Prospects of Radio Astrometry with VLBI Networks

Phillip Galli (IAG/USP)

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Astrometry

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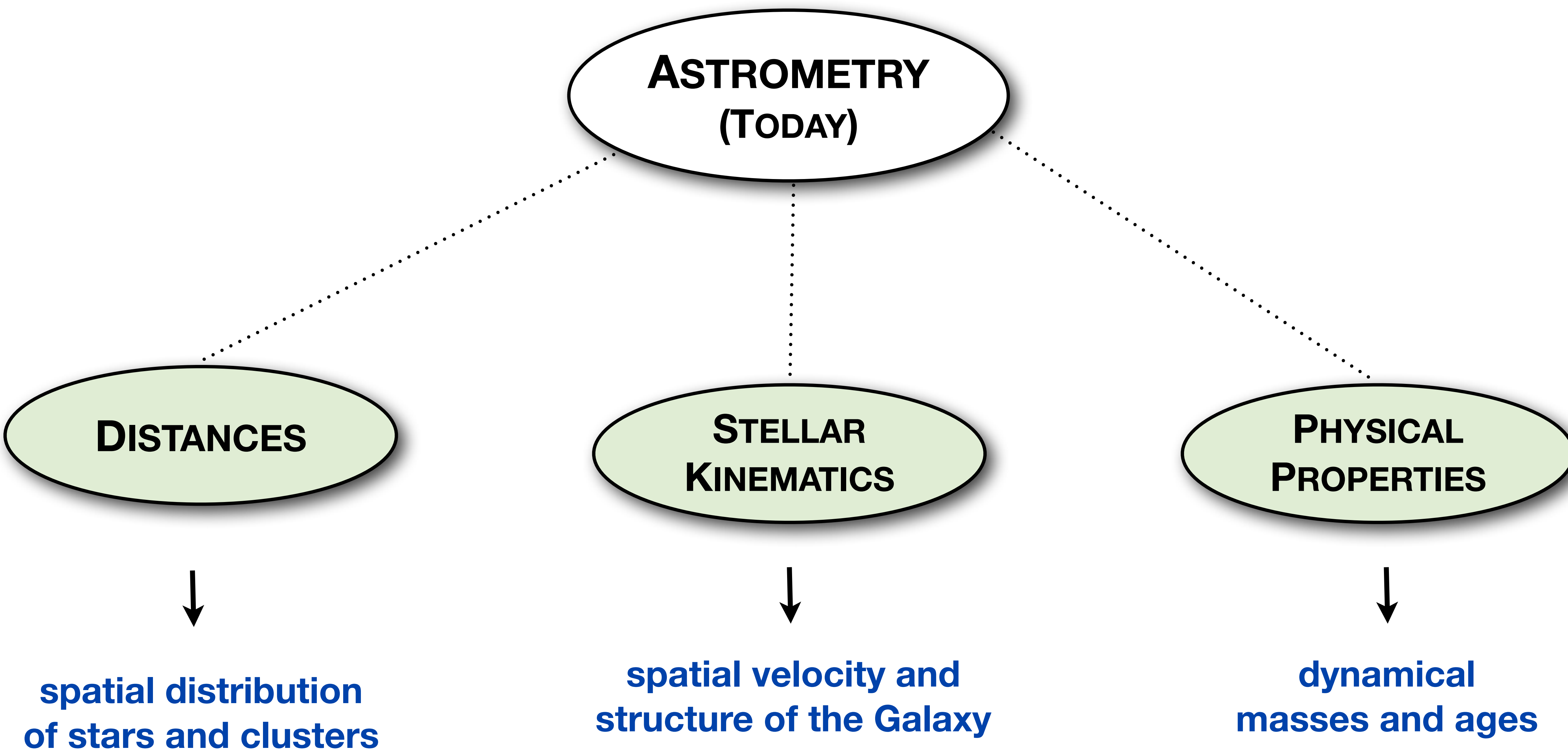

Prospects of Modern Astrometry

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FROM SPACE:

✔ MICRO-ARCSECOND ASTROMETRY
✔ ALL-SKY SURVEY (G < 20.7 MAG)
✔ 1 BILLION STARS

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➤ DOUBLE-CHECK

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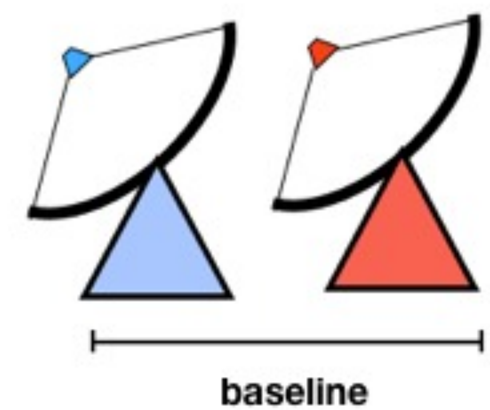
VERY LONG BASELINE INTERFEROMETRY (VLBI)



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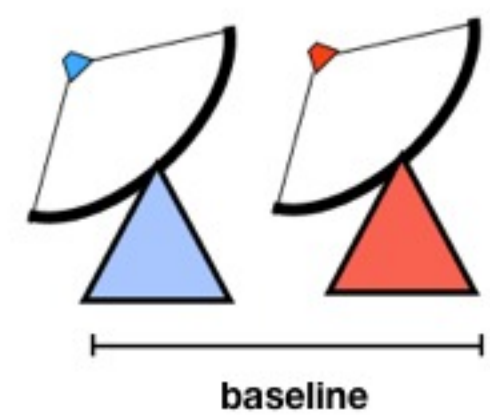
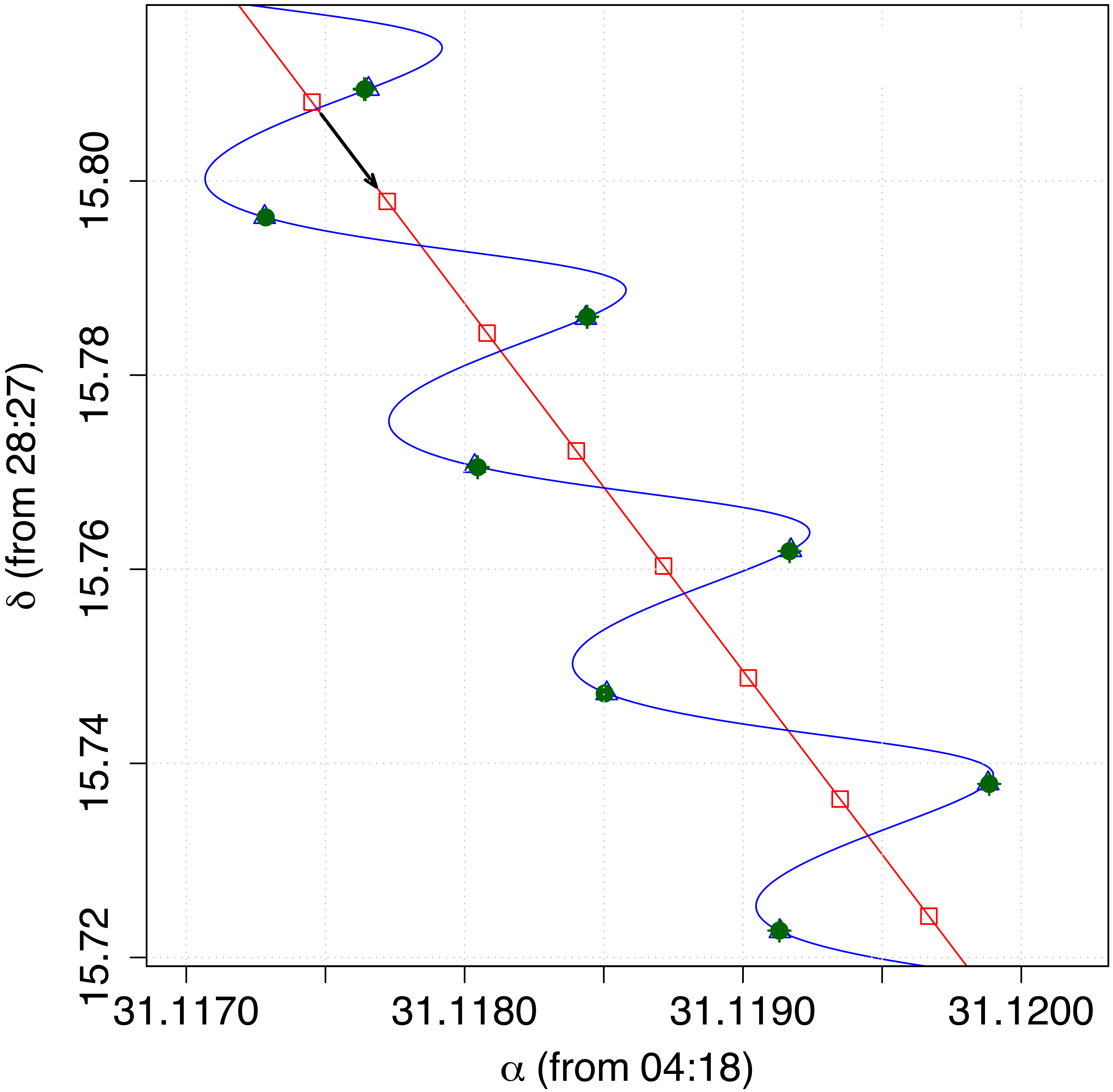


✔ MICRO-ARCSECOND ASTROMETRY
✔ RADIO: HIGH EXTINCTION
✔ TARGET-ORIENTED (> 5 YEARS)

The Gould Belt's Distances Survey (GOBELINS)

- **Aims:** stellar distances and proper motions of young stars (with unprecedented accuracy).
- **Targets:** nearby star-forming regions (**Taurus**, Ophiuchus, Orion, Serpens and Perseus).
- **Methods:** multi-epoch VLBI astrometry.
- **Instrument:** Very Long Baseline Array (VLBA)
  - ✳ transcontinental baselines (~ 8000 km)
  - ✳ Angular resolution: ~1 mas
  - ✳ Astrometry precision: 10-50 μas
- **Project:**
  - ✳ 2000 hours with the VLBA (PI: L. Loinard)
  - ✳ start: 2012, end: 2017/2018

Example 1: V410Tau (HD 283518)



This Work

$\mu_\alpha \cos\delta$ = 8.708 ± 0.027 mas/yr
μ_δ = -24.969 ± 0.021 mas/yr
π = 7.755 ± 0.038 mas
d = 128.9 ± 0.6 pc

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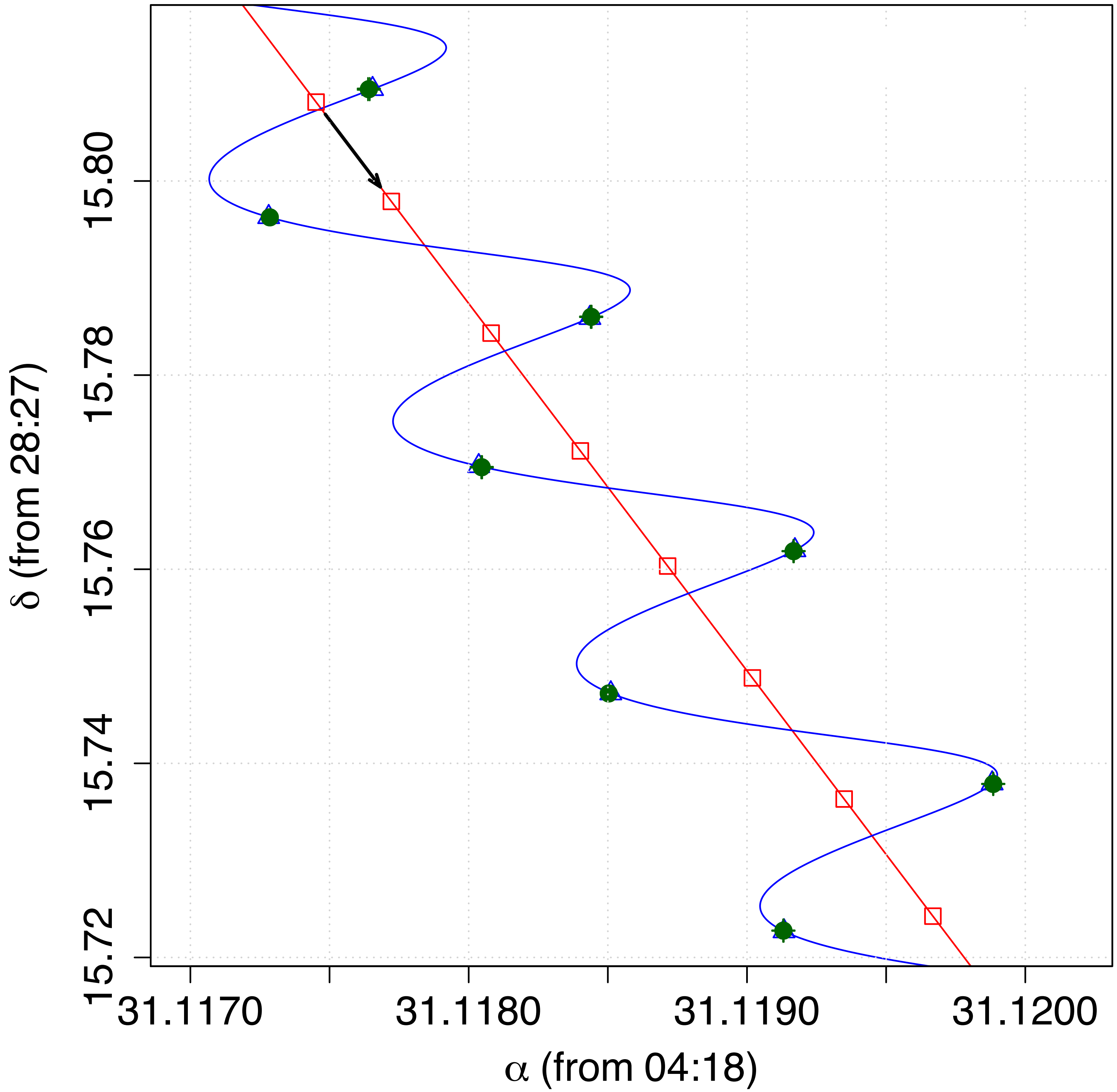

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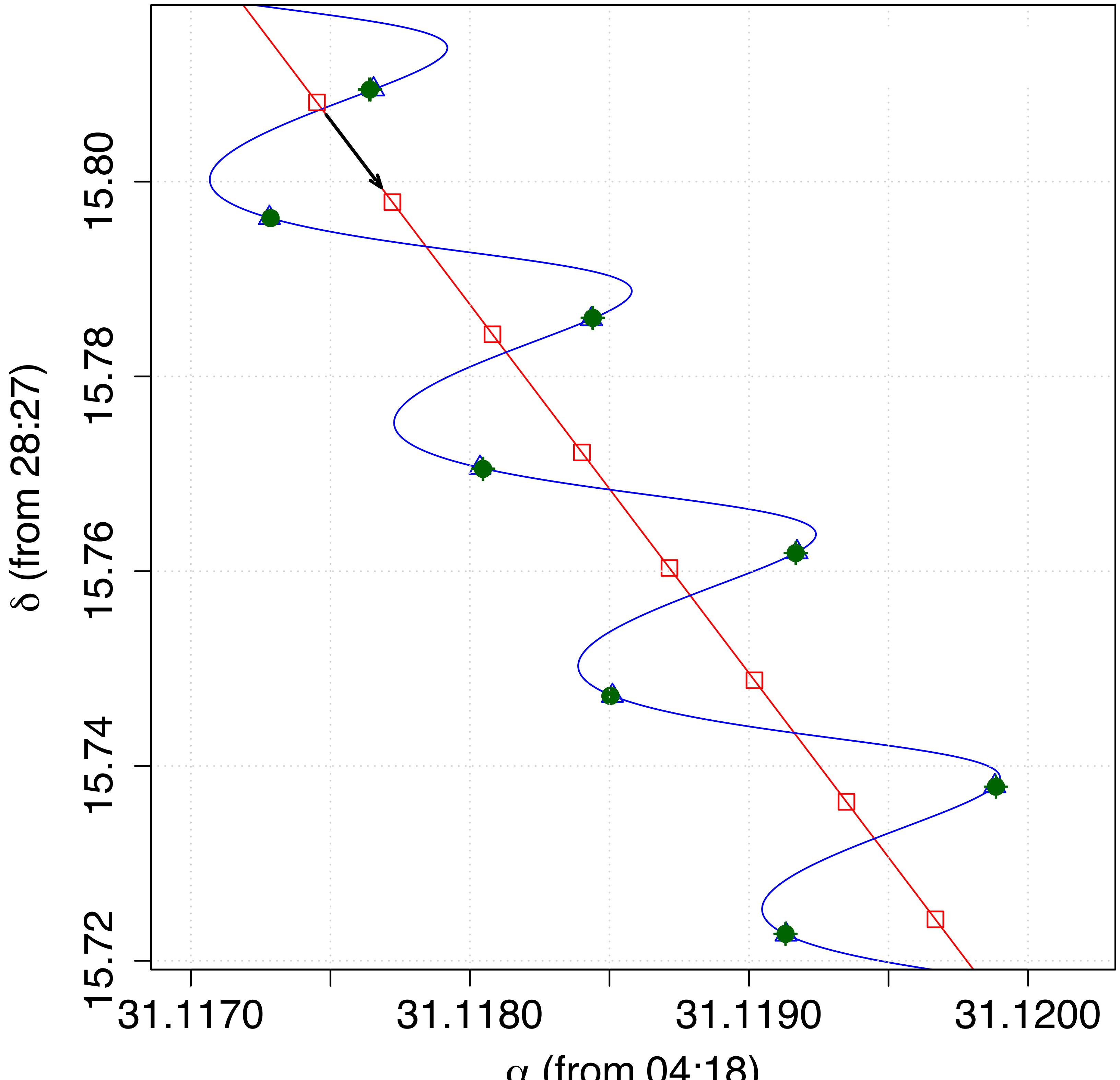

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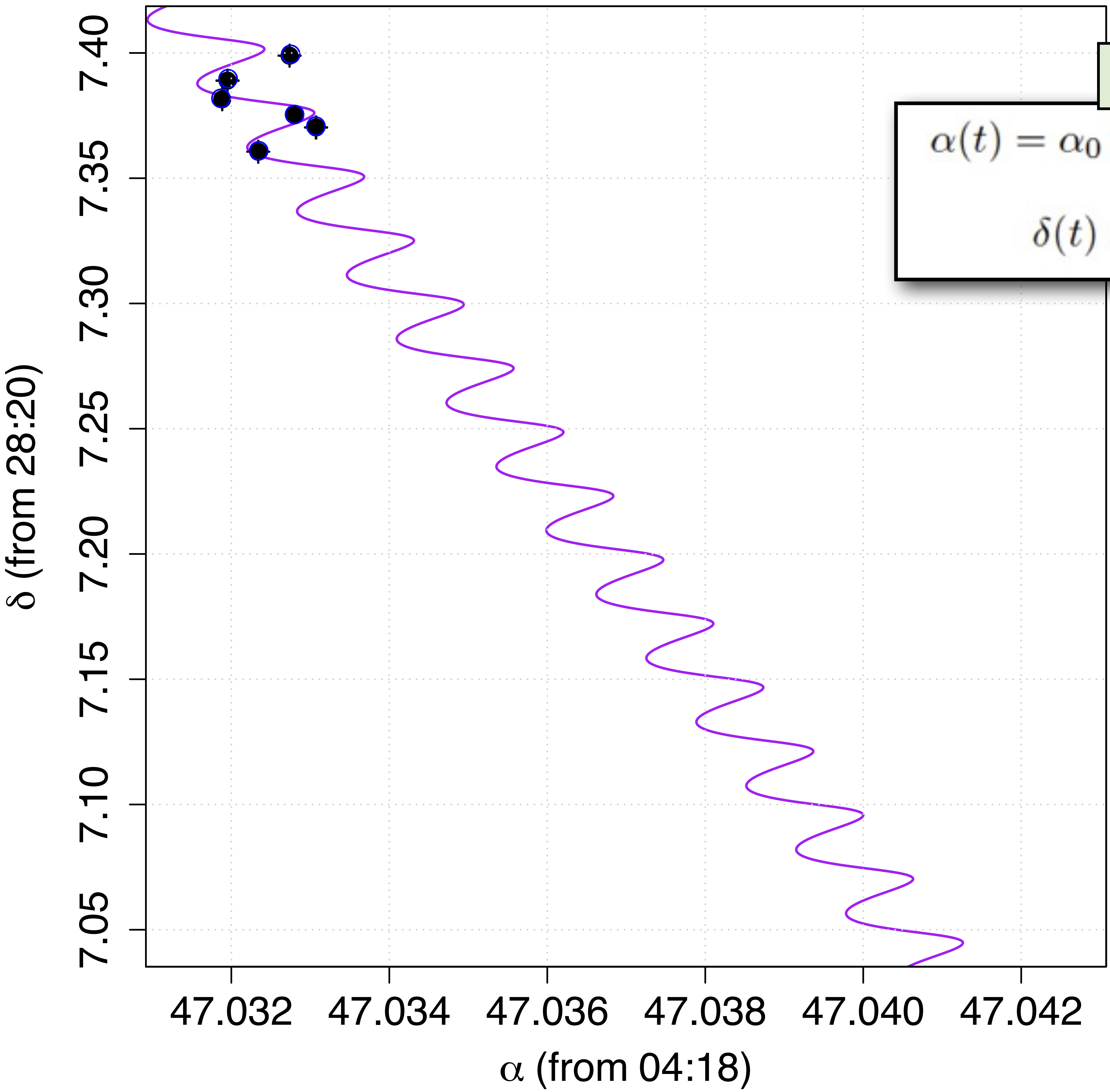
Hipparcos

$\mu_\alpha \cos\delta$ = 7.28 ± 2.75 mas/yr
μ_δ = -27.77 ± 2.03 mas/yr
π = 10.18 ± 2.40 mas
d = 98 [+30, -19] pc

Example 2: V1023Tau (Hubble 4)



SYSTEM OF EQUATIONS

$$\alpha(t) = \alpha_0 + (\mu_\alpha \cos\delta)t + \pi f_\alpha(t)$$

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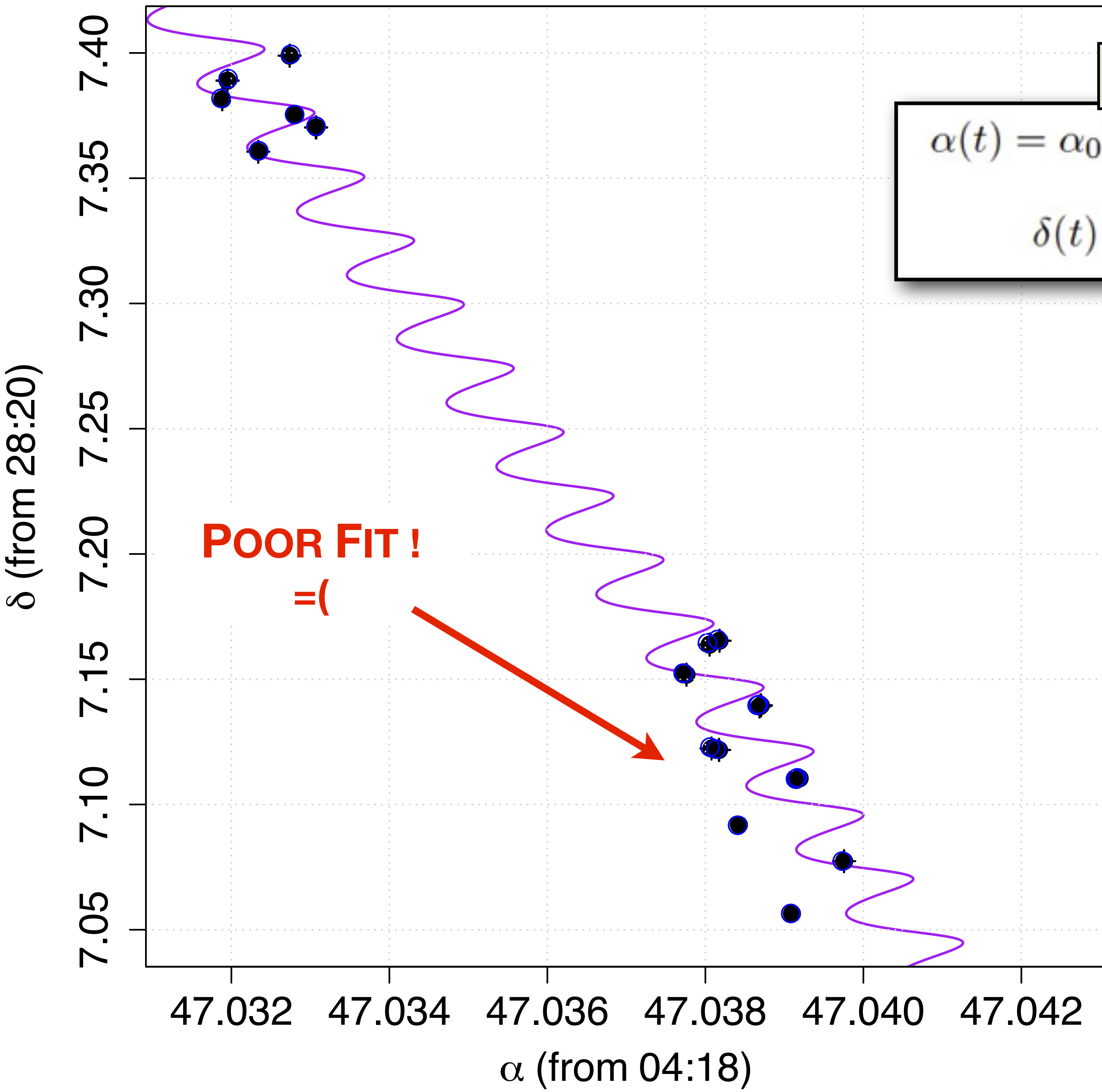

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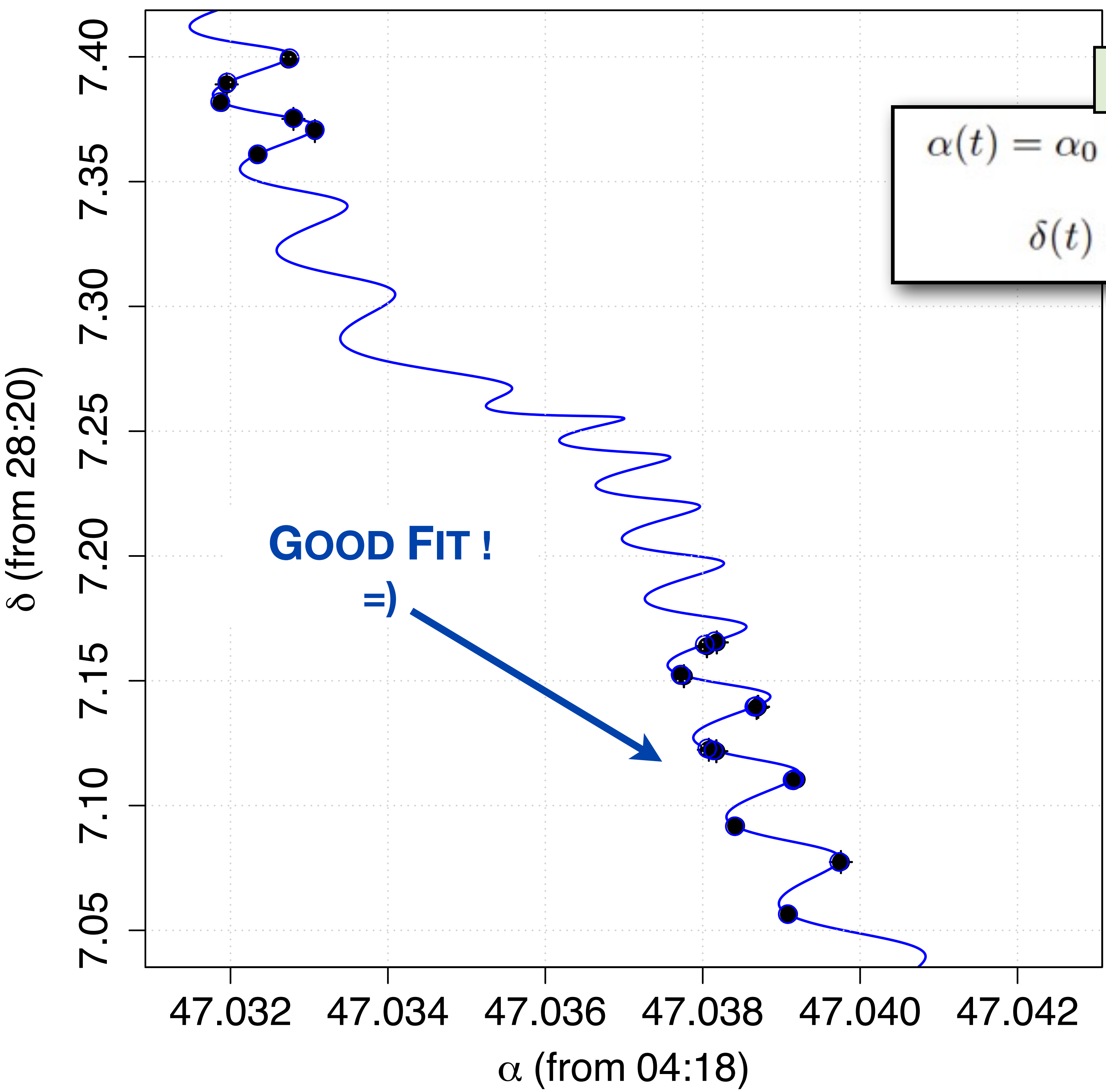

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ORBITAL MOTION !!!

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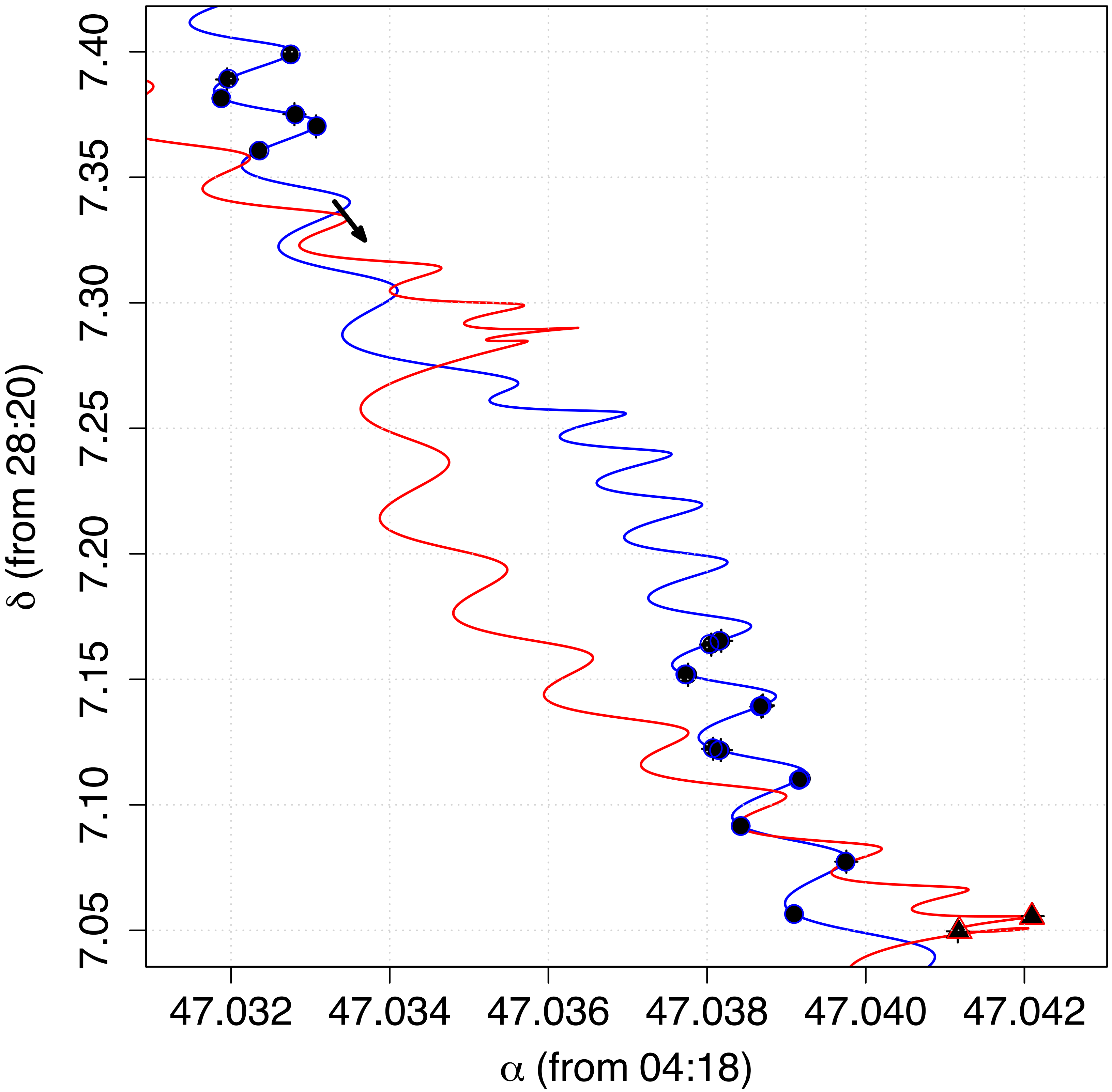


ASTROMETRY

$\mu_\alpha \cos\delta$ = 10.836 ± 0.013 mas/yr
μ_δ = -25.448 ± 0.014 mas/yr
π = 7.589 ± 0.054 mas
d = 131.8 ± 0.9 pc

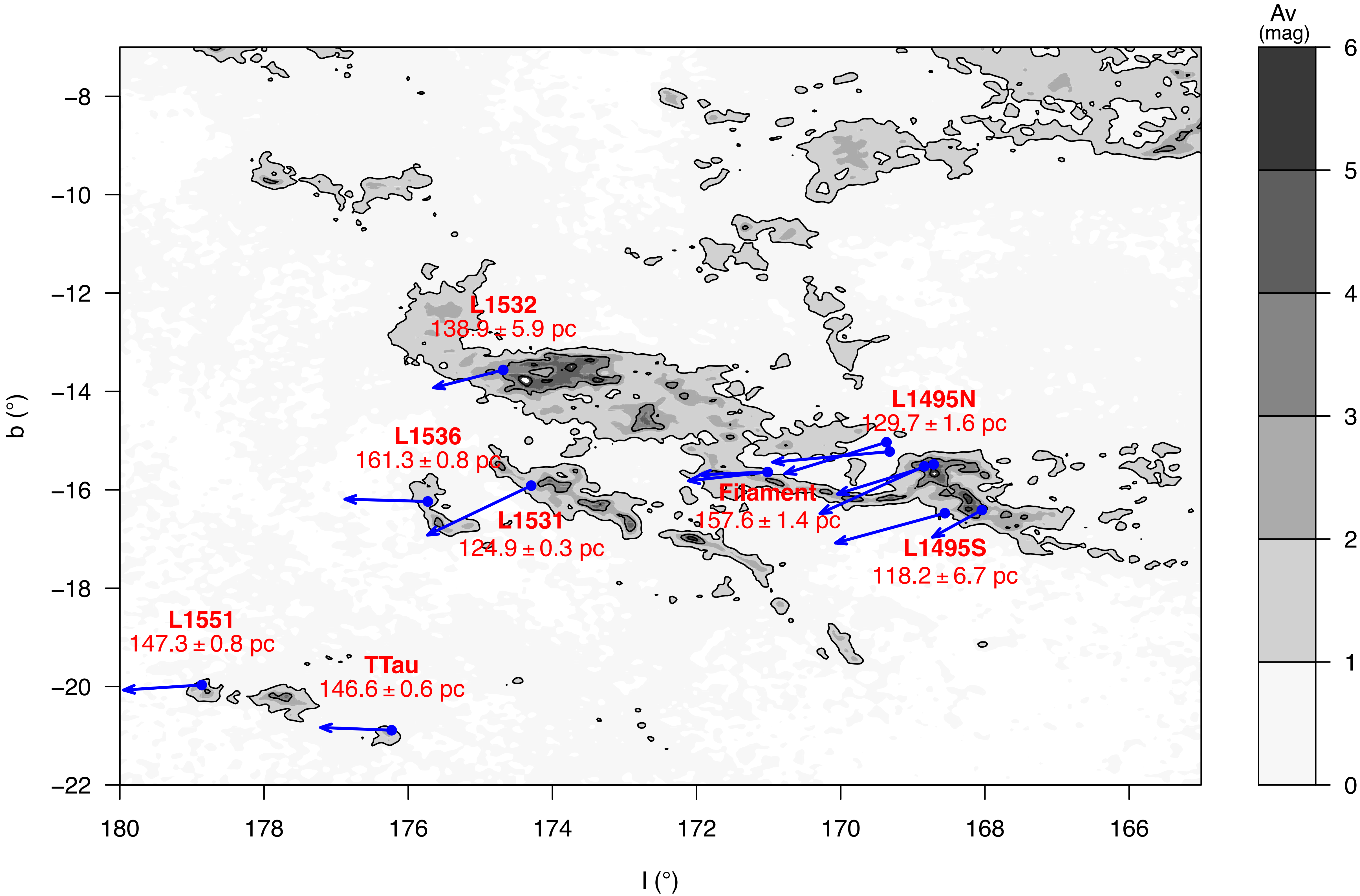
ORBITAL MOTION

a_1 = 2.411 ± 0.023 au
a_2 = 4.329 ± 0.170 au
P = 9.171 ± 0.010 yr
e = 0.767 ± 0.001
T_P = 2458035.7 ± 6.2 JD
Ω = 70.1° ± 4.3°
ω = 233.7° ± 3.9°
i = 40.8° ± 1.0°

DYNAMICAL MASSES

m_1 = 2.38 ± 0.11 $M_\odot$
m_2 = 1.33 ± 0.13 $M_\odot$

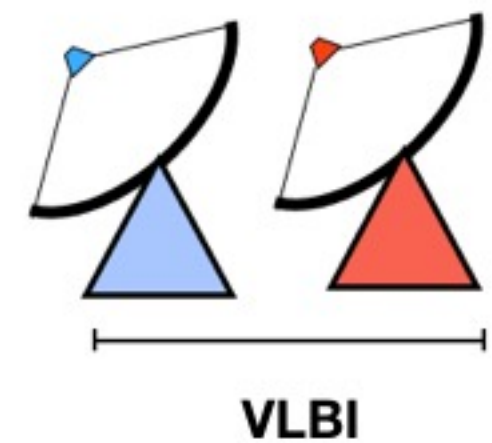
Distance to the Taurus Star-Forming Region



Conclusions

1) Radio Astrometry:

- ✳ VLBI observations can deliver state-of-the-art astrometry.
- ✳ complement the Gaia satellite from the ground.



2) The LLAMA Project and SPAnet:

- ✳ construct the first Latin American VLBI network (targets in the southern sky)
- ✳ develop a new research field (“radio astrometry”) in Brazil.