

CESAR Science Case – Calculation guide

Real solar diameter:	1.391.684 km
Real solar diameter for the day of the transit:	31'30"
Real Venus diameter for de day of the transit:	0'58"
Sun-Venus distance for the day of the transit (V):	106.411.500 km
Grades, minutes and seconds conversion:	1° = 60' = 3600"
Grades to radians conversion:	180° = π (rad)

Method 1

To measure the linear distance between the observatories:

$$a) \overline{AB} = 2R \sin\left(\frac{\theta_1 + \theta_2}{2}\right)$$

$$b) \overline{AB} = 2R \sin\left(\frac{\beta'}{2}\right) \quad \text{where} \quad \cos\beta' = \sin\alpha_1 \sin\alpha_2 + \cos\alpha_1 \cos\alpha_2 \cos(\delta_2 - \delta_1)$$

To calculate the Earth-Sun distance:

$$E = \frac{\overline{AB}}{S} + V$$

Method 2

To calculate the parallax:

$$\sin(\pi_v) \cong \frac{d}{R_{EV}} \quad \text{and} \quad \sin(\pi_s) \cong \frac{d}{R_{ES}} \quad \text{where} \quad R_{ES} = R_{VS} + R_{EV}$$

$$\Delta\pi = \pi_s \left[\frac{R_{VS}}{R_{ES} - R_{VS}} \right]$$

To calculate the Earth-Sun distance:

$$A'B' = \frac{1}{2} \left[\sqrt{D^2 - (A_1 A_2)^2} - \sqrt{D^2 - (B_1 B_2)^2} \right]$$

$$R_{ES} = \left[\frac{d}{A'B' \cdot (R_{ES}/R_{VS} - 1)} \right]$$

Method 3

To calculate the earth Sun distance:

$$S = \sqrt{\left(\frac{D}{2}\right)^2 - \left(\frac{t_1 d}{2}\right)^2} - \sqrt{\left(\frac{D}{2}\right)^2 - \left(\frac{t_2 d}{2}\right)^2}$$

$$R_{ES} = \left[\frac{d}{S \cdot R_{ES}/R_{VS} - 1} \right]$$