Efectul Doppler longitudinal

$\omega_{obs} = \omega_{sursa} \cdot \sqrt{\frac{c-v}{c+v}}$, $\omega = 2\pi\nu$, $\lambda = \frac{c}{\nu}$

$2\pi\nu_{obs} = 2\pi\nu_{sursa} \cdot \sqrt{\frac{c-v}{c+v}} \; / : 2\pi \Rightarrow \frac{1}{\nu_{obs}} = \frac{1}{\nu_{sursa}} \cdot \sqrt{\frac{c+v}{c-v}} \; / \cdot c$

$\Rightarrow \lambda_{obs} = \lambda_{sursa} \cdot \sqrt{\frac{c+v}{c-v}}$

Efectul Doppler transversal

$\omega_{obs} = \omega_{sursa} \cdot \sqrt{1 - \frac{v^2}{c^2}}$

$2\pi\nu_{obs} = 2\pi\nu_{sursa} \cdot \sqrt{1 - \frac{v^2}{c^2}} \; / : 2\pi \Rightarrow \frac{1}{\nu_{obs}} = \frac{1}{\nu_{sursa}} \cdot \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} \; / \cdot c$

$\Rightarrow \lambda_{obs} = \lambda_{sursa} \cdot \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$

$\lambda_{Ca\,K} = 3930$ angstrom $= 3930 \cdot 10^{-10}$ m ($\lambda_{1\,sursa}$)

$\lambda_{o\,Ca\,K} = 3934$ angstrom $= 3934 \cdot 10^{-10}$ m ($\lambda_{1\,obs}$)

$\lambda_{Ca\,H} = 3966$ angstrom $= 3966 \cdot 10^{-10}$ m ($\lambda_{2\,sursa}$)

$\lambda_{o\,Ca\,H} = 3969$ angstrom $= 3969 \cdot 10^{-10}$ m ($\lambda_{2\,obs}$)

$\lambda_{obs} = \lambda_{sursa} \cdot \sqrt{\frac{c+v}{c-v}} \Rightarrow \frac{c+v}{c-v} = \frac{\lambda^2_{obs}}{\lambda^2_{sursa}}$

$\Rightarrow (c+v)\lambda^2_{sursa} = \lambda^2_{obs}(c-v)$

$$v = c \cdot \frac{\lambda^2_{obs} - \lambda^2_{sursa}}{\lambda^2_{sursa} + \lambda^2_{obs}}$$

$c = 3 \cdot 10^8$ m/s

$v_1 = c \cdot \frac{\lambda^2_{1\,obs} - \lambda^2_{1\,sursa}}{\lambda^2_{1\,sursa} + \lambda^2_{1\,obs}} = 3 \cdot 10^8 \cdot \frac{3934^2 - 3930^2}{3934^2 + 3930^2} = 305{,}188$ km/s

$v_2 = c \cdot \frac{\lambda^2_{2\,obs} - \lambda^2_{2\,sursa}}{\lambda^2_{2\,obs} + \lambda^2_{2\,sursa}} = 3 \cdot 10^8 \cdot \frac{3969^2 - 3966^2}{3969^2 + 3966^2} = 226{,}843$ km/s ~~266,01~~

$\Rightarrow \bar{v} = \frac{v_1 + v_2}{2} = 266{,}0155$ km/s

$d = 2537000$ ani lumină $= 2537000 \cdot 9{,}46 \cdot 10^{15}$ m $=$
$= 24 \cdot 10^{21}$ m (distanța dintre Andromeda și calea Lactee)

$\bar{v} = \frac{d}{t} \Rightarrow t = \frac{d}{\bar{v}}$

$t = \frac{24 \cdot 10^{21}}{266,0155 \cdot 10^{3}} = 90,22 \cdot 10^{15}$ ani $= \frac{90,22 \cdot 10^{15}}{31536 \cdot 10^{3}} =$

$= 2,86 \cdot 10^{9}$ ani $= 2,86$ miliarde de ani

$\Rightarrow$ galaxiile vor intra în contact în aproximativ 2,86 miliarde de ani.