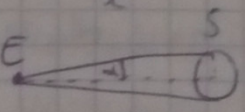
Physik des Universums

Aufgabe 1

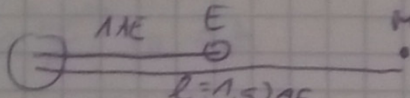
a)



$\tan \alpha = \frac{r}{l} \Rightarrow \alpha = \arctan \frac{r}{l} = \arctan \frac{7{,}0 \cdot 10^8 m}{1{,}5 \cdot 10^{11} m}$

$\beta = 2\alpha = 0{,}53°$

b)



$\beta_{min} = 2 \cdot \arctan\left(\frac{6{,}8 \cdot 10^6 m/s}{0{,}52 \cdot 1{,}5 \cdot 10^{11} m}\right)$

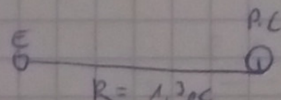
$= 5{,}0 \cdot 10^{-3}°$

$= 0{,}3'$

$l_{max} = 2{,}52$ AE

$\beta_{max} = 1{,}0 \cdot 10^{-3}° = 0{,}06'$

c)



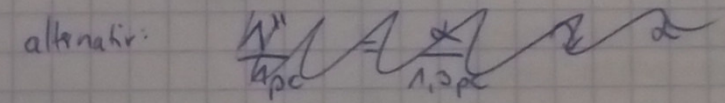
$\alpha = \arctan\left(\frac{2r}{R}\right)$

$= \arctan\left(\frac{2 \cdot 0{,}145 \cdot 7{,}0 \cdot 10^8 m}{1{,}3 \cdot 3{,}1 \cdot 10^{16} m}\right)$

$\approx 0{,}001''$

d) $\alpha = \arctan\left(\frac{2 r_E}{R}\right) = \arctan\left(\frac{2 \cdot 6{,}4 \cdot 10^6 m}{1{,}3 \cdot 3{,}1 \cdot 10^{16} m}\right) \approx 6{,}6 \cdot 10^{-5}''$

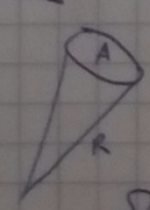
alternativ:



~~$\tan \alpha \cdot 1{,}3 pc = \alpha_c = \tan(1'') \cdot 1 pc \Rightarrow \alpha = \arctan\left[\tan(1'') \cdot \frac{1}{1{,}3}\right]$~~

Aufgabe 2

a)



$\Omega = \frac{A}{R^2} \qquad \Omega = \frac{\pi \cdot R_\odot^2}{r_\odot^2} = \frac{\pi \cdot (7{,}0 \cdot 10^8 m)^2}{(1{,}5 \cdot 10^{11} m)^2}$

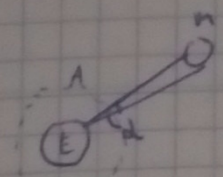
$\approx 6{,}8 \cdot 10^{-5}$ sr

$\Omega = 2\pi(1 - \cos(\frac{\alpha}{2})) \overset{\text{aus 1a)}}{\approx} 6{,}8 \cdot 10^{-5}$ sr

b) $\Omega = \frac{\pi \cdot R_E^2}{r_\odot^2} = \frac{\pi \cdot (6{,}4 \cdot 10^6 m)^2}{(1{,}5 \cdot 10^{11} m)^2} \approx 5{,}7$ nsr

c) $\Omega = \frac{\pi \cdot d^2/4}{r_S^2} = \frac{\pi \cdot (1{,}4 \cdot 10^9 m)^2}{4 \cdot (7{,}8 \cdot 10^{11} m)^2} \approx 25{,}3$ nsr

Aufgabe 4)

a) 

$\alpha = 5''$ $\quad r_M = 3{,}84 \cdot 10^8\,m$

$\tan\alpha = \frac{d_L}{r_M}$

$\Rightarrow d_L = \tan\alpha \cdot r_M \approx \underline{\underline{9{,}3\,km}}$

b) $n_M = n_0 \cdot 50\% \cdot \frac{A_S}{A_{LK}}$

$n_0 = 10^9$

$A_S = 1100\,cm^2$

$A_{LK} = \pi \cdot \frac{d_{LK}^2}{4} \approx$

$\approx \underline{\underline{8{,}1 \cdot 10^9}}$

c) $n_T = n_M \cdot 0{,}1 \cdot \frac{A_T}{A_F}$

$A_T = \pi \cdot \frac{(7\,cm)^2}{4} \approx$

$A_F = 200\,km^2$

$\approx \underline{\underline{1{,}8}}$

d)

Messung über mehrere Stunden: sonst nicht signifikant

3.) $m = -2{,}5 \log\left(\frac{F}{F_{vrga}}\right)$

$m_{V_S} = -26{,}7\,mag$

$m_{VM} = -12{,}5\,mag$

$\rightarrow F_{SM} = \frac{-26{,}7}{10^{-2{,}5}} \cdot F_{vrga}$

$F_M = \frac{-12{,}5}{10^{-2{,}5}} \cdot F_{vrga}$

$\frac{F_S}{F_M} = \frac{10^{\frac{26{,}7}{2{,}5}}}{10^{\frac{12{,}5}{2{,}5}}} = 10^{\frac{26{,}7 - 12{,}5}{2{,}5}} \approx \underline{\underline{4{,}79 \cdot 10^5}}$