

Lex. I.

*Corpus omne perseverare in statu suo quiescendi vel movendi unifor-
miter in directum, nisi quatenus a viribus impressis cogitur statum
illum mutare.*

Projectilia perseverant in motibus suis nisi quatenus a resisten-
tia aeris retardantur & vi gravitatis impelluntur deorsum.
Trochus, cujus partes coherendo perpetuo retrahunt sese
a motibus rectilineis, non cessat rotari nisi quatenus ab aere re-
tardatur. Majora autem Planetarum & Cometarum corpora mo-
tus suos & progressivos & circulares in spatiis minus resistentibus
factos conservant diutius.

Lex. II.

*Mutationem motus proportionalem esse vi motrici impressæ, & fieri se-
cundum lineam rectam qua vis illa imprimitur.*

Si vis aliqua motum quemvis generet, dupla duplum, tripla tri-
plum generabit, sive simul & semel, sive gradatim & successive im-
pressa fuerit. Et hic motus quoniam in eandem semper plagam
cum vi generatrice determinatur, si corpus antea movebatur, mo-
tui ejus vel conspiranti additur, vel contrario subducitur, vel obli-
quo oblique adjicitur, & cum eo secundum utriusq; determinatio-
nem componitur.

Lex. III.



Titelblatt des „Atlas novus coelestis“ (1742) von J.G. Doppelmaier, mit einigen berühmten Astronomen.

OPTICKS:
OR, A TREATISE
OF THE
REFLEXIONS, REFRACTIONS,
INFLEXIONS and COLOURS
OF
LIGHT.
ALSO
Two TREATISES
OF THE
SPECIES and MAGNITUDE
OF
Curvilinear Figures.

LONDON,
Printed for SAM. SMITH, and BENJ. WALFORD,
Printers to the Royal Society, at the Prince's Arms in
St. Paul's Church-yard. MDCCIV.

AXIOMATA SIVE LEGES MOTUS

Lex. I.

Corpus omne perseverare in statu suo quiescendi vel movendi uniformiter in directum, nisi quatenus a viribus impressis cogitur statum illum mutare.

Projectilia perseverant in motibus suis nisi quatenus a resistentia aeris retardantur & vi gravitatis impelluntur deorsum. Trochus, cujus partes cohaerendo perpetuo retrahunt sese a motibus rectilineis, non cessat rotari nisi quatenus ab aere retardatur. Majora autem Planetarum & Cometarum corpora motus suos & progressivos & circulares in spatiis minus resistentibus factos conservant diutius.

Lex. II.

Mutationem motus proportionalem esse vi motrici impressae, & fieri secundum lineam rectam qua vis illa imprimitur.

there; & a few more whom he knew.

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after dinner, the weather being warm, we went into the garden, & drank tea under the shade of some apple-trees; only he, & my self. amidst other discourse, he told me, he was just in the same situation, as when formerly, the notion of gravitation came into his mind. why sh^d that apple always descend perpendicularly to the ground, thought he to himself; occasion'd by the fall of an apple, as he sat in a contemplative mood. why sh^d it not go sideways, or upwards? but constantly to the earths center? assuredly, the reason is, that the earth draws it. there must be a drawing power in matter. & the sum of the drawing power in the matter of the earth must be in the earths center, not in any side of the earth. therefore does this apple fall perpendicularly, or toward the center. if matter thus draws matter; it must be in proportion of its quantity. therefore the apple draws the earth, as well as the earth draws the apple.

Thus by degrees, he began to apply the property of gravitation to the motion of the earth, & of the heavenly bodies: to distances, their magnitudes, their periodical revolutions: to find out, that this propo-

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Newtons Apfel im Original

Vor seinem Tod im Jahr 1727 schilderte Isaac Newton seine Lebenserfahrungen dem Historiker William Stukeley, der sie 25 Jahre später als Biografie "Memoires of Sir Isaac Newton's Life" veröffentlichte. Das Werk beschreibt die Geschichte von Newtons Eingebung zur Ursache der Schwerkraft wie folgt:

Why should that apple always descend perpendicularly to the ground, thought he to himself, occasion'd by the fall of an apple (...). Why should it not go sideways, or upwards, but constantly to the earths center? Assuredly, the reason is, that the earth draws it. There must be a drawing power in matter. (...) If matter thus draws matter; it must be in proportion of its quantity. Therefore the apple draws the earth, as well as the earth draws the apple. (...) he began to apply this property of gravitation to the motion of the earth, and of the heavenly bodies; to consider their distances, their magnitudes, their periodical rotations (...).