Relativistic analysis of an earth-satellite time transfer

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Context

Time transfer via laser links from earth to satellite for low orbit satellites

Possible applications : ***T2L2***,*ACES*

Aim : Increase precision in **photon transfer**

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incorporate the $\mathbf{J_2}$ **term** in the **relativistic** description of the **earth potential**

Foreseeable future ??

Precision in time transfer ~10^{-14} s

Could be reached in a few years

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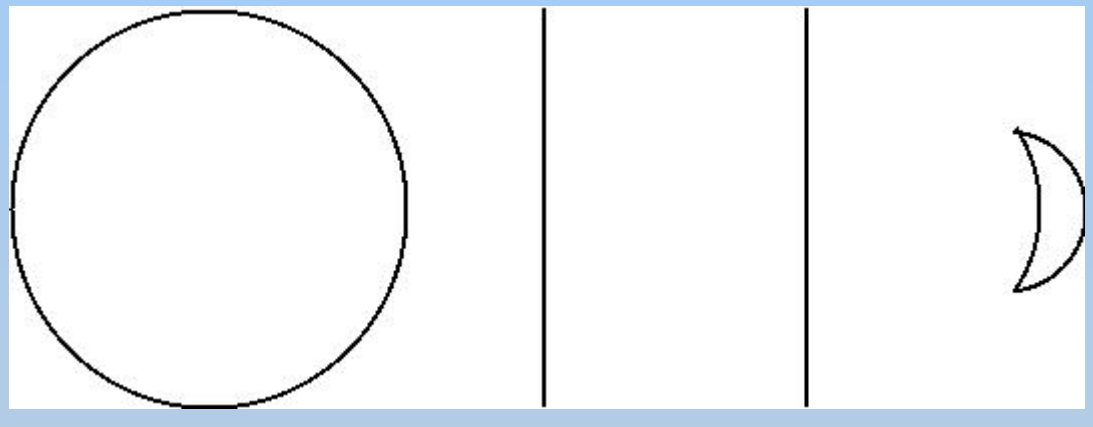
Need hight frequency laser pulse

Which domain for which potential

~20 000 km ~40 000 km



$J_2 > C_{22}, J_3, \ldots >$ Moon & Sun

Sun &/or Moon $> J_2, \ldots$

$J_2 >$ Moon & Sun $> C_{22}, J_3, \ldots$

Numerically ...

$$ds^2 = \left(-1 + \frac{2U}{c^2} + \ldots\right) c^2 dt^2 + \left(1 + \frac{2U}{c^2} + \ldots\right) |d\vec{r}|^2 + 2 g_{0i} c\, dt dx^i$$

<u>First relativistic order</u>

- $J_2 \rightarrow 10^{-14}$ s (~1000 km altitude)
- $J_3, C_{22} \ldots \rightarrow 10^{-16}$ s

<u>Higher relativistic order terms</u>

- $g_{0i} \rightarrow 10^{-16}$ s (Lense-Thirring on light motion)

Conclusion

- **Complete relativistic treatment** of the time transfer **is needed** in order to **fit the future data**
- **In foreseeable future**, including the J_2 Earth potential term in such treatment **will be necessary**

→ **We derived the complete formulae including the corresponding terms**