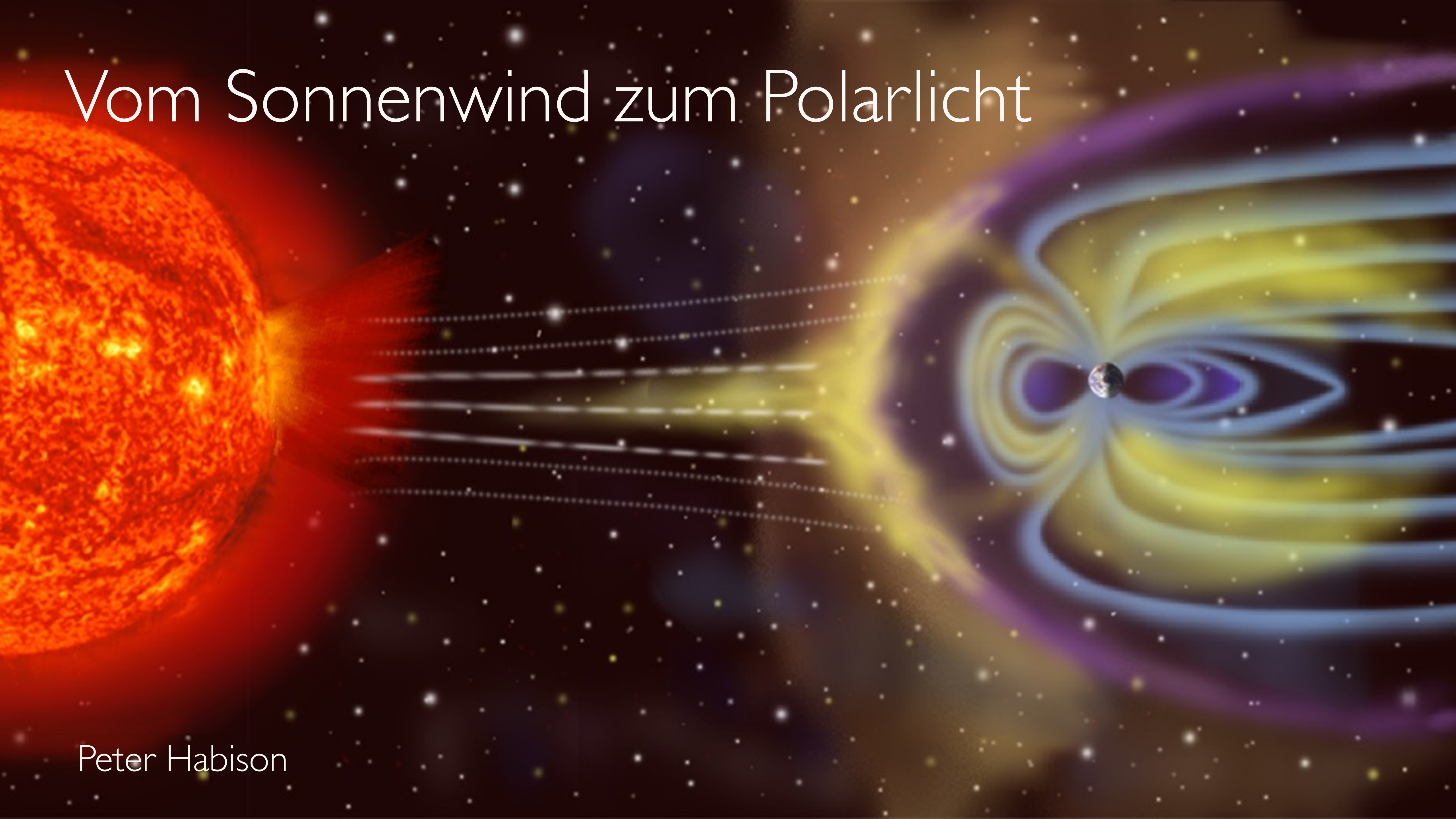


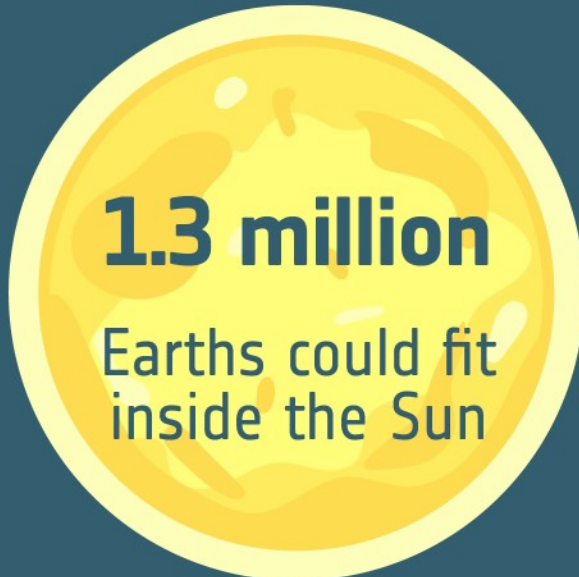
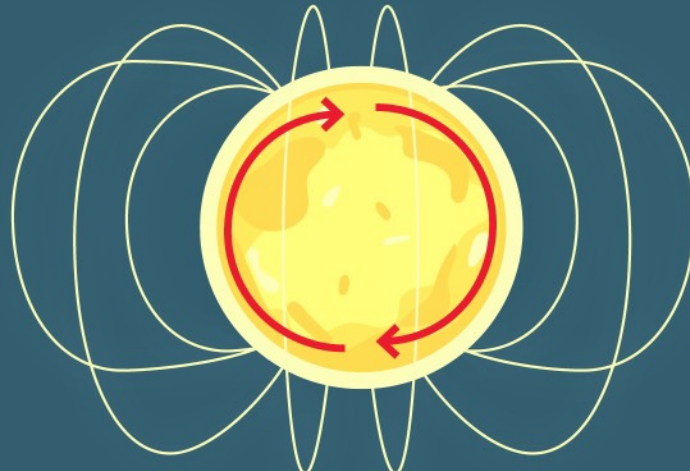
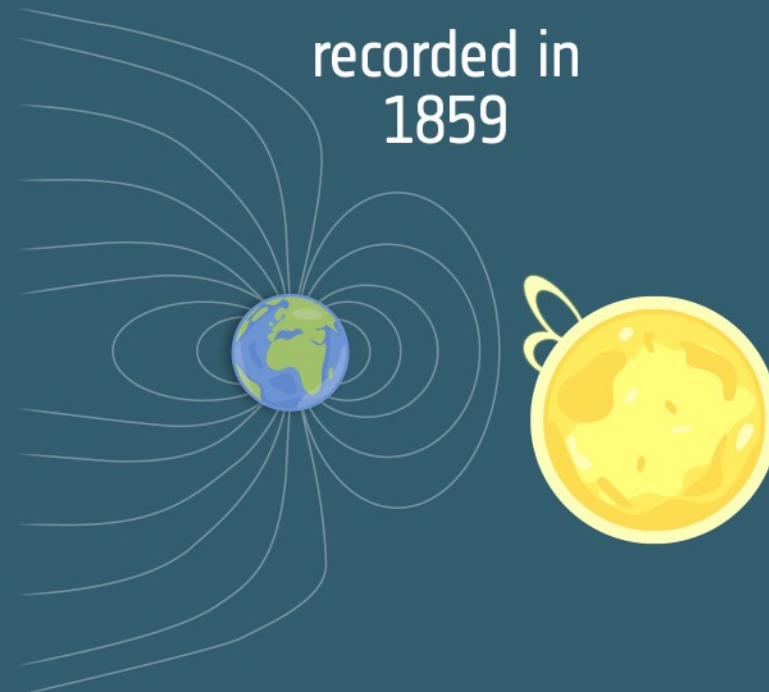
Vom Sonnenwind zum Polarlicht

Peter Habison



MEET THE SUN



Diameter  1 392 684 km about 109 Earth diameters	Mass 1.9 x 10³⁰ kg  about 333 060 Earths	Volume 1.4 x 10²⁷ m³ 1.3 million Earths could fit inside the Sun 	Temperature  15 million°C in the Sun's core 1 million°C in the Sun's corona 5500°C at the Sun's surface	Age  4.6 billion years The Sun is halfway through its life	Light travel time  8 min for light to reach Earth 
Rotation  36 days at the poles 25 days at the equator	Speed  220 km/s around the galaxy 250 million years to orbit the centre of the Milky Way	Impressive characteristics Flipping magnetic field every 11 years  Biggest solar storm to hit Earth recorded in 1859  Largest sunspot measured in 1947  35 times Earth's area			



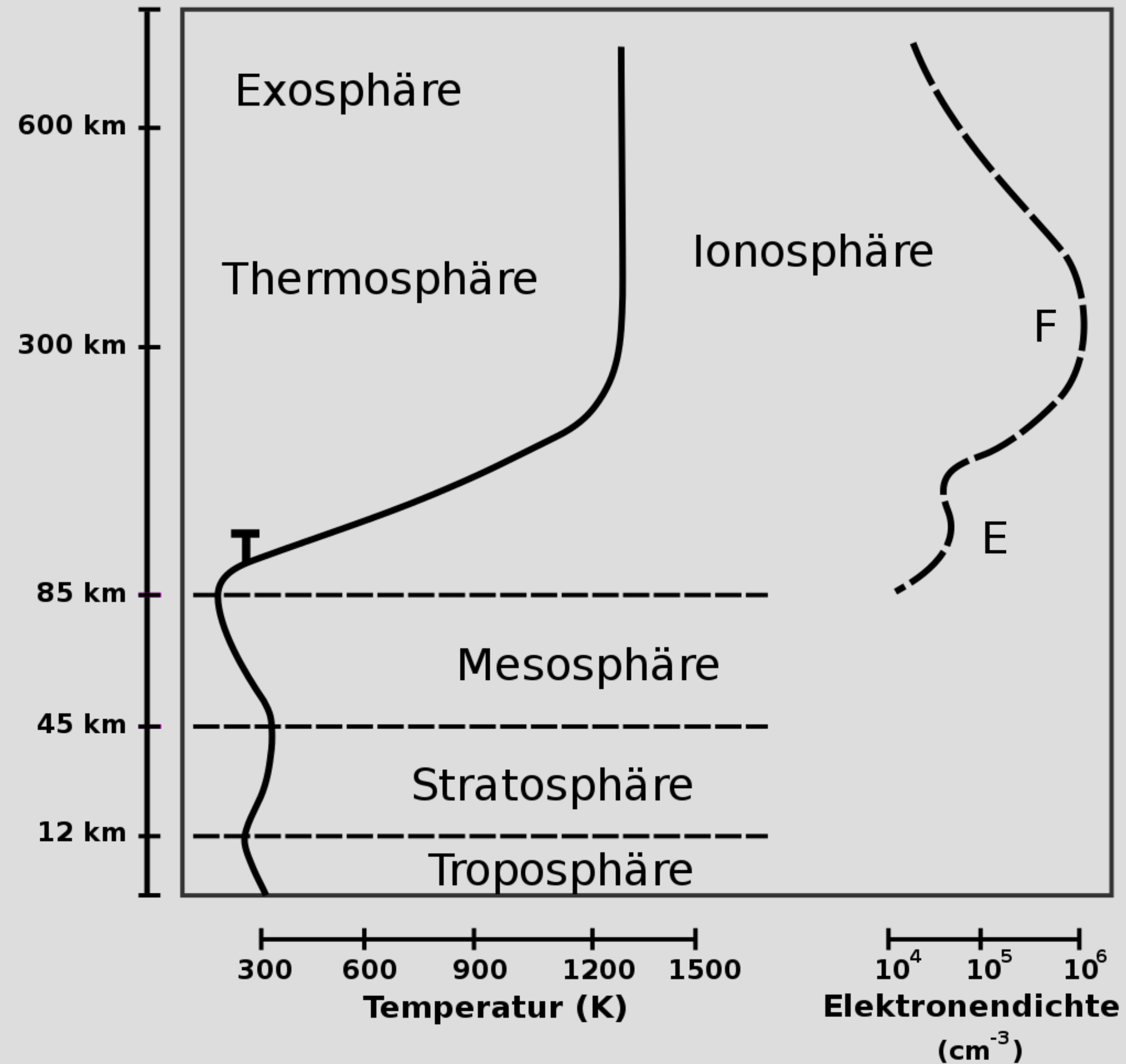
Erde-Mond System



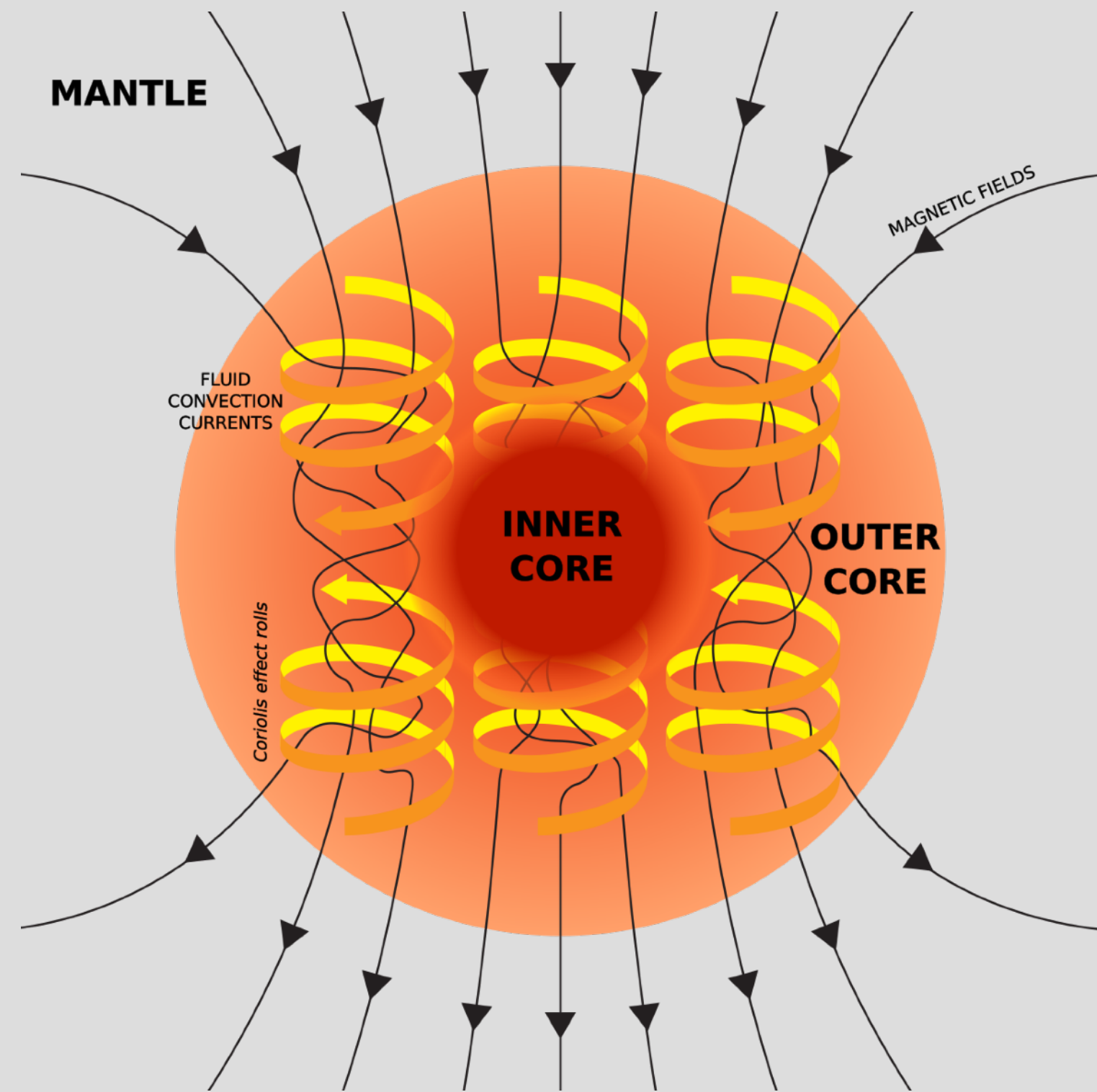
Die Atmosphäre der Erde



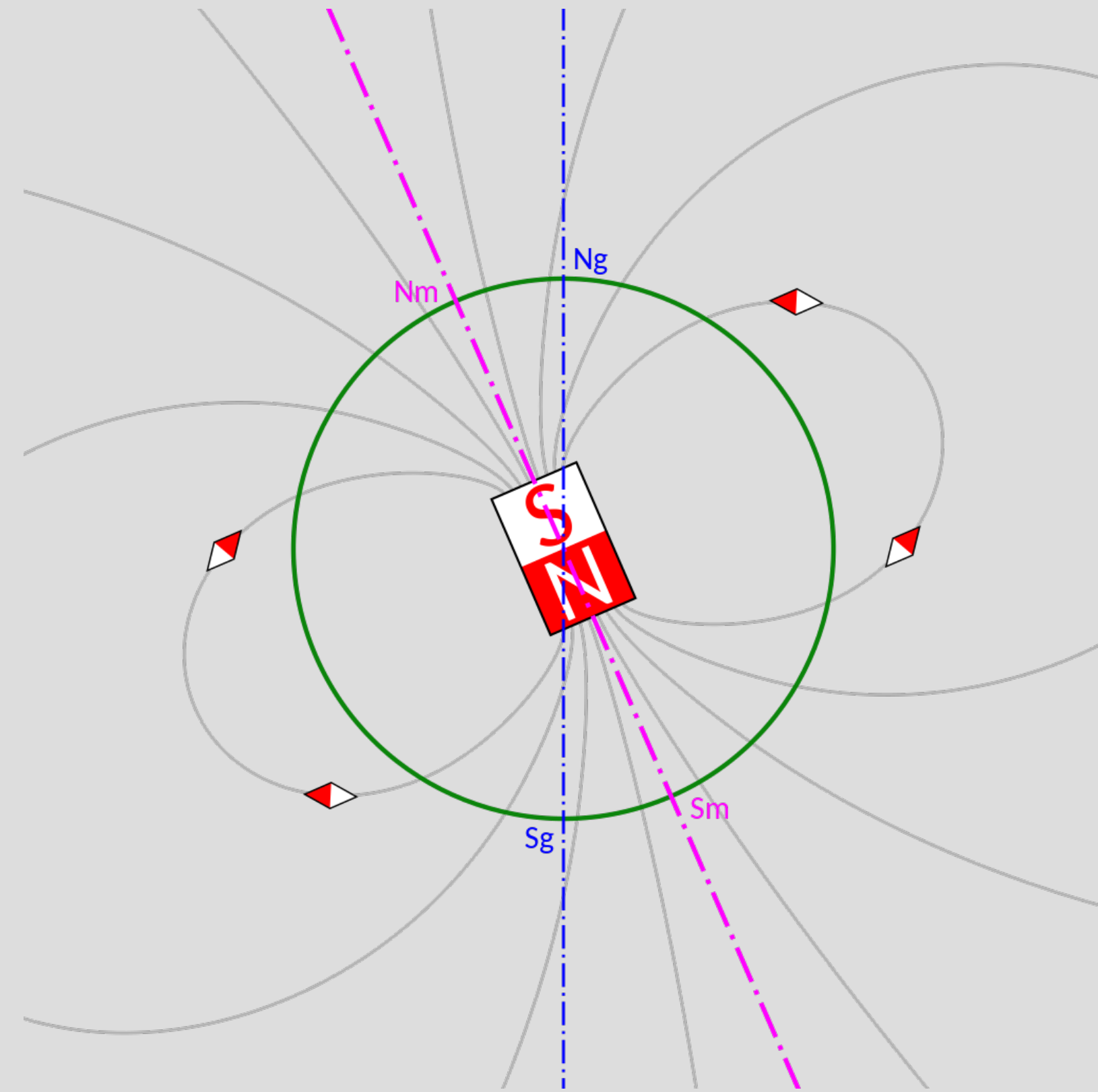
Beziehung Atmosphäre - Ionosphäre



Magnetfeld der Erde

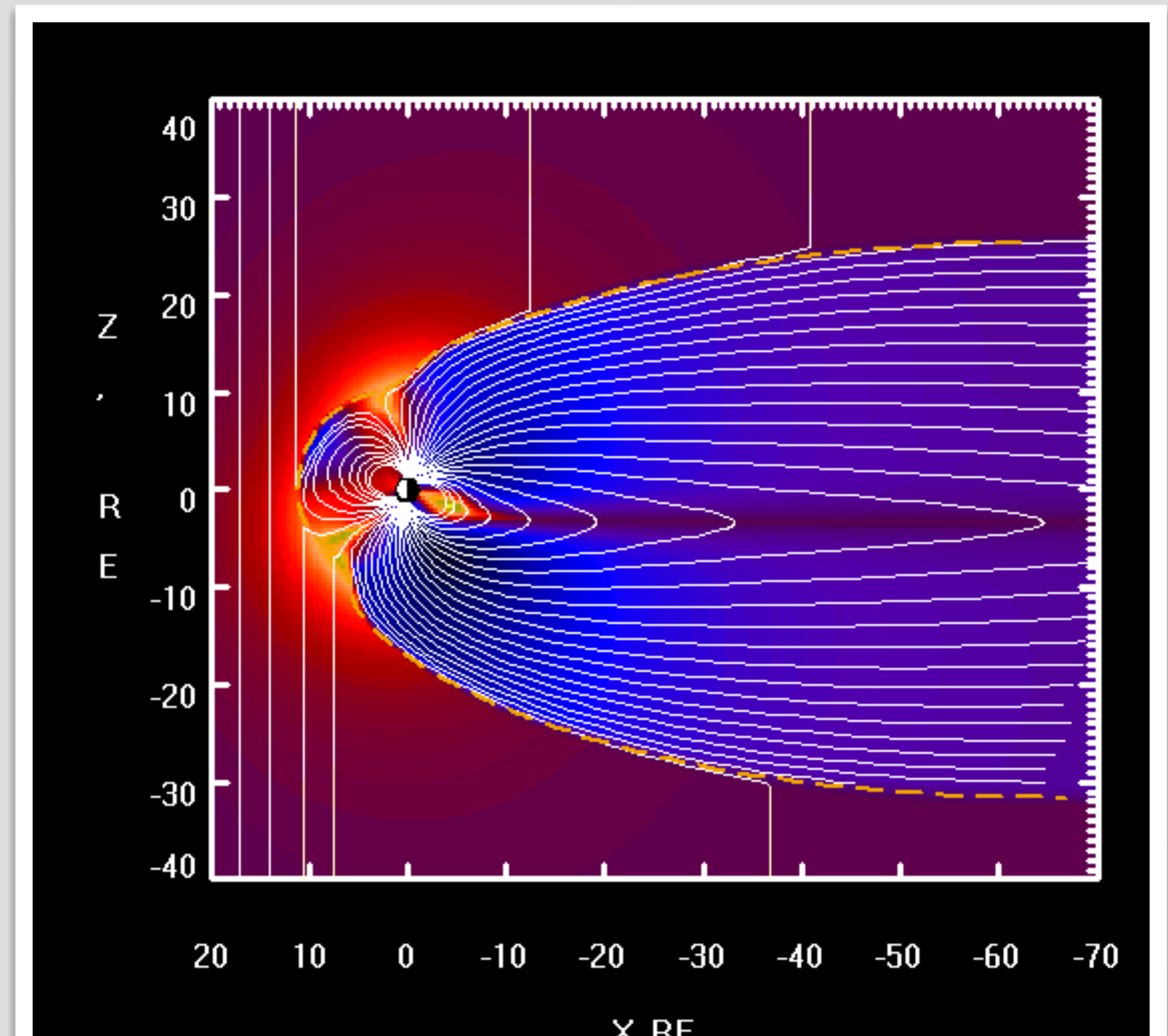
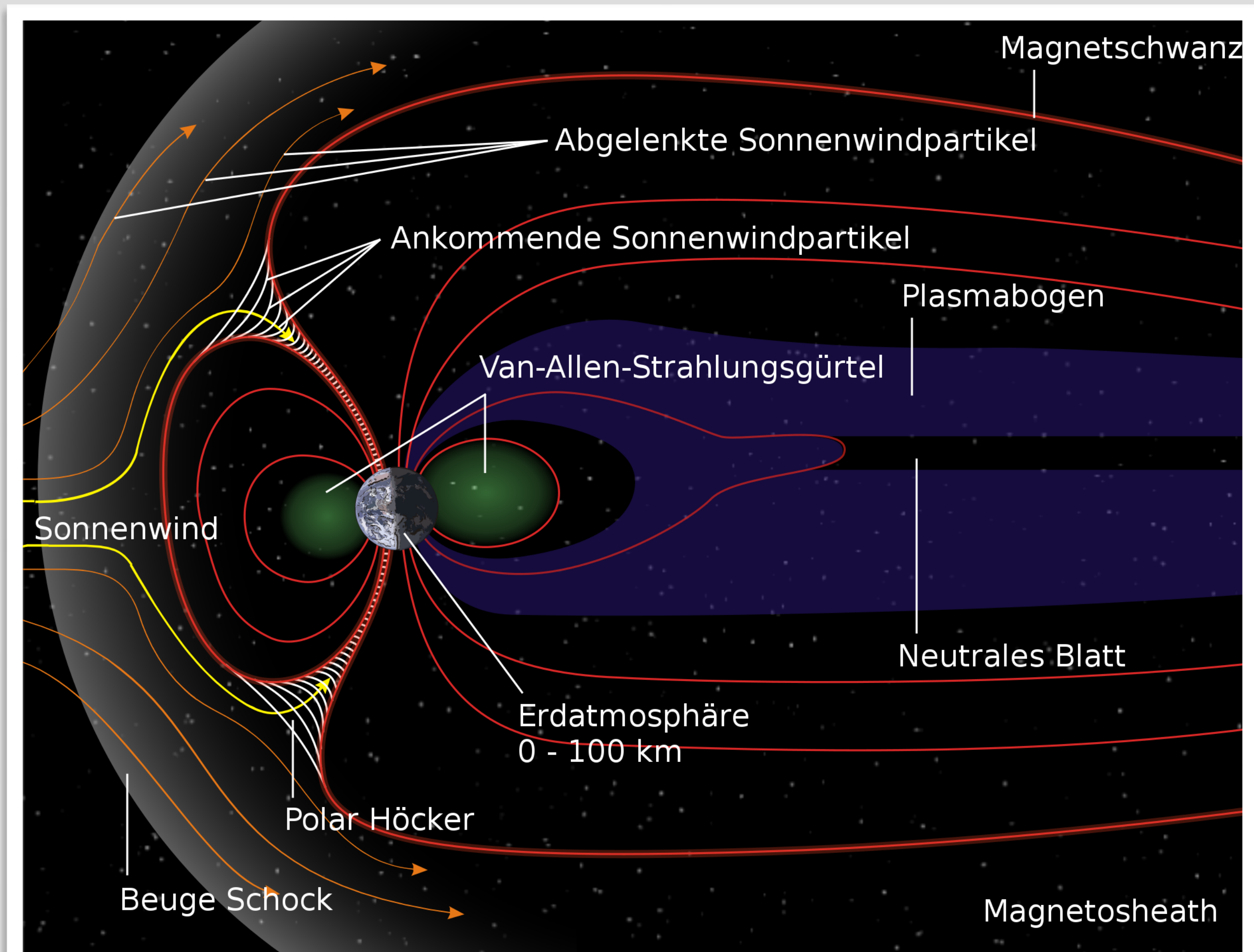


Modell Geodynamo der Erde



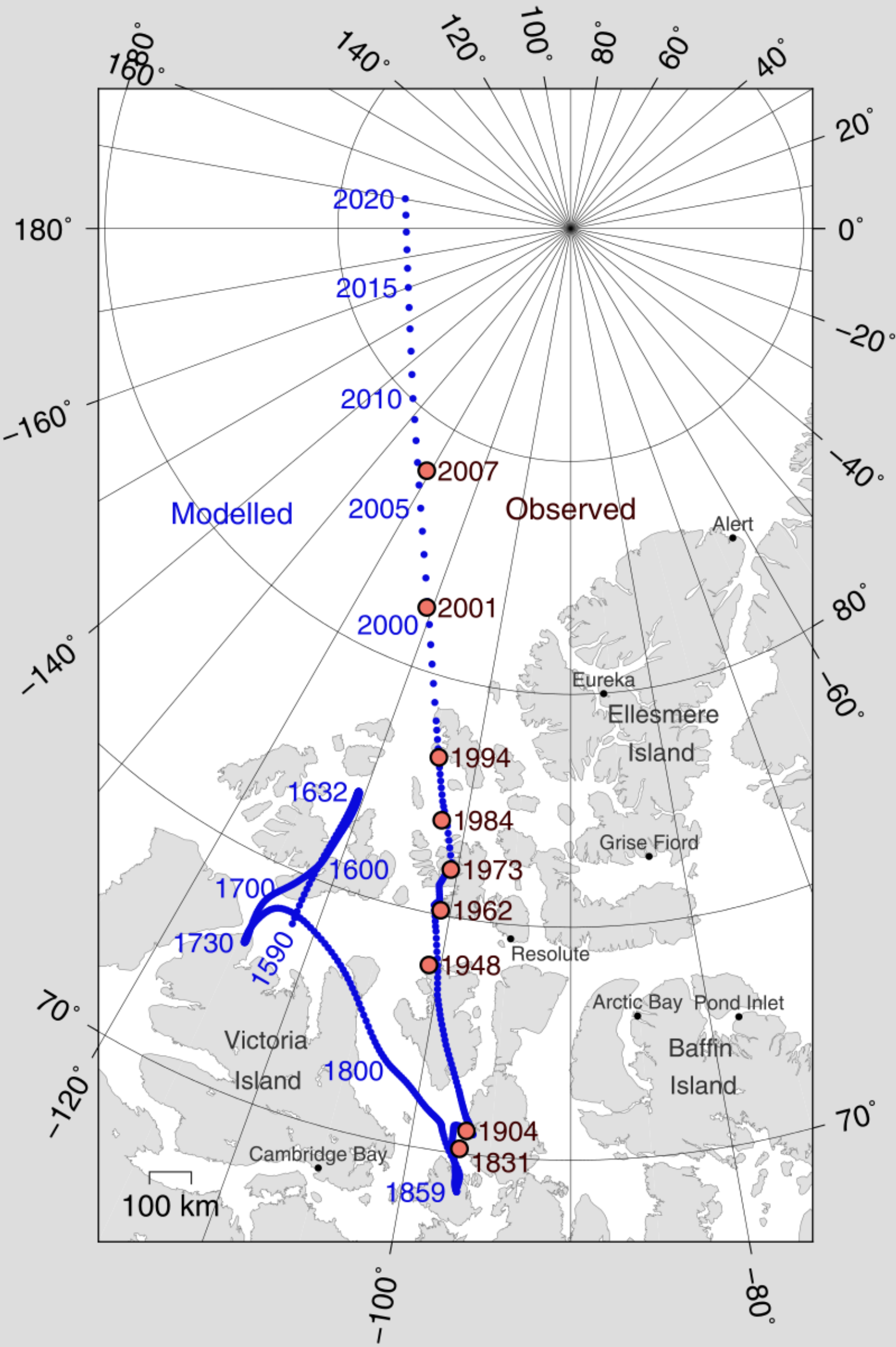
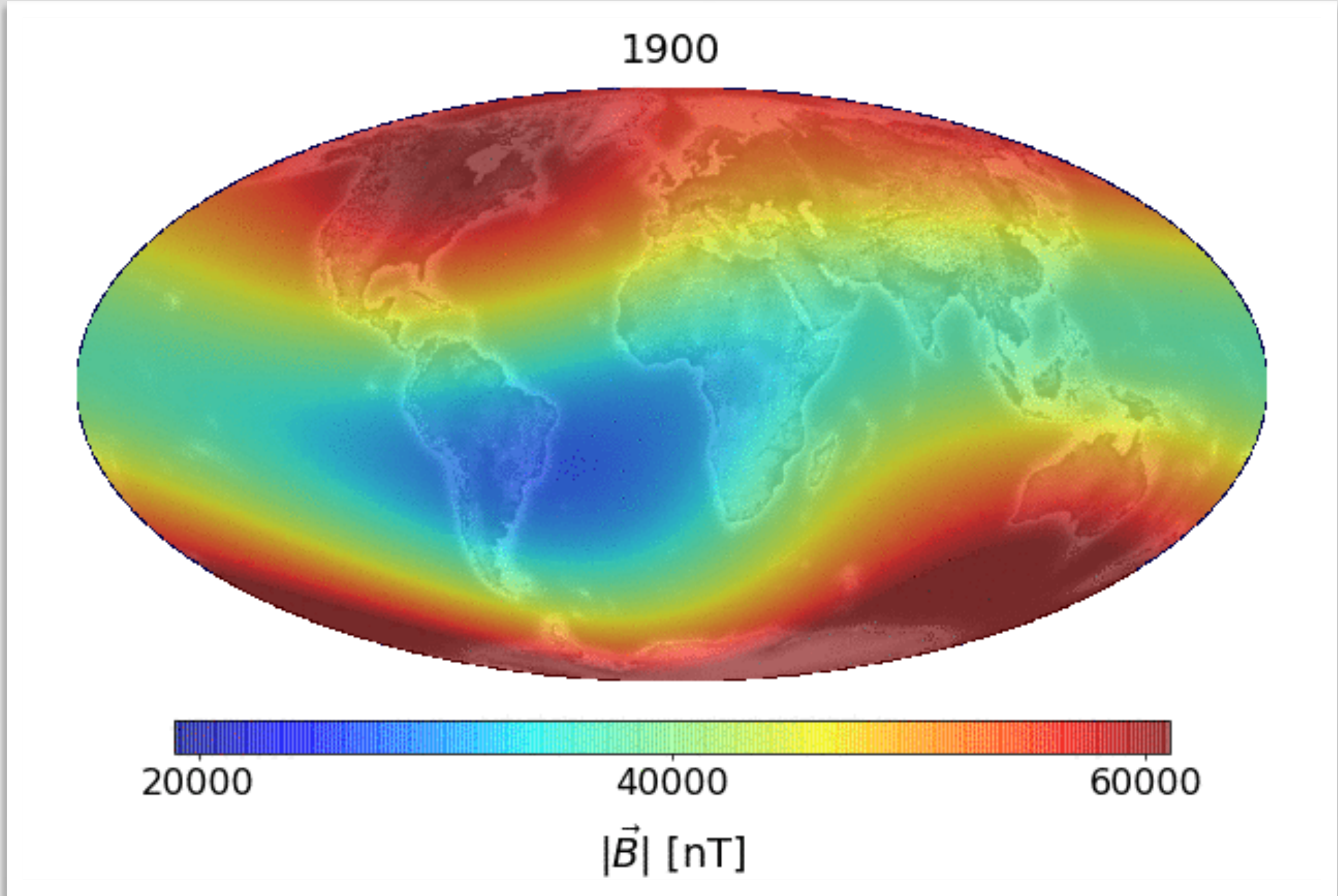
Magnetisches Dipolfeld

Magnetosphäre der Erde



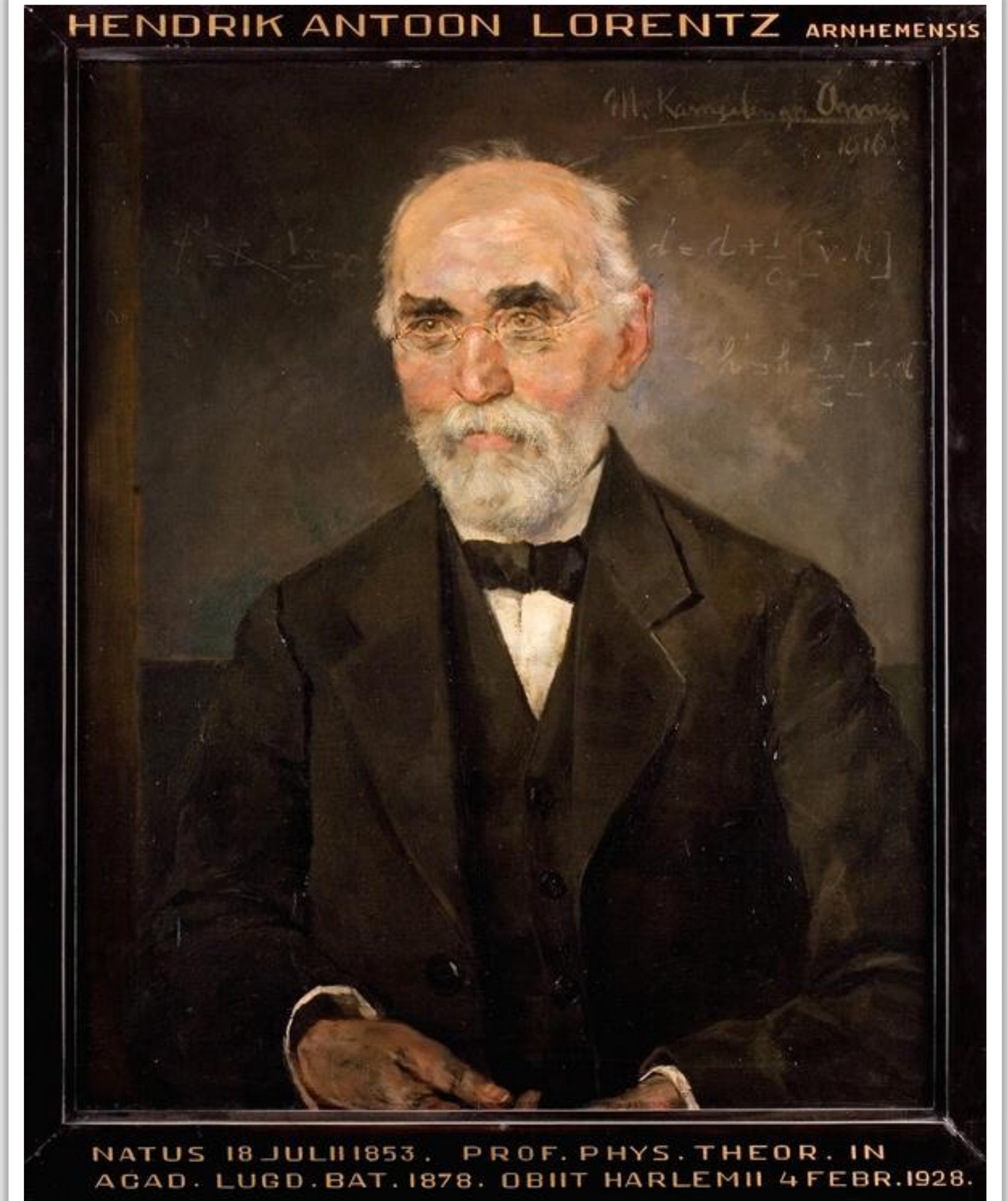
Variation Magnetfeldstärke der Erde

Year	1990 (definitive)	2000 (definitive)	2010 (definitive)	2020
North magnetic pole	 78.095°N 103.689°W	 80.972°N 109.640°W	 85.020°N 132.834°W	 86.494°N 162.867°E
South magnetic pole	 64.910°S 138.902°E	 64.661°S 138.303°E	 64.432°S 137.325°E	 64.081°S 135.866°E

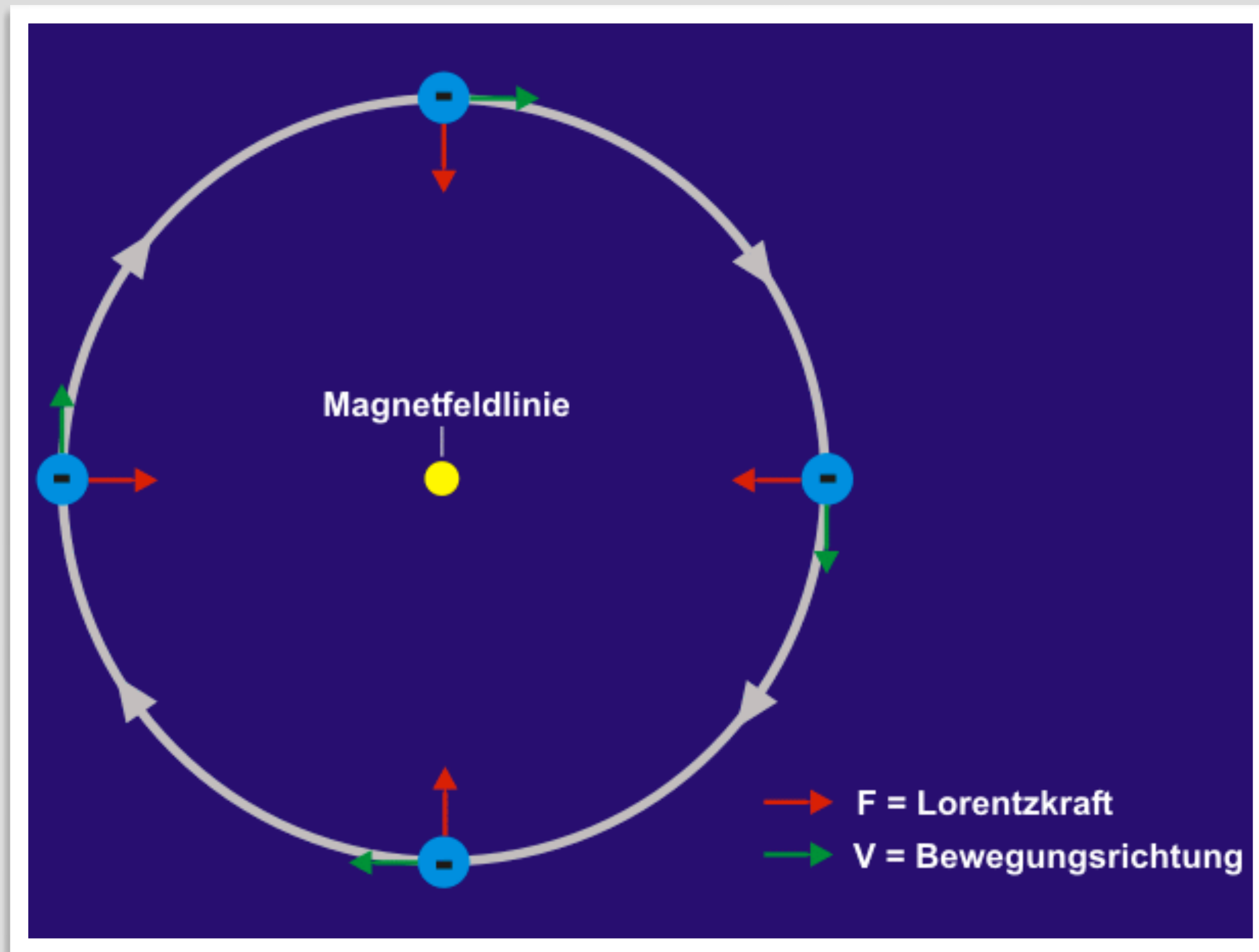


Die Lorentzkraft

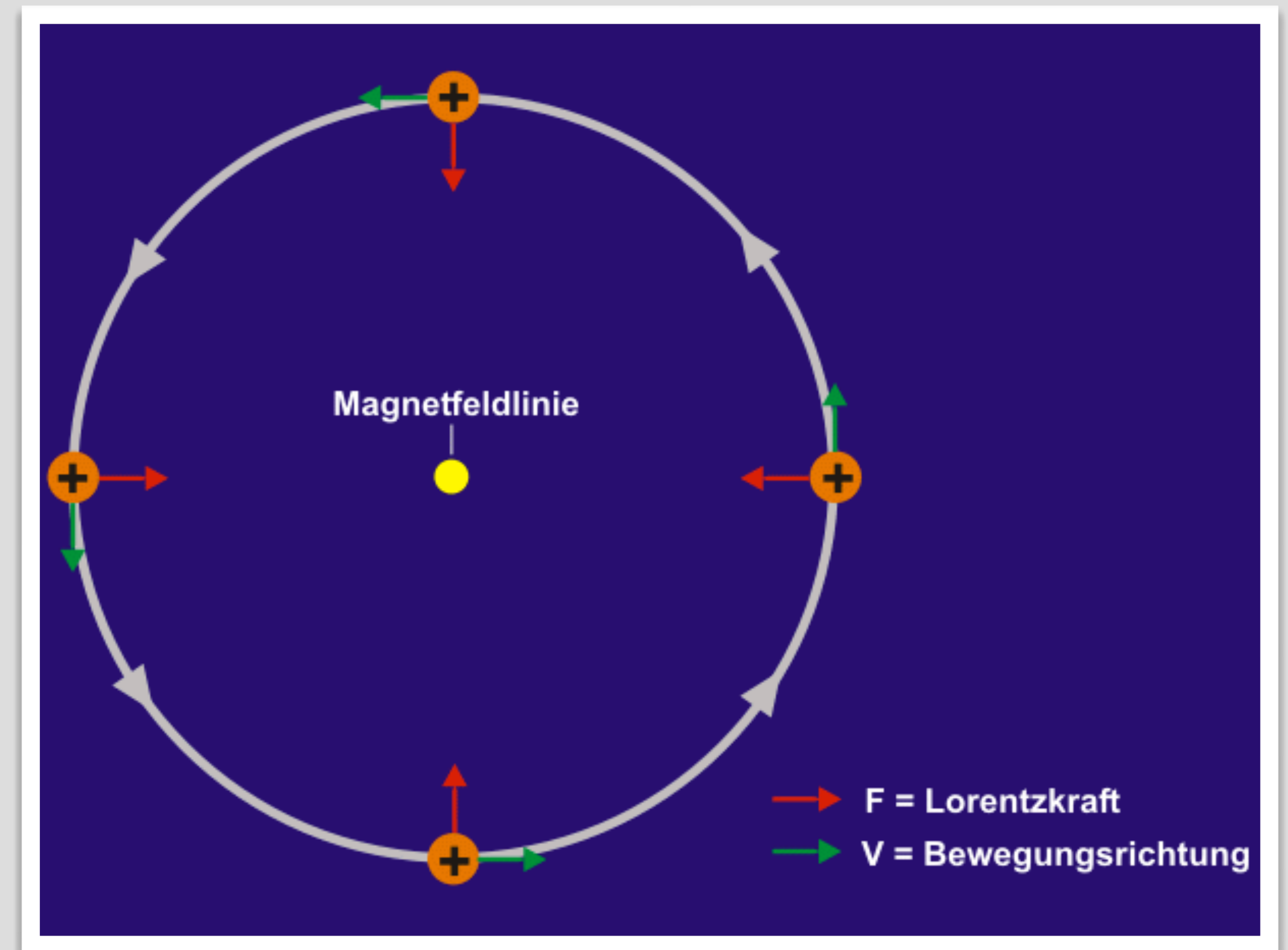
$$\vec{F} = \vec{F}_E + \vec{F}_B = q\vec{E} + q\vec{v} \times \vec{B}$$



Elektronen und Protonen

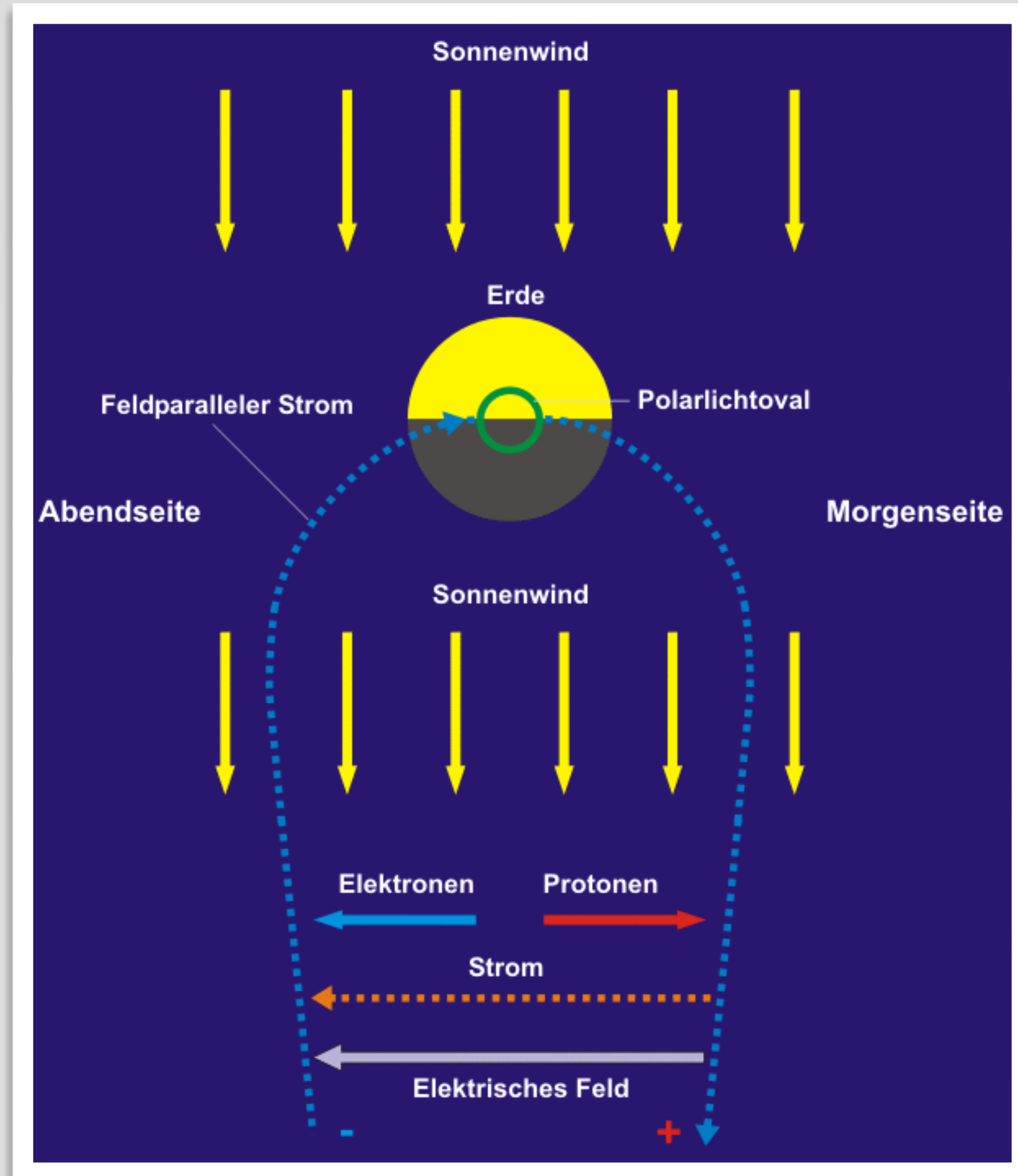


Ablenkung eines negativen Teilchens
durch die Lorentzkraft

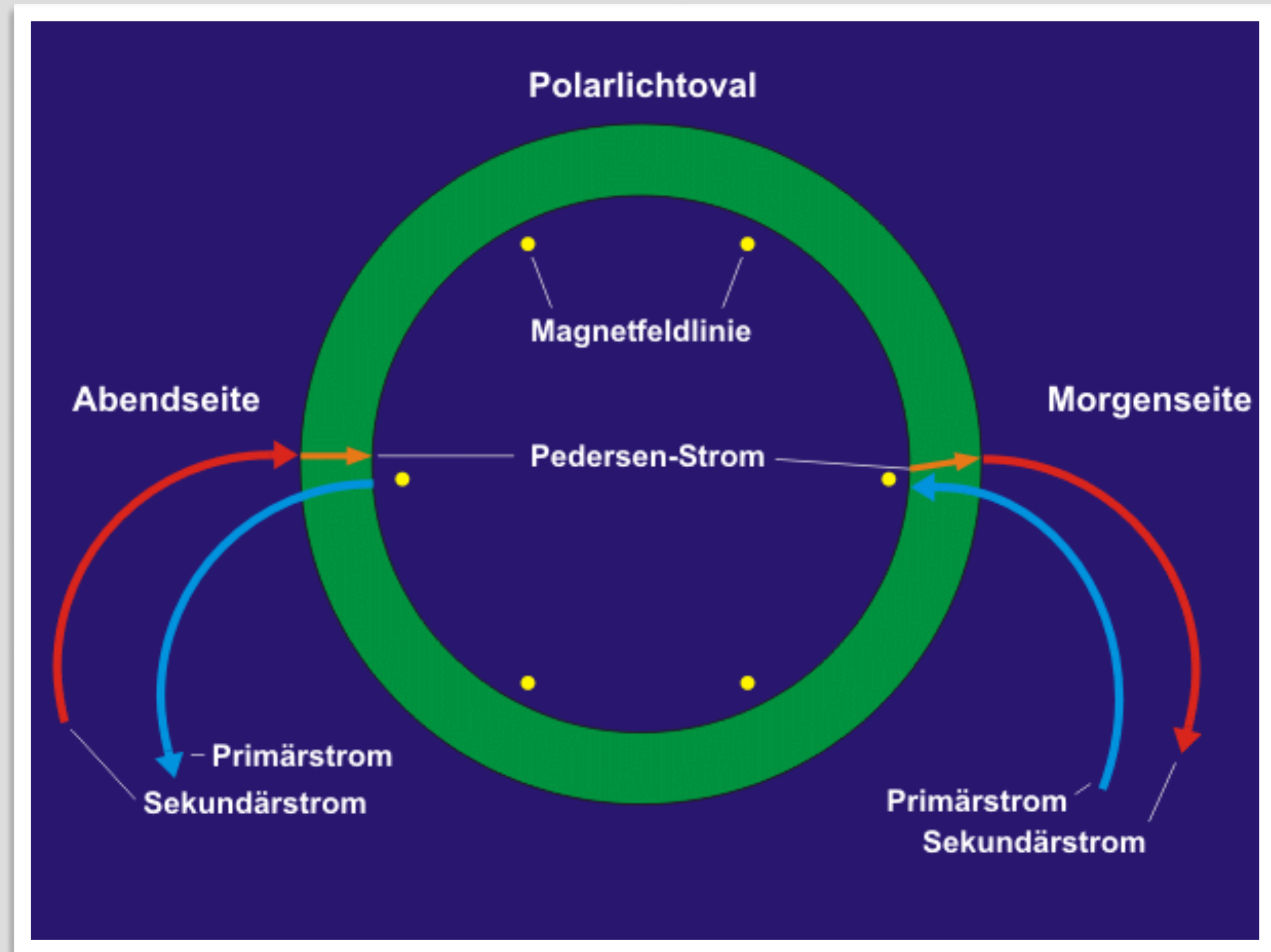


Ablenkung eines positiven Teilchens
durch die Lorentzkraft

Magnetosphäre als Generator

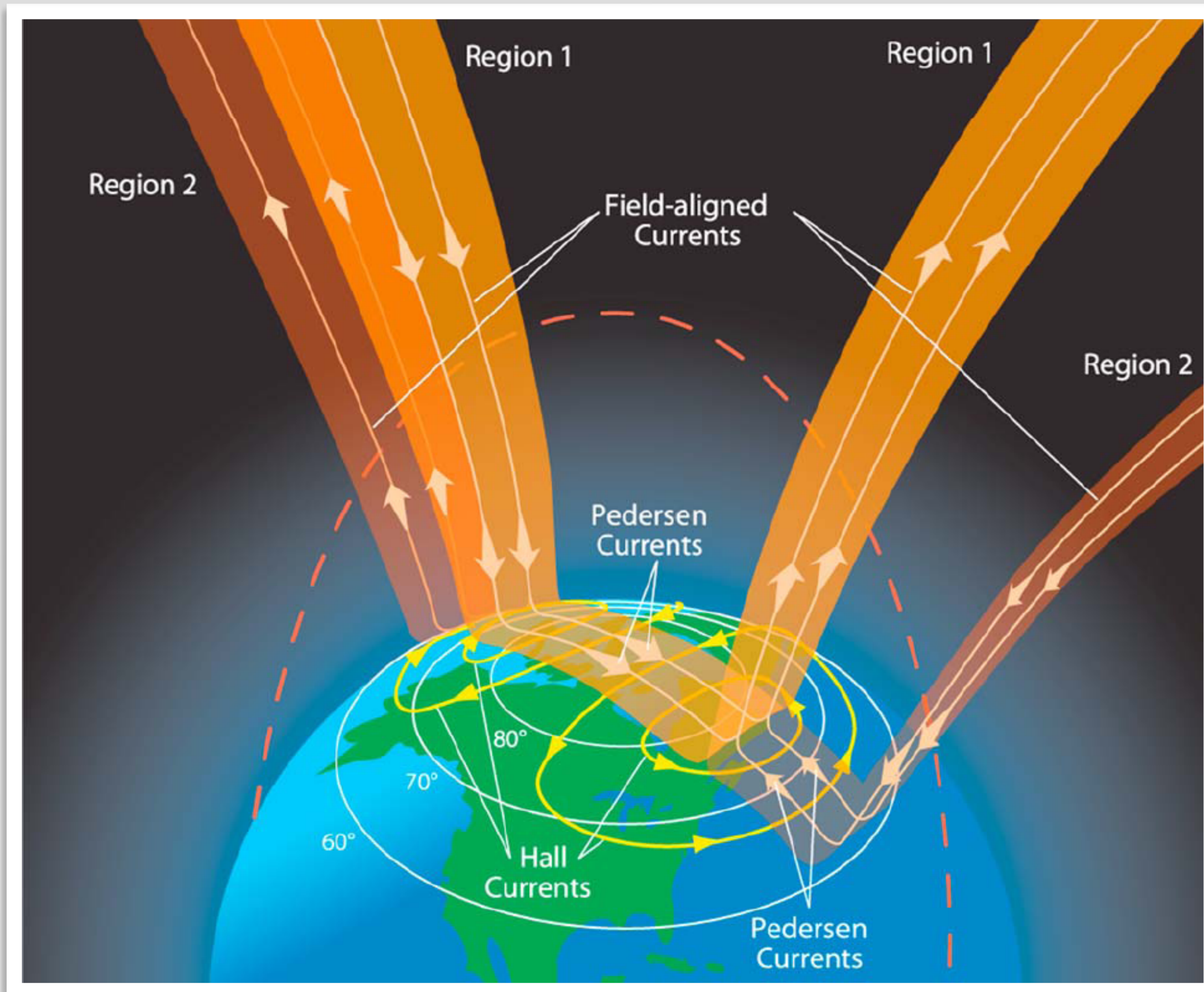


Ströme und Ladungen in der Magnetosphäre



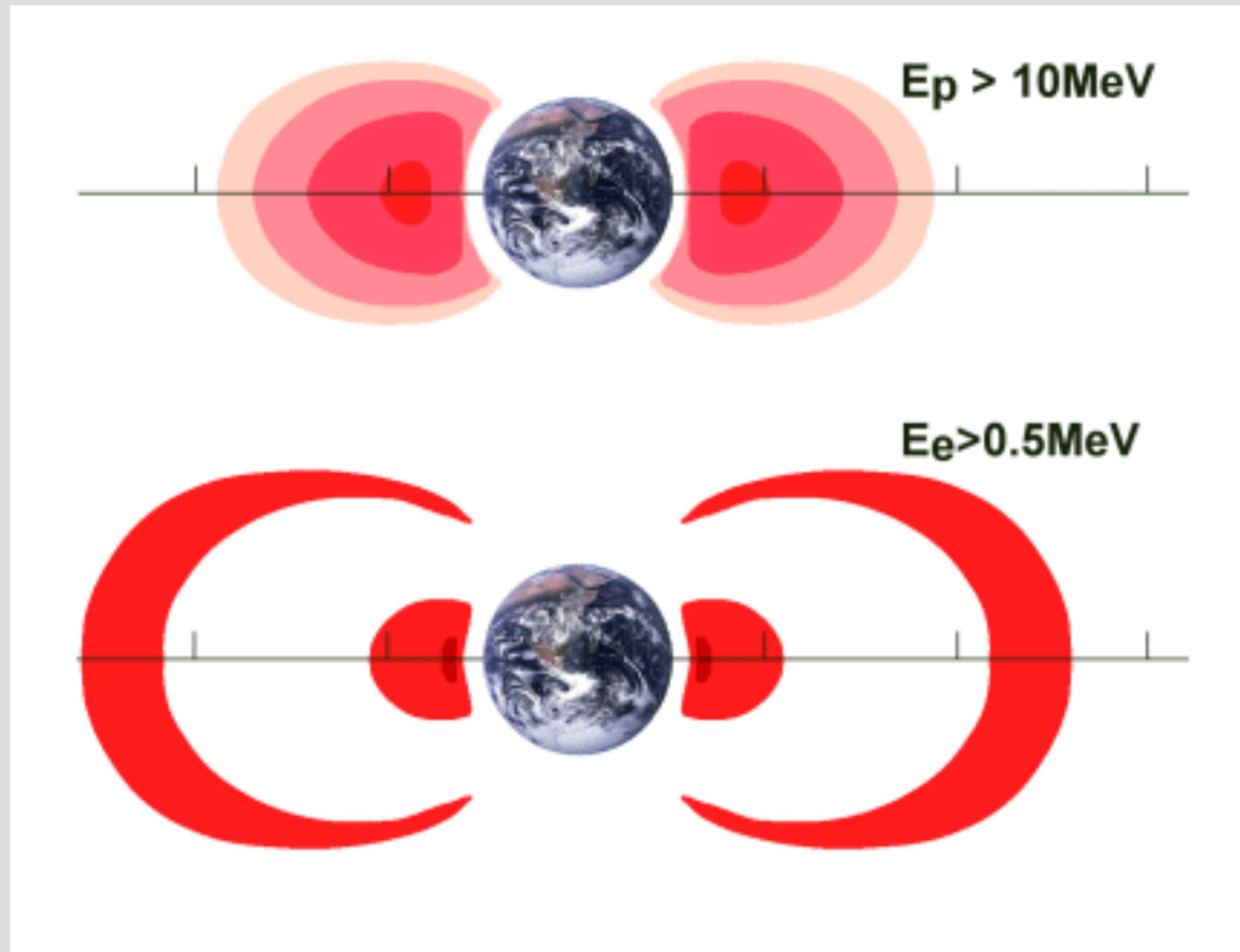
Ströme im Polarlichtoval

Die Birkeland, Pederson und Hall Ströme



Birkeland, Pedersen und Hall Ströme

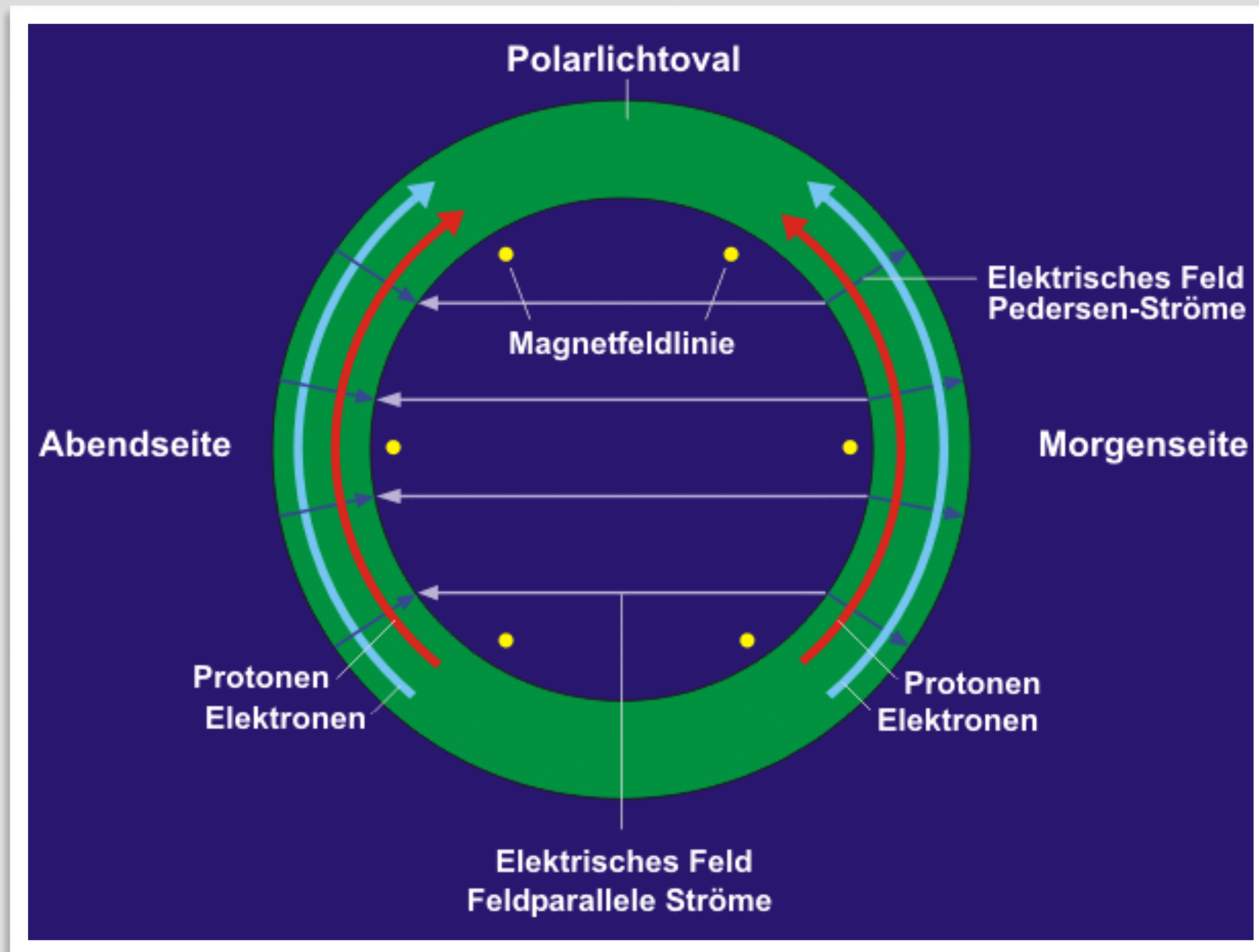
Van Allen Strahlungsgürtel



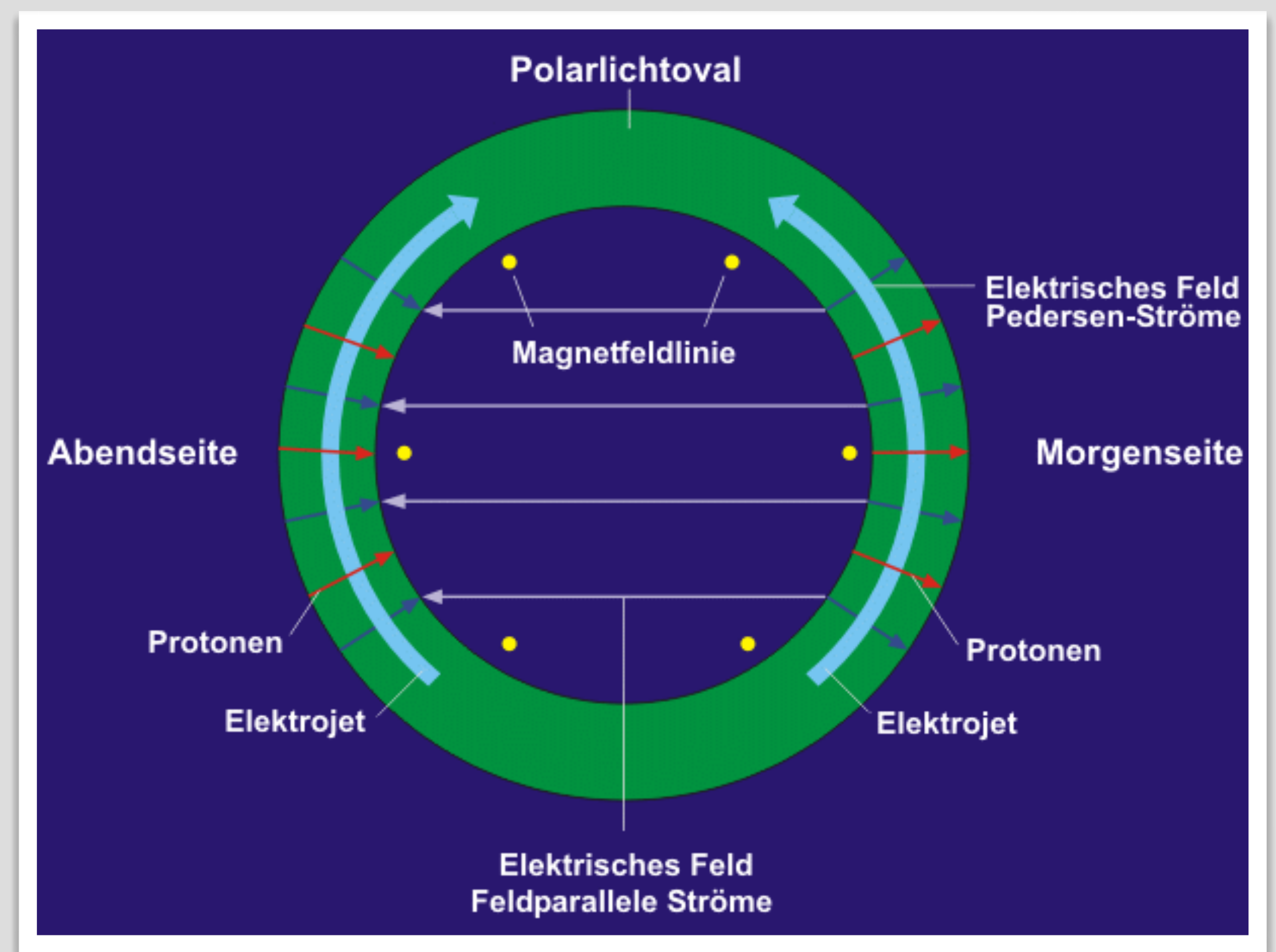
Protonen: 700-6000 km Höhe

Elektronen: 16.000 - 58.000 km Höhe

Polarlichtoval in 300 und 100 km Höhe

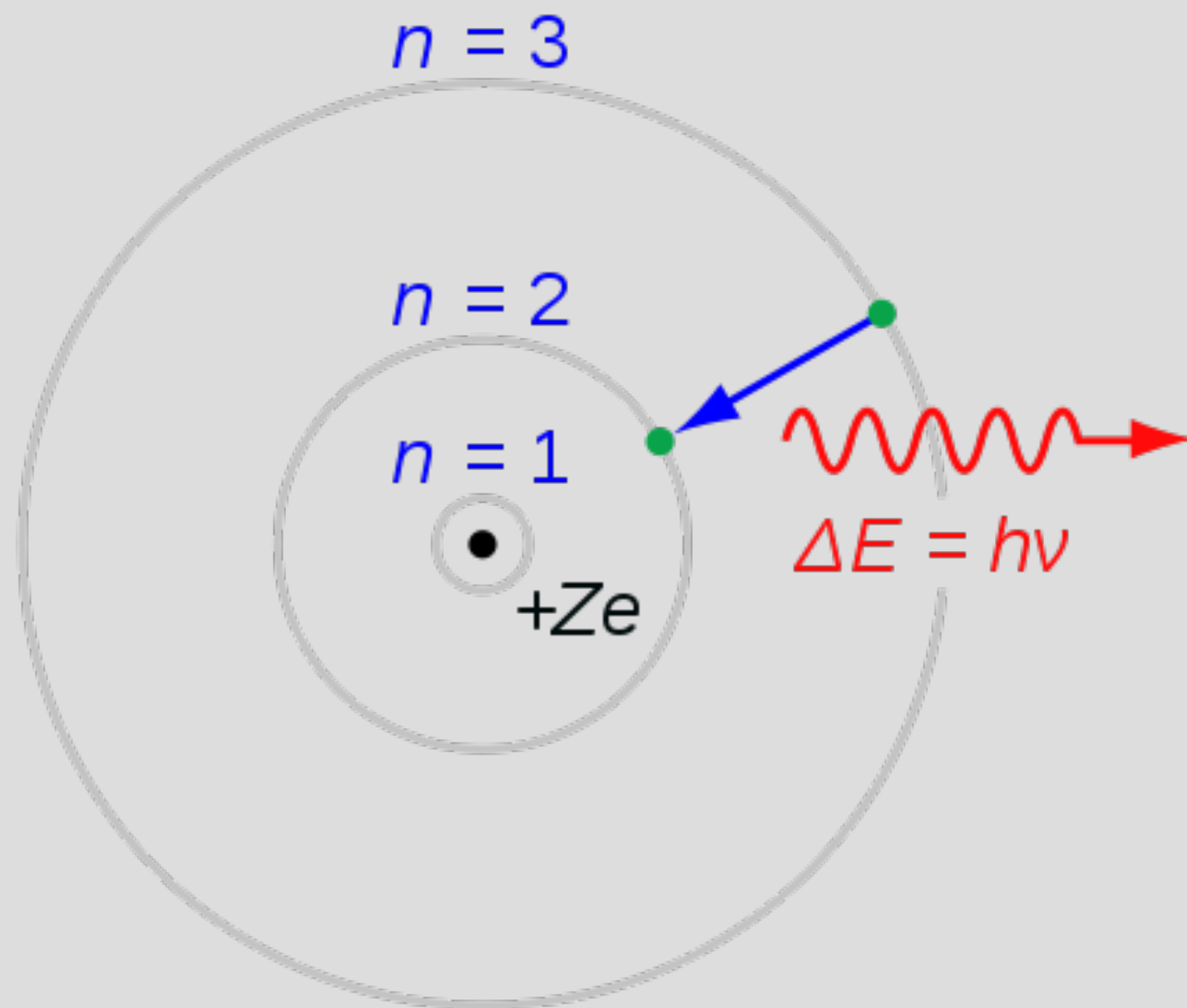


Polarlichtoval in 300 km Höhe



Polarlichtoval in 100 km Höhe

Die Entstehung der Leuchterscheinung



Bohr'sches Atommodell mit Strahlungsübergang $n=3$ auf $n=2$

- Luftmoleküle brechen in angeregte Atome auseinander
- Luftatome werden durch Stöße mit Elektronen angeregt
- Luftatome werden durch Stöße mit Elektronen ionisiert

Farbe	Wellenlänge	Element	Höhe
Rot	630 nm	Angeregter Sauerstoff	200 km
Grün	557 nm	Angeregter Sauerstoff	100 km
Violett	428 nm	Angeregter Stickstoff	<100 km

Die Valance-Jones Klassifikation

Abk.	englisch	deutsch
HA	Homogeneous Arc	Gleichmäßiger Bogen
HB	Homogeneous Band	Gleichmäßiges Band
RA	Rays Arc	Strahlenförmiger Bogen
RB	Rays Band	Strahlenförmiges Band
DS	Diffuse Surface	Diffuse Fläche
PS	Pulsating Surface	Pulsierende Fläche
PA	Pulsating Arc	Pulsierende Bögen
C	Corona	Korona (ringförmige Strahlen)
F	Flaming	In den Zenit gerichtete, pulsierende Strahlen

Formen



Farben

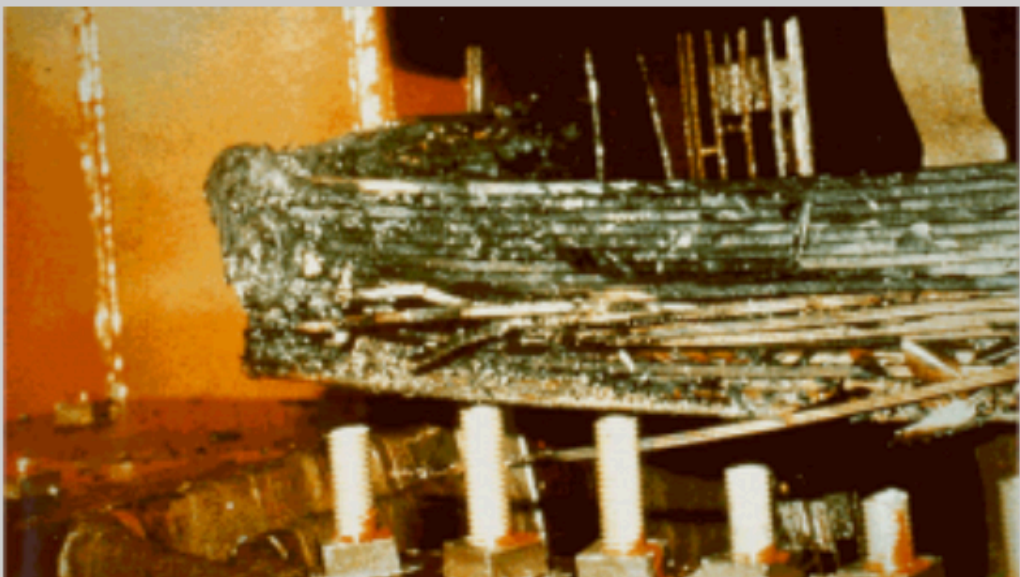


Korona

Exceptional Aurora - October 8, 2024 | Grand Portage, MN | Travis Novitsky

Weltraumwetter und Polarlichtvorhersage

<https://www.swpc.noaa.gov/>



ELECTRIC POWER TRANSMISSION

The electric power grid, and consequently the power to your home and business, can be disrupted by space weather.



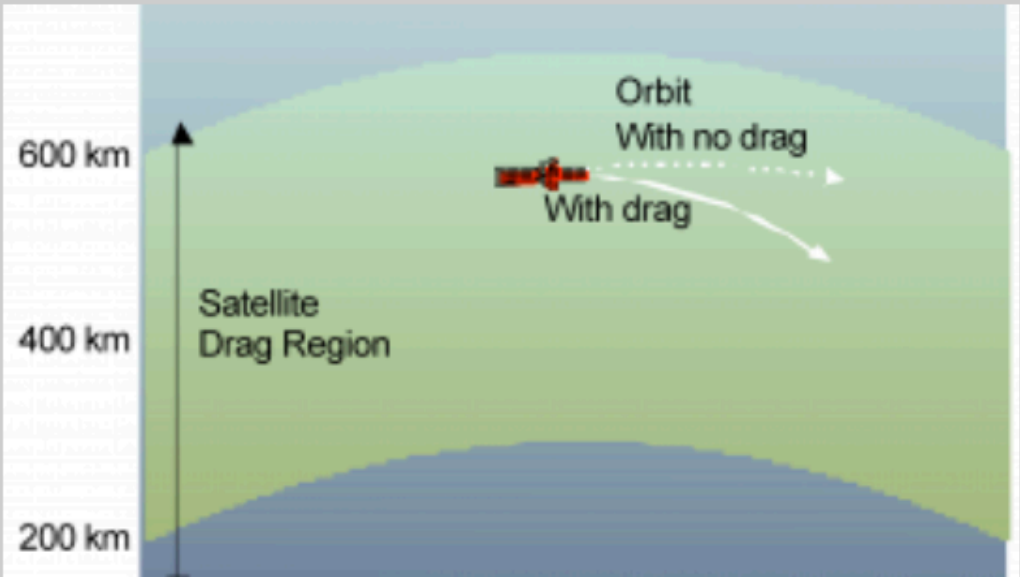
HF RADIO COMMUNICATIONS

Space weather impacts radio communication in a number of ways.



SATELLITE COMMUNICATIONS

Satellite communication refers to any communication link that involves the use of an artificial satellite in its propagation path.



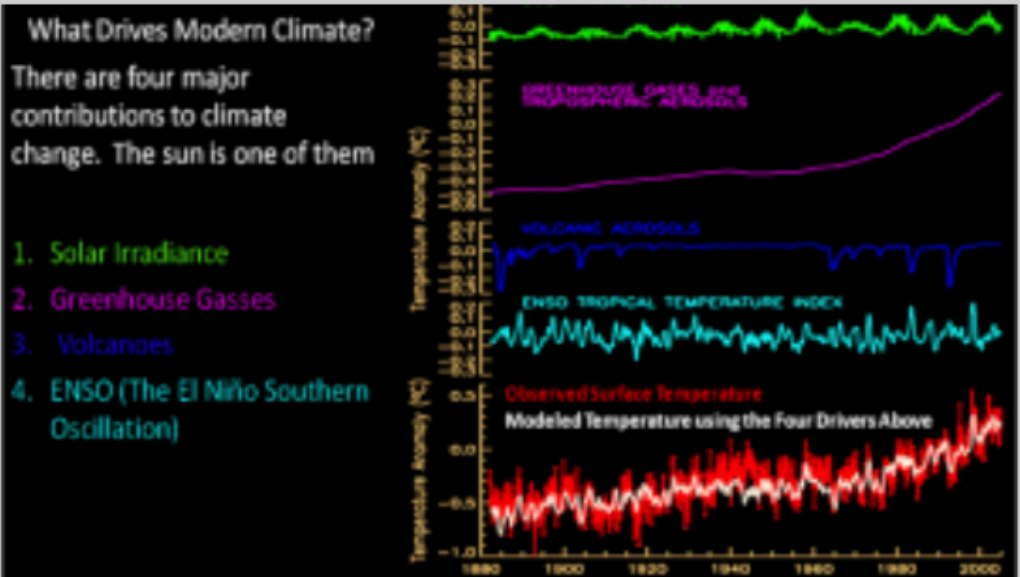
SATELLITE DRAG

Drag is a force exerted on an object moving through a fluid, and it is oriented in the direction of relative fluid flow.



SPACE WEATHER AND GPS SYSTEMS

The use of single and dual frequency radio navigation systems, like GPS, has grown dramatically in the last decade.

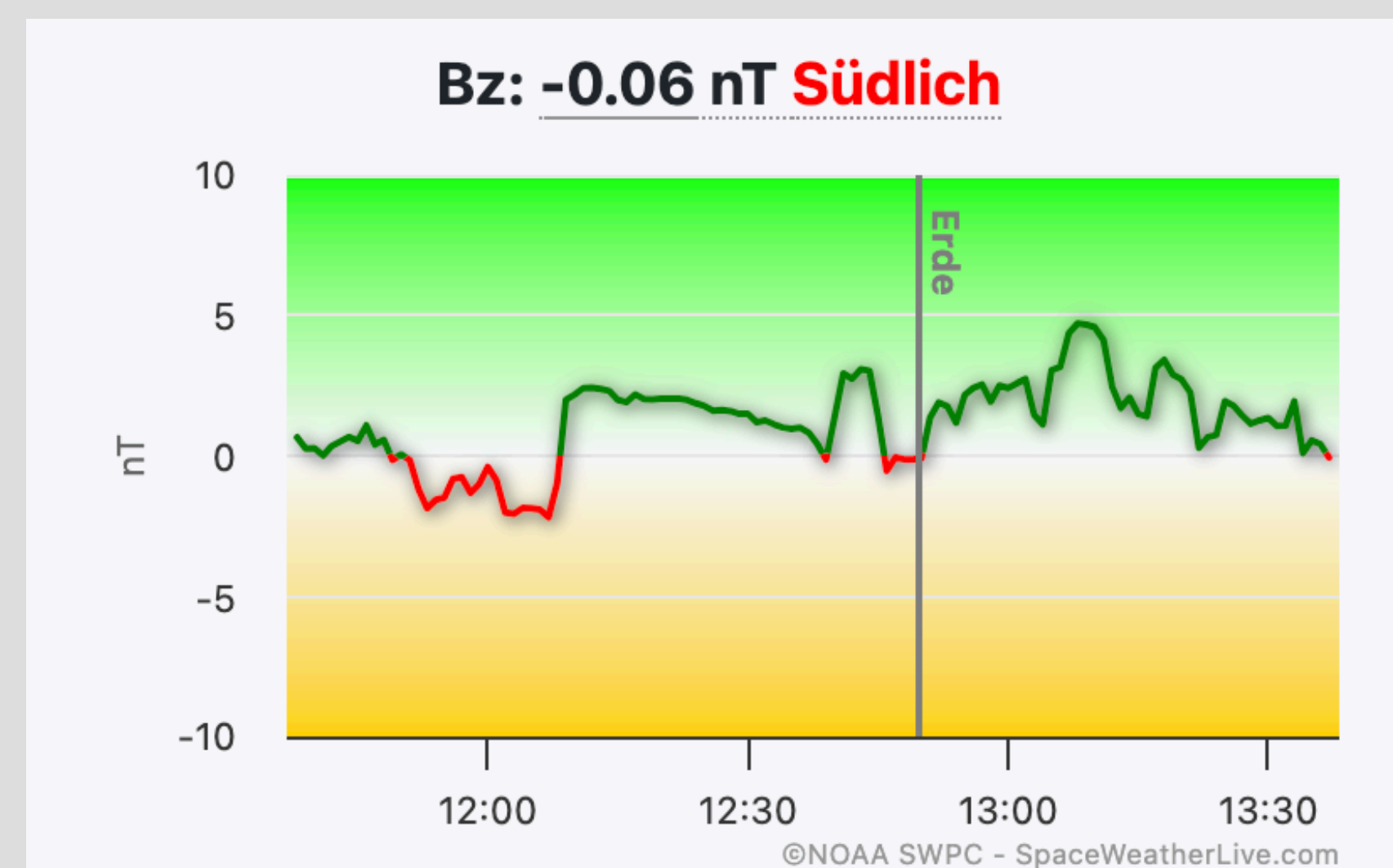
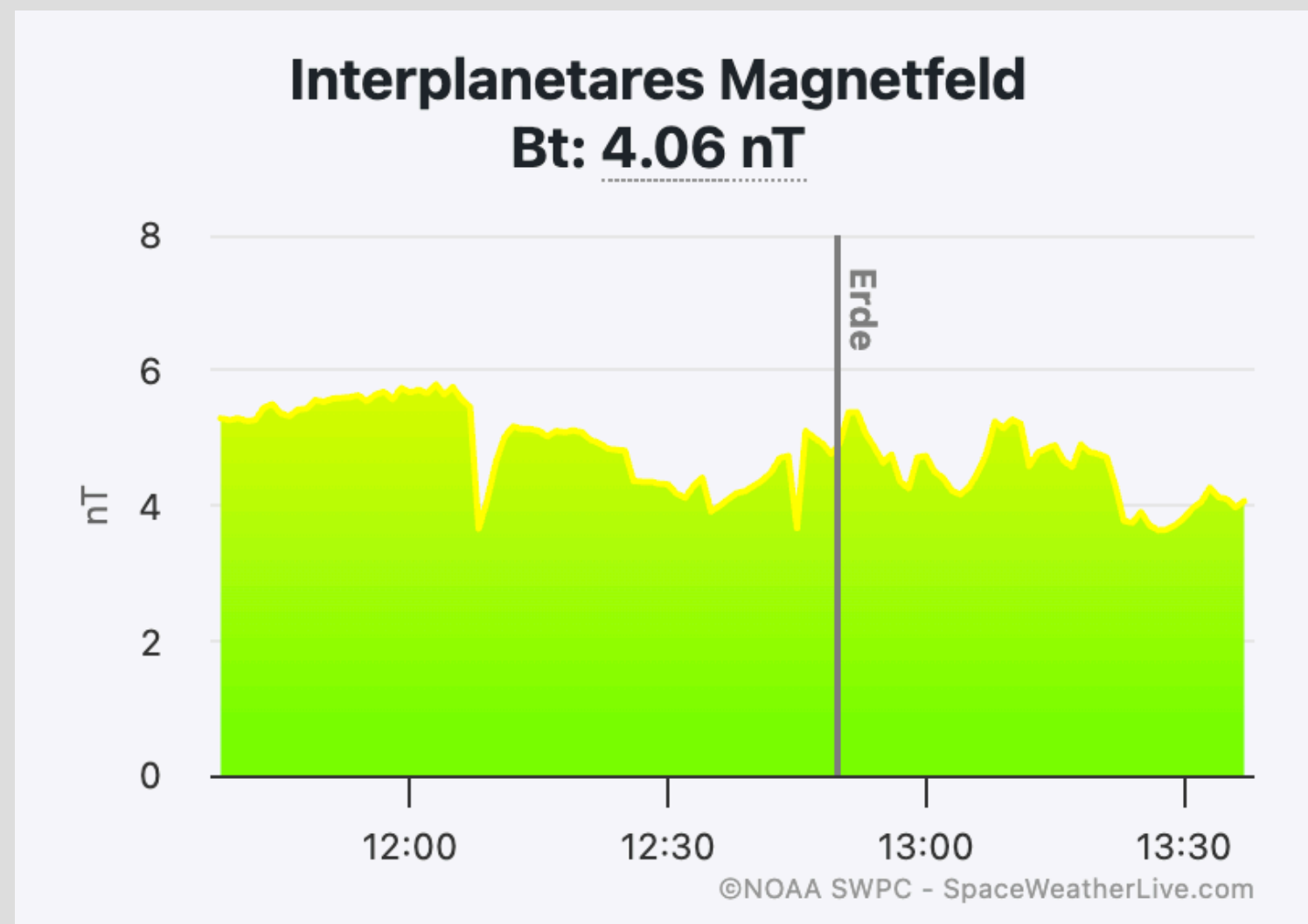
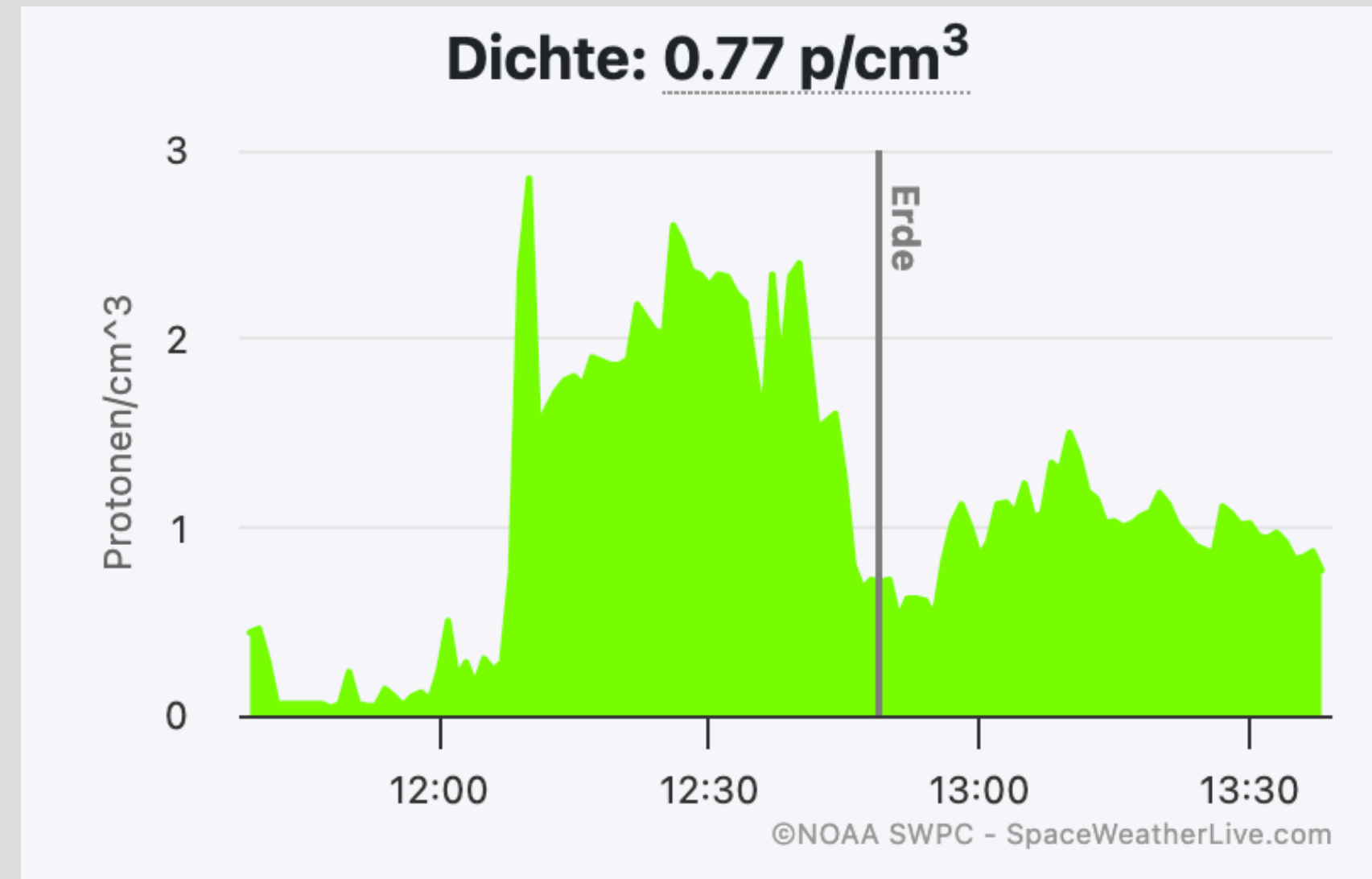
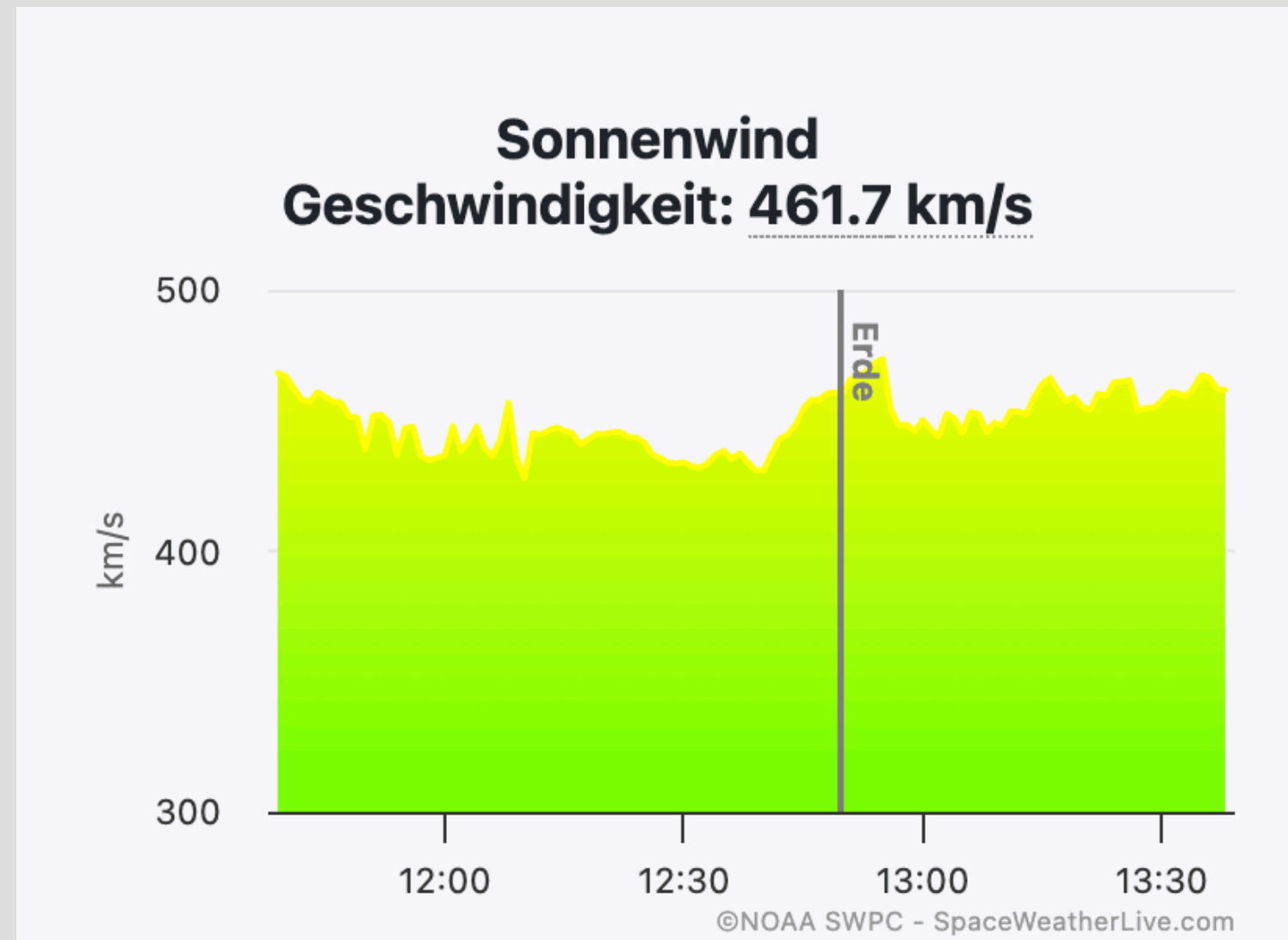


SPACE WEATHER IMPACTS ON CLIMATE

All weather on Earth, from the surface of the planet out into space, begins with the Sun.

Echtzeit Sonnenwind

<https://www.spaceweatherlive.com/>



Die Einführung des Kp-Index



Julius Bartels
1899-1965

Wurde 1949 am Geophysikalischen Institut Potsdam von Julius Bartels entwickelt, um die solare Teilchenstrahlung über ihre magnetischen Effekte zu messen.

Der Kp-Wert ist ein wichtiges Maß für den Energieeintrag aus dem Sonnenwind in das System Erde

Der Kp-Wert beruht auf Daten von 13 geomagnetischen Observatorien weltweit

Der Kp-Index wurde 1967 von der International Association of Geomagnetism and Aeronomy (IAGA) als wichtige Maßgröße anerkannt.

Der Kp-Index und seine Skala

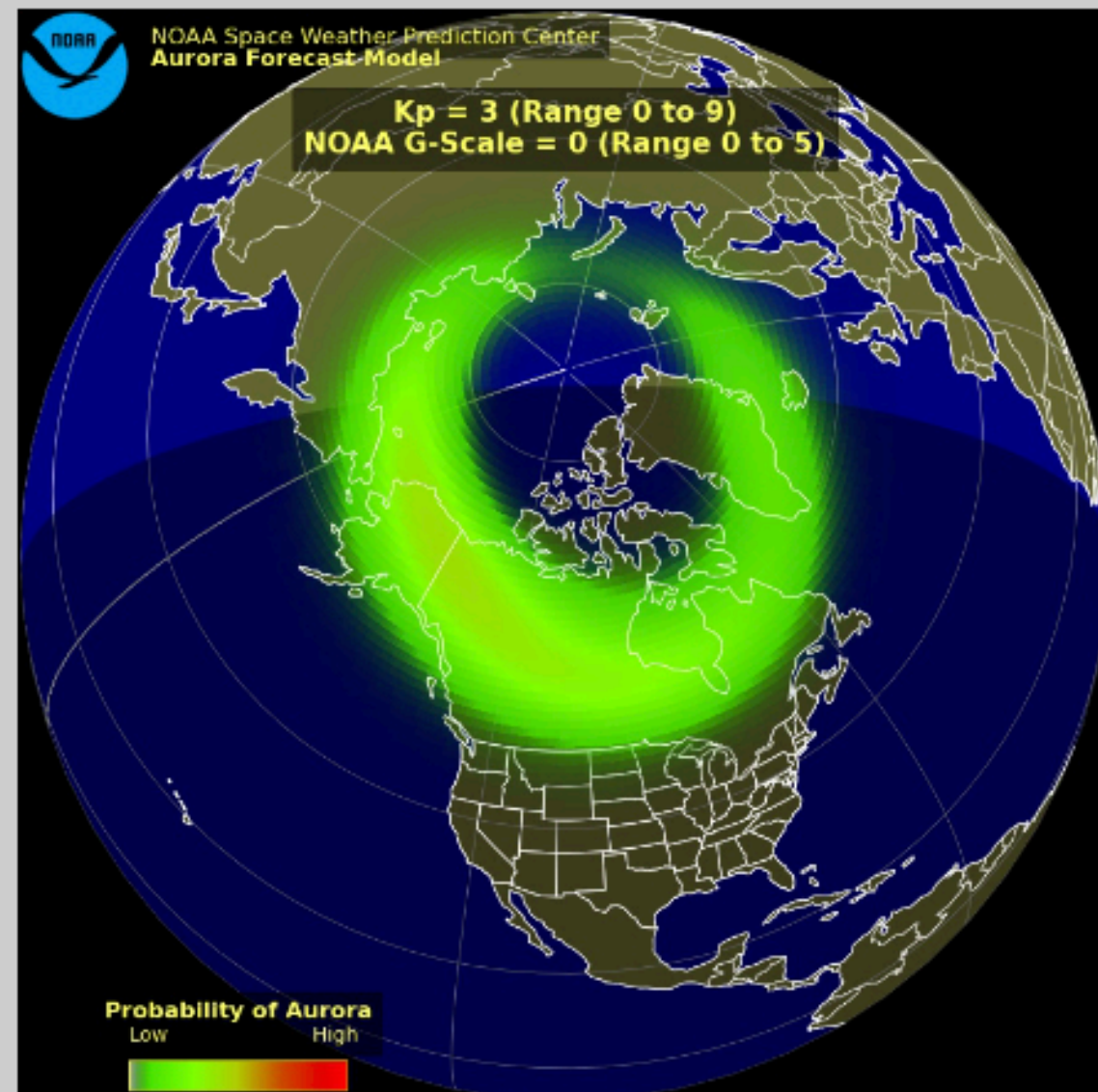
<https://kp.gfz-potsdam.de/>

Kp	G-scale	Geomagnetic latitude	Auroral activity	Average frequency
0	G0	66° or higher	Quiet	
1	G0	64.5°	Quiet	
2	G0	62.4°	Quiet	
3	G0	60.4°	Unsettled	
4	G0	58.3°	Active	
5	G1	56.3°	Minor storm	1700 per cycle (900 days per cycle)
6	G2	54.2°	Moderate storm	600 per cycle (360 days per cycle)
7	G3	52.2°	Strong storm	200 per cycle (130 days per cycle)
8	G4	50.1°	Severe storm	100 per cycle (60 days per cycle)
9	G5	48° or lower	Extreme storm	4 per cycle (4 days per cycle)

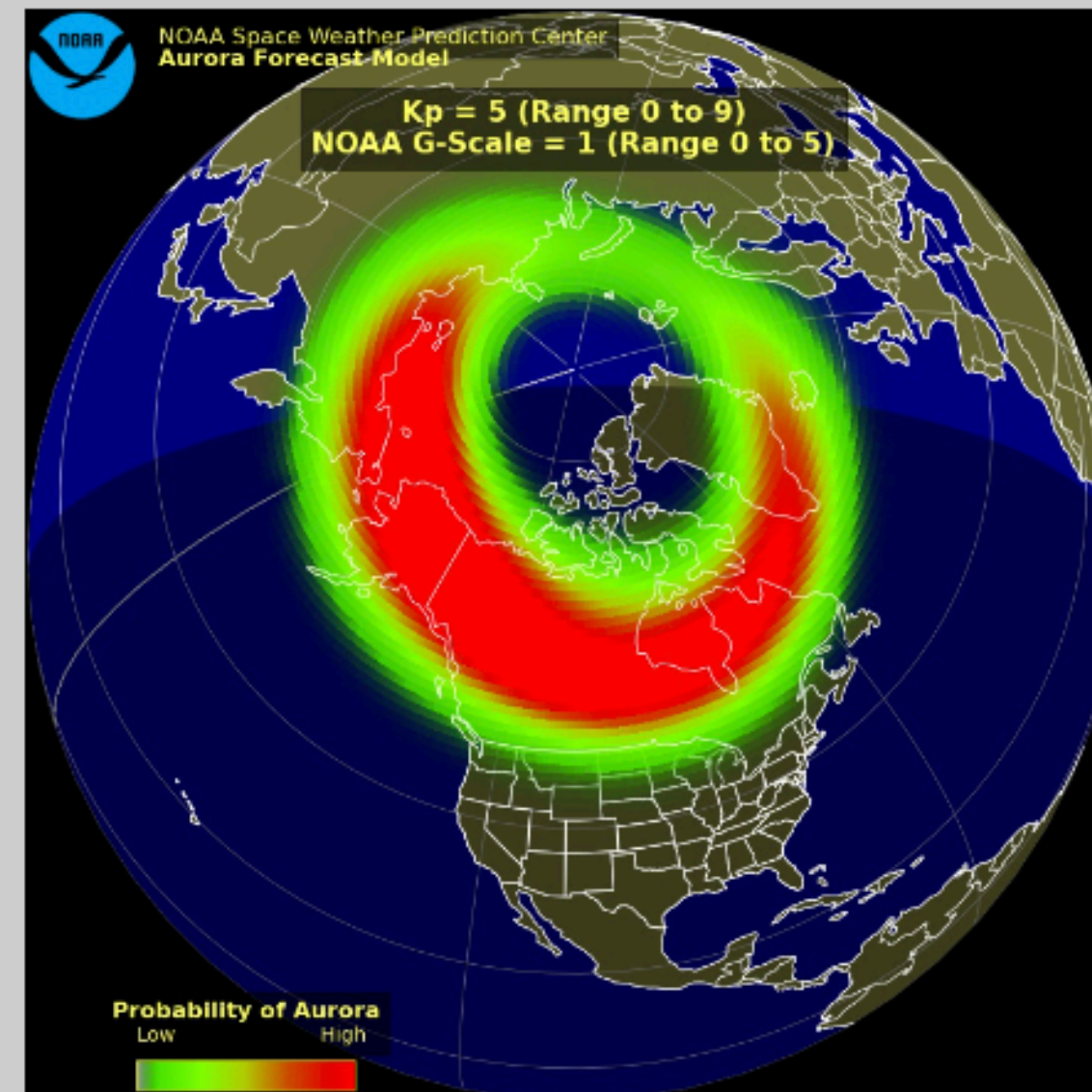
Zusammenhang Kp-Index und Polarlicht

<https://www.swpc.noaa.gov/communities/aurora-dashboard-experimental>

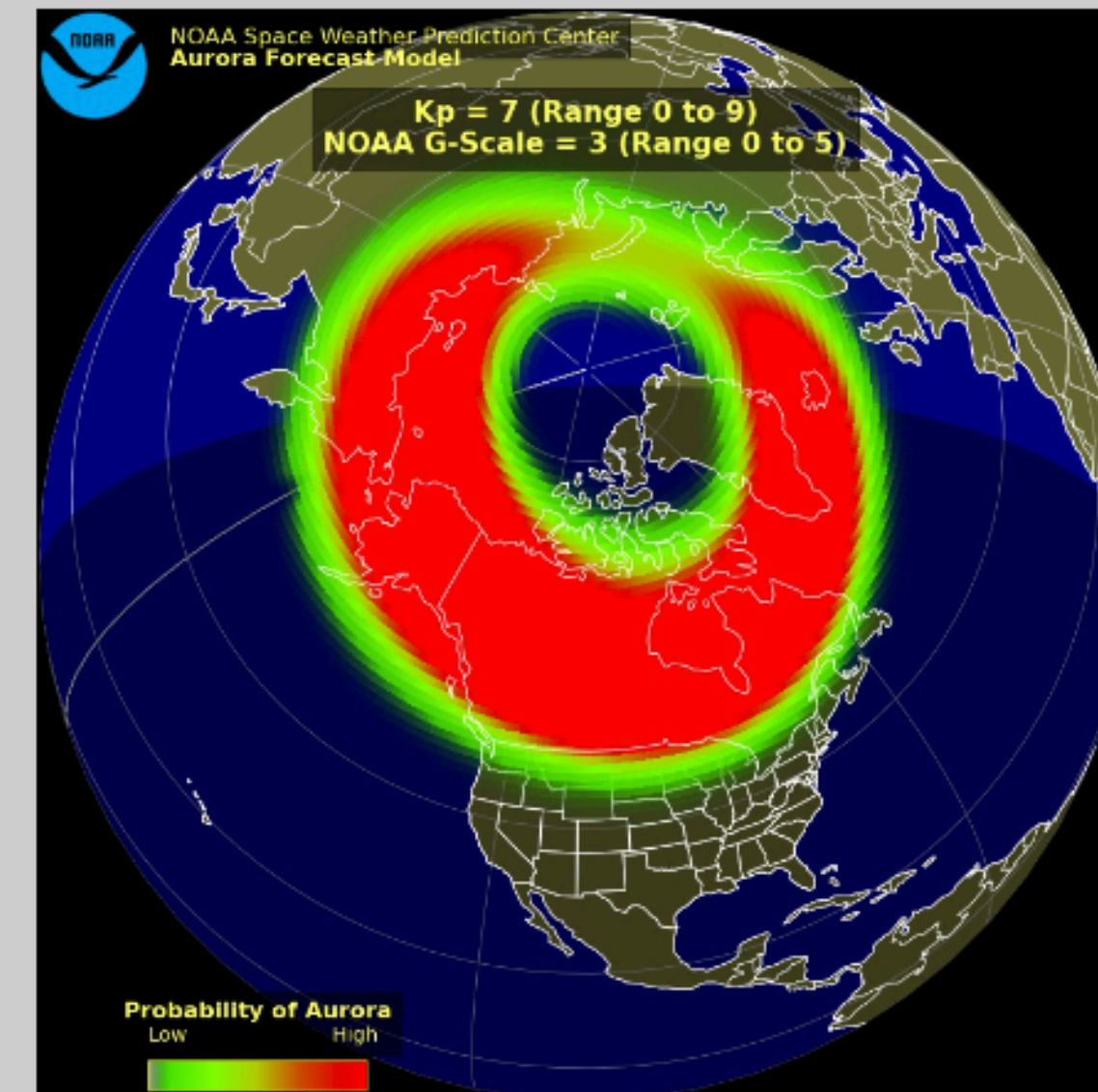
HOW DO CHANGES IN KP AFFECT THE AURORA?



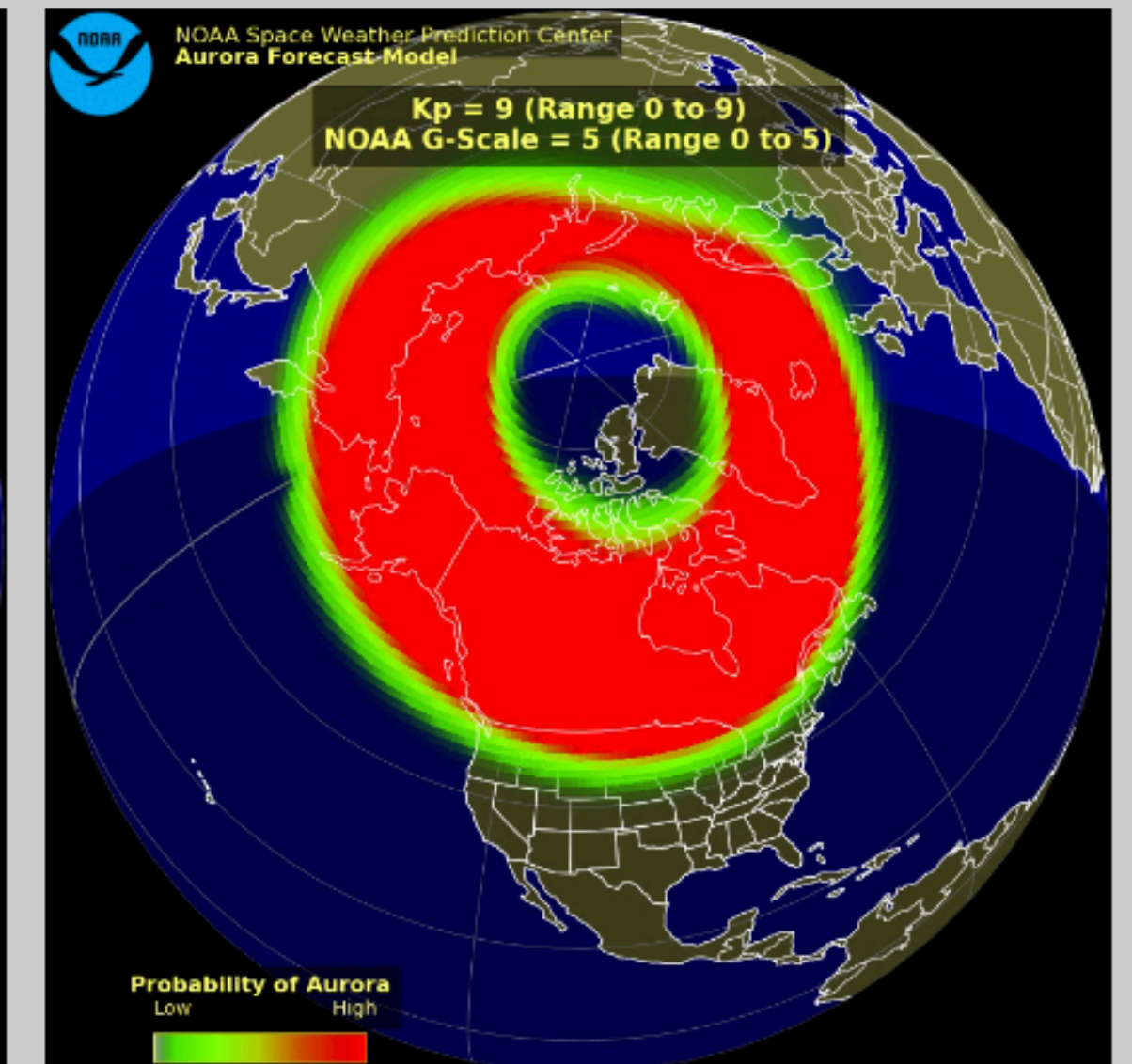
Kp = 3 Quiet Aurora



Kp = 5 Moderate Aurora



Kp = 7 Active Aurora



Kp = 9 Very Active Aurora

Kp < 5

Kp = 5 (G1)

Kp = 6 (G2)

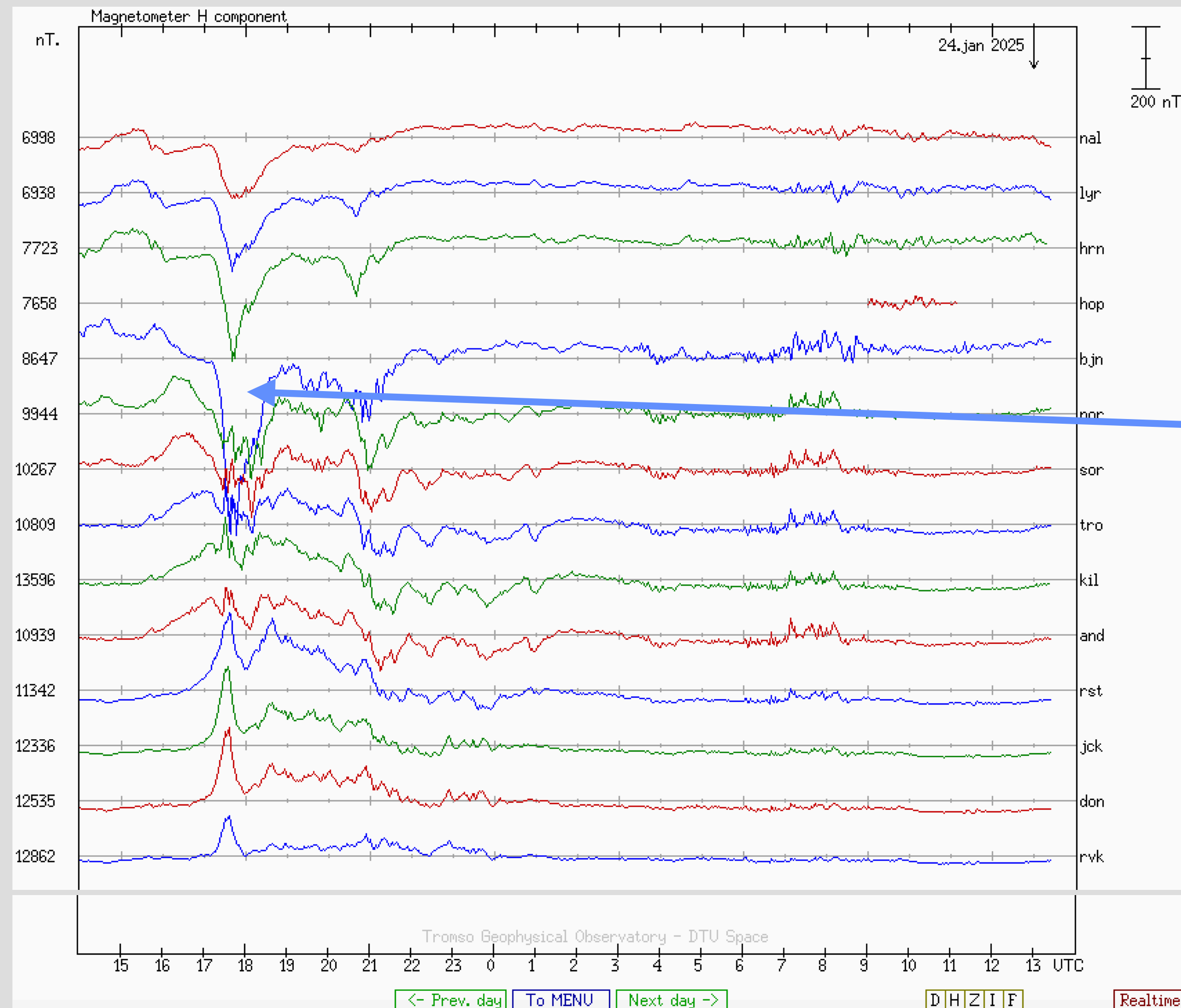
Kp = 7 (G3)

Kp = 8, 9- (G4)

Kp = 9o (G5)

Kp-Wert und Magnetometer

<https://geo.phys.uit.no/>



Magnetometermessungen vom
23. und 24. Jänner 2025

Das war unser Polarlicht vom
23. Jänner um 19:00 Uhr MEZ!

Polarlicht Vorhersage

<https://www.swpc.noaa.gov/products/aurora-30-minute-forecast>



Apps fürs Mobiltelefon (Auswahl)



Aurora Now - Polarlicht
Aurora alerts and forecast
Entwickelt für iPad. Nicht für macOS



Northern Lights Aurora Alerts
Aurora Borealis Forecast
Entwickelt für iPad. Nicht für macOS



Auroras Forecast
Wetter
Entwickelt für iPad. Nicht für macOS



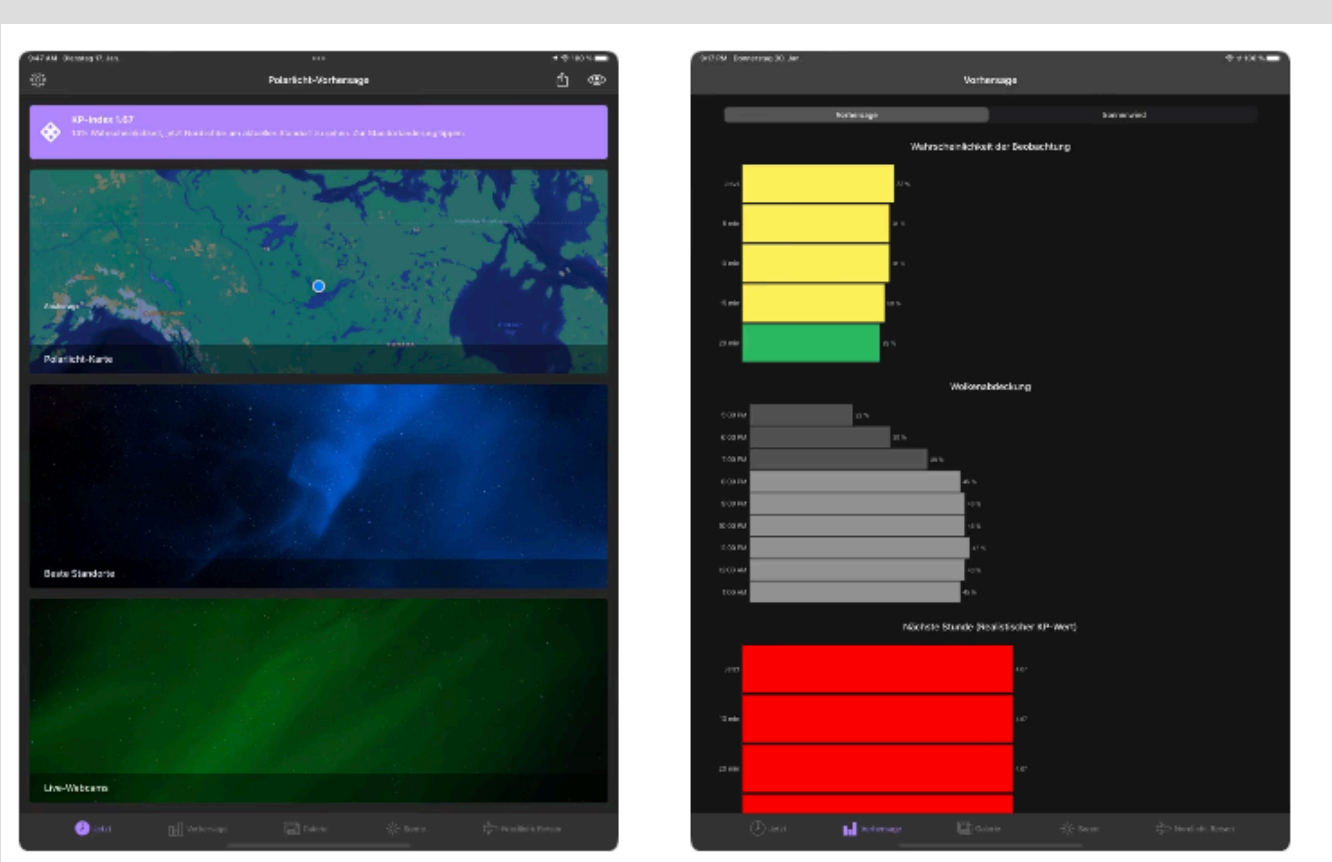
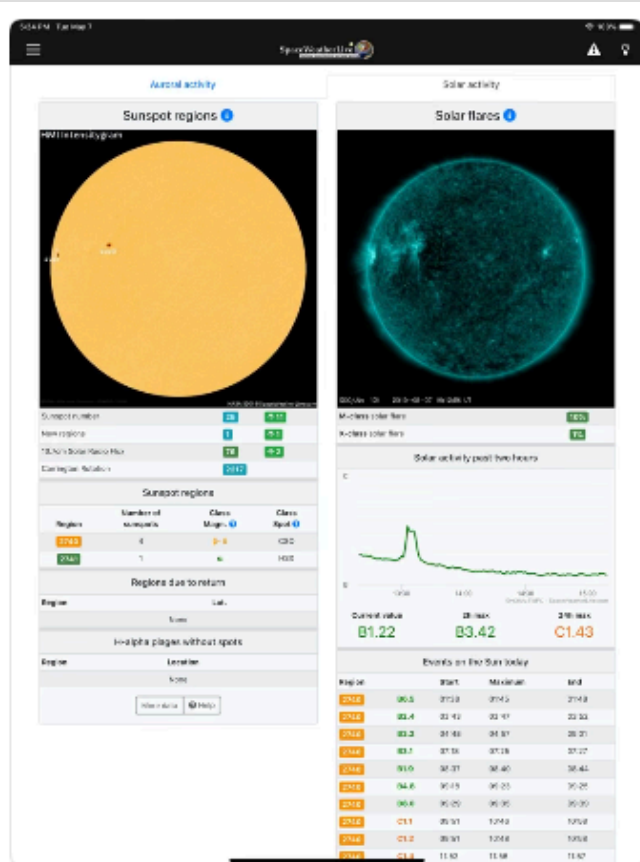
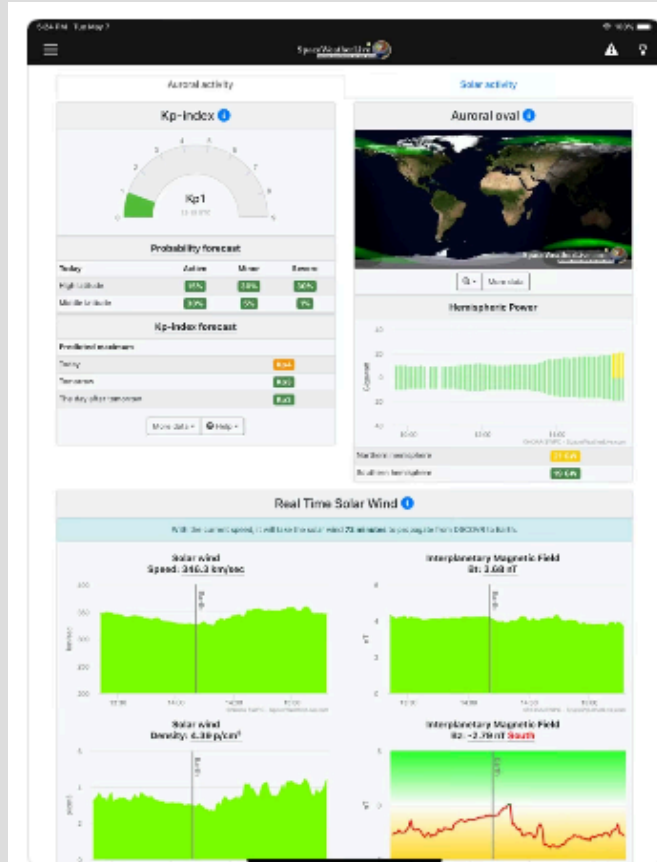
Sky Guide
Sternenhimmel astronomie
Entwickelt für iPad



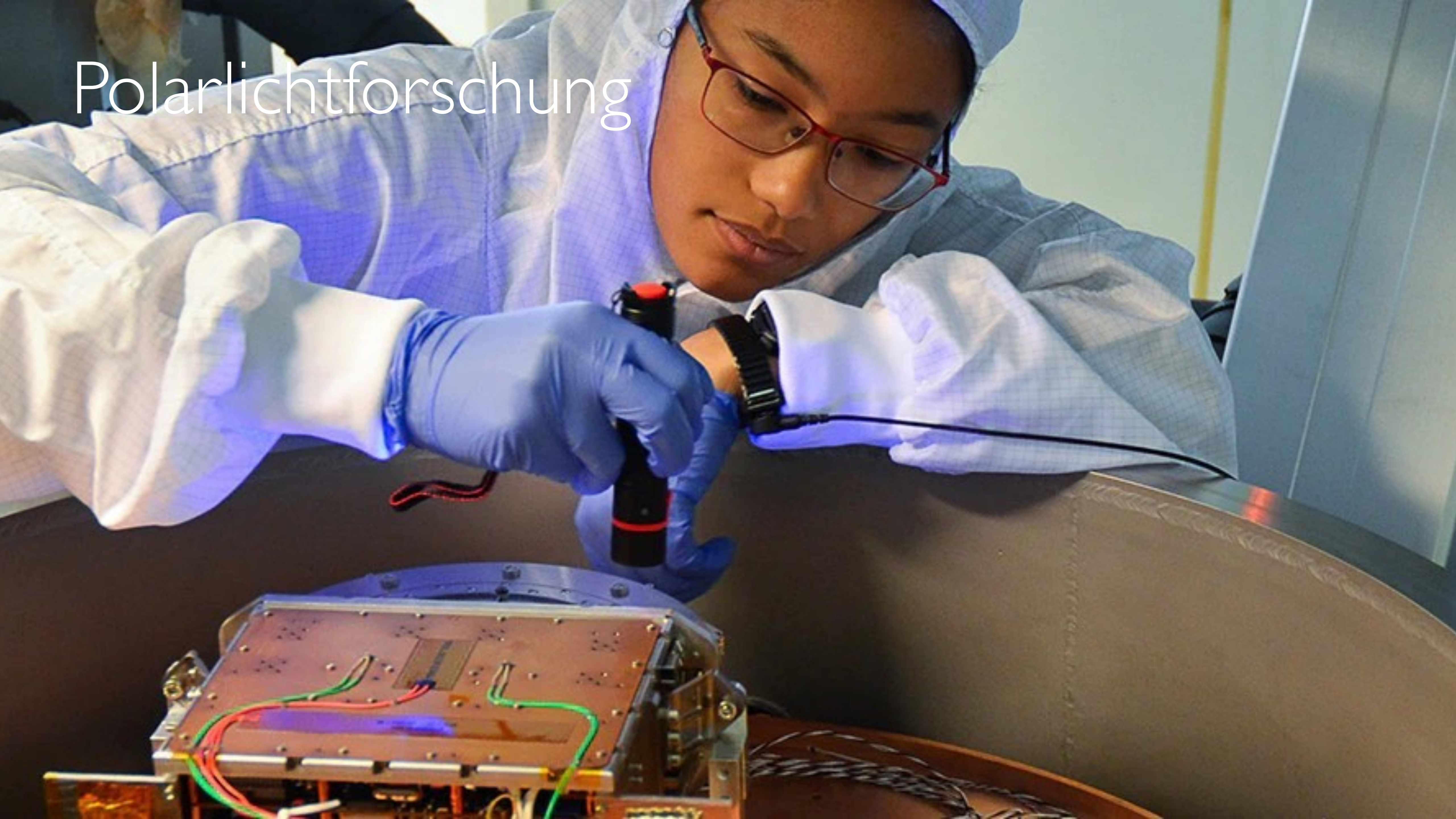
SpaceWeatherLive
Aurora and solar activity app
Entwickelt für iPad. Nicht für macOS



Polarlicht-Vorhersage Pro
Nordlichtwarnungen
Entwickelt für iPad



Polarlichtforschung



Andøya Space Center



Suborbitale- und orbitale Raketenstarts



Sounding Rockets für Atmosphärenforschung



Alomar Observatory



Geophysikalisches Observatorium Tromsø

https://site.uit.no/spaceweather/



Tromsø Geophysical Observatory (TGO) Norwegian Centre for Space Weather (NOSWE)

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SPACE WEATHER IMPACTS

	Geomagnetic storms				
	Last 24-3 h	Last 3-1 h	Last 1h	Now	Next 1h
Ny-Ålesund (Polar Cap)	Disturbed	Quiet	Quiet	Quiet	Quiet
Tromsø (Auroral Zone)	Disturbed	Quiet	Quiet	Quiet	Quiet
Dombås (Sub-Auroral Zone)	Quiet	Quiet	Quiet	Quiet	Quiet

24-Jan-2025 (11:52:38) UTC

Norwegian Centre for Space Weather

NOSWE event analysis tool

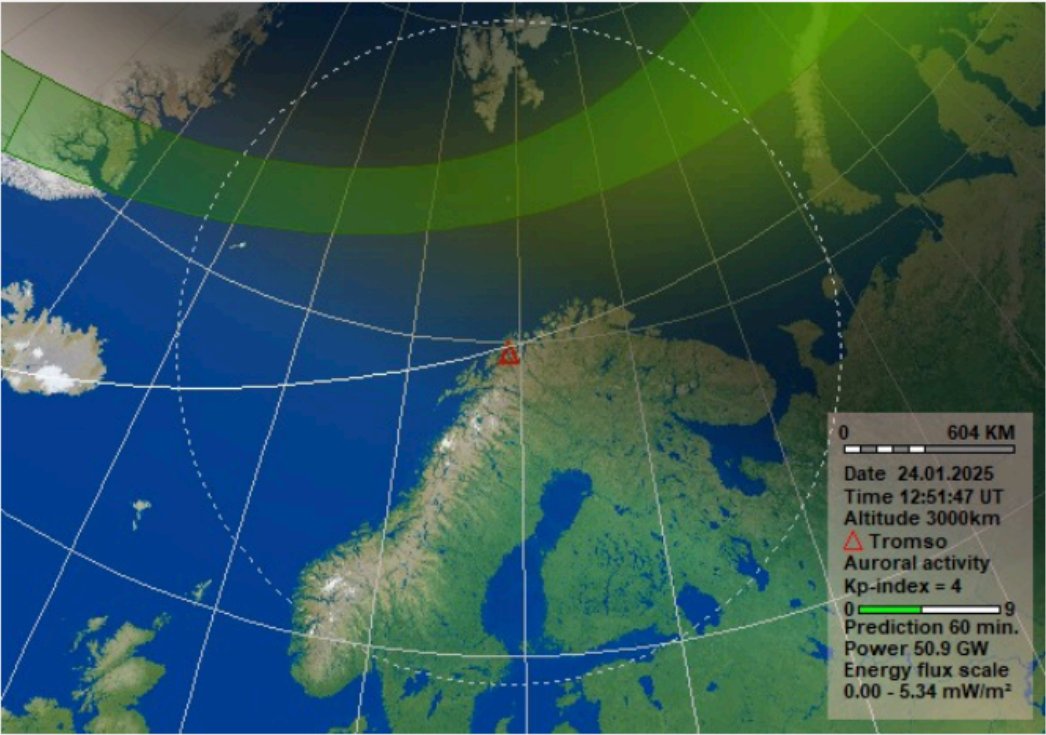
Radio blackouts	Radiation storms
Quiet	Quiet

24-Jan-2025 (11:51:03) UTC

Ref. NOAA SWPC

Norwegian Centre for Space Weather

NORTHERN LIGHTS IN THE NEXT HOUR



Forskningsstation Ramfjordheide

https://uit.no/infrastruktur/enhet?p_document_id=685673



Schwedisches Institut für Weltraumphysik

<https://www.irf.se/en/>



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Swedish Institute of Space Physics

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Aurora Borealis

Solar maximum creates frequent auroras.

[Tips for studying auroras!](#)

Aurora Australis

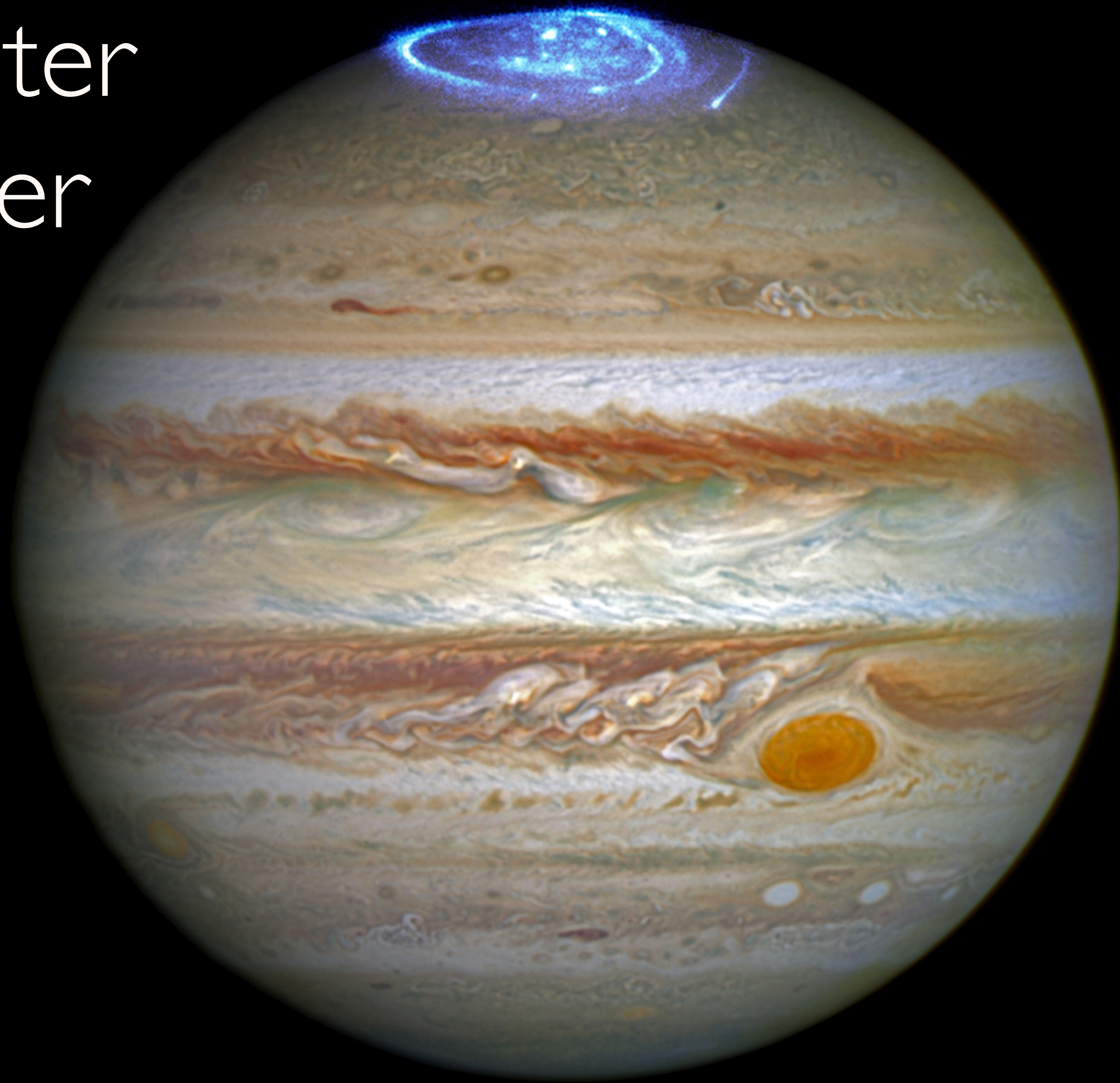
Amundsen-Scott-Südpolstation



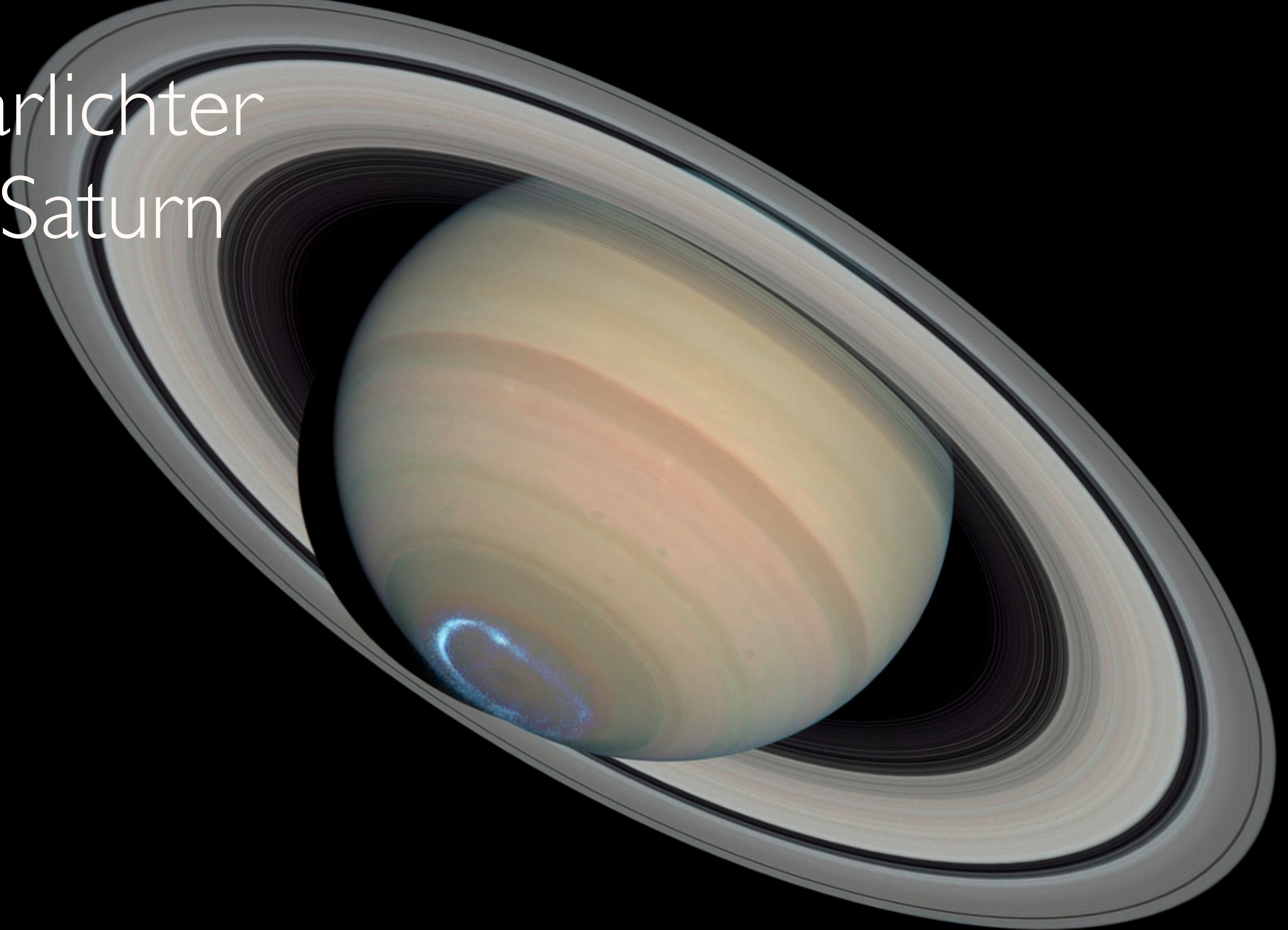
Aus dem Weltraum



Polarlichter am Jupiter



Polarlichter am Saturn



Clear Skies und Good Luck!

stem&mint e.U.

<https://stemandmint.com>

