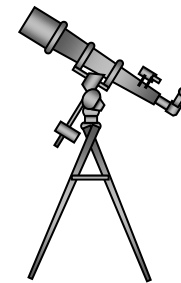




ASTRONOMIE WAHLFACH



ENTFERNUNGSBESTIMMUNG 1. TEIL

Grafiken: S. Hanssen



Bild: NASA Goddard Space Flight Center Image by Reto Stöckli (land surface, shallow water, clouds). Enhancements by Robert Simmon (ocean color, compositing, 3D globes, animation). Data and technical support: MODIS Land Group; MODIS Science Data Support Team; MODIS Atmosphere Group; MODIS Ocean Group Additional data: USGS EROS Data Center (topography); USGS Terrestrial Remote Sensing Flagstaff Field Center (Antarctica); Defense Meteorological Satellite Program (city lights) via <https://climatekids.nasa.gov/why-earth/> [Public Domain (PD-USGov)]; Grafik: S. Hanssen

LAUFZEITMESSUNGEN

Aktive Laufzeitmessungen für den Mond (Laser) und die inneren Planeten Merkur, Venus und Mars sowie Asteroiden (Radar).

Versagt bei weiter entfernten Objekten, da Signallaufzeit zu lang und die reflektierte Energie zu klein.



Bild oben links: „McDonald Observatory“ via https://science.nasa.gov/science-news/science-at-nasa/2004/21jul_llr/ [Public Domain (PD-USGov)]

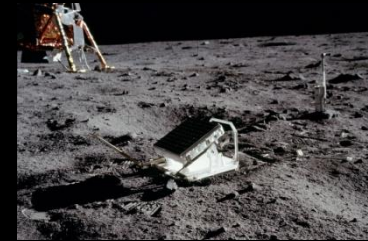


Bild oben : Apollo 11 lunar laser ranging retroreflector array via https://science.nasa.gov/science-news/science-at-nasa/2004/21jul_llr/ [Public Domain (PD-USGov)]

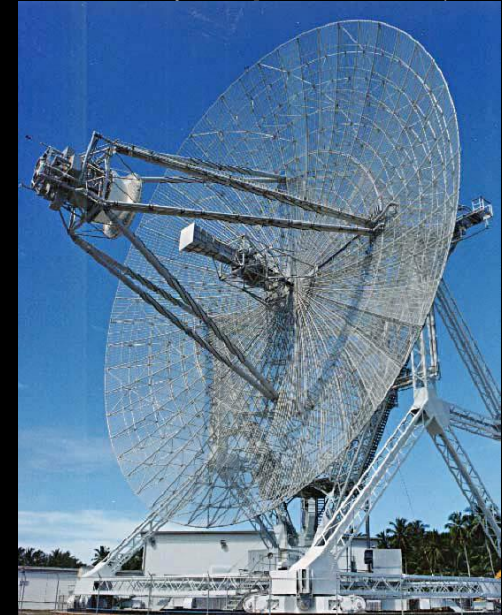


Bild unten rechts: „Radar antenna“ via <https://commons.wikimedia.org/w/index.php?curid=46717> [Public Domain]

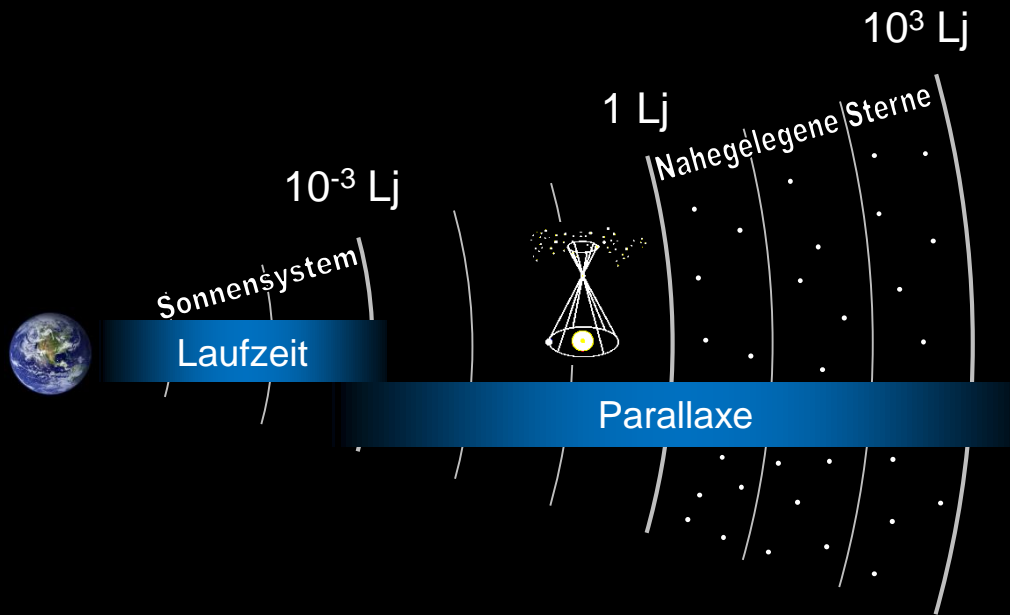


Bild: NASA Goddard Space Flight Center Image by Reto Stöckli (land surface, shallow water, clouds). Enhancements by Robert Simmon (ocean color, compositing, 3D globes, animation). Data and technical support: MODIS Land Group; MODIS Science Data Support Team; MODIS Atmosphere Group; MODIS Ocean Group Additional data: USGS EROS Data Center (topography); USGS Terrestrial Remote Sensing Flagstaff Field Center (Antarctica); Defense Meteorological Satellite Program (city lights) via <https://climatekids.nasa.gov/why-earth/> [Public Domain (PD-USGov)]; Grafik: S. Hanssen

TRIGONOMETRISCHE PARALLAXE

Über die Ortsveränderung der Erde im Laufe eines Jahres verschieben sich nahe Objekte vor weit entferntem Sternhintergrund.

Hinweis:

Animation
siehe

<https://www.coe.edu/application/files/7715/5010/9655/paranim-2.gif>

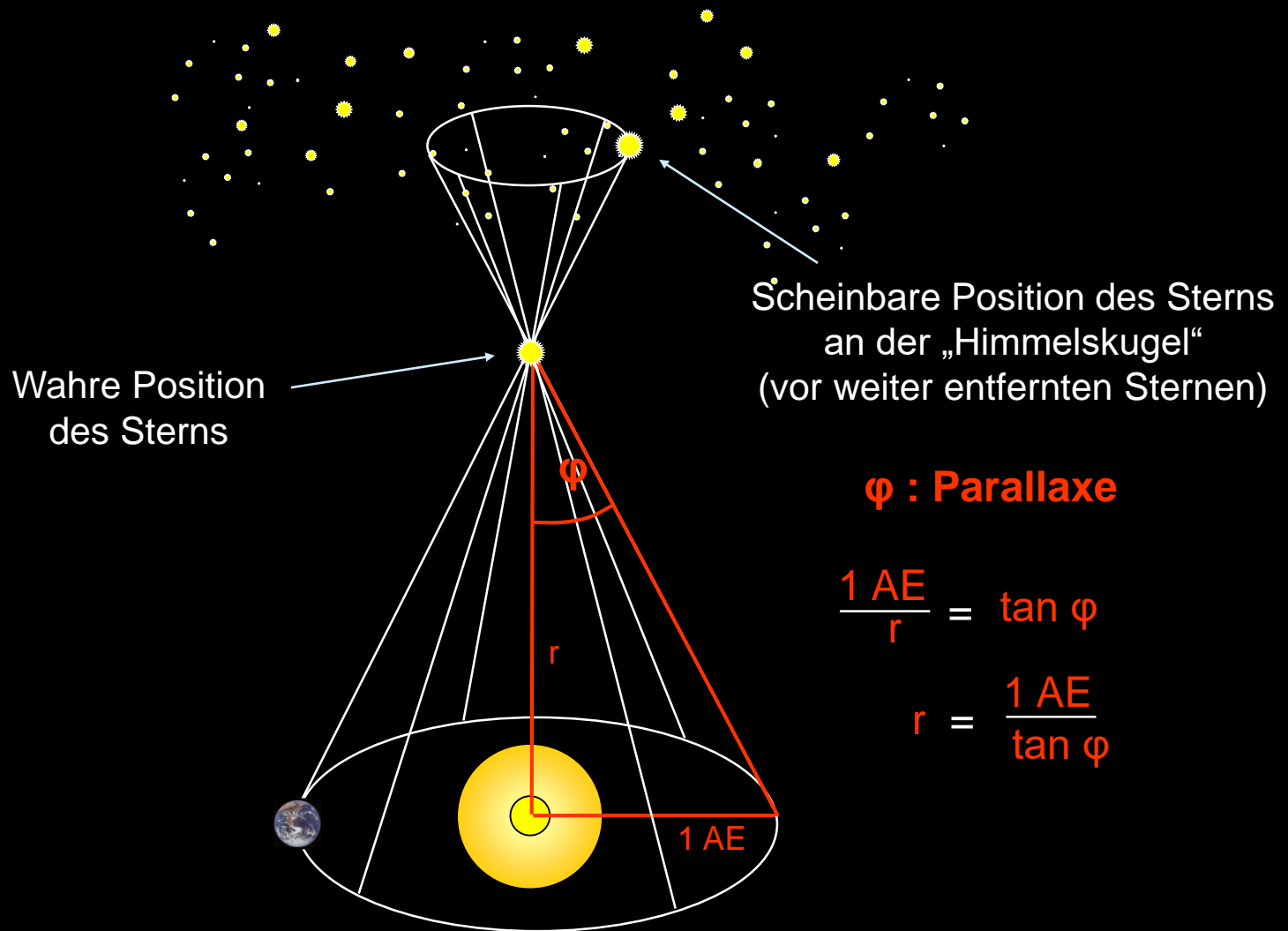


Bild: NASA Goddard Space Flight Center Image by Reto Stöckli (land surface, shallow water, clouds). Enhancements by Robert Simmon (ocean color, compositing, 3D globes, animation). Data and technical support: MODIS Land Group; MODIS Science Data Support Team; MODIS Atmosphere Group; MODIS Ocean Group Additional data: USGS EROS Data Center (topography); USGS Terrestrial Remote Sensing Flagstaff Field Center (Antarctica); Defense Meteorological Satellite Program (city lights) via <https://climatekids.nasa.gov/why-earth/> [Public Domain (PD-USGov)]; Grafik: S. Hanssen



ENTFERNUNGSBESTIMMUNG 2. TEIL

Grafiken: S. Hanssen

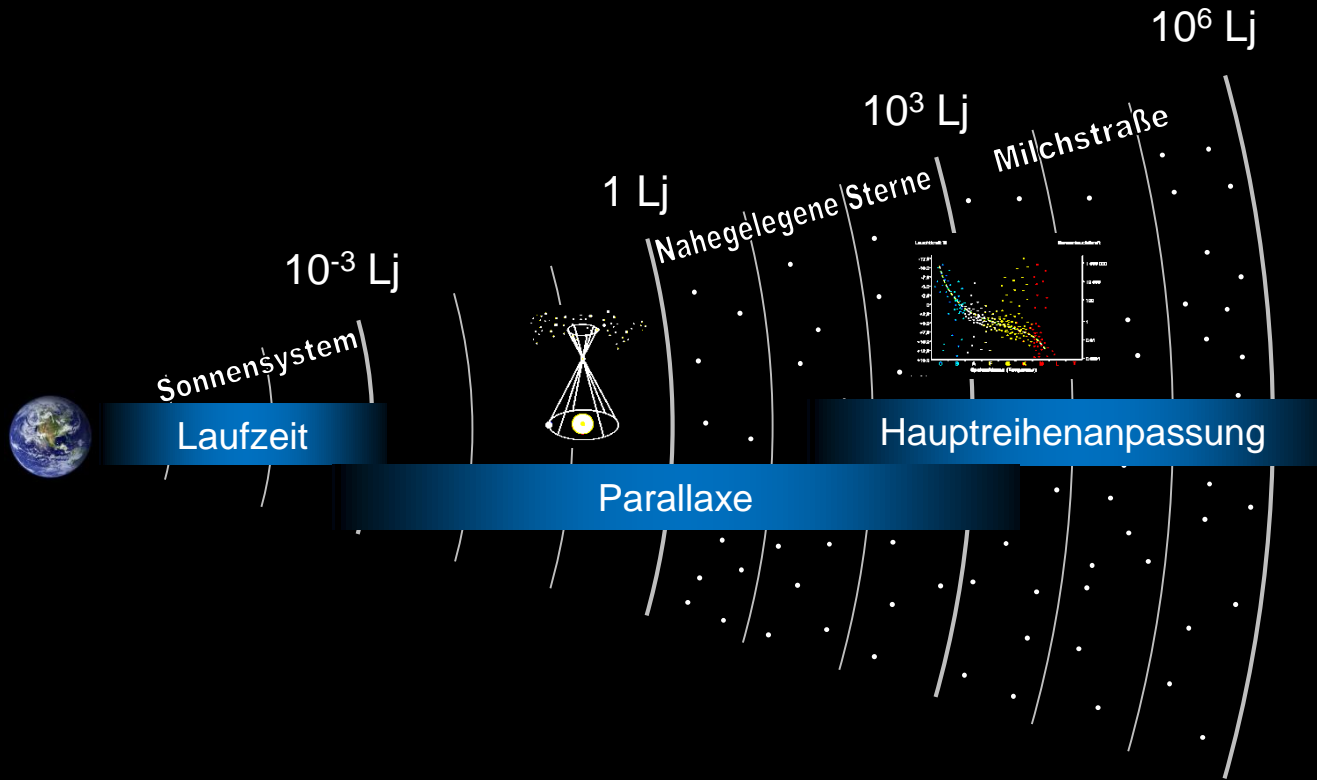
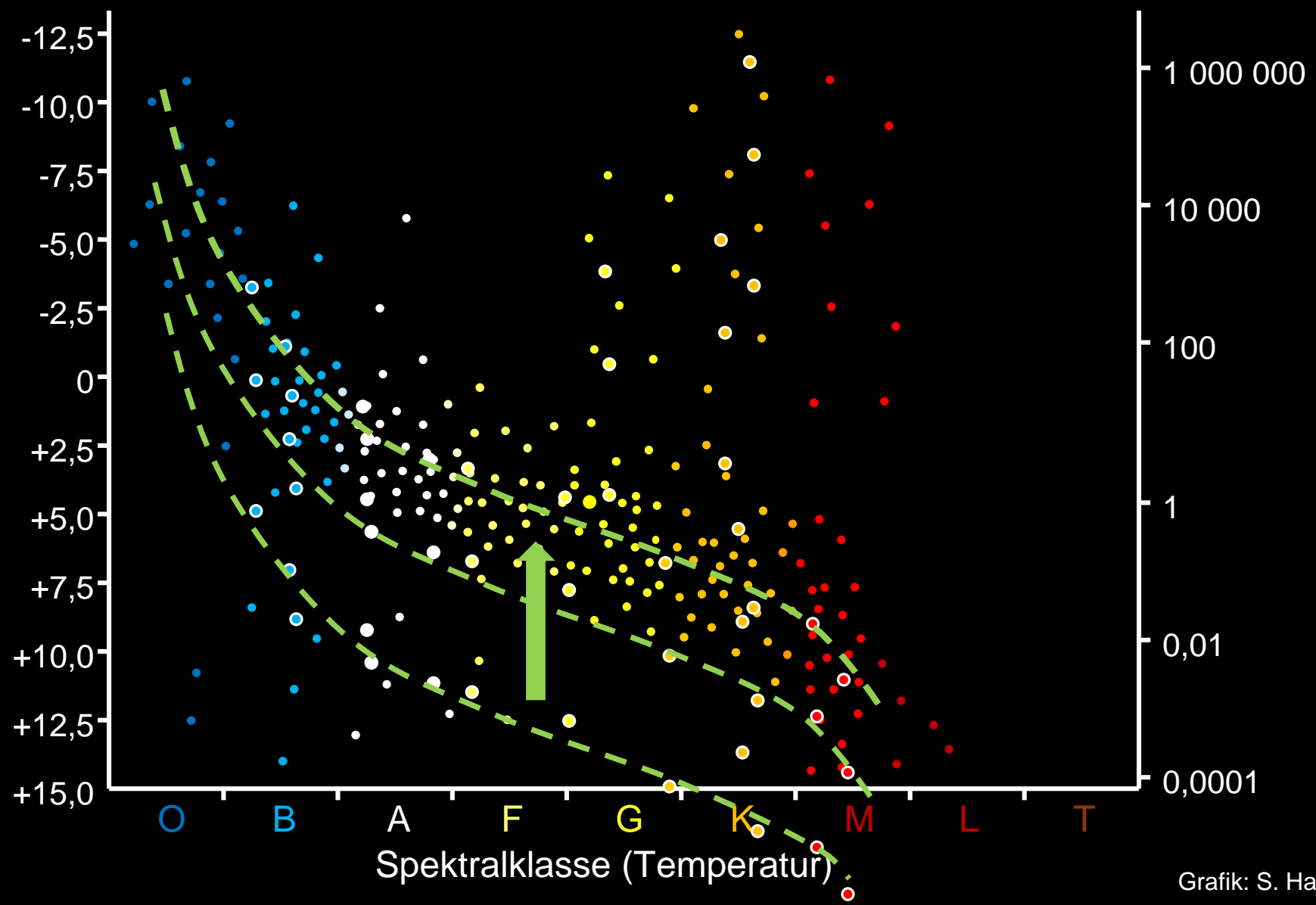


Bild: NASA Goddard Space Flight Center Image by Reto Stöckli (land surface, shallow water, clouds). Enhancements by Robert Simmon (ocean color, compositing, 3D globes, animation). Data and technical support: MODIS Land Group; MODIS Science Data Support Team; MODIS Atmosphere Group; MODIS Ocean Group Additional data: USGS EROS Data Center (topography); USGS Terrestrial Remote Sensing Flagstaff Field Center (Antarctica); Defense Meteorological Satellite Program (city lights) via <https://climatekids.nasa.gov/why-earth/> [Public Domain (PD-USGov)]; Grafik: S. Hanssen

Leuchtkraft M

Sonnenleuchtkraft



Grafik: S. Hanssen



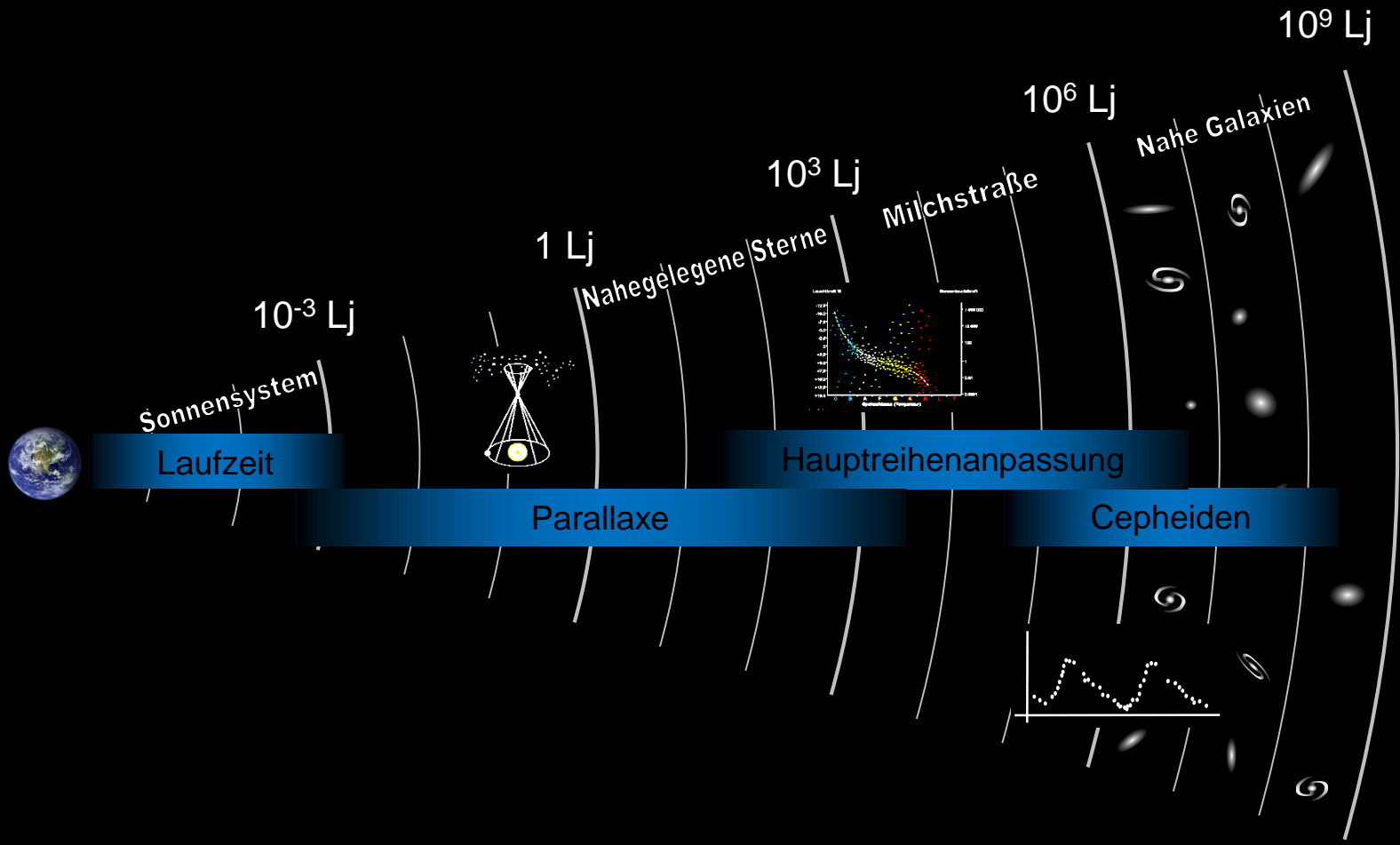
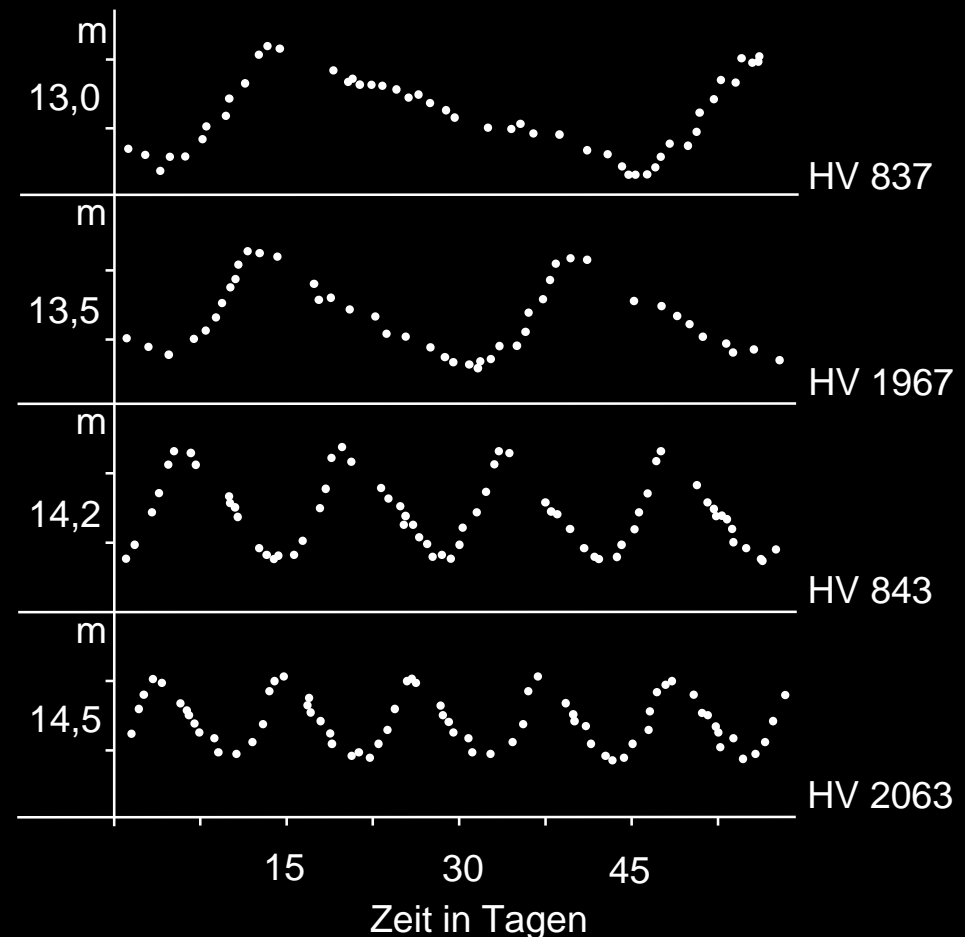


Bild: NASA Goddard Space Flight Center Image by Reto Stöckli (land surface, shallow water, clouds). Enhancements by Robert Simmon (ocean color, compositing, 3D globes, animation). Data and technical support: MODIS Land Group; MODIS Science Data Support Team; MODIS Atmosphere Group; MODIS Ocean Group Additional data: USGS EROS Data Center (topography); USGS Terrestrial Remote Sensing Flagstaff Field Center (Antarctica); Defense Meteorological Satellite Program (city lights) via <https://climatekids.nasa.gov/why-earth/> [Public Domain (PD-USGov)]; Grafik: S. Hanssen

CEPHEIDEN

Veränderliche Sterne,
mittlerer Masse (ca. vier bis
zehn M_{\odot} , benannt nach dem
Stern δ Cephei (Sternbild
Cepheus)

Cepheiden verändern ihre
Leuchtkraft streng
periodisch, hellere
Cepheiden haben eine
größere Periode.



Grafik: S. Hanssen

STANDARDKERZEN:

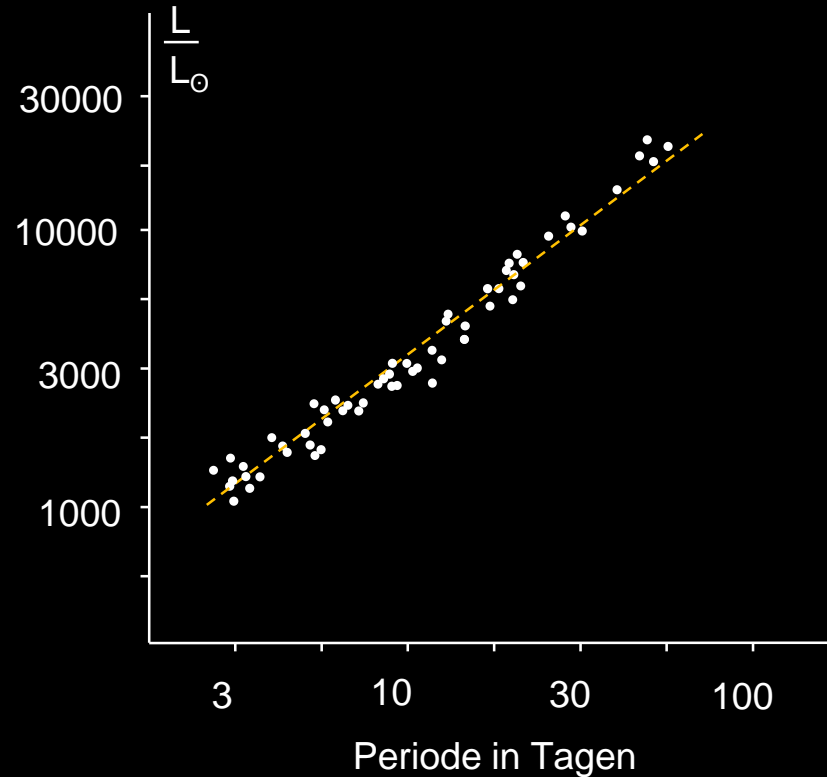
Als Standardkerze bezeichnet man ein leuchtendes Objekt bekannter absoluter Helligkeit.

Cepheiden:

Aus der Periode Schluss auf ihre absolute Helligkeit
→ Standardkerzen zum Bestimmen von Entfernungen bis 20 Mpc.

Abstandsbestimmung über das Entfernungsmodul:

$$5 \log_{10} \frac{D}{\text{kpc}} = m - M + 5 \text{mag}$$



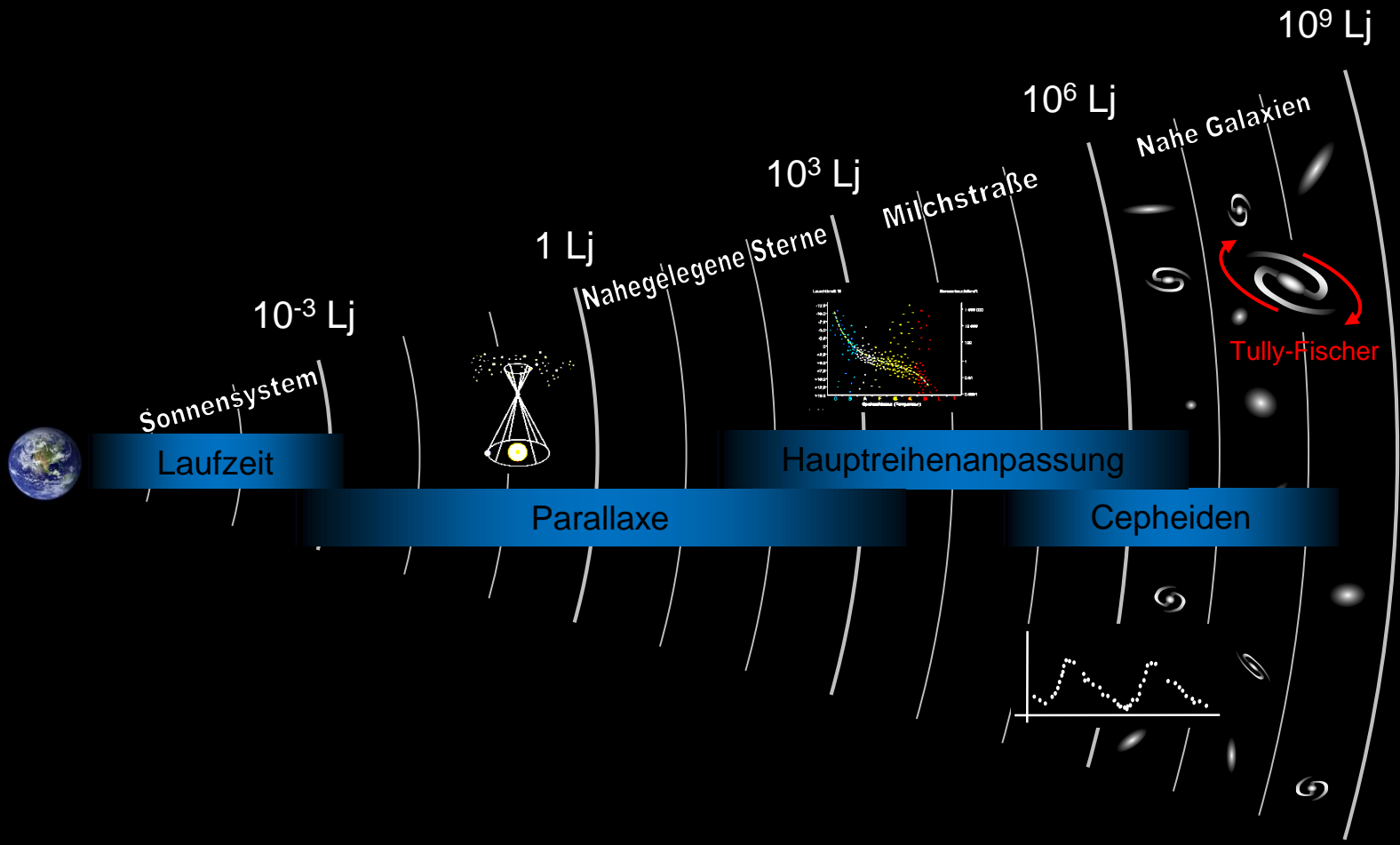


Bild: NASA Goddard Space Flight Center Image by Reto Stöckli (land surface, shallow water, clouds). Enhancements by Robert Simmon (ocean color, compositing, 3D globes, animation). Data and technical support: MODIS Land Group; MODIS Science Data Support Team; MODIS Atmosphere Group; MODIS Ocean Group Additional data: USGS EROS Data Center (topography); USGS Terrestrial Remote Sensing Flagstaff Field Center (Antarctica); Defense Meteorological Satellite Program (city lights) via <https://climatekids.nasa.gov/why-earth/> [Public Domain (PD-USGov)]; Grafik: S. Hanssen

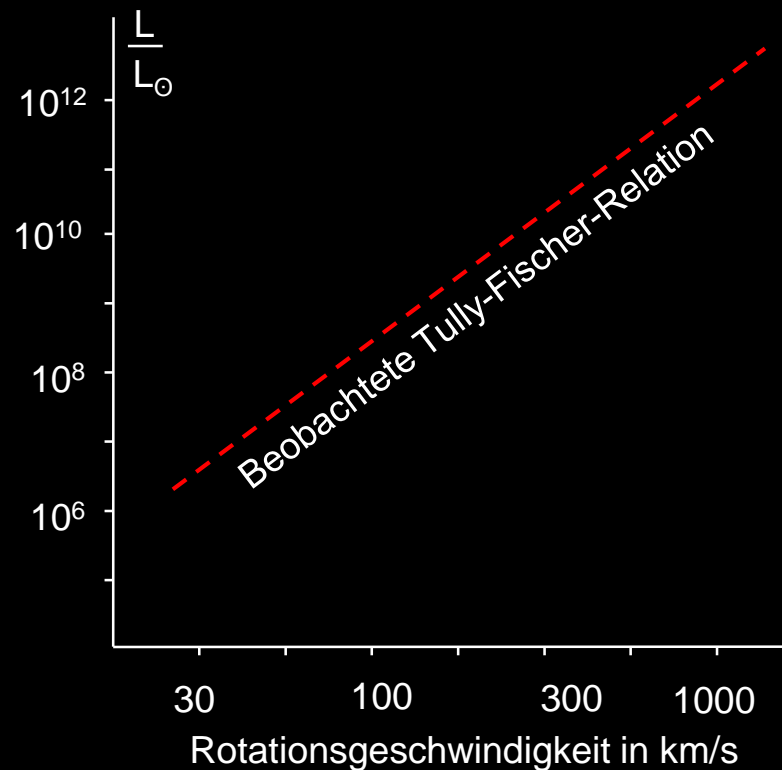
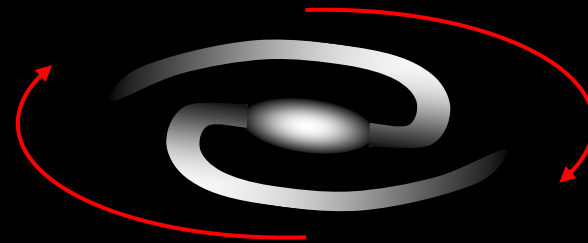


TULLY-FISCHER-RELATION

Beschreibung eines Zusammenhangs zwischen der Rotationsgeschwindigkeit von Spiralgalaxien und ihrer Leuchtkraft: $L \sim (v_{\max})^\beta$

$\beta = 3,0$ im B-Band ($\lambda = 400 \text{ nm}$)
 $\beta = 3,2$ im I-Band ($\lambda = 800 \text{ nm}$)
 $\beta = 4,2$ im H-Band ($\lambda = 1200 \text{ nm}$)

Aus der Verschiebung ihrer Spektrallinien und der daraus folgenden Rotationsgeschwindigkeit kann auf ihre Leuchtkraft und damit bei bekannter Helligkeit auf ihre Entfernung geschlossen werden



Grafik: S. Hanssen

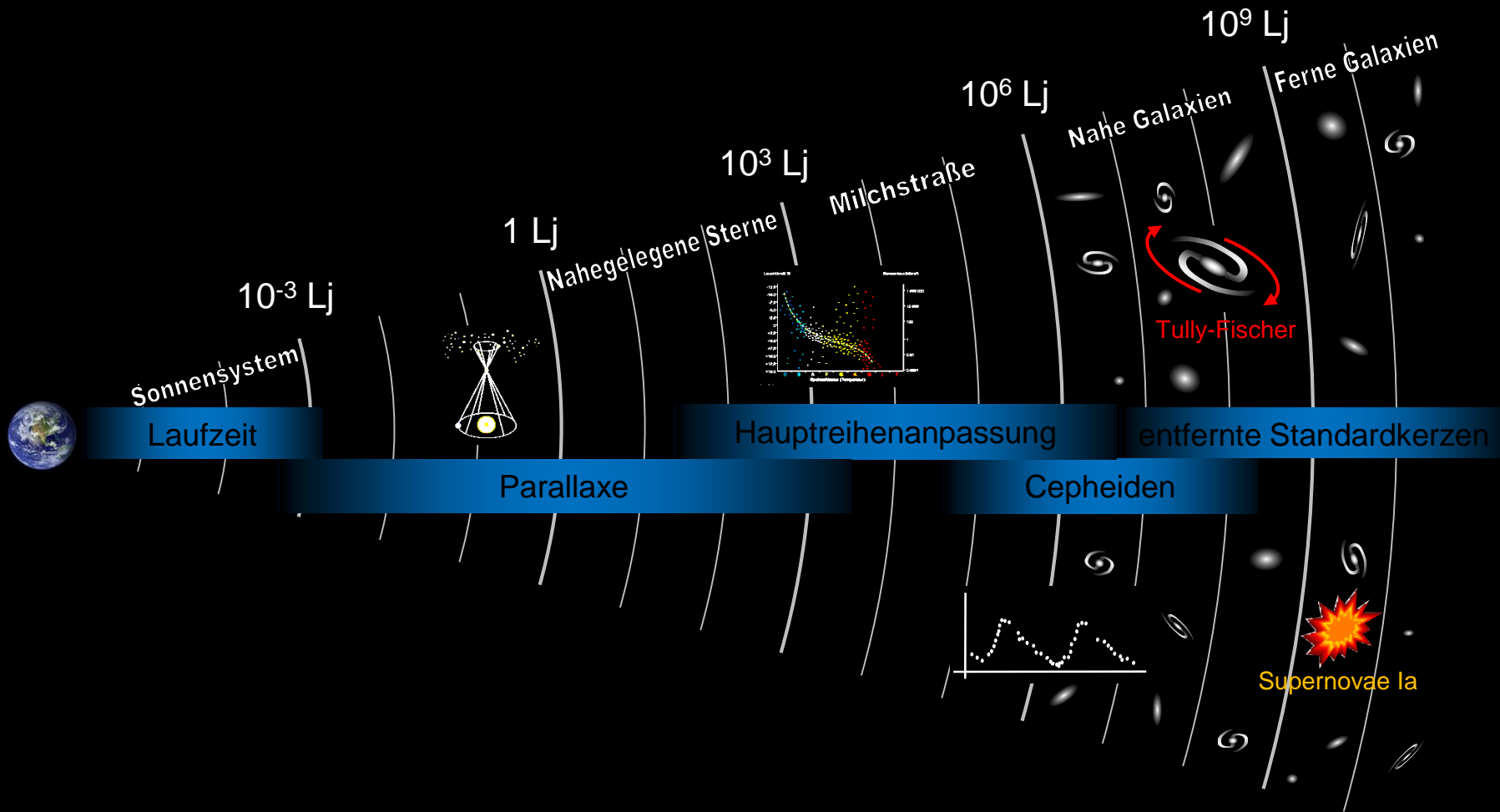


Bild: NASA Goddard Space Flight Center Image by Reto Stöckli (land surface, shallow water, clouds). Enhancements by Robert Simmon (ocean color, compositing, 3D globes, animation). Data and technical support: MODIS Land Group; MODIS Science Data Support Team; MODIS Atmosphere Group; MODIS Ocean Group Additional data: USGS EROS Data Center (topography); USGS Terrestrial Remote Sensing Flagstaff Field Center (Antarctica); Defense Meteorological Satellite Program (city lights) via <https://climatekids.nasa.gov/why-earth/> [Public Domain (PD-USGov)]; Grafik: S. Hanssen

SUPERNOVAE IA

Relativ homogene Gruppe von Supernovae

Phillips-Beziehung beschreibt empirischen Zusammenhang zwischen Lichtkurvenverlauf von Supernovae (Typ Ia) und der absoluten Helligkeit.



Von Thunderf00t - Supernova in M101, Aug 25th, full processing [CC BY 3.0] via <https://commons.wikimedia.org/w/index.php?curid=16272395>

SUPERNOVAE IA

Relativ homogene Gruppe von Supernovae

Phillips-Beziehung beschreibt empirischen Zusammenhang zwischen Lichtkurvenverlauf von Supernovae (Typ Ia) und der absoluten Helligkeit.

Bild:
Supernova 1994D in NGC 4256 (50 Mio. Lj)



Bild: „SN1994D.jpg“ von NASA/ESA, The Hubble Key Project Team and The High-Z Supernova Search Team via <https://commons.wikimedia.org/wiki/File:SN1994D.jpg> [CC BY 3.0]