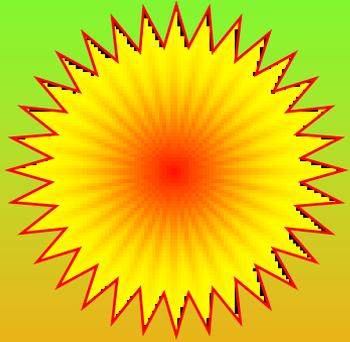


Movimentos aparentes dos Astros

Prof. J. Meléndez,
baseado no Prof. R. Boczko

IAG - USP

Movimentos aparentes

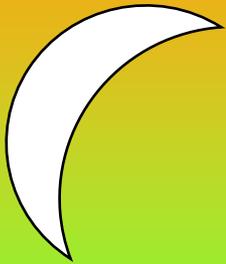


Movimento diurno (diário) aparente do Sol

Movimento anual aparente do Sol

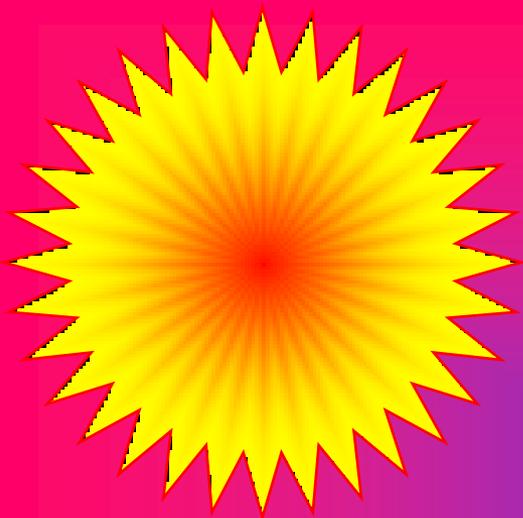


Movimento diurno (diário) aparente das estrelas



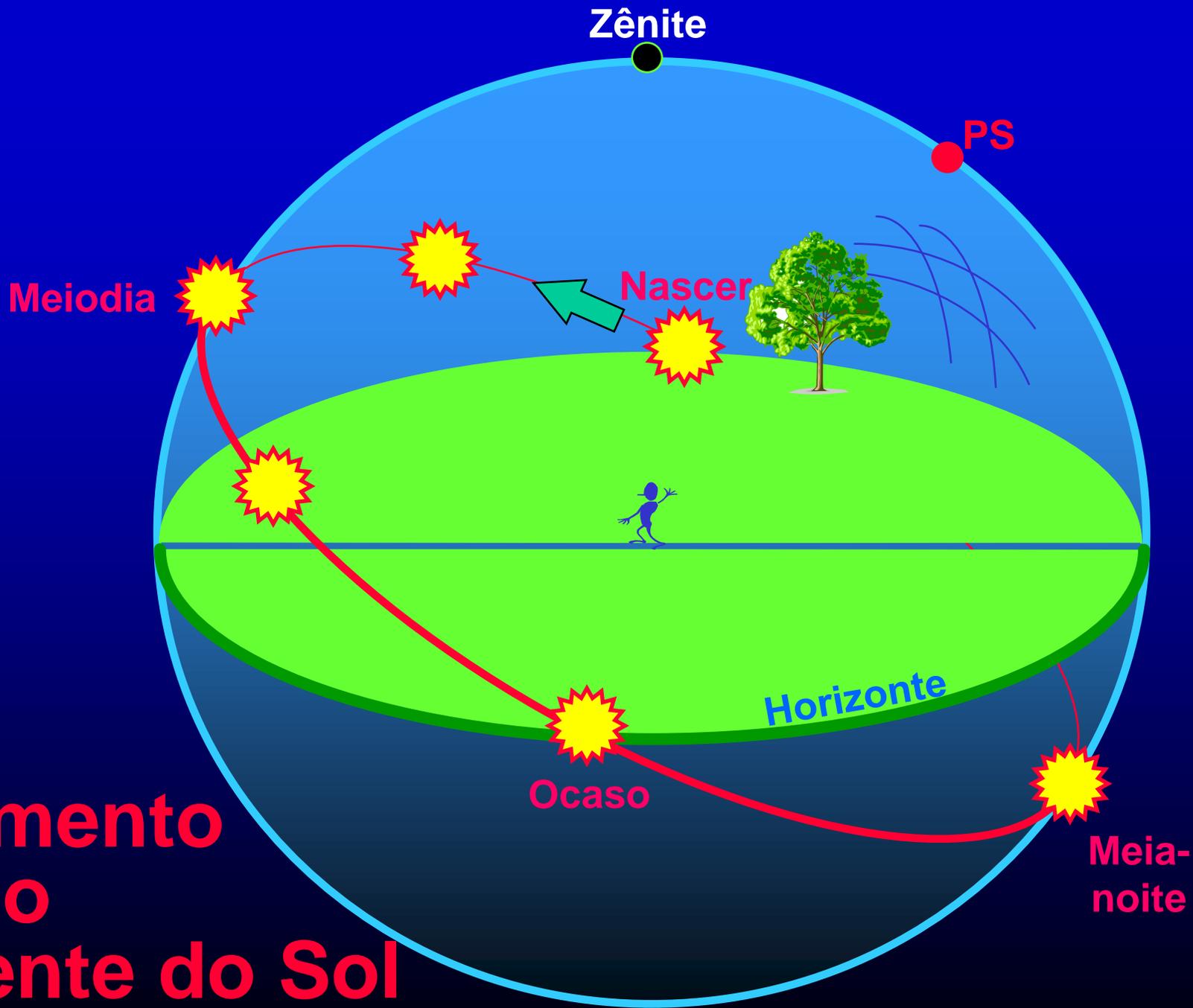
Movimento diurno (diário) aparente da Lua

Movimento mensal aparente da Lua



Movimento diurno (diário) aparente do Sol

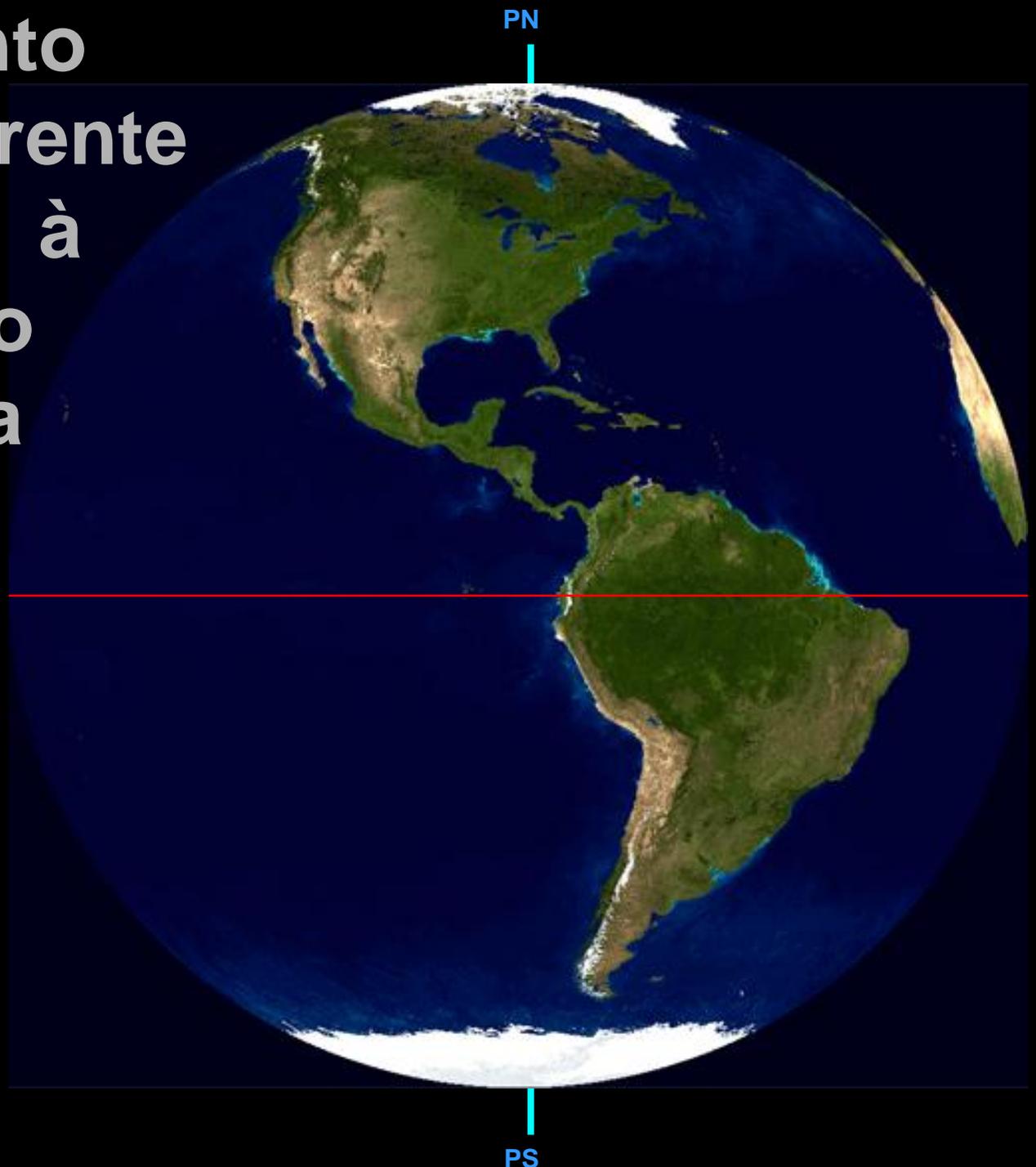
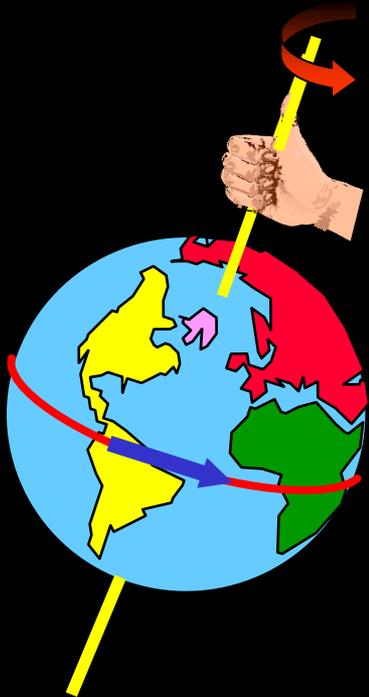
Movimento diurno aparente do Sol



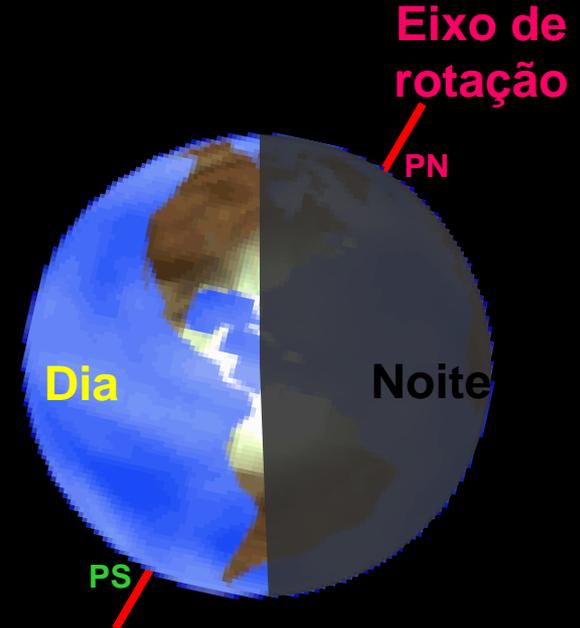
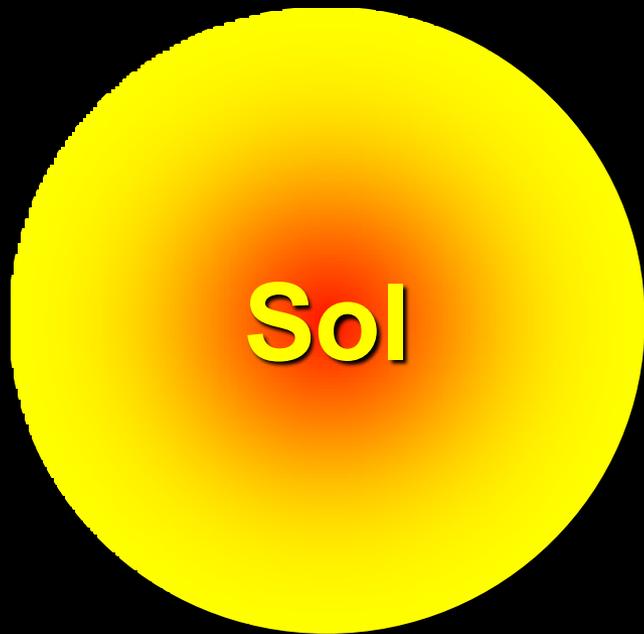
Movimento diurno aparente do Sol no início do inverno



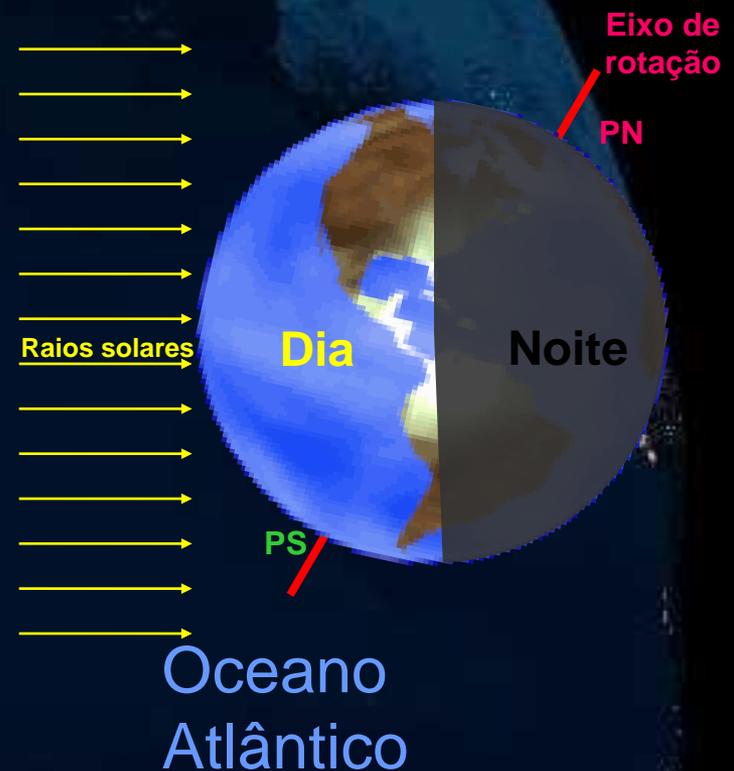
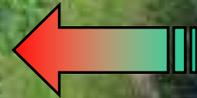
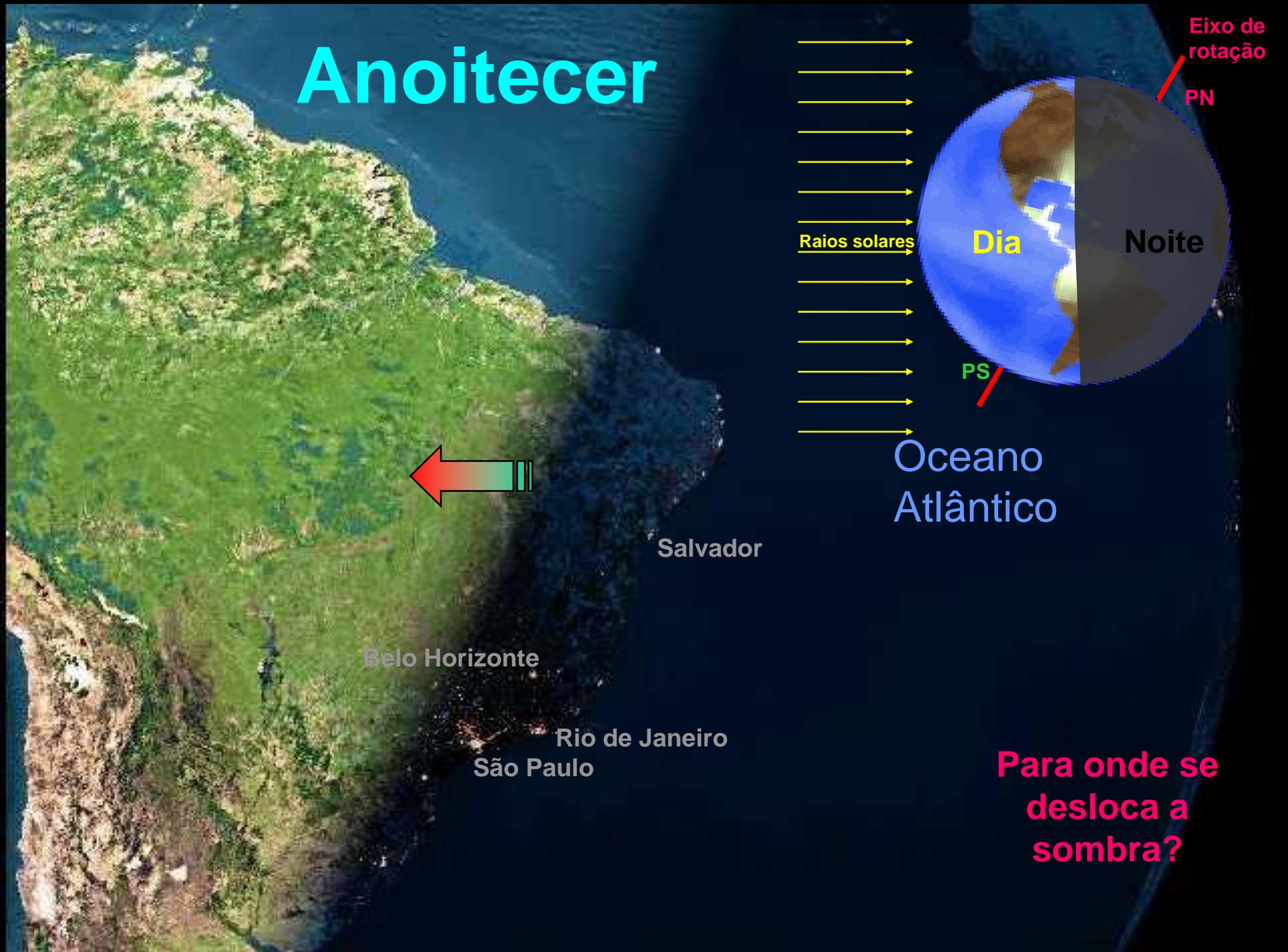
Movimento Diurno Aparente é devido à Rotação da Terra



Motivos do dia e da noite na Terra



Anoitecer



Eixo de rotação
PN

Raios solares

Dia

Noite

PS

Oceano Atlântico

Salvador

Belo Horizonte

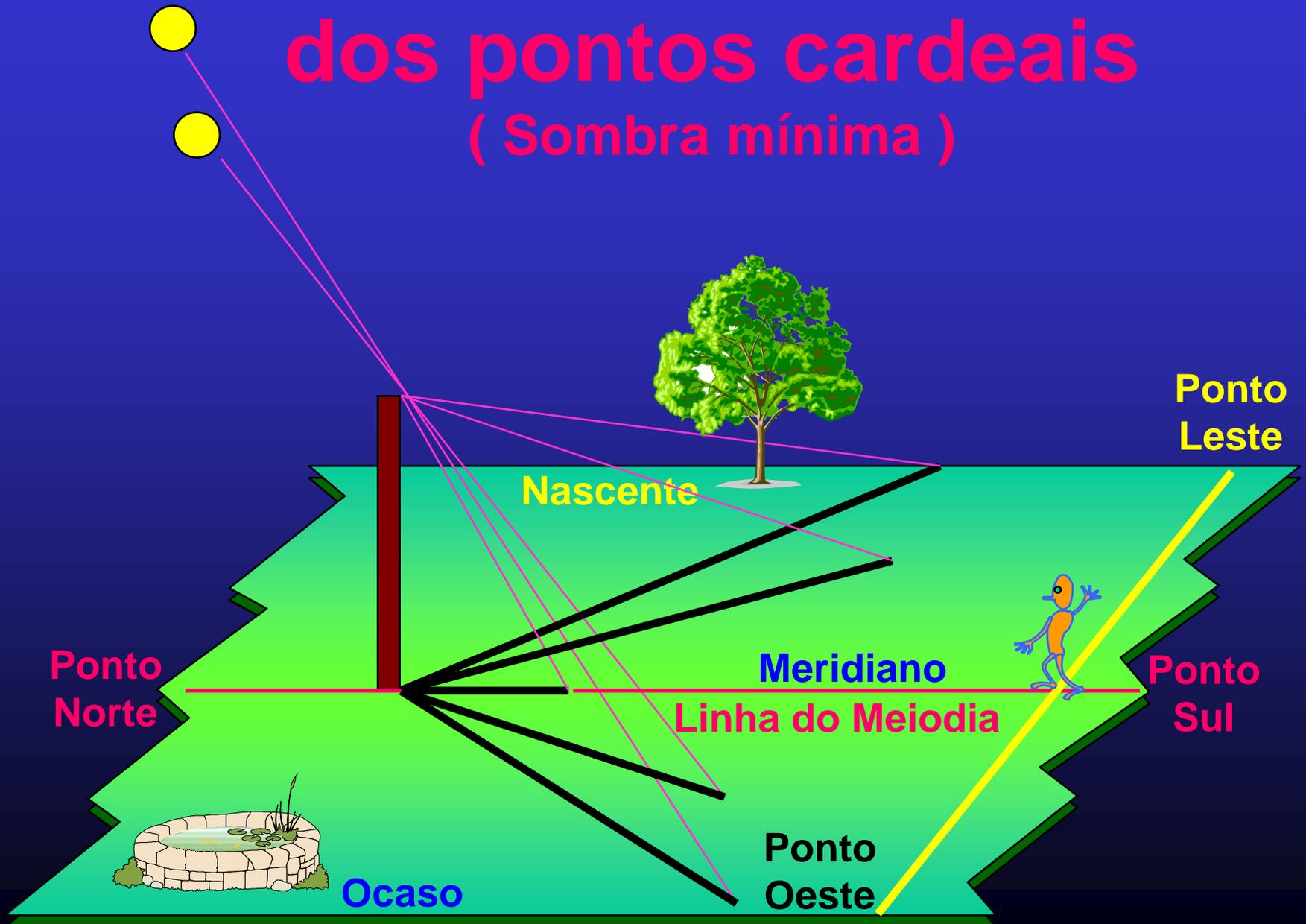
Rio de Janeiro

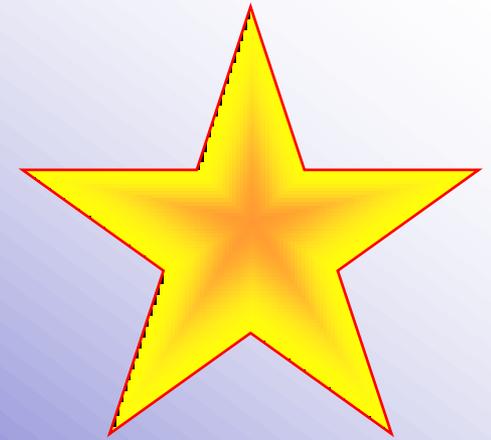
São Paulo

Para onde se desloca a sombra?

Pontos Carduais

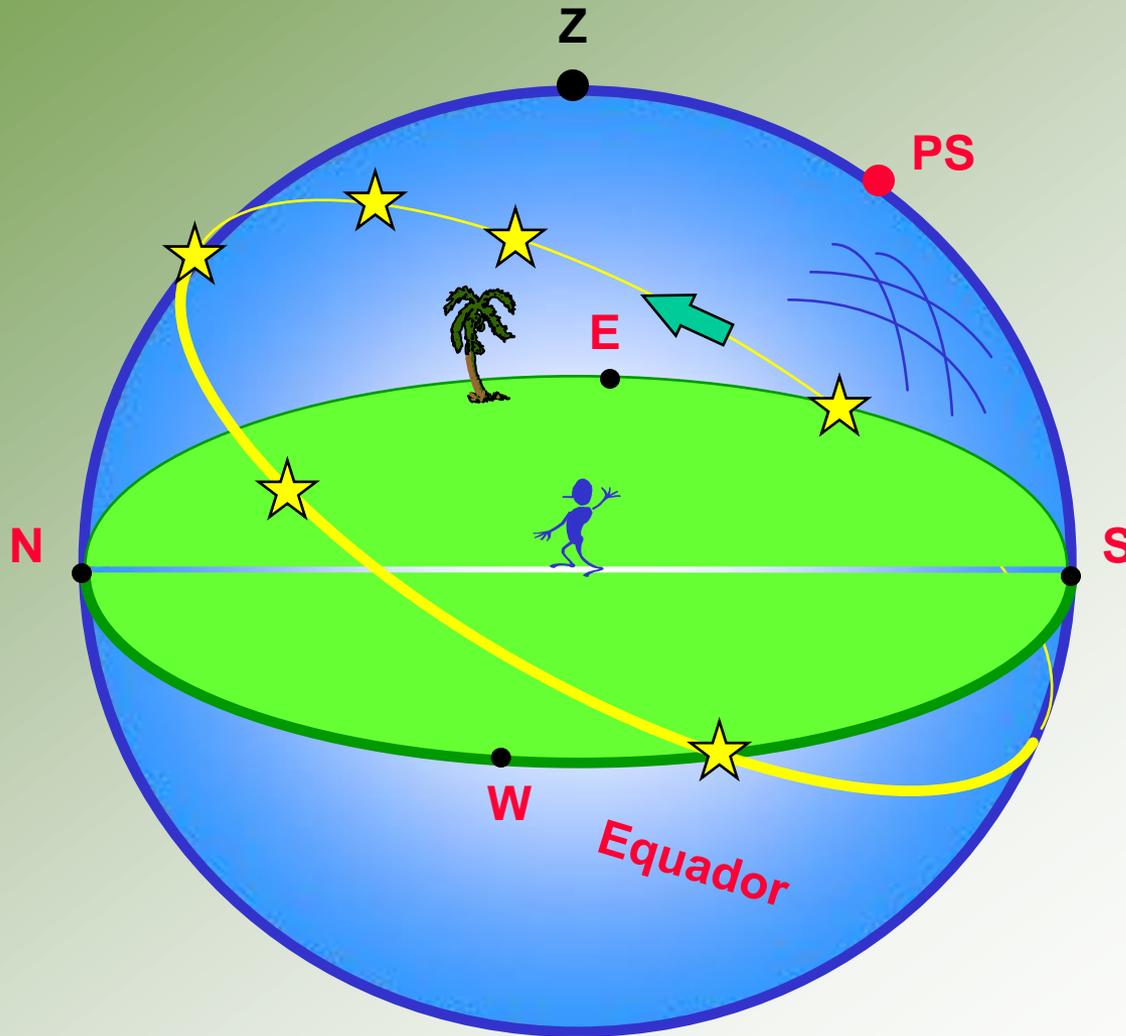
Determinação do meridiano e dos pontos cardeais (Sombra mínima)





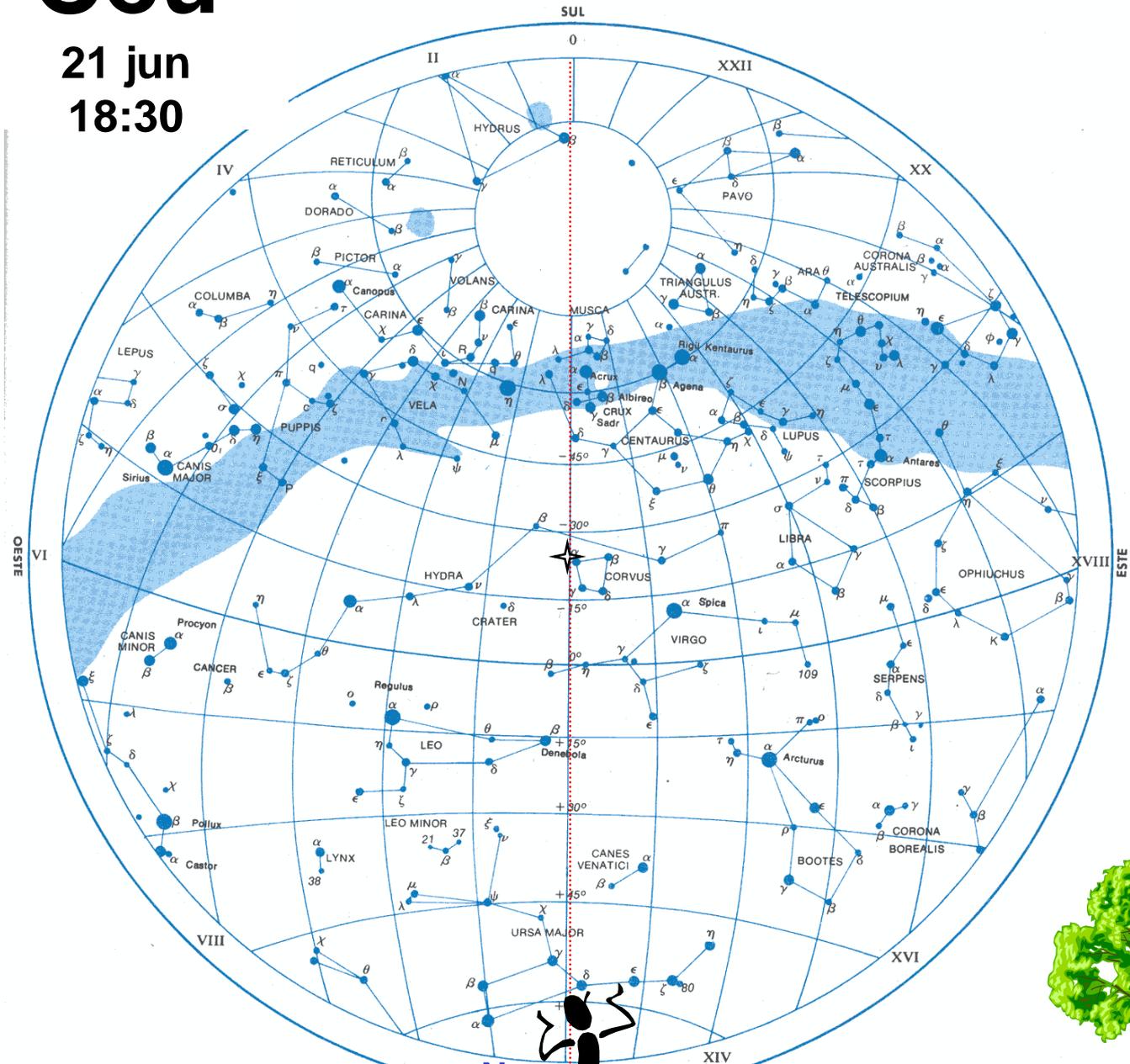
Movimento diurno aparente das estrelas

Movimento diurno aparente visto do hemisfério Sul



Céu

21 jun
18:30



Oeste

Norte

Leste



Movimento noturno aparente olhando ao Sul



20 horas

24 horas

22 horas

Polo Sul

Sul

Sentido horário



Leste

Oeste



Movimento diurno aparente olhando para o Polo Celeste Sul



Movimento diurno aparente em torno do PS visto dos Andes

Via Láctea

Nuvens de Magalhães

Ojos del Salado

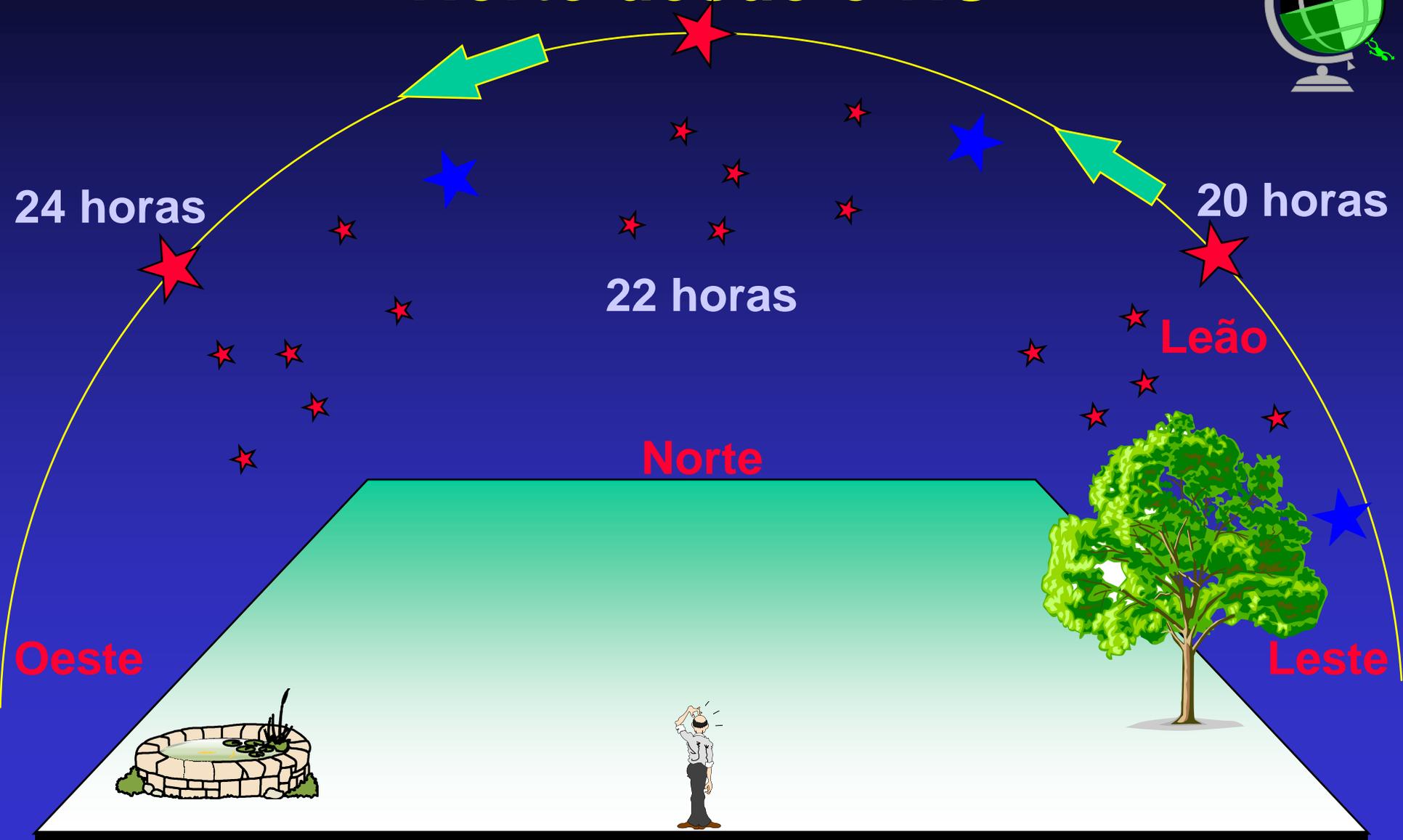
Mais alto vulcão ativo da Terra

Altitude = 6000 m

Temperatura = -18°C

Exposição \cong 1 horas

Movimento noturno aparente olhando ao Norte desde o HS



24 horas

20 horas

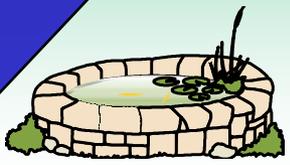
22 horas

Leão

Norte

Oeste

Leste



Movimento noturno aparente olhando para o norte desde o HN



Sentido anti-horario

Norte

Oeste

Leste

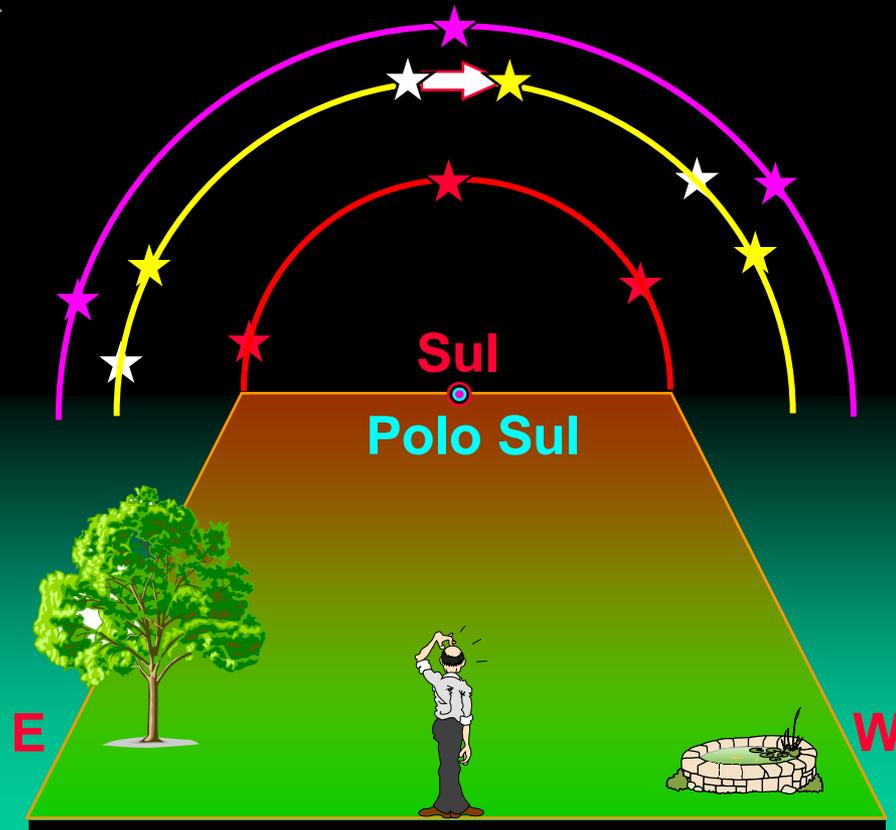
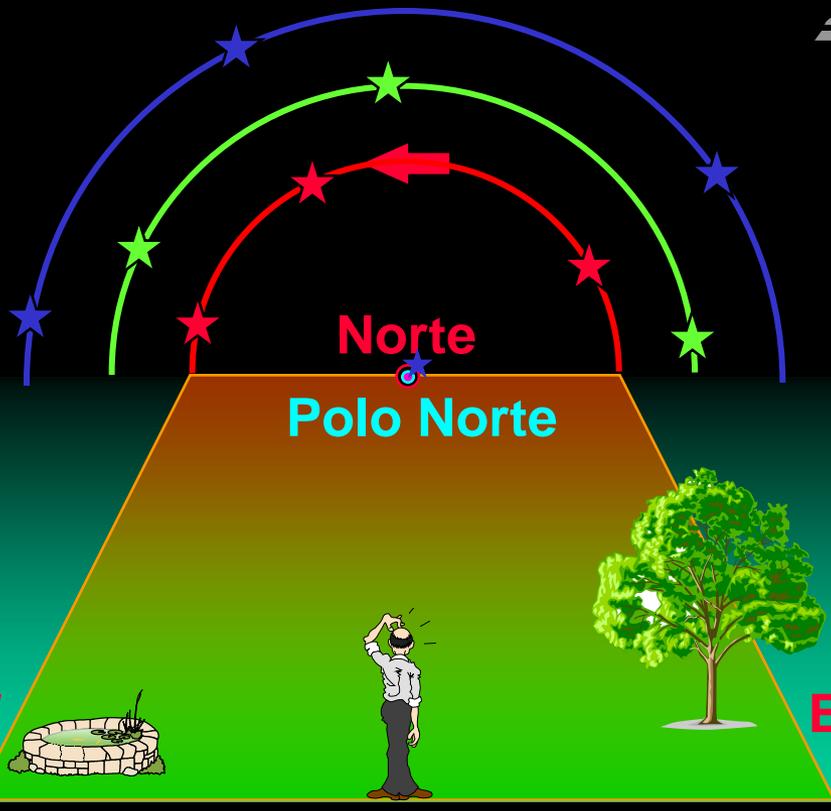




**Movimento diurno
aparente olhando para o
Polo Celeste Norte**

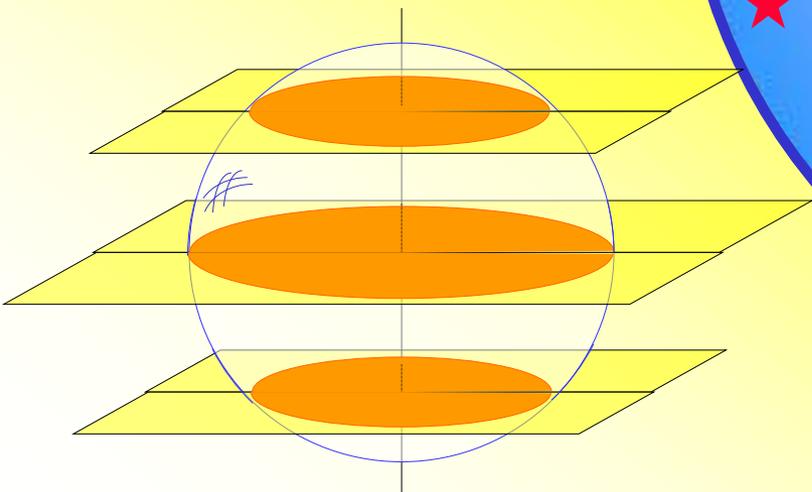
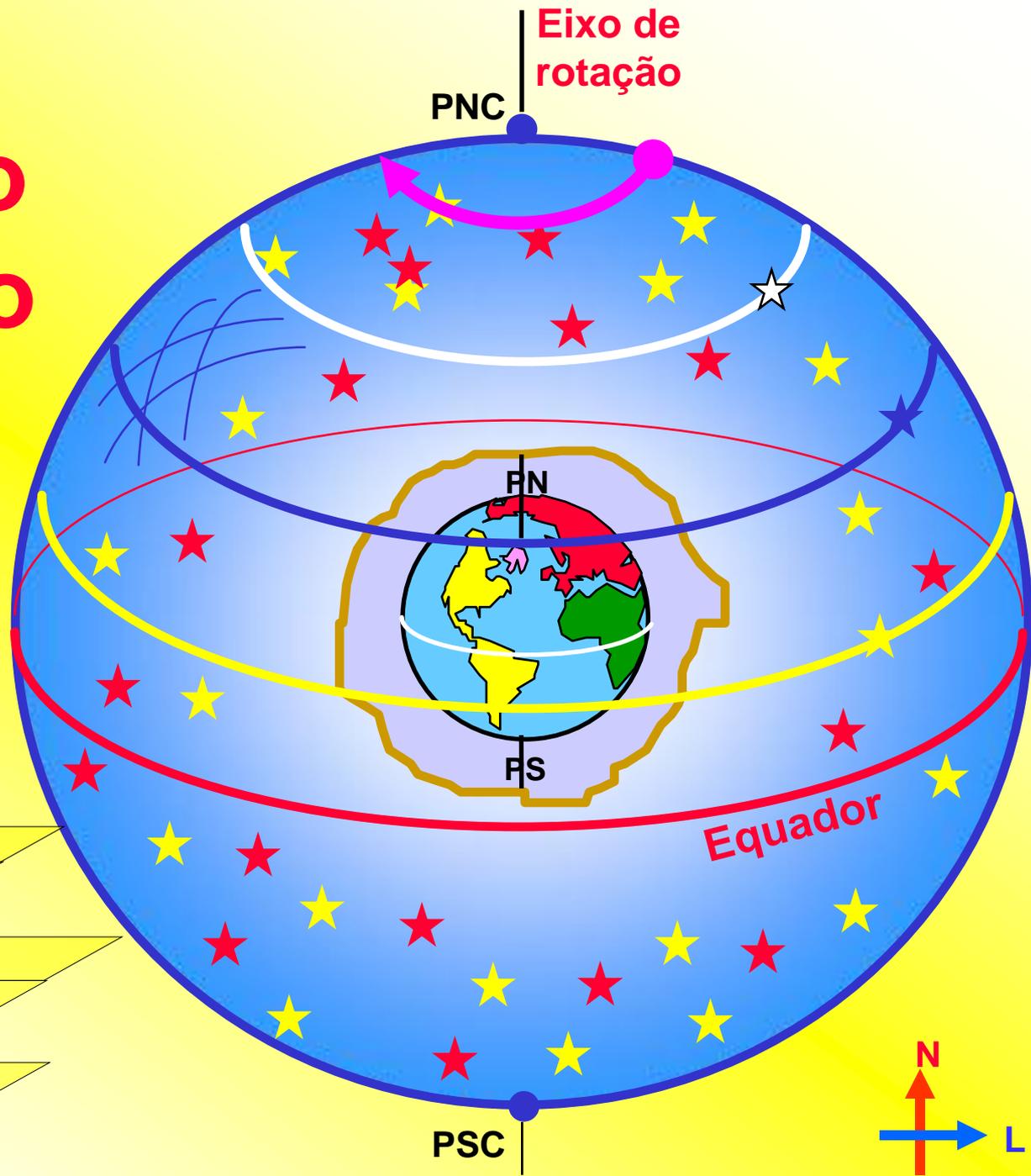


Movimento noturno aparente para o observador no equador



Esfera celeste

**Trajetoórias
diurnas são
paralelas ao
equador**

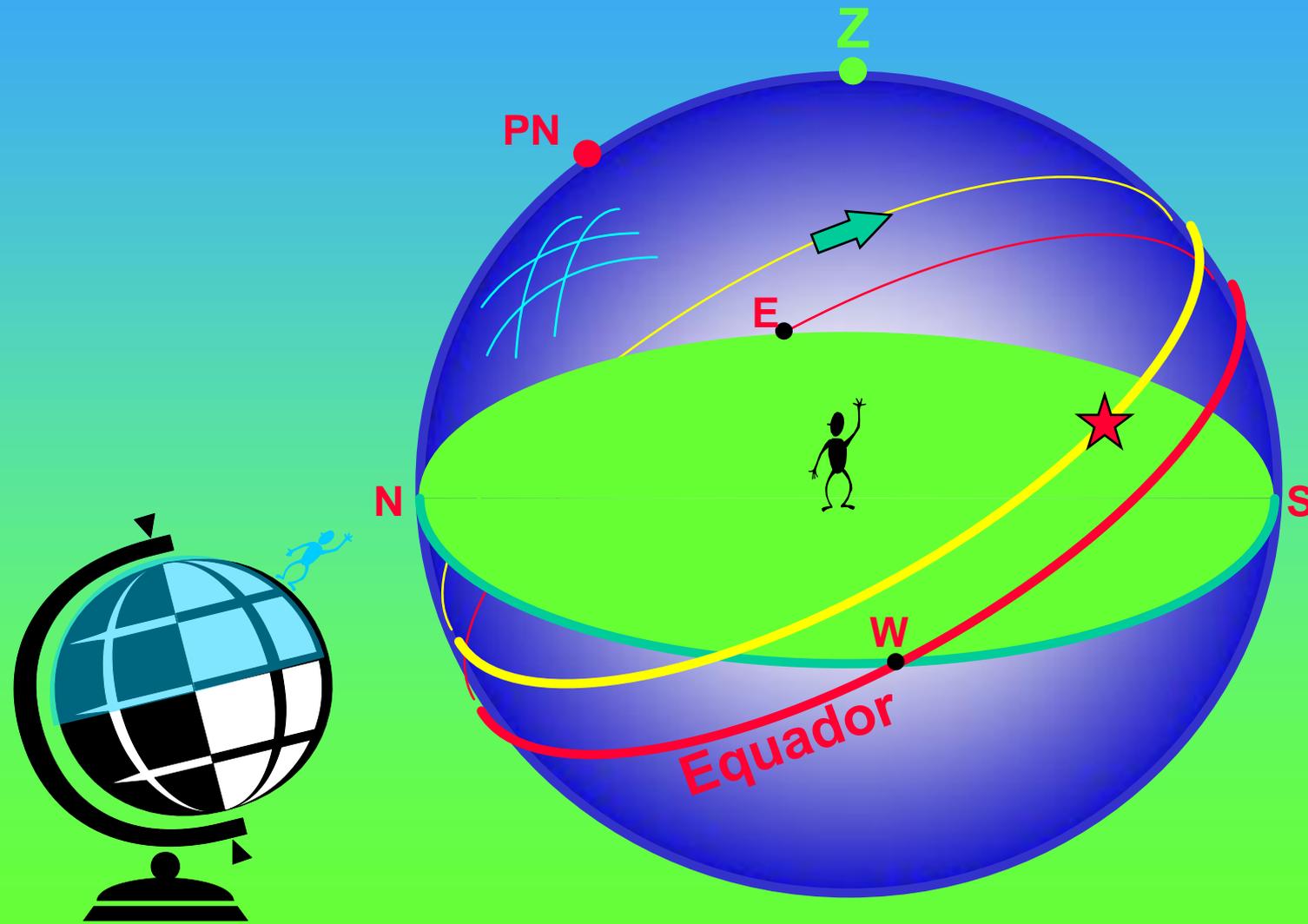


**Movimento aparente
das estrelas
dependendo da latitude
do observador**

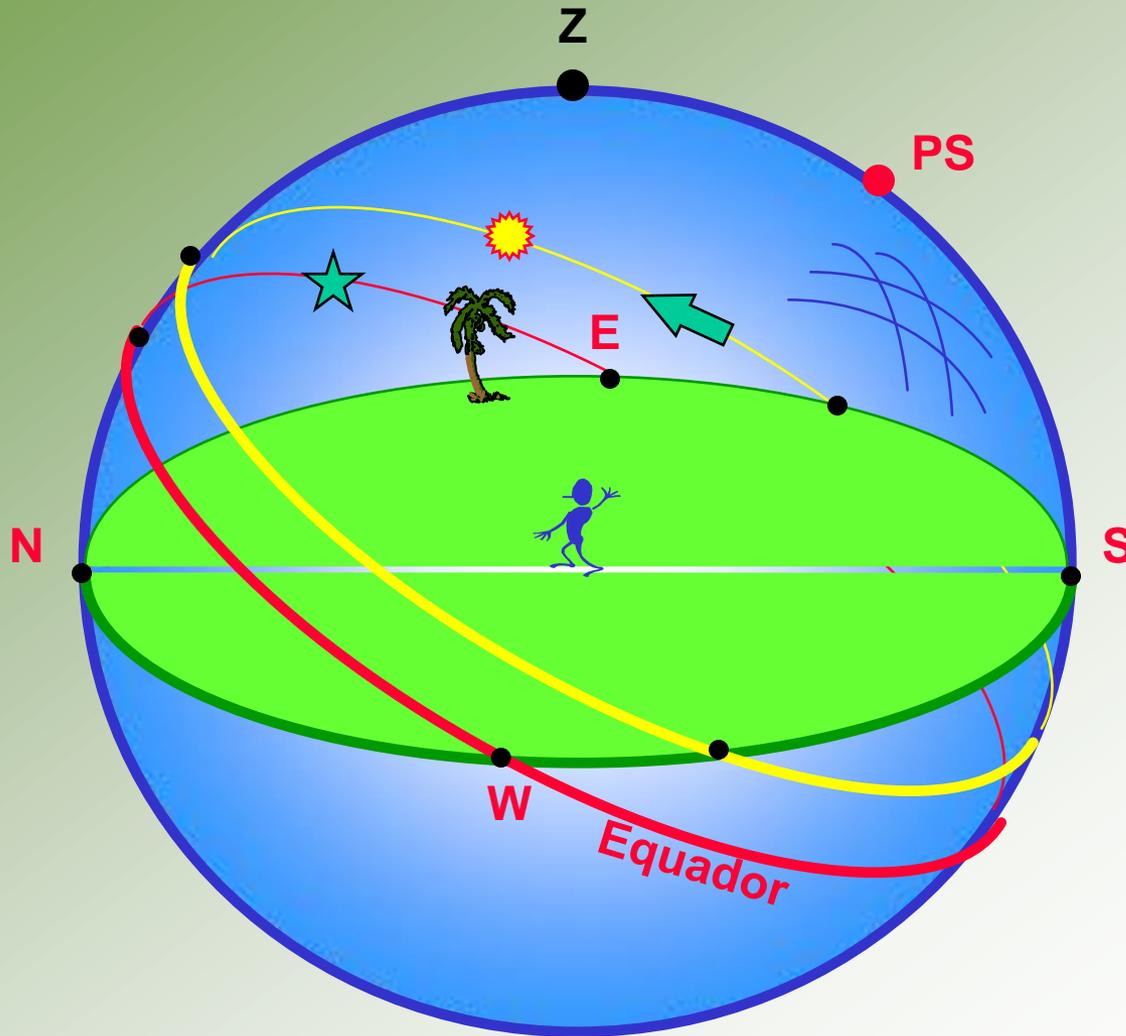
Estrela Polar Norte



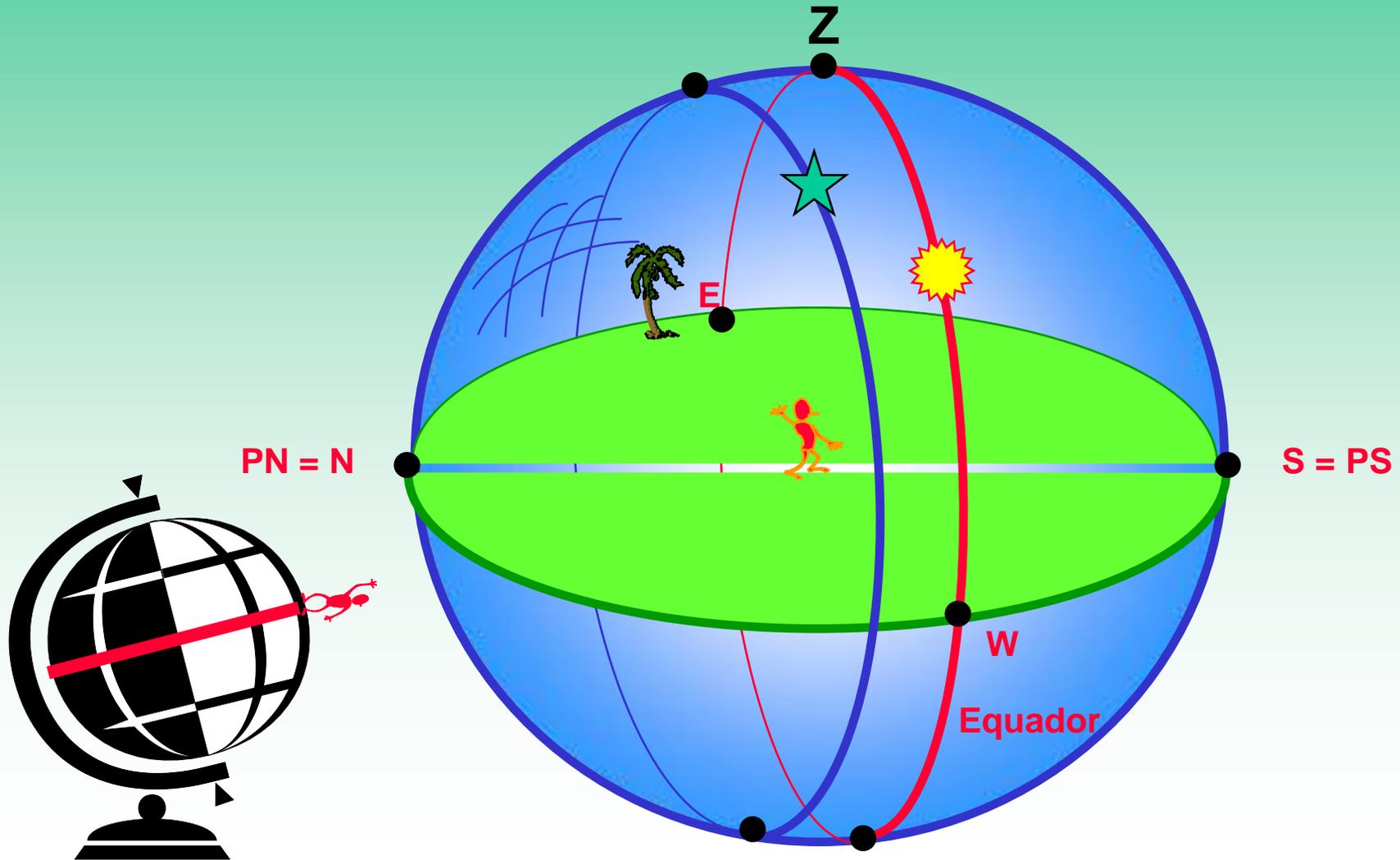
Movimento Diurno Aparente visto do Hemisfério Norte



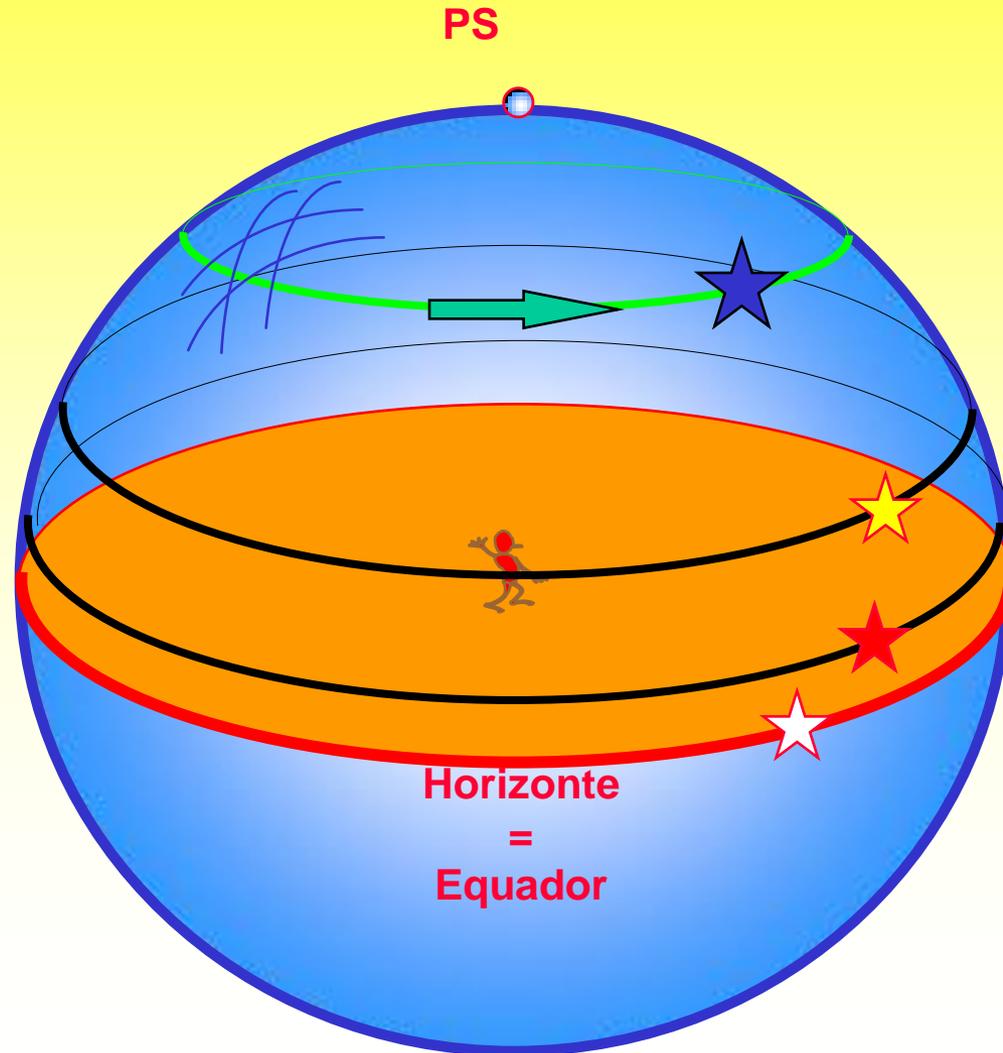
Movimento diurno aparente visto do hemisfério Sul



Movimento diurno aparente visto do equador

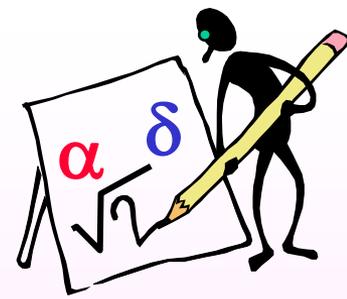


Movimento diurno aparente das estrelas visto do Polo Sul

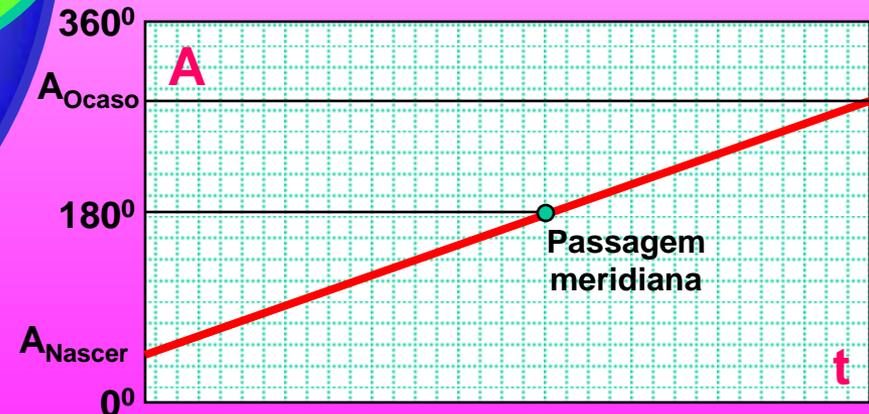
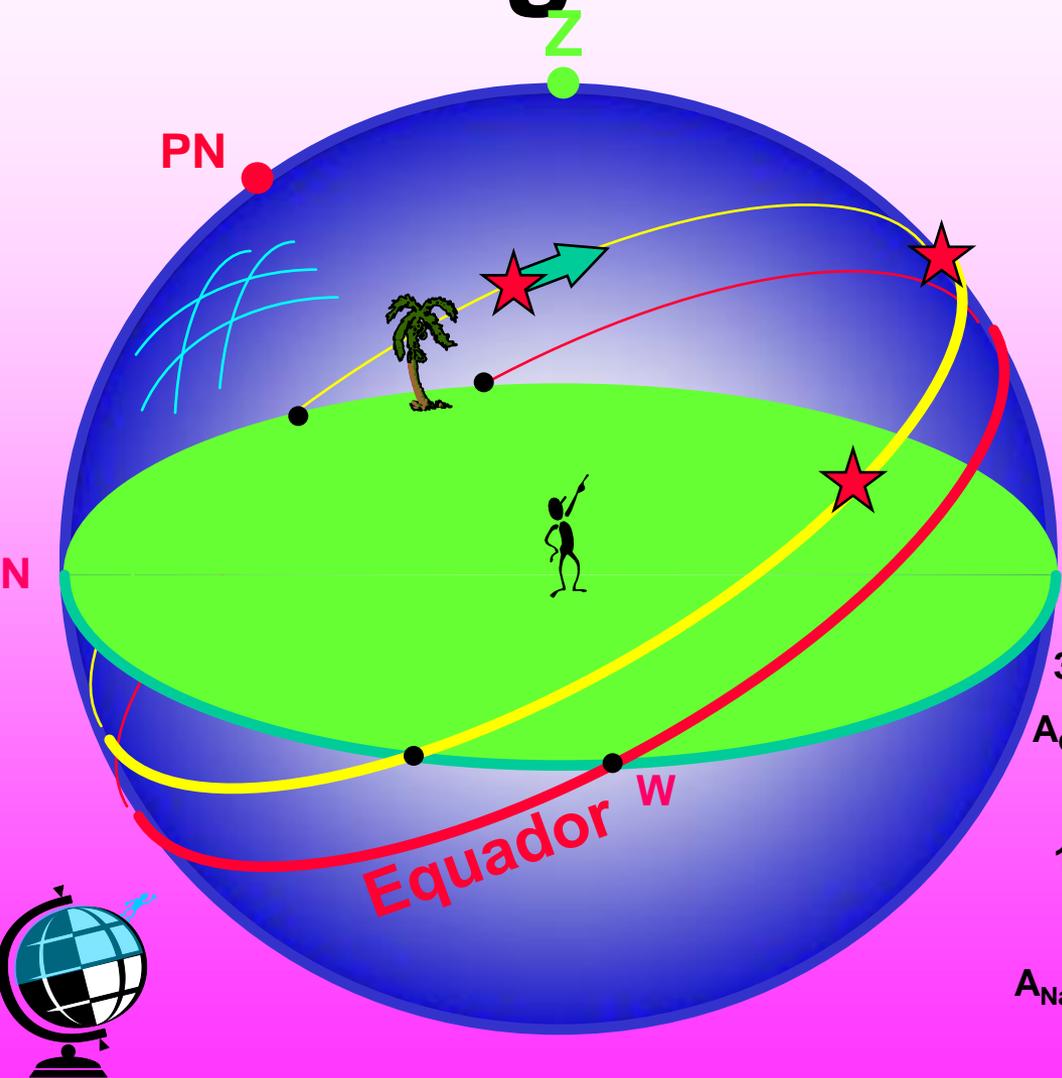


**Azimute de um
astro ao longo
do dia**

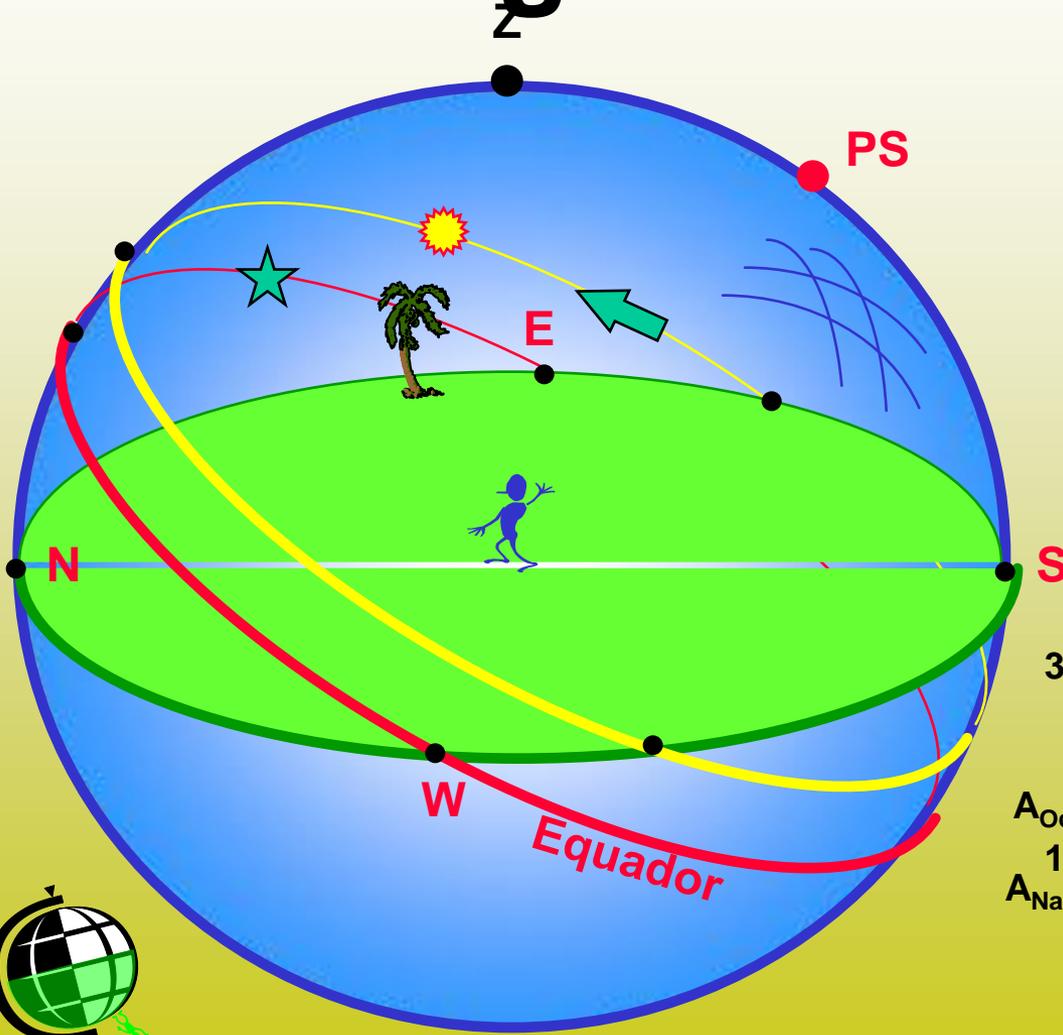
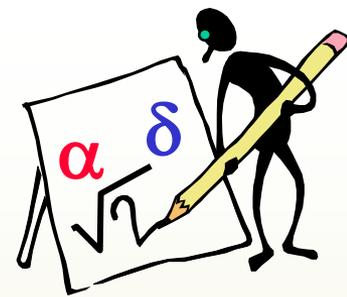
Azimute de um astro ao longo do dia no HN



Enunciado:
Como varia o azimute de um astro ao longo do dia?

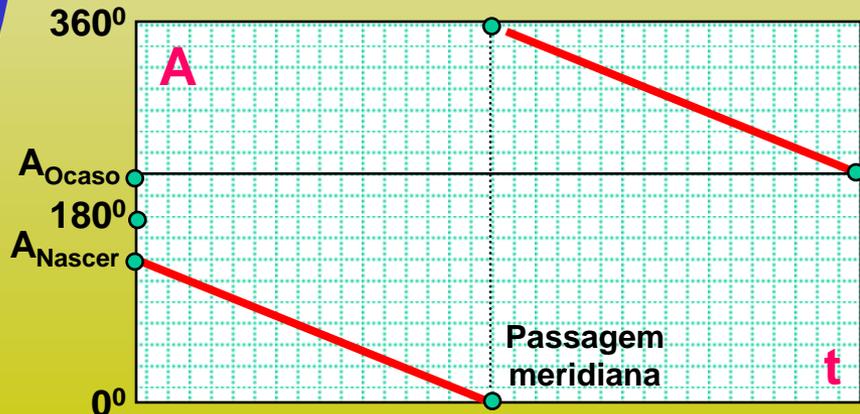


Azimute de um astro ao longo do dia no HS



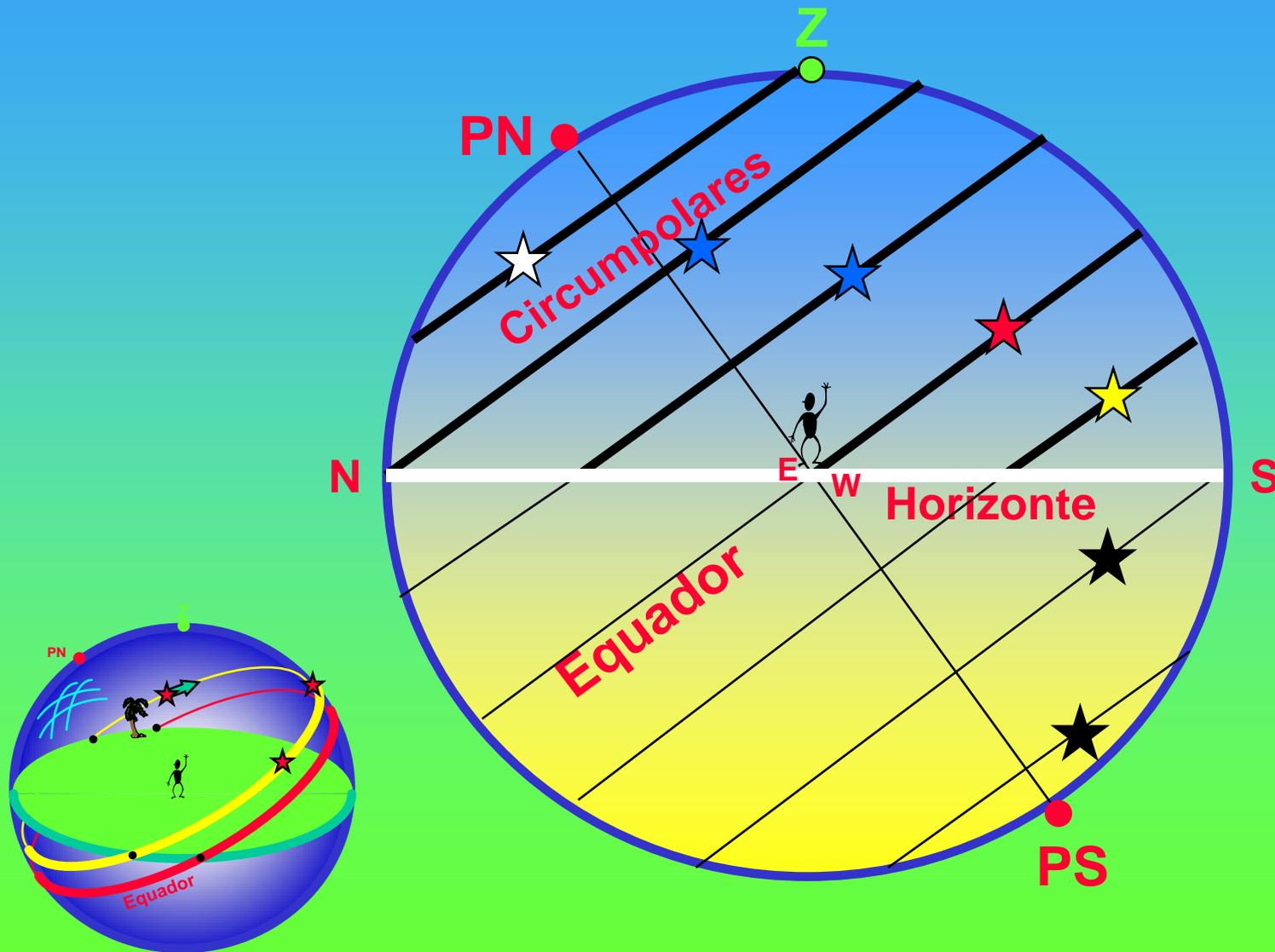
Enunciado:
Como varia o azimute de um astro ao longo do dia?

Seria mais razoável contar os azimutes a partir do Sul para o Oeste!

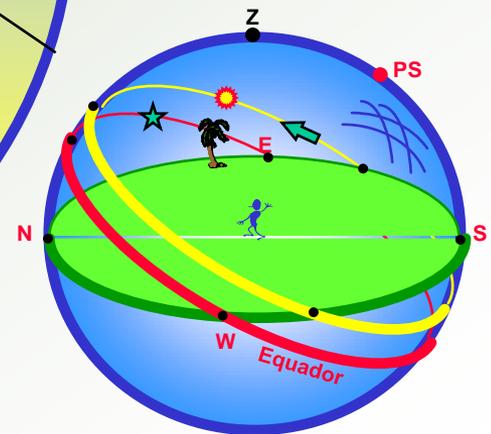
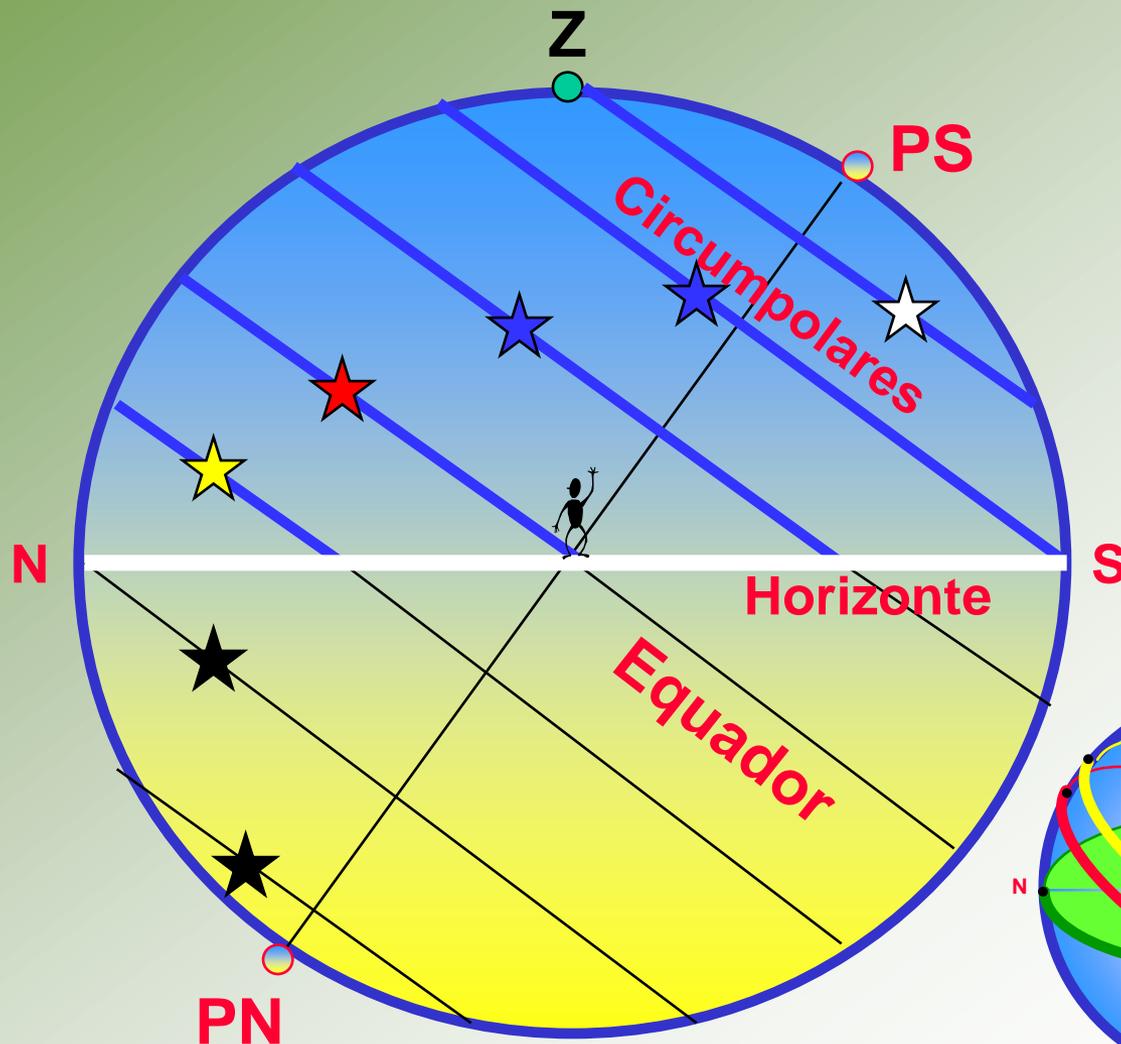


Movimentos diurnos projetados no plano meridiano

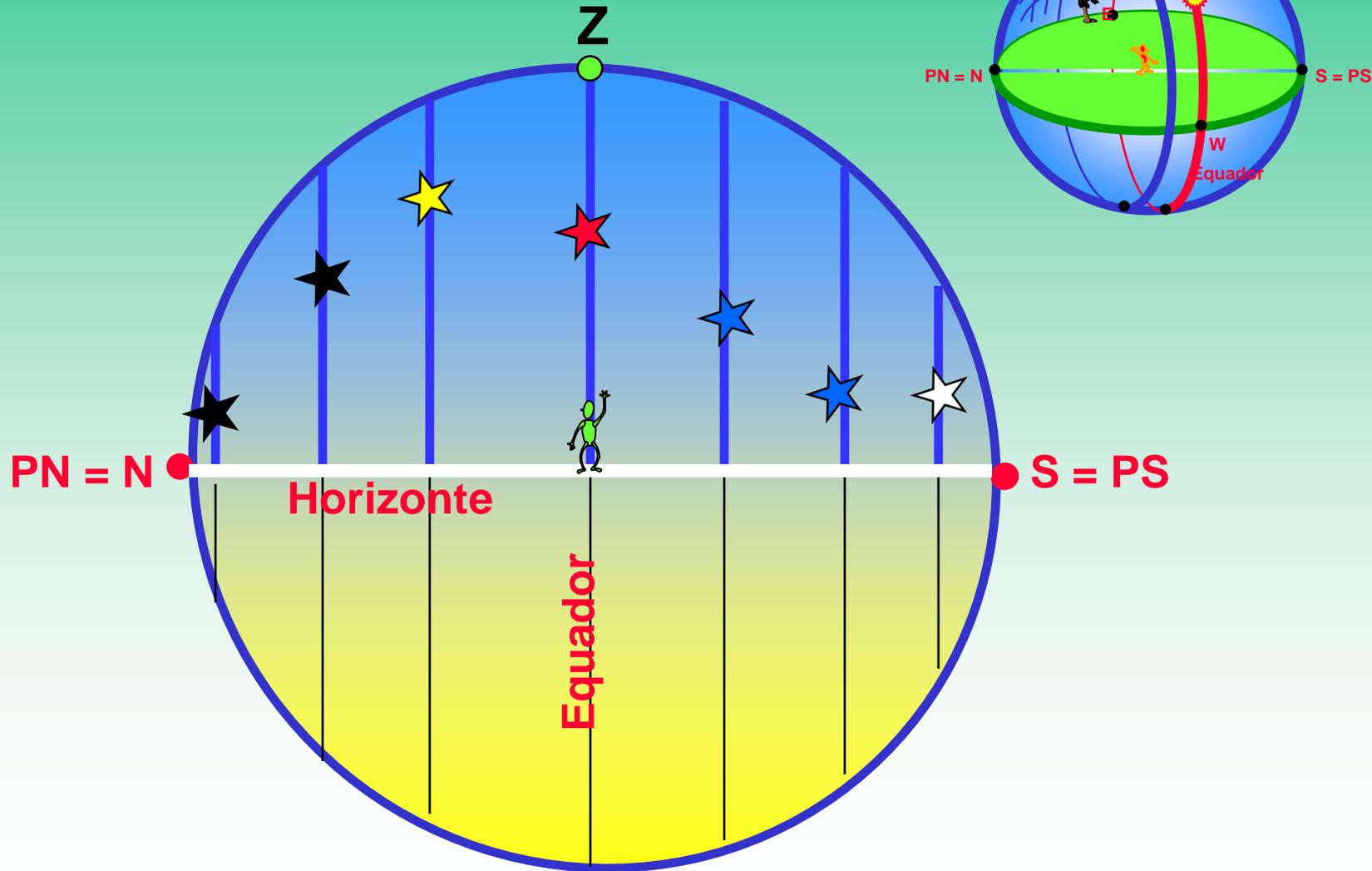
Movimento Diurno Aparente visto do Hemisfério Norte



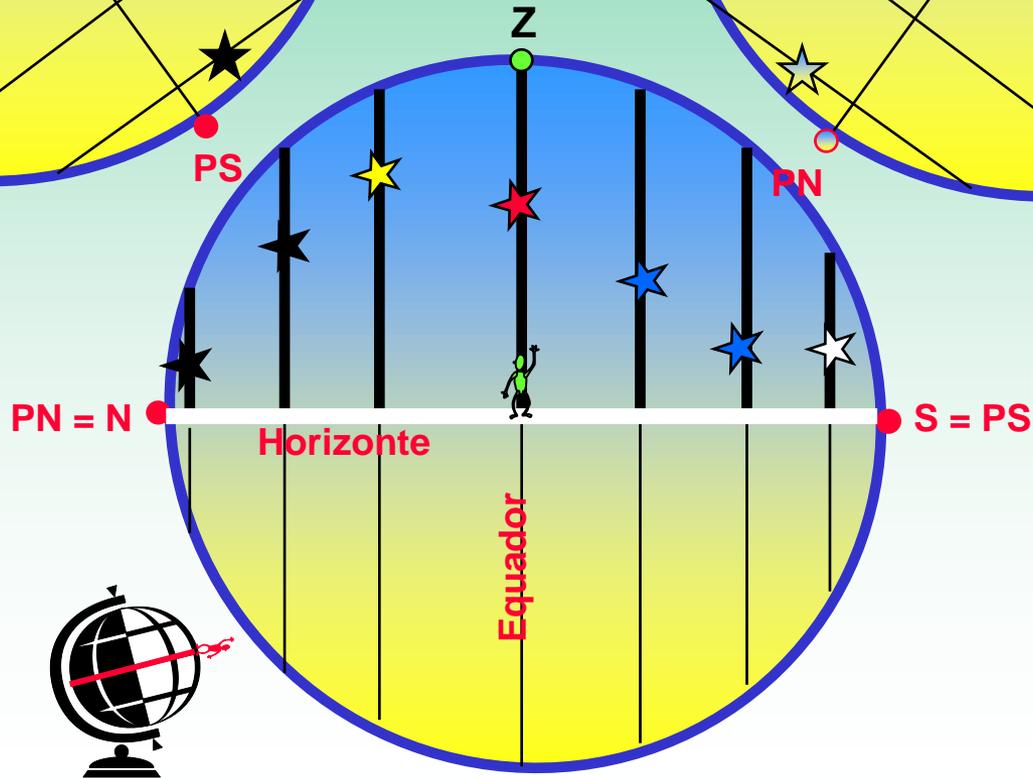
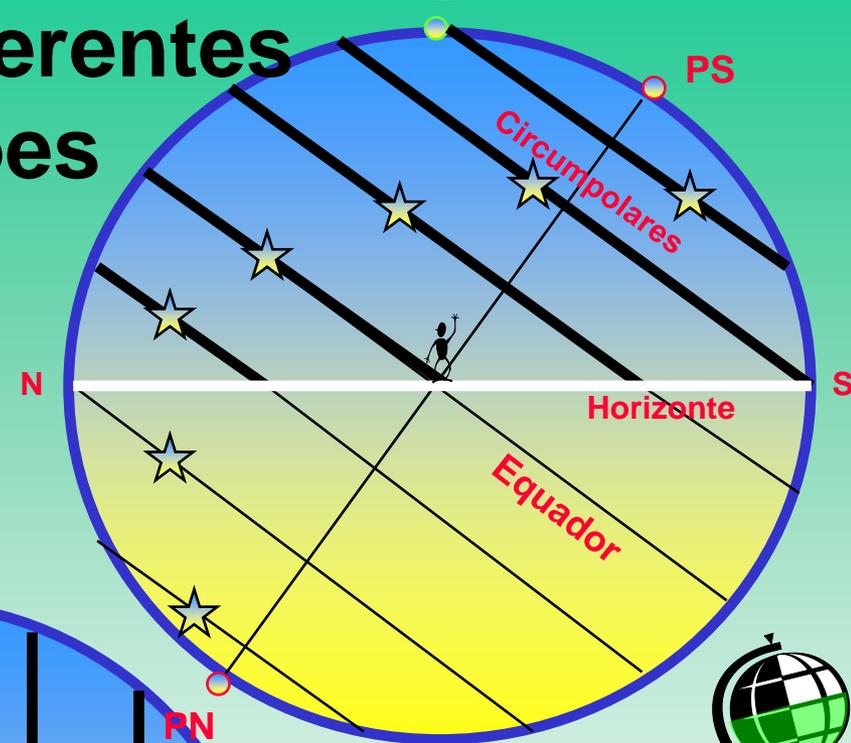
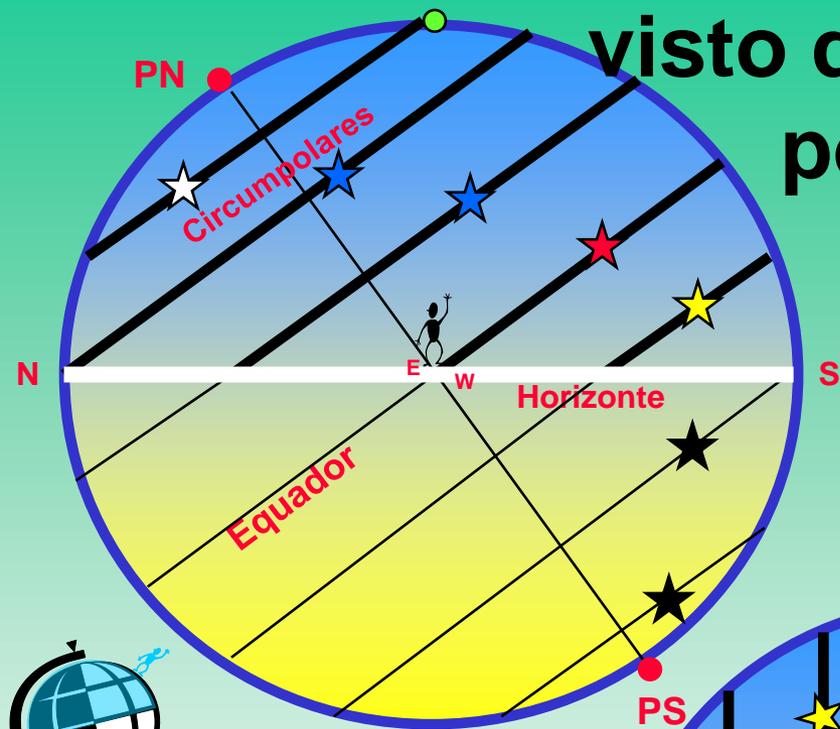
Movimento diurno aparente visto do hemisfério Sul



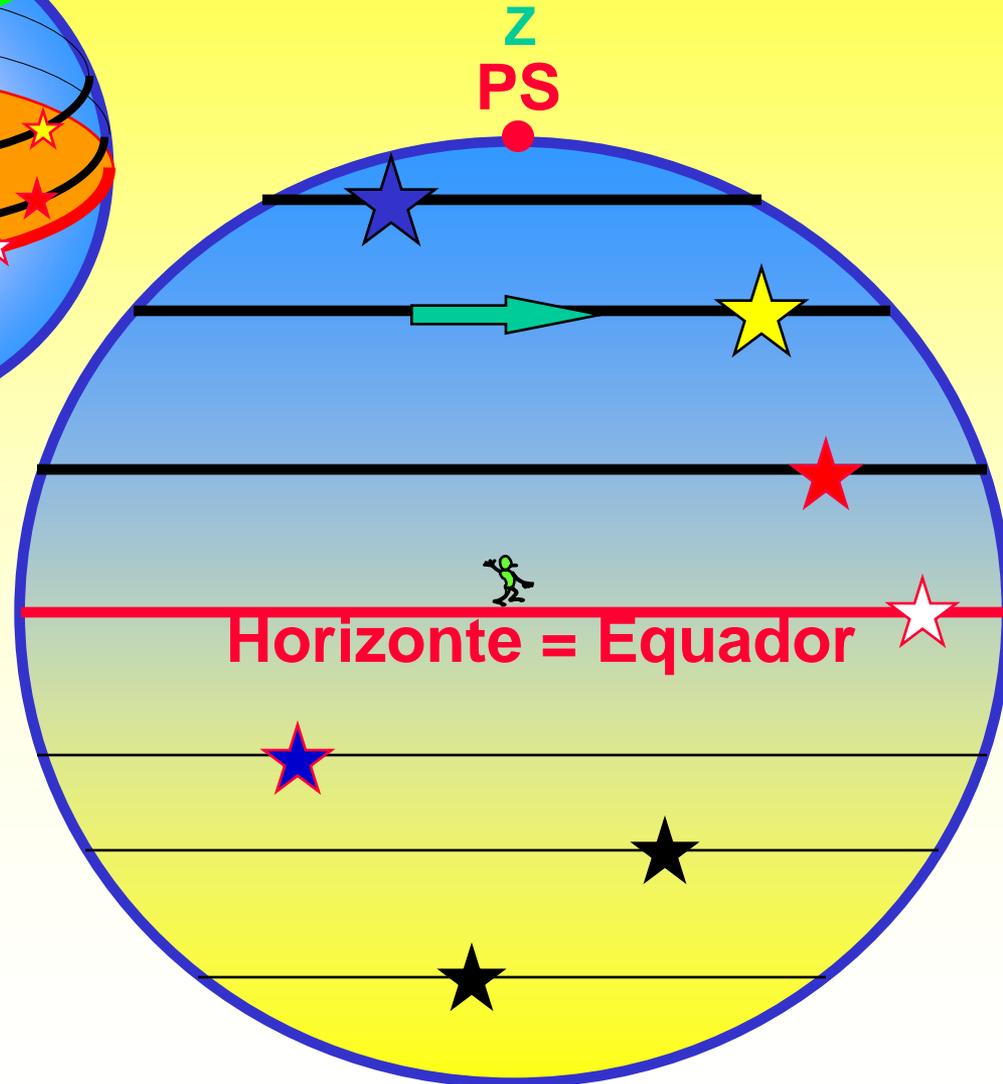
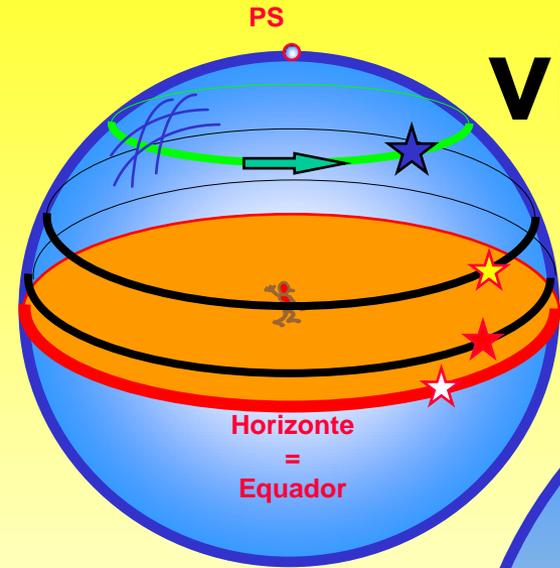
Movimento diurno aparente visto do equador



Movimento diurno aparente visto de diferentes posições



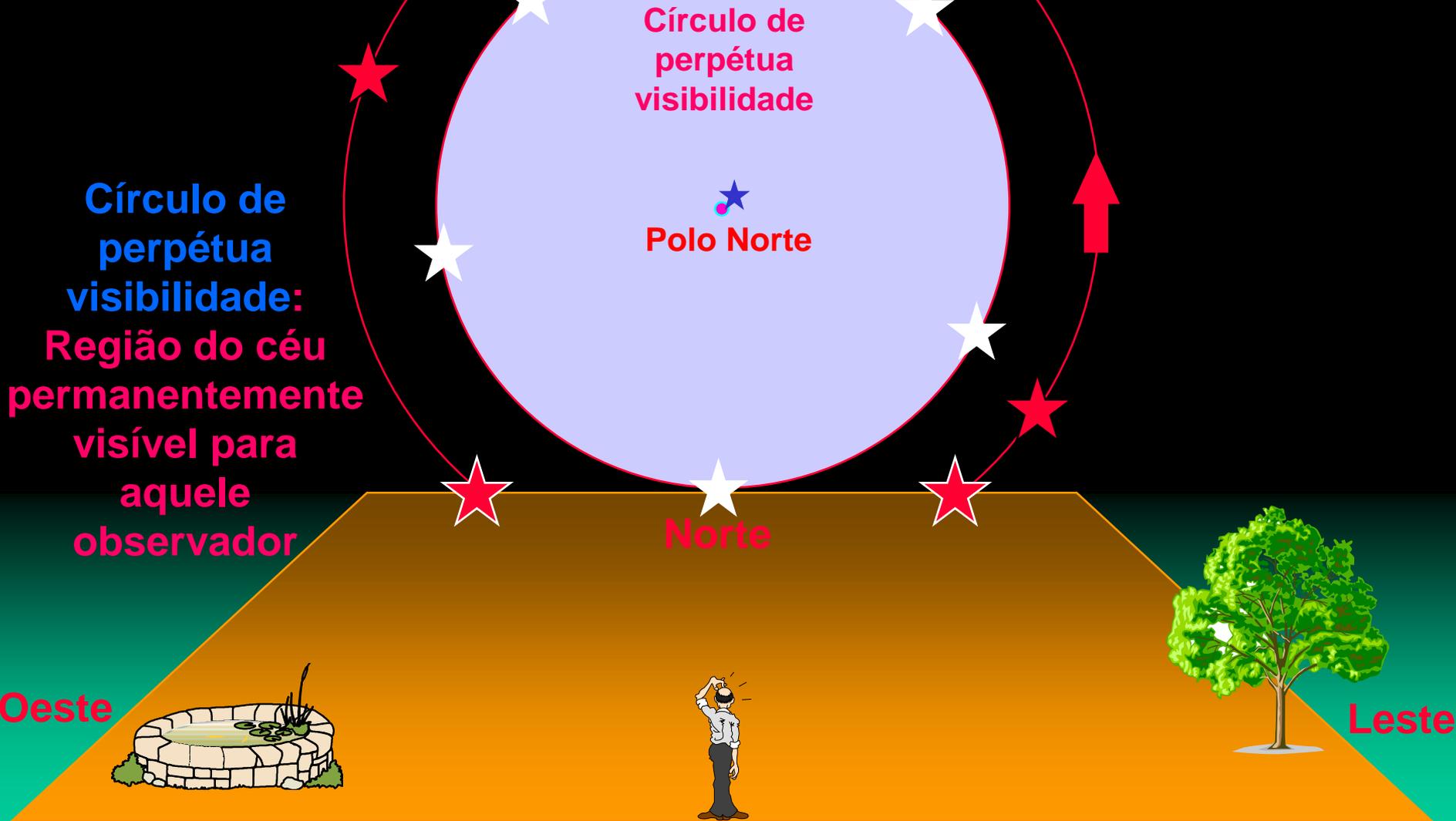
Movimento diurno aparente visto do Polo Sul



Condição de visibilidade de um astro



Círculo de perpétua visibilidade olhando para o norte



Condição de (in)visibilidade no Hemisfério Norte



Circumpolares

Visíveis: $\delta_* > \delta_{\text{CirVis}}$



$$\delta_{\text{CirVis}} + \varphi = 90^\circ$$

$$\delta_{\text{CirVis}} = 90^\circ - \varphi$$

$$\delta_* \geq 90^\circ - \varphi$$

Circumpolares

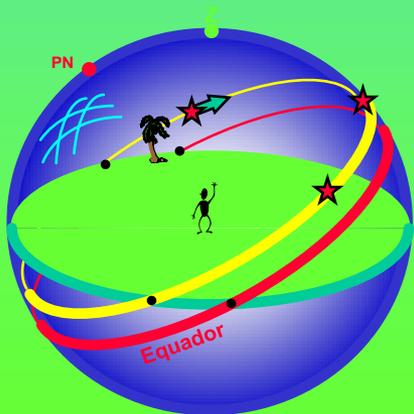
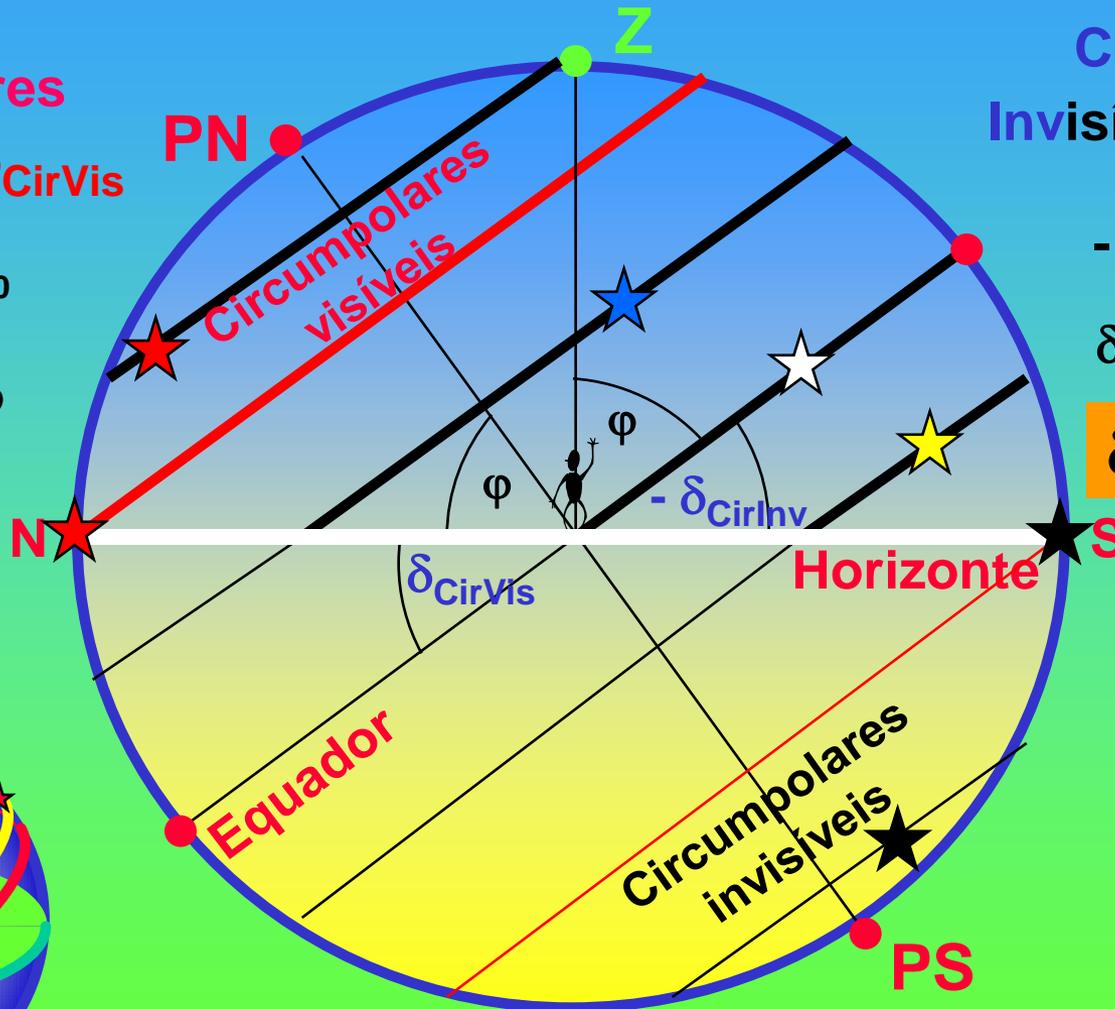
Invisíveis $\delta_* < \delta_{\text{CirInv}}$



$$-\delta_{\text{CirInv}} + \varphi = 90^\circ$$

$$\delta_{\text{CirInv}} = -90^\circ + \varphi$$

$$\delta_* \leq -(90^\circ - \varphi)$$



Estrelas com Nascer e Ocaso no HN:

$$-(90^\circ - \varphi) \leq \delta_* \leq +(90^\circ - \varphi)$$



Circumpolares

Visíveis: $\delta_* > \delta_{\text{CirVis}}$



$$\delta_{\text{CirVis}} + \varphi = 90^\circ$$

$$\delta_{\text{CirVis}} = 90^\circ - \varphi$$

$$\delta_* \geq 90^\circ - \varphi$$

Circumpolares

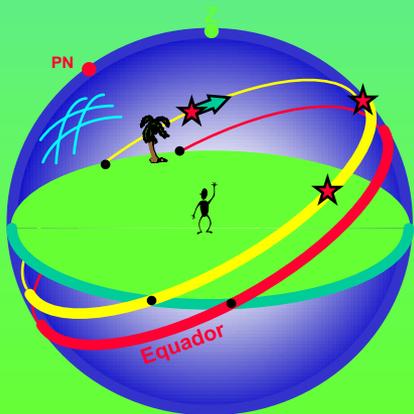
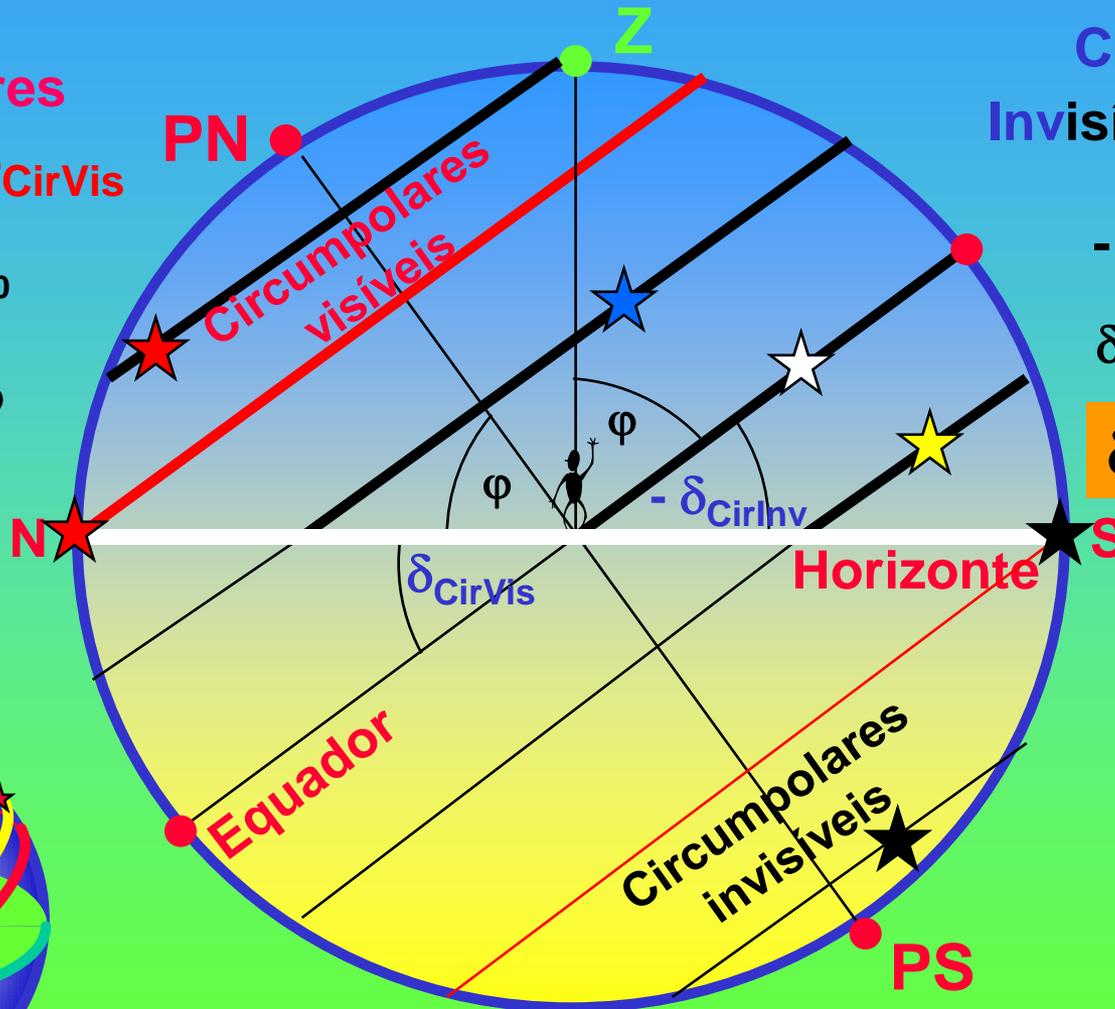
Invisíveis $\delta_* < \delta_{\text{CirInv}}$



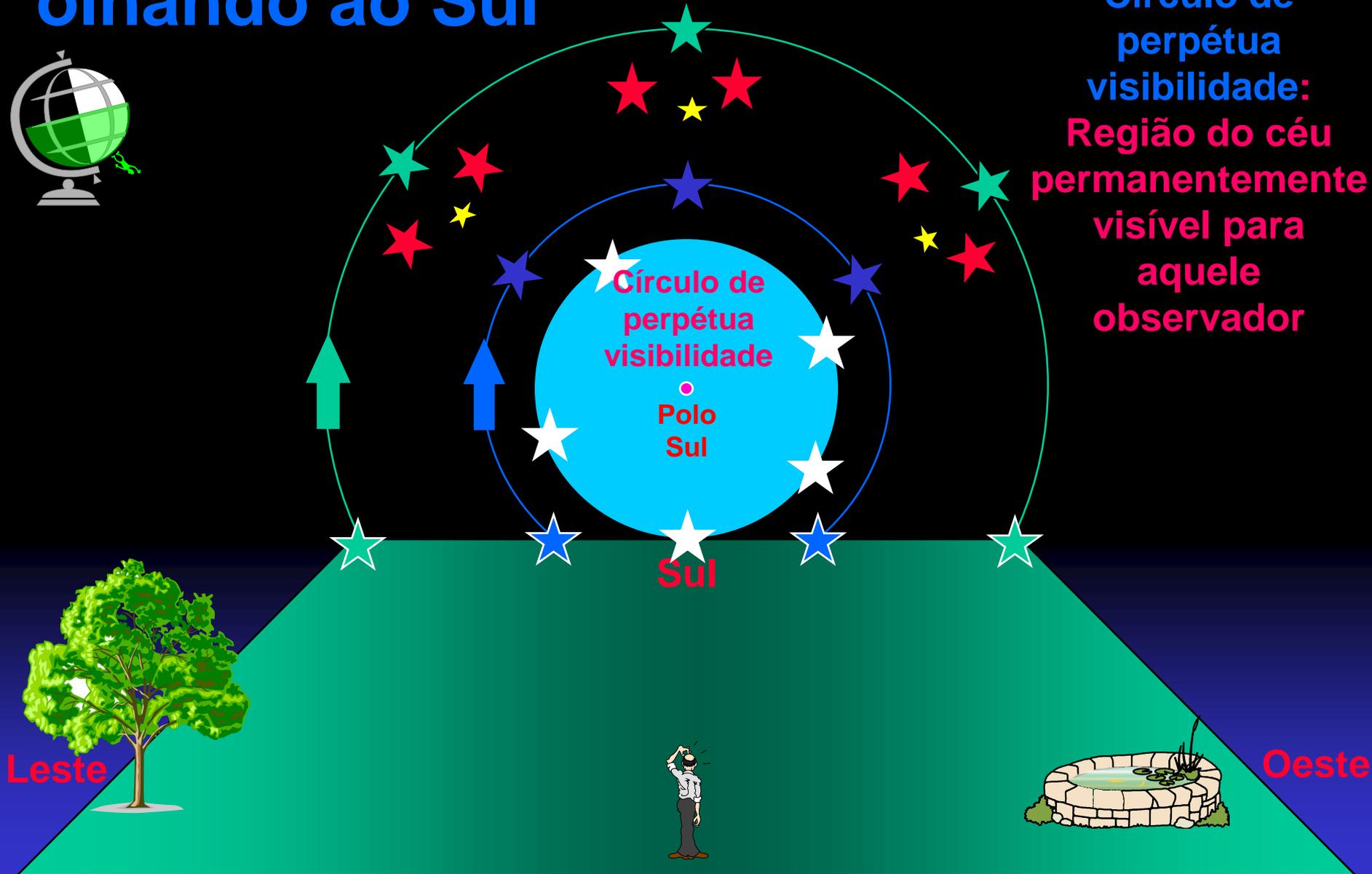
$$-\delta_{\text{CirInv}} + \varphi = 90^\circ$$

$$\delta_{\text{CirInv}} = -90^\circ + \varphi$$

$$\delta_* \leq -(90^\circ - \varphi)$$



Círculo de perpétua visibilidade olhando ao Sul



Círculo de perpétua visibilidade:
Região do céu permanentemente visível para aquele observador

Condição de (in)visibilidade no hemisfério Sul



Circumpolares invisíveis



$$\delta_{\text{CirInv}} - \varphi = 90^\circ$$

$$\delta_{\text{CirInv}} = 90^\circ + \varphi$$

$$\delta_* \geq 90^\circ + \varphi$$

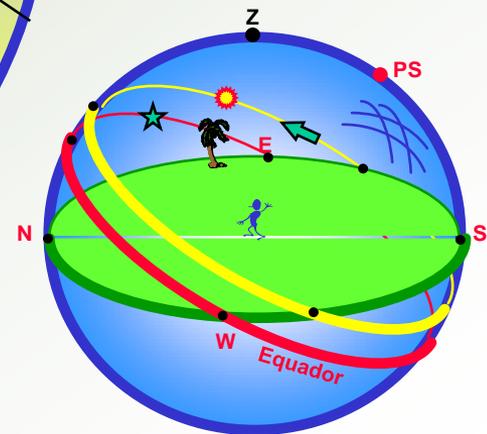
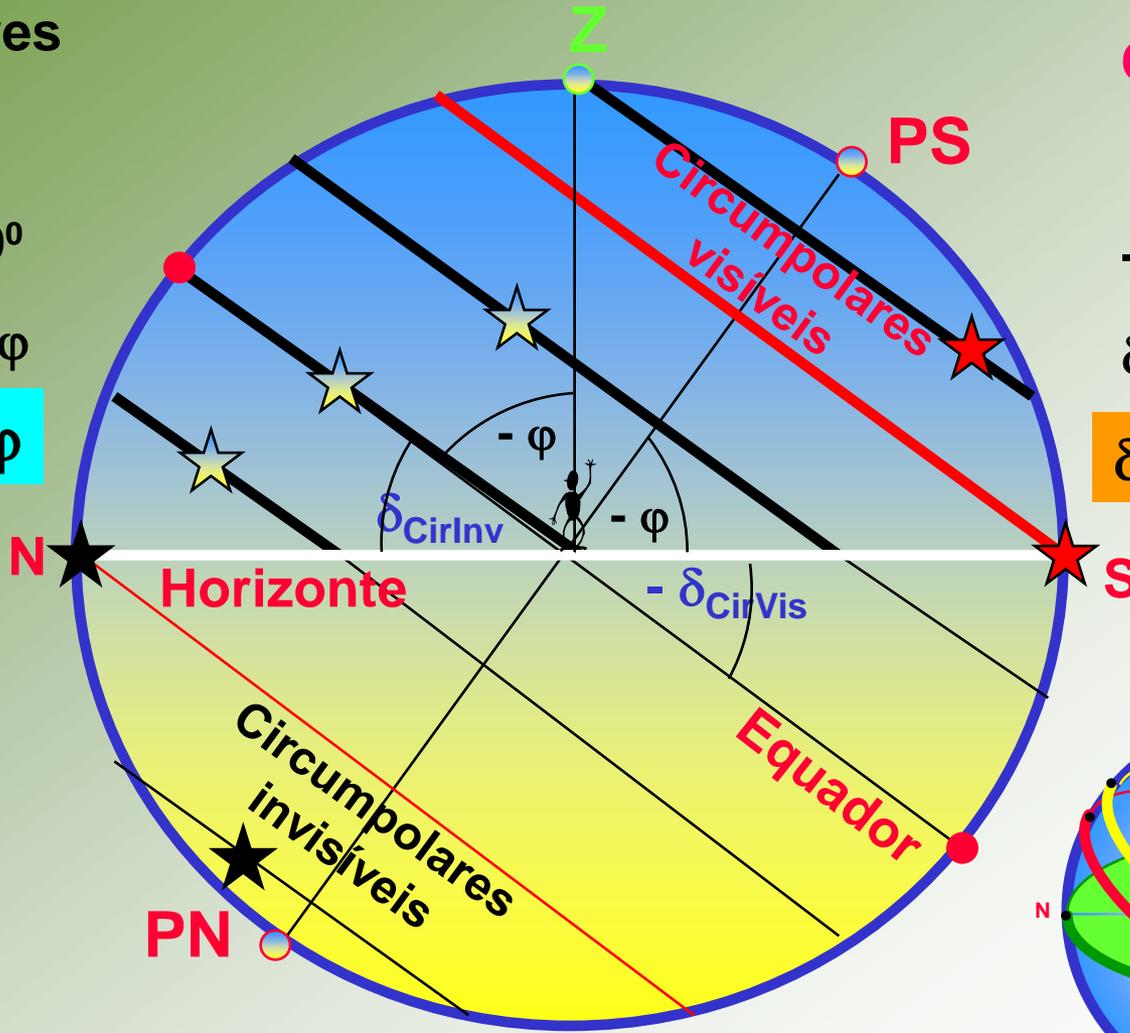
Circumpolares visíveis



$$-\delta_{\text{CirVis}} - \varphi = 90^\circ$$

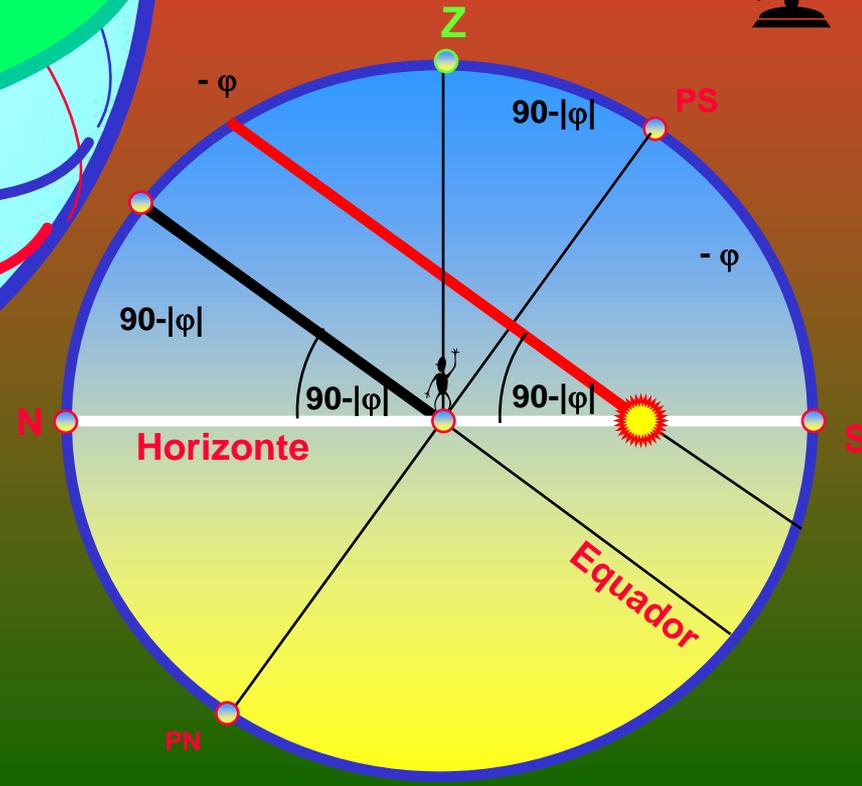
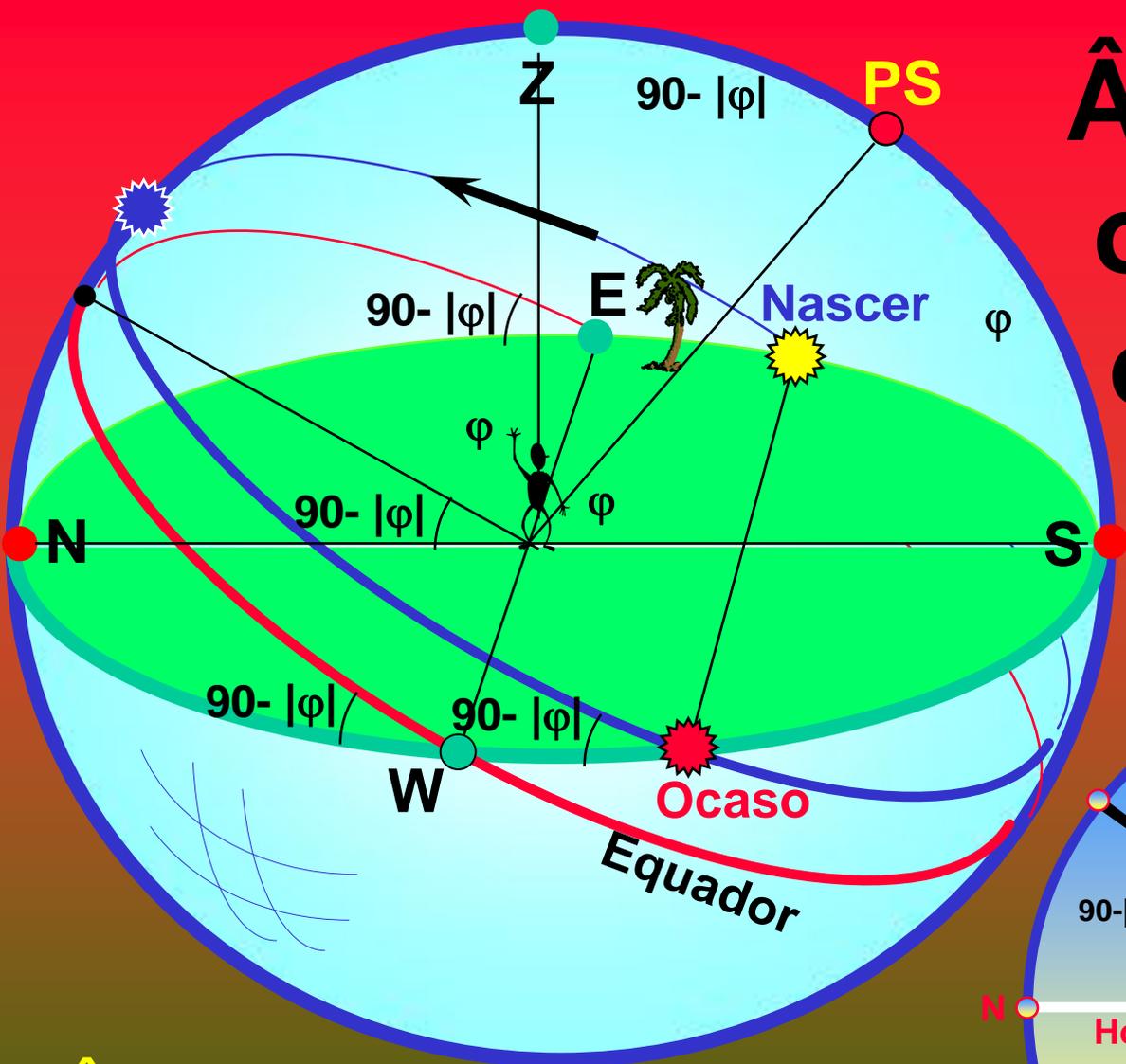
$$\delta_{\text{CirVis}} = -90^\circ - \varphi$$

$$\delta_* \leq -(90^\circ + \varphi)$$

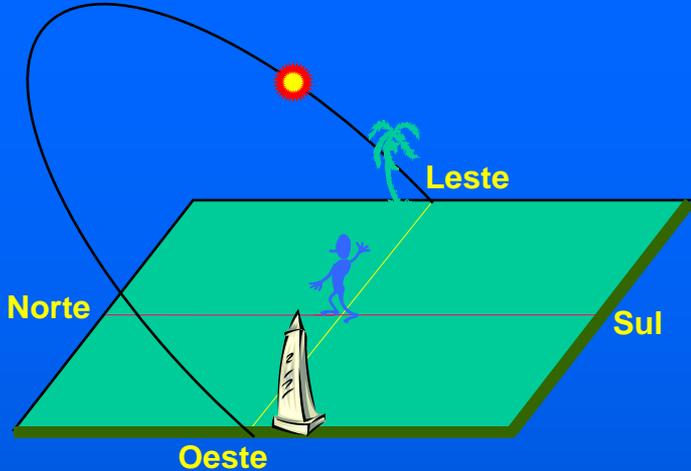


**Observando o
nascer ou o ocaso**

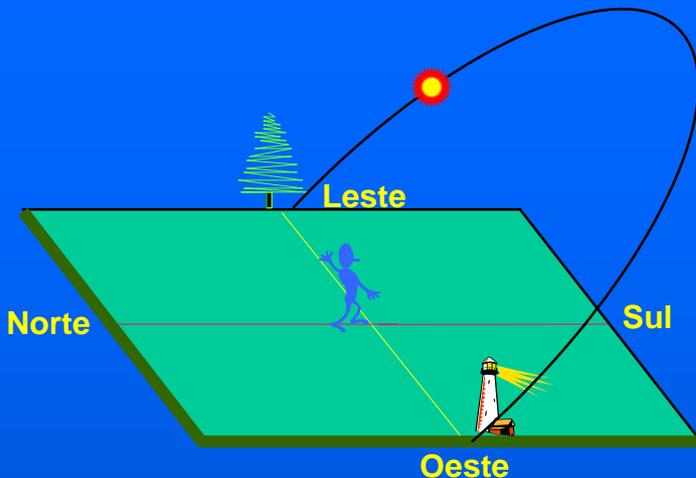
Ângulo entre o equador e o horizonte



Ângulo entre o equador e o plano do horizonte: $90^\circ - |\varphi|$

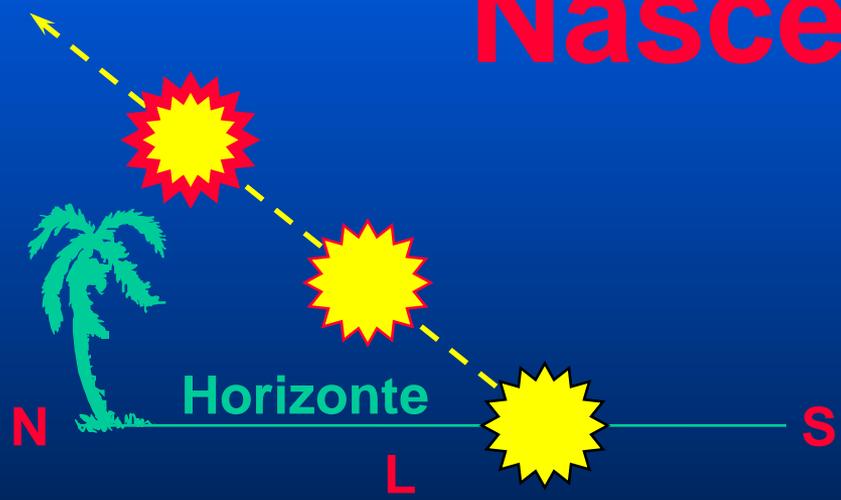


Observador no Hemisfério Sul

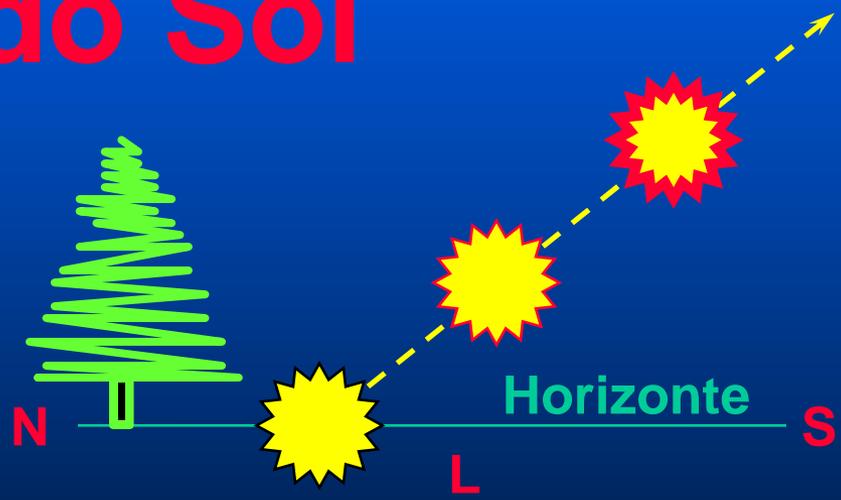


Observador no Hemisfério Norte

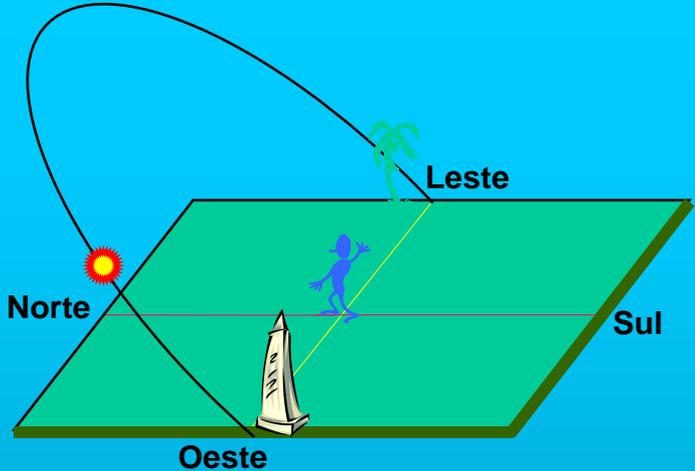
Nascer do Sol



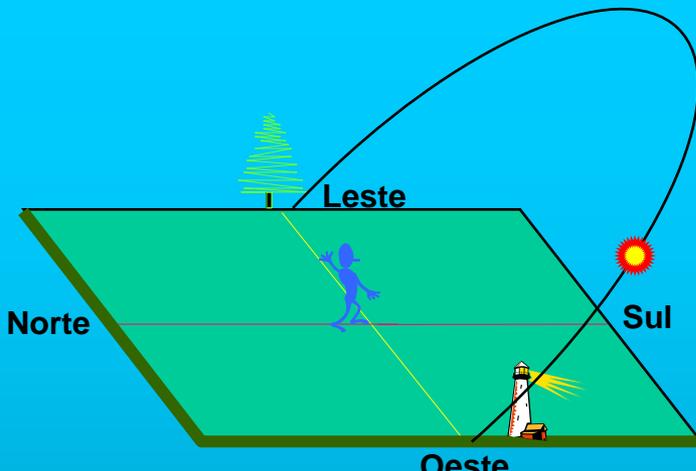
Visto por um observador no Hemisfério Sul



Visto por um observador no Hemisfério Norte

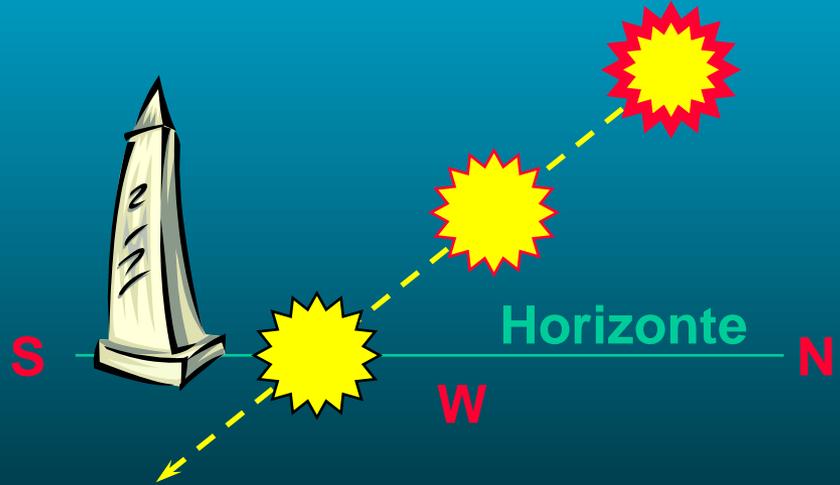


Observador no Hemisfério Sul

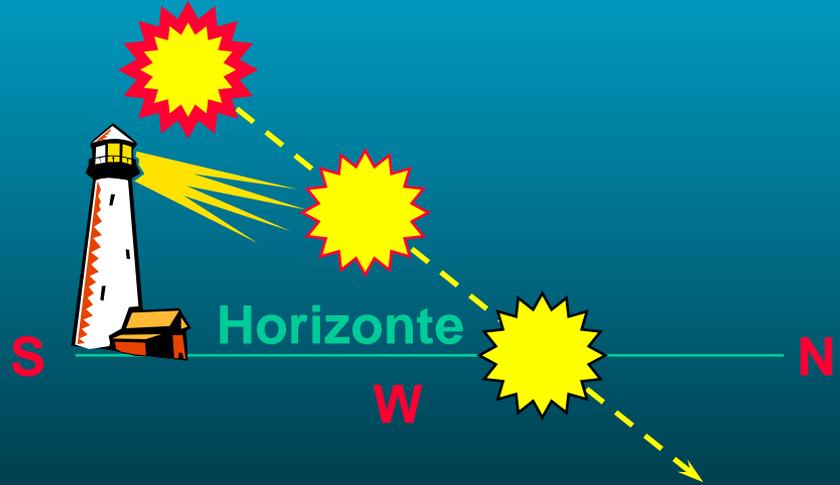


Observador no Hemisfério Norte

Ocaso do Sol

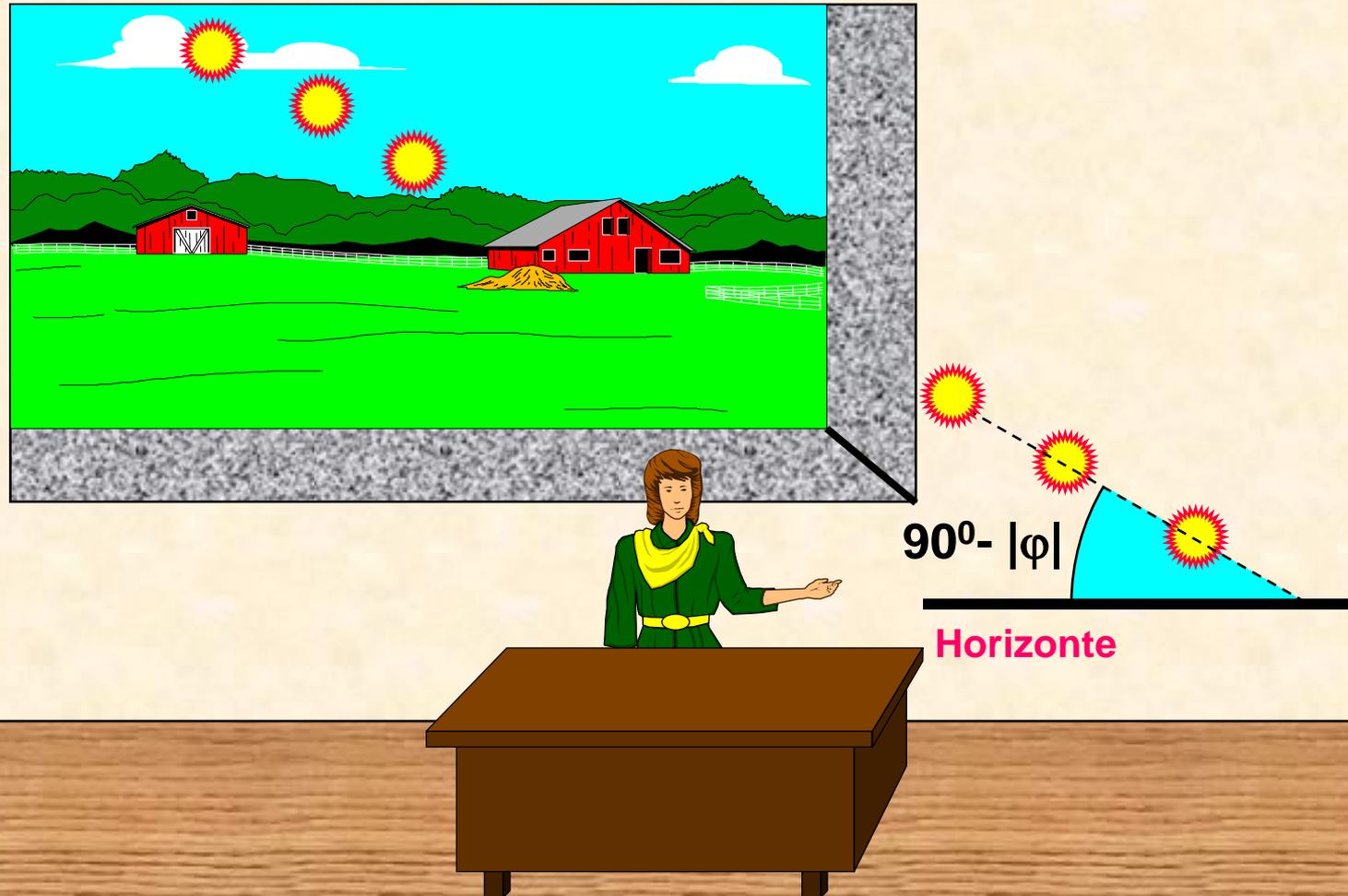


Visto por um observador no Hemisfério Sul



Visto por um observador no Hemisfério Norte

Obtendo a latitude local observando perto do nascer ou do ocaso



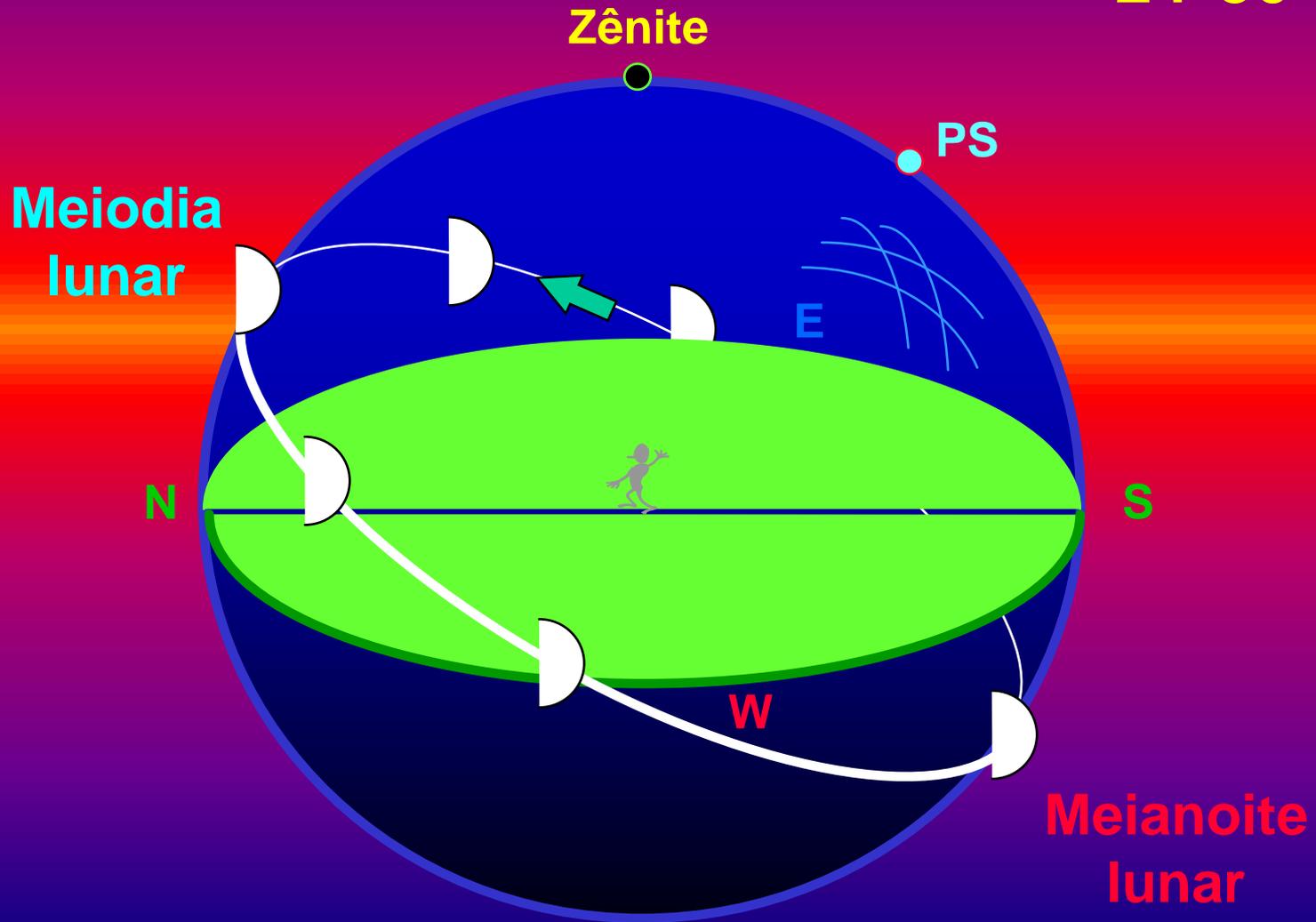


**Movimento
diurno
aparente da Lua**

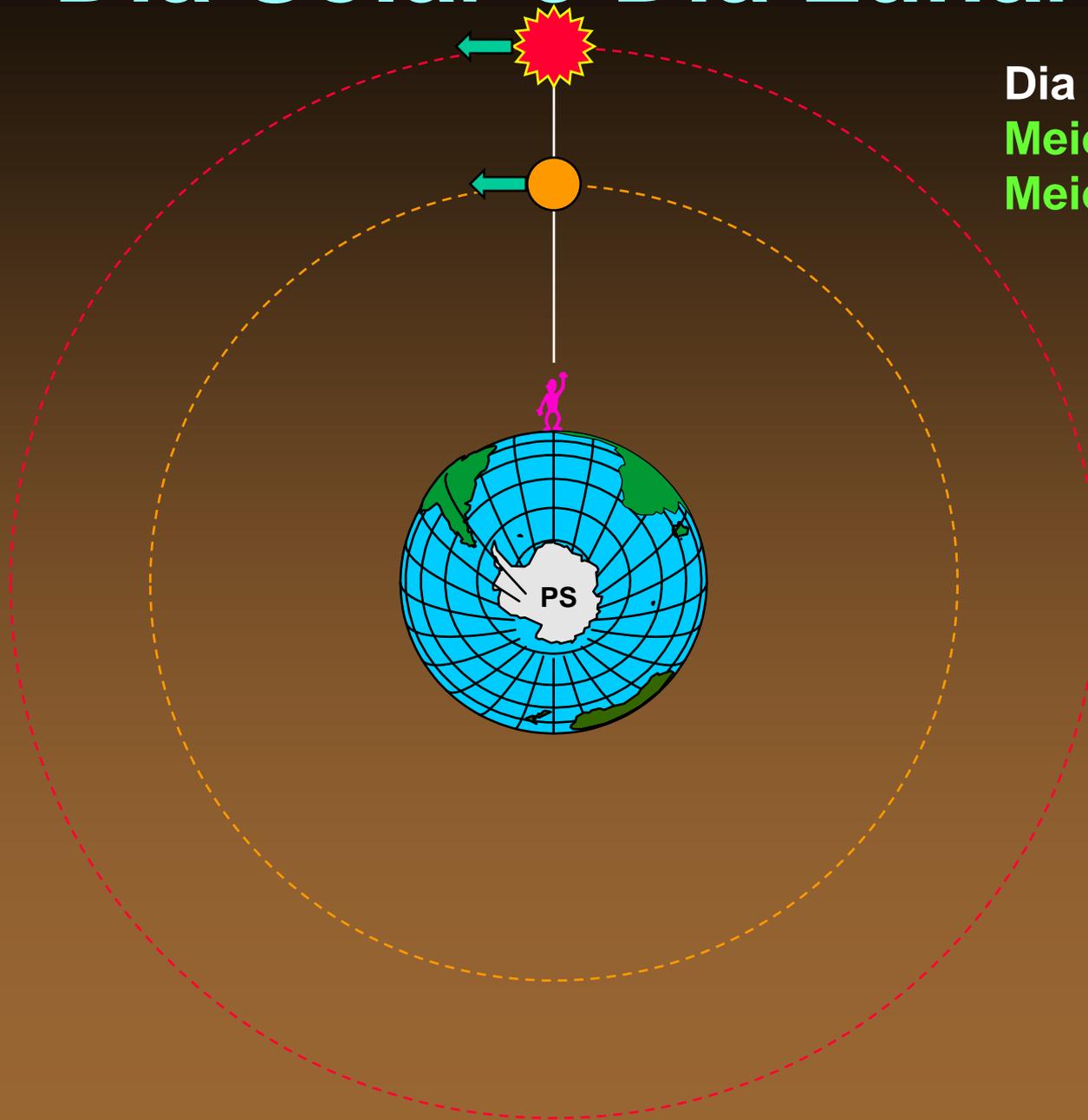
Movimento diurno aparente da

Lua

Dia Lunar
24^h50^m28^s



Dia Solar e Dia Lunar

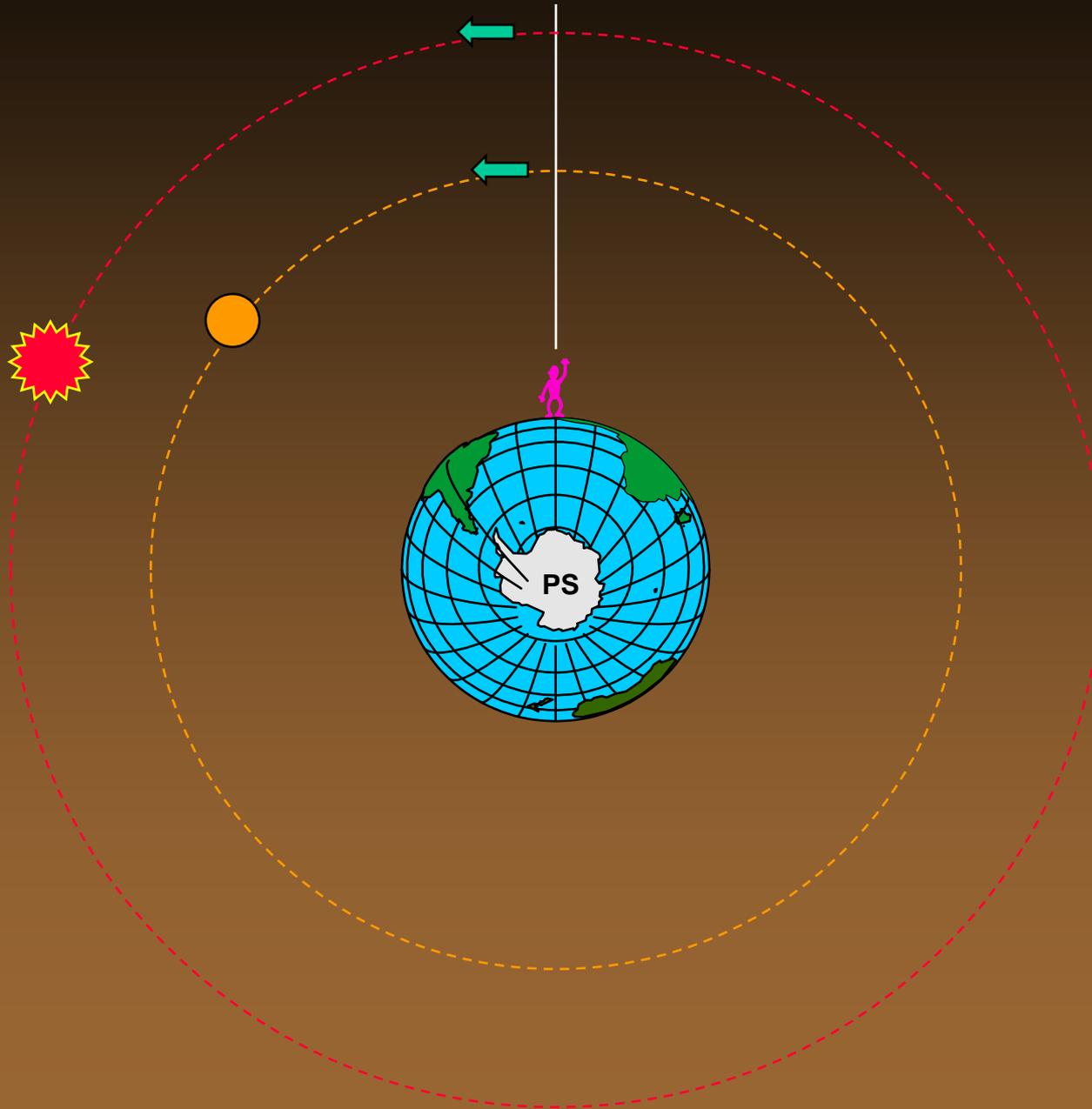


Dia 1

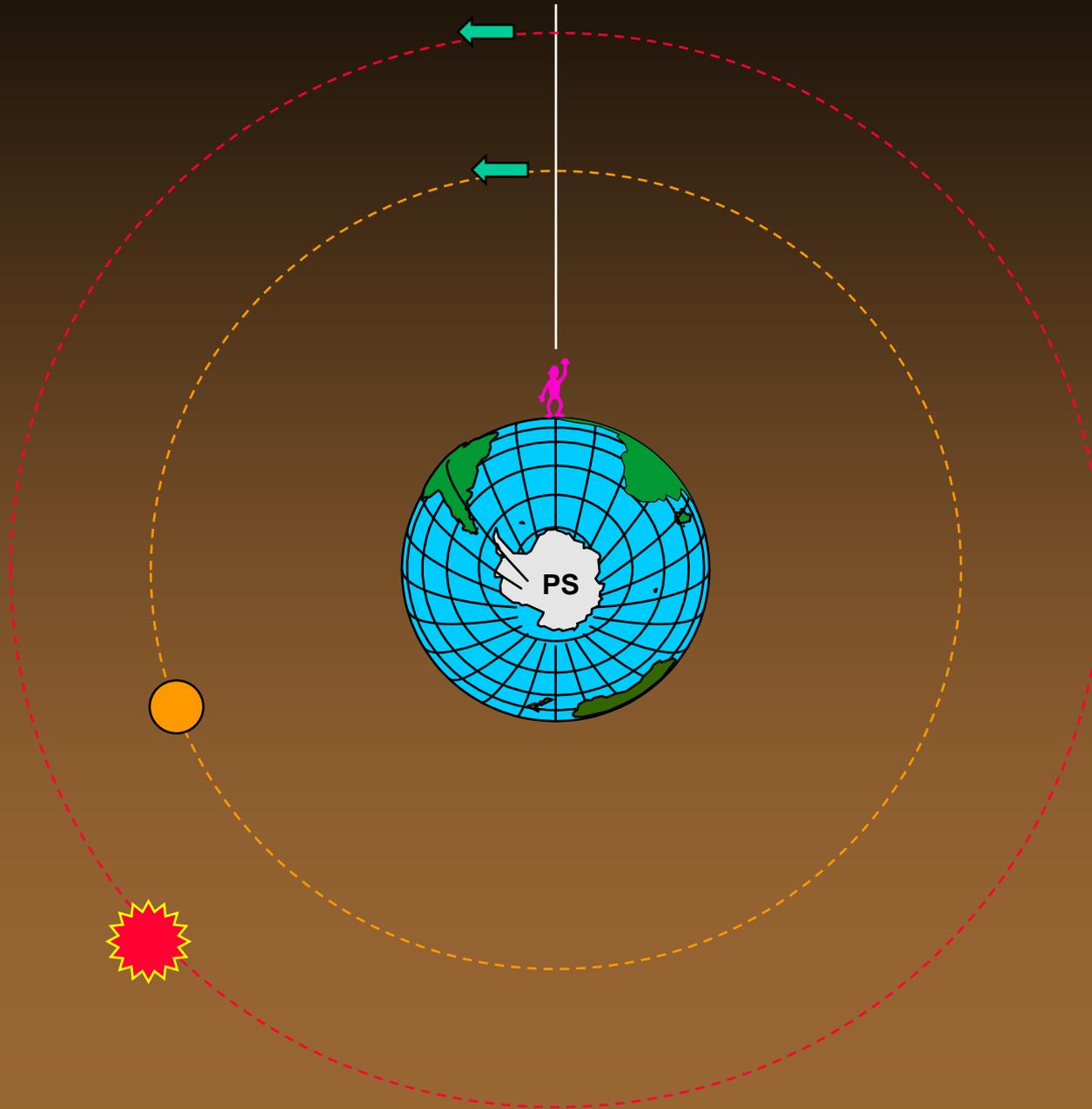
Meiodia solar

Meiodia lunar

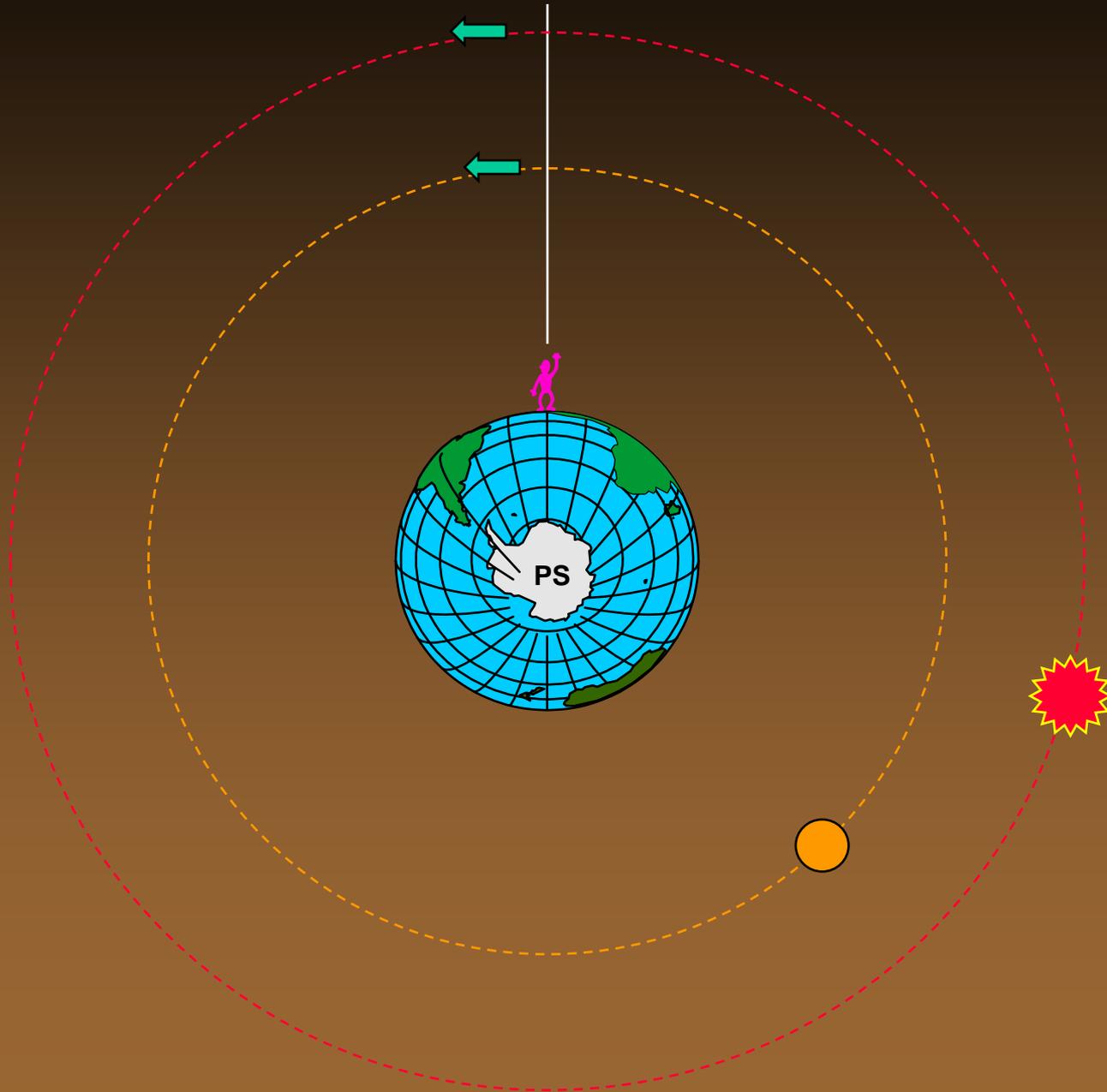
Dia Solar e Dia Lunar



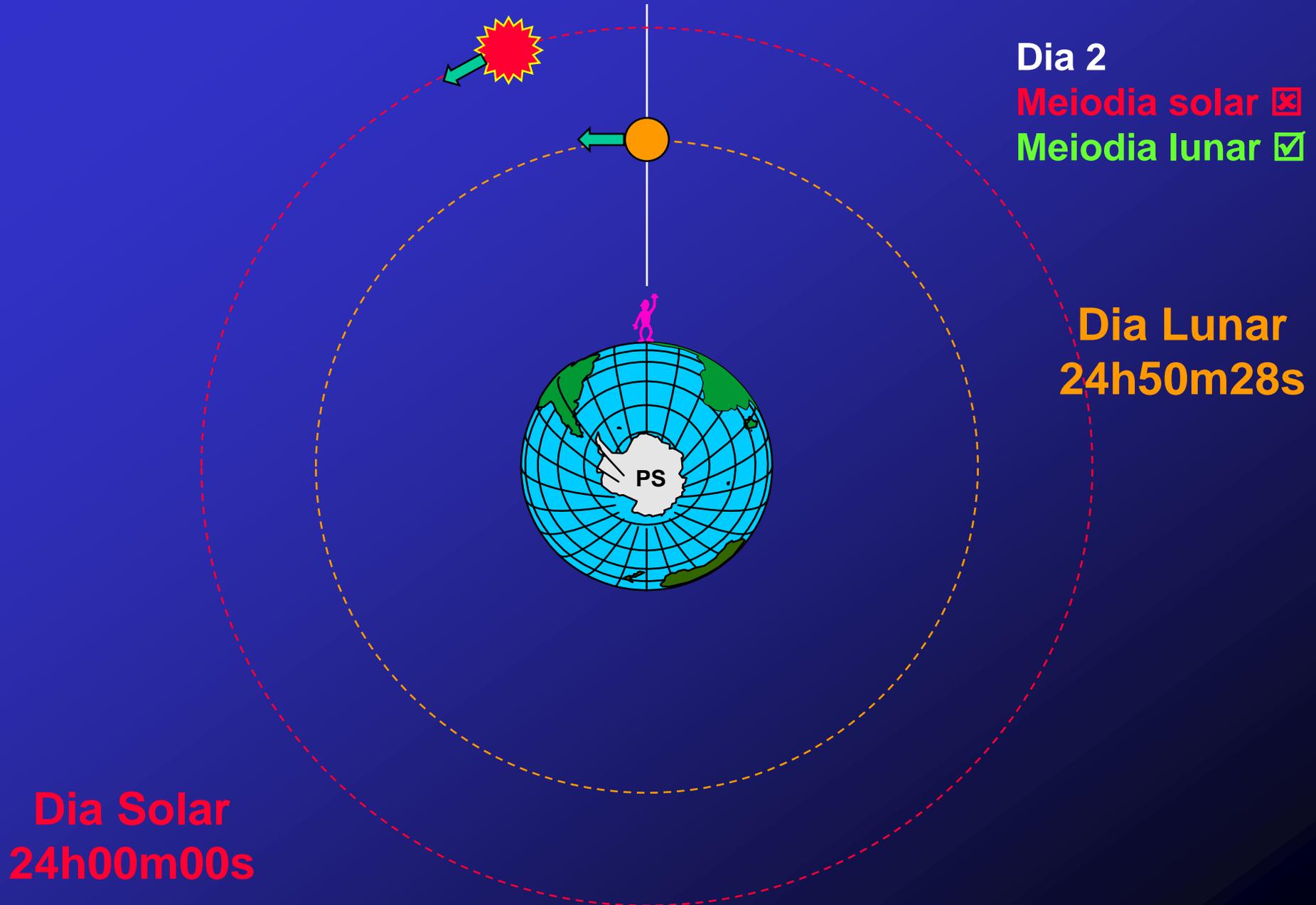
Dia Solar e Dia Lunar



Dia Solar e Dia Lunar



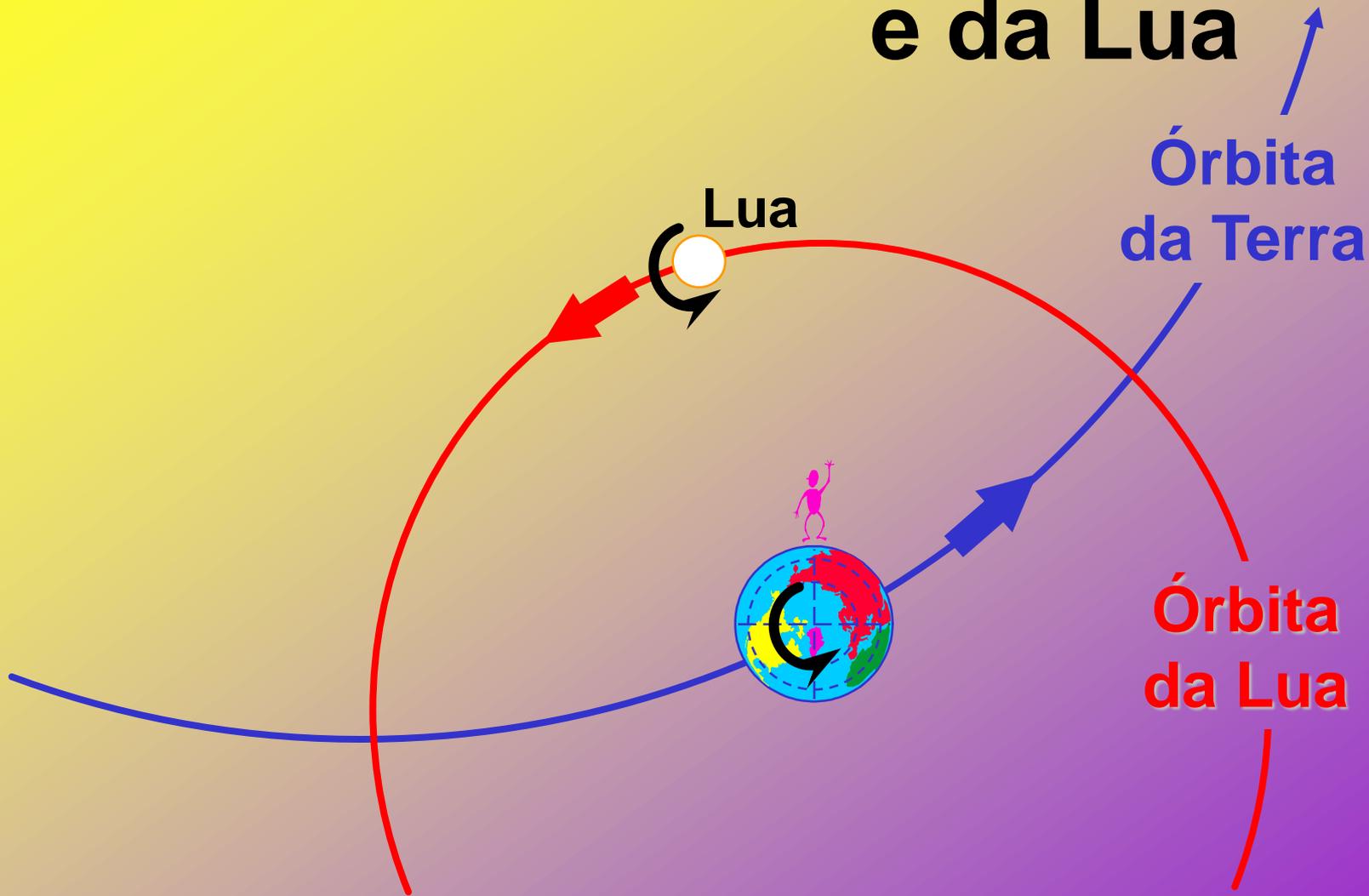
Dia Solar e Dia Lunar



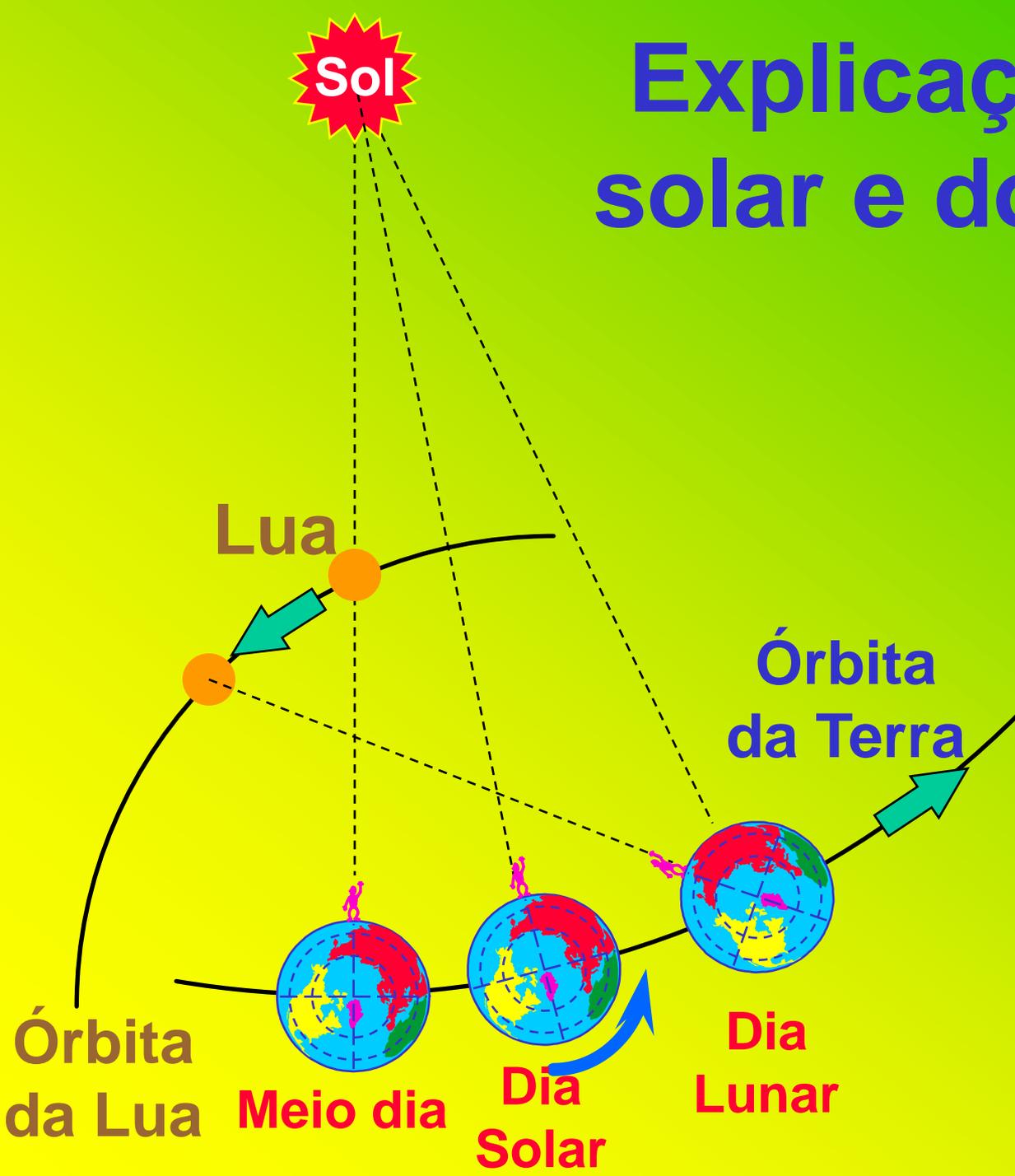


Sol

Sentidos de rotação e de translação da Terra e da Lua



Explicação do dia solar e do dia lunar




Dia Solar
24h00m00s


Dia Lunar
24h50m28s

Movimento mensal aparente da Lua



Movimento da Lua no céu



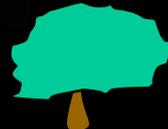
20h

Oeste



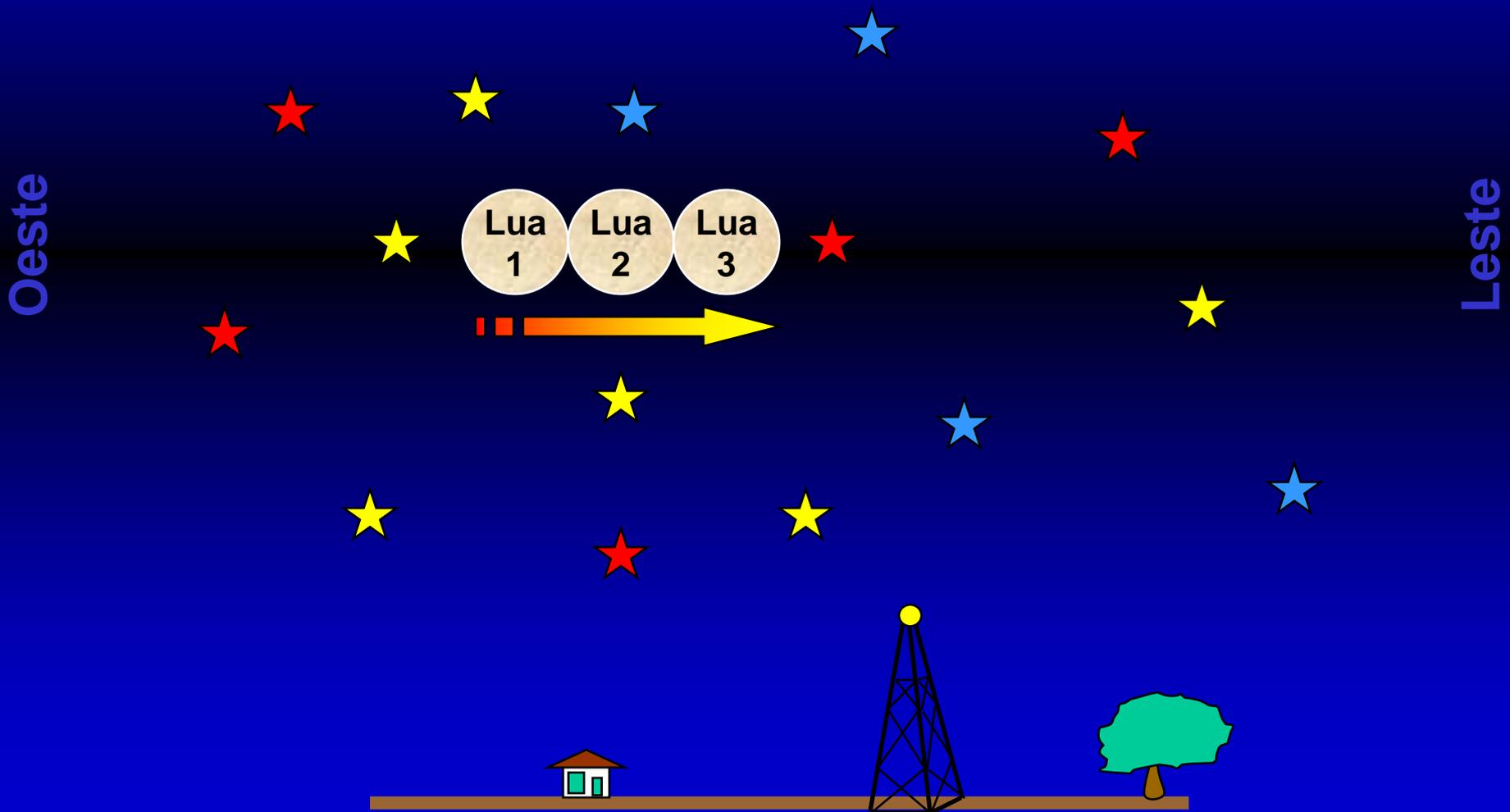
Leste

21h



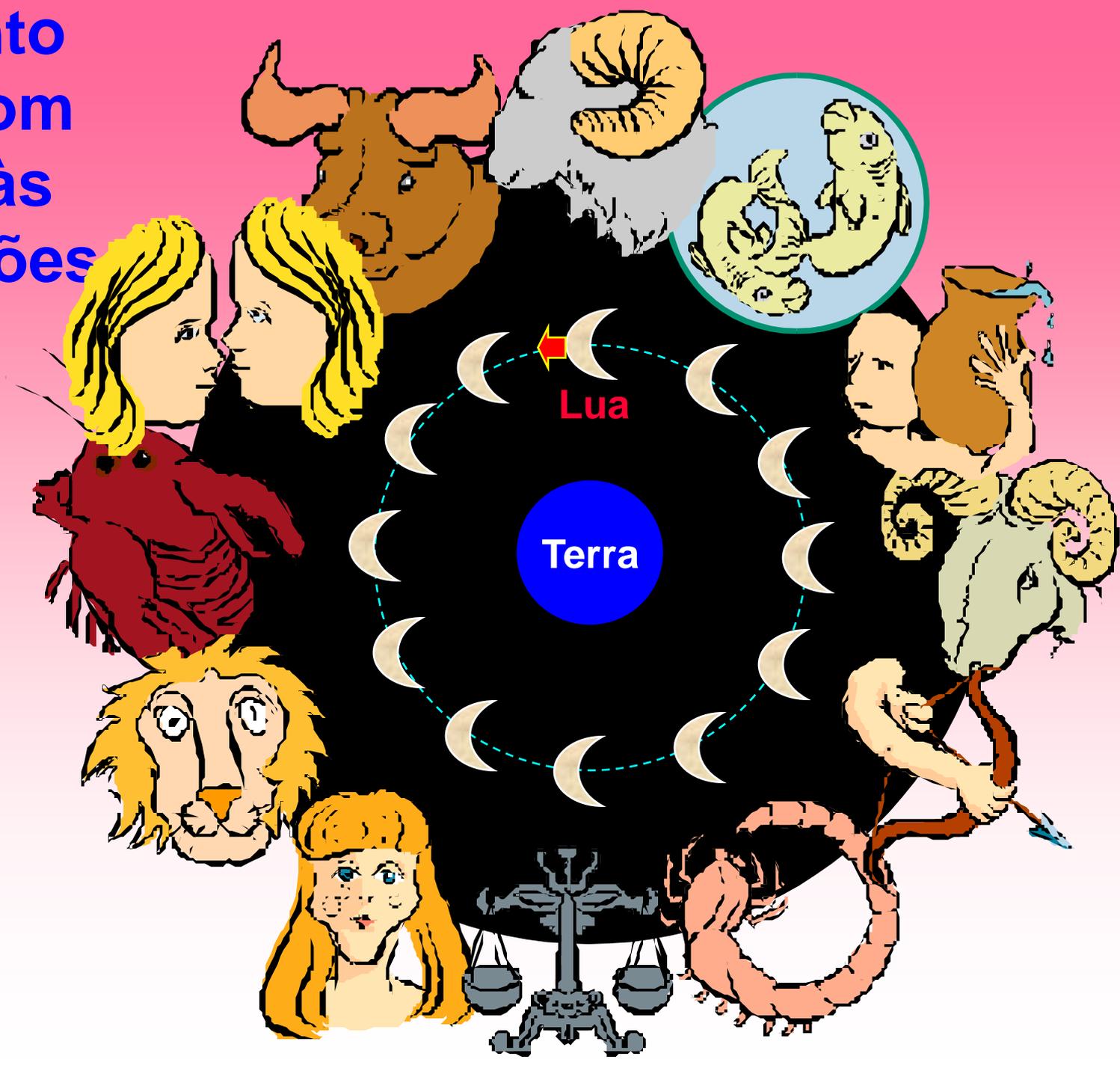
22h

Movimento da Lua com relação às estrelas



Movimento da Lua com relação às constelações

Período (sideral) ~ 27,3 dias



Film

A seguir: Movimento Anual Aparente do Sol