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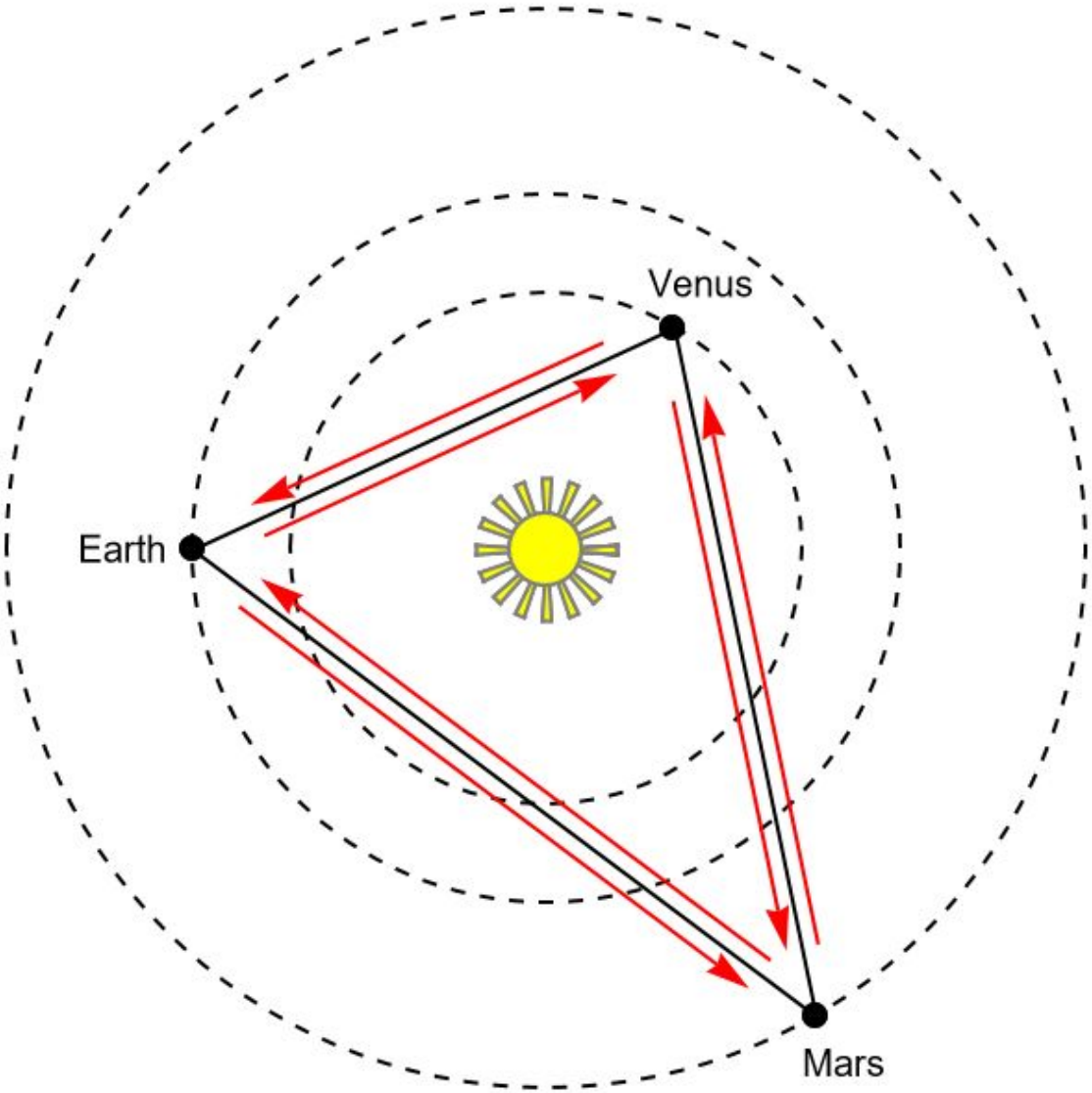
# Interplanetary Laser Trilateration Network (ILTN)

1. What is it?
2. How does it work?
3. How well does it work?
4. Benefits

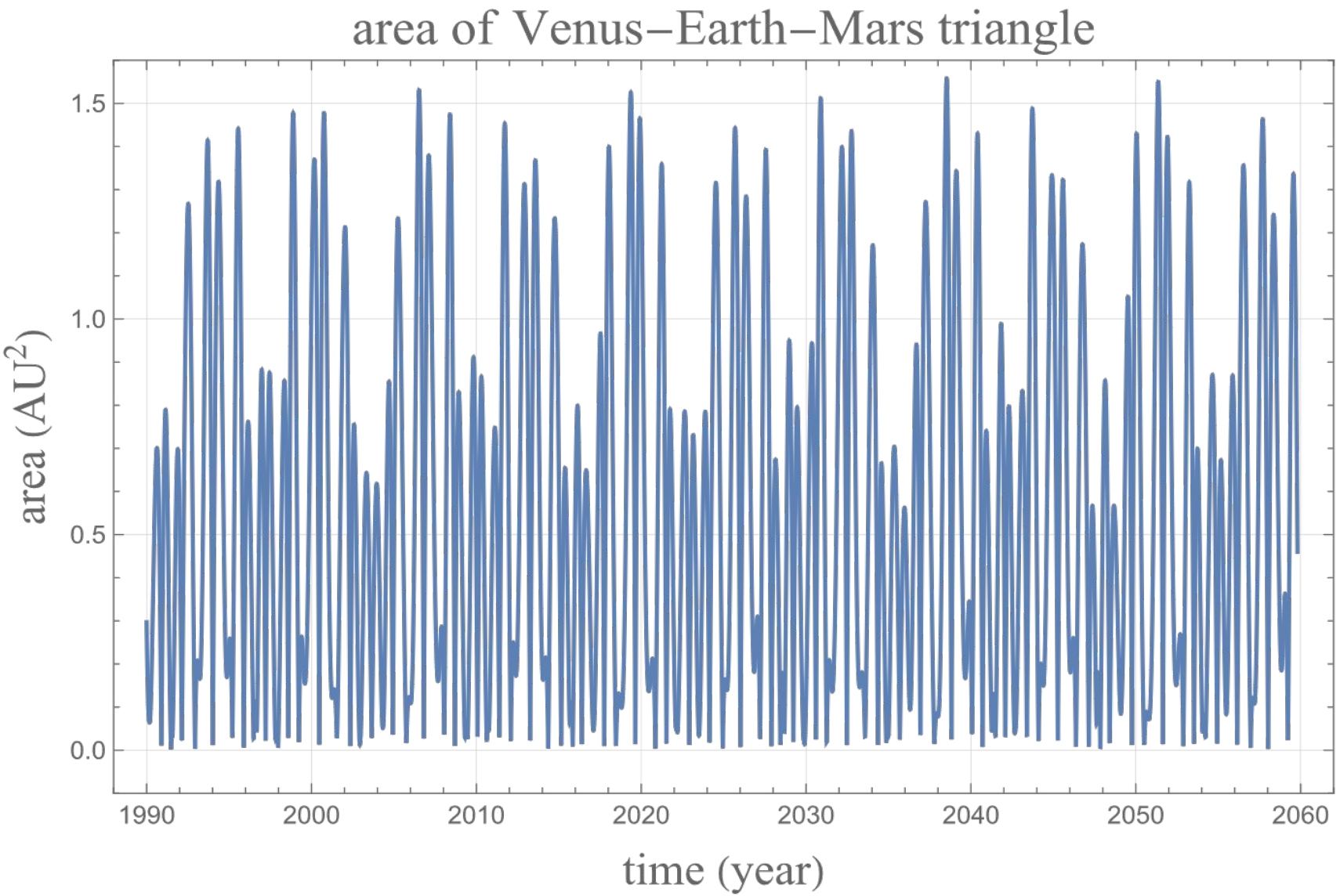
# 1. What is it?

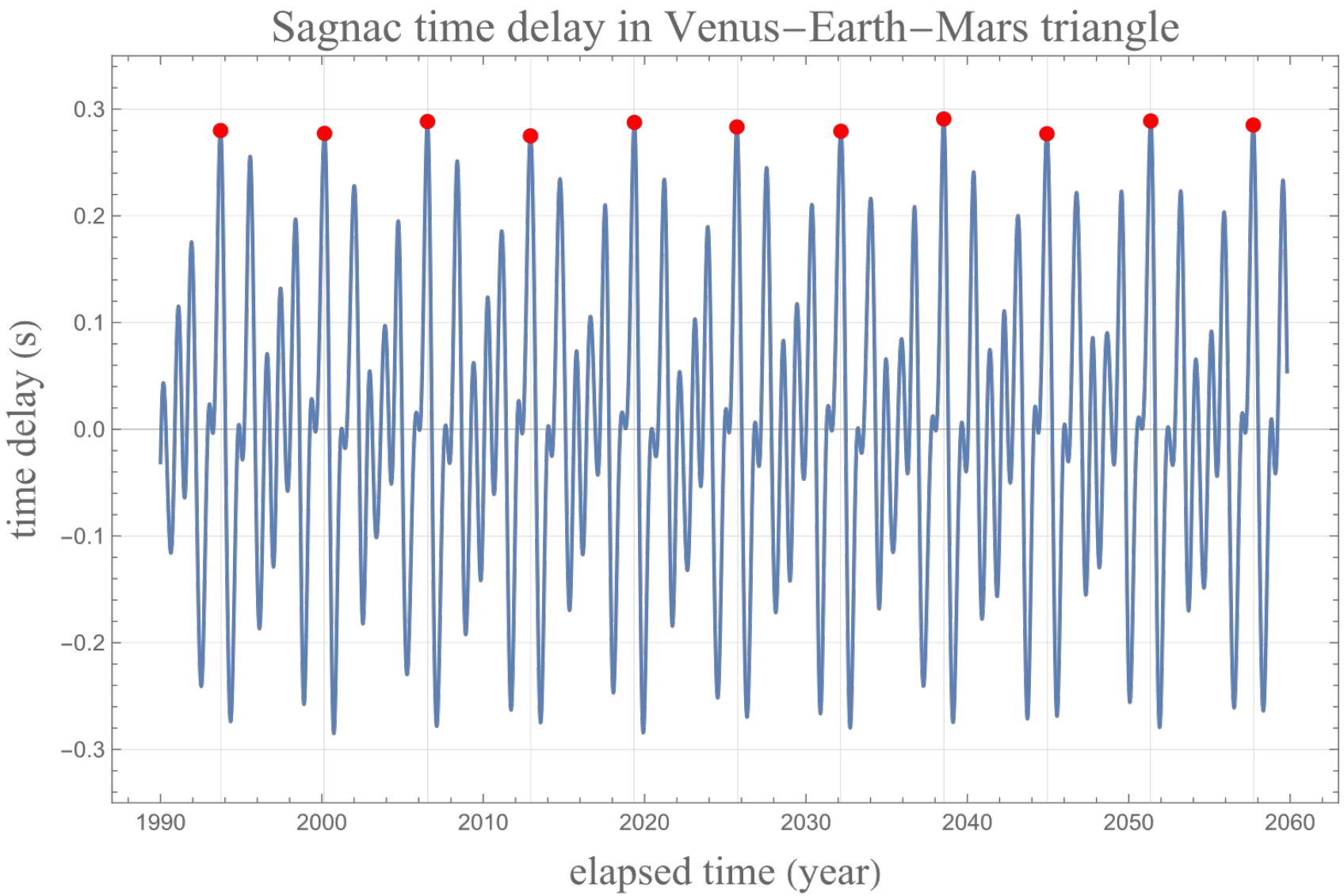
- Assume we have 3 spacecraft, moving in small-ish orbits around Venus, Earth, and Mars
- Each spacecraft communicates with the other 2
- Short laser pulses are sent, in both directions, between each pair of spacecraft
- Travel times are recorded for all laser pulses


Venus
Earth
Mars

# 2. How does it work?

- Enclosed area in Venus-Earth-Mars triangle has significant temporal variation
- Sagnac effect is difference between travel times, for laser pulses, in ***prograde*** and ***retrograde*** directions
- Size of spacecraft orbits, in motion about host planets, determines the cadence of orbital motion sensing


area of Venus–Earth–Mars triangle
area (AU$^2$)
1.5
1.0
0.5
0.0
1990
2000
2010
2020
2030
2040
2050
2060
time (year)


Sagnac time delay in Venus−Earth−Mars triangle
time delay (s)
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3
1990
2000
2010
2020
2030
2040
2050
2060
elapsed time (year)

# 3. How well does it work?

- Enclosed area in Venus-Earth-Mars triangle has significant temporal variation.

- Sagnac effect is difference between travel times in ***prograde*** and ***retrograde*** directions.

- Both effects are dominated by a periodic term with period close to 6.4 years.

# 4. Benefits

- Improved estimates, for speeds of planetary orbital motion, compared to current DSN estimates

- Orders of magnitude improvement in estimates of solar system angular rotation rate