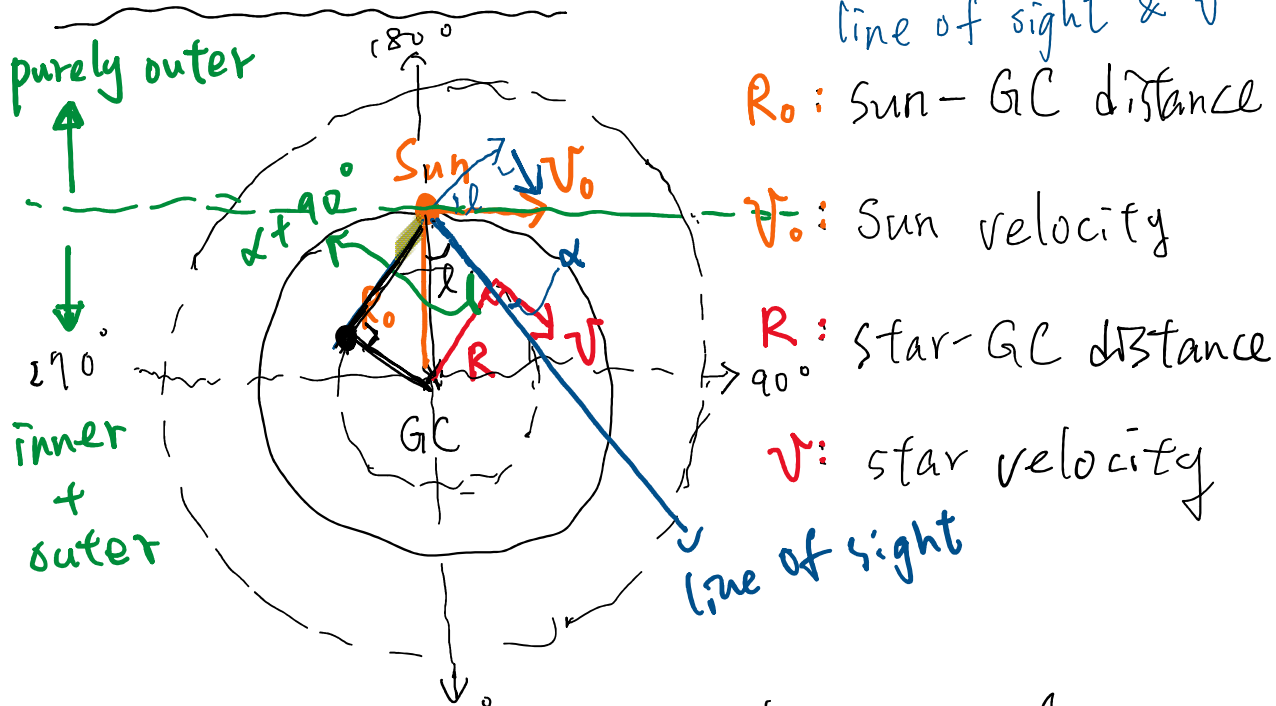


Week 3 Problem Session

Thursday, January 21, 2021 10:55 AM

Galactic Rotation



l : Galactic longitude

α : angle between line of sight & V

R_0 : Sun-GC distance

V_0 : Sun velocity

R : star-GC distance

V : star velocity

line of sight

radial velocity: velocity along line-of-sight

$$V_r = V \cos \alpha - V_0 \sin l \quad *$$

$$\triangle \quad \frac{R}{\sin l} = \frac{R_0}{\sin(\alpha + 90^\circ)} = \frac{R_0}{\cos \alpha}$$

$$\Rightarrow \cos \alpha = R_0 \sin l / R$$

$$* \Rightarrow \underline{V_r} = \underline{V} \left(\frac{R_0 \sin l}{R} \right) - V_0 \sin l$$

- [...]

$$= R_0 \sin l \left(\frac{v}{R} - \frac{v_0}{R_0} \right)$$

* longitude range

limit for inner ring: $l_{\max} > l > -l_{\max}$
 where $l_{\max} < 90^\circ$
 outer ring: $360^\circ > l > 0^\circ$

$270^\circ > l > 90^\circ$: purely outer
 $90^\circ > l > -90^\circ$: inner + outer

Given $v(R) = \text{const}$ ($200 - 220 \frac{\text{km}}{\text{s}}$)
 $\sim v_0$ (v_{LSR})

$$v_r = R_0 \sin l \left(\frac{v}{R} - \frac{v_0}{R_0} \right) \quad // \quad v = v_0 = \text{const}$$

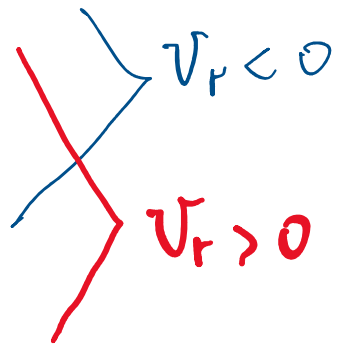
$$= R_0 \sin l \cdot v \left(\frac{1}{R} - \frac{1}{R_0} \right)$$

$$= v \sin l \left(\frac{R_0}{R} - 1 \right)$$

(i) Inner ring: $R < R_0 \Rightarrow \left(\frac{R_0}{R} - 1\right) > 0$

② $l_{max} > l > -l_{max}$

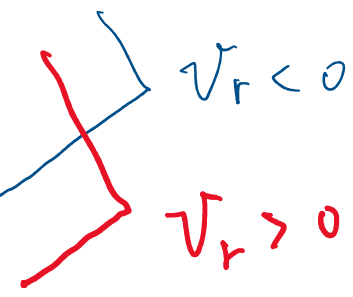
$\Rightarrow \begin{cases} 0^\circ > l > -l_{max} \Rightarrow \sin l < 0 \\ l_{max} > l > 0^\circ \Rightarrow \sin l > 0 \end{cases}$



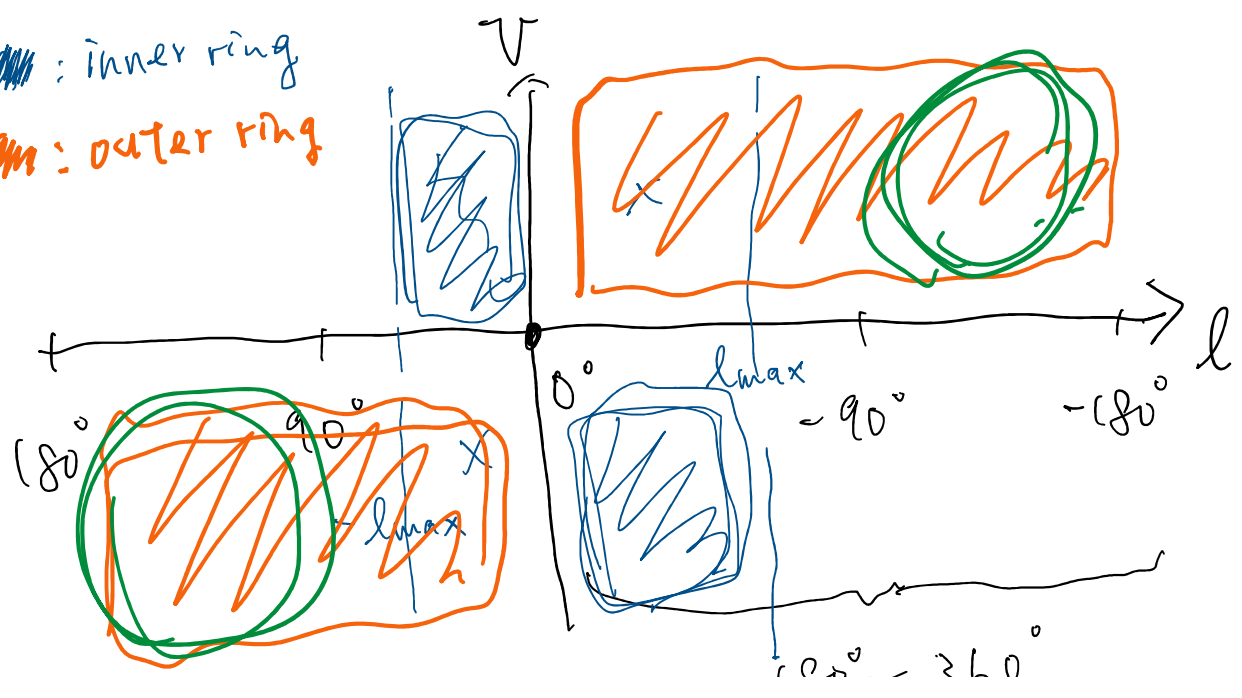
(ii) Outer ring: $R > R_0 \Rightarrow \left(\frac{R_0}{R} - 1\right) < 0$

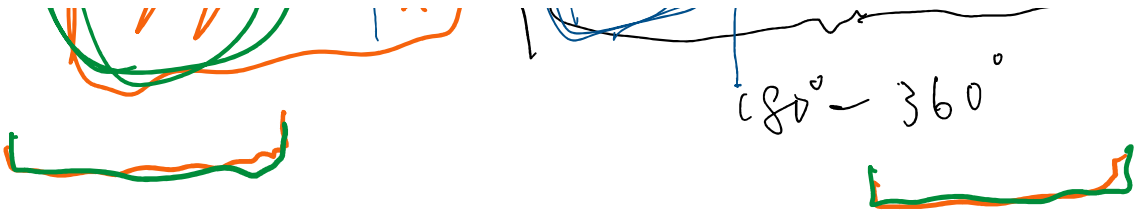
② $360^\circ > l > 0^\circ$

$\Rightarrow \begin{cases} 180^\circ > l > 0^\circ \Rightarrow \sin l > 0 \\ 360^\circ > l > 180^\circ \Rightarrow \sin l < 0 \end{cases}$



/// : inner ring
/// : outer ring





purely outer