

# Some common problems in geodesy and astrometry after establishing ICRF

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# Distribution of duties between astrometry and geodesy

- Connection between the 2 sciences was established by the **plumb-line** near Earth surface
- Astrometry: Earth's axis in space (known, need only more precise determination)
- IERS (formerly International Latitude Service): determination of polar motion  $(\Delta\varphi, \Delta\lambda) \leftarrow (\alpha, \delta)$ 
  - Pole was common for terrestrial and celestial frames  
→ difficulties in division of Earth's axis motion about CF and TS

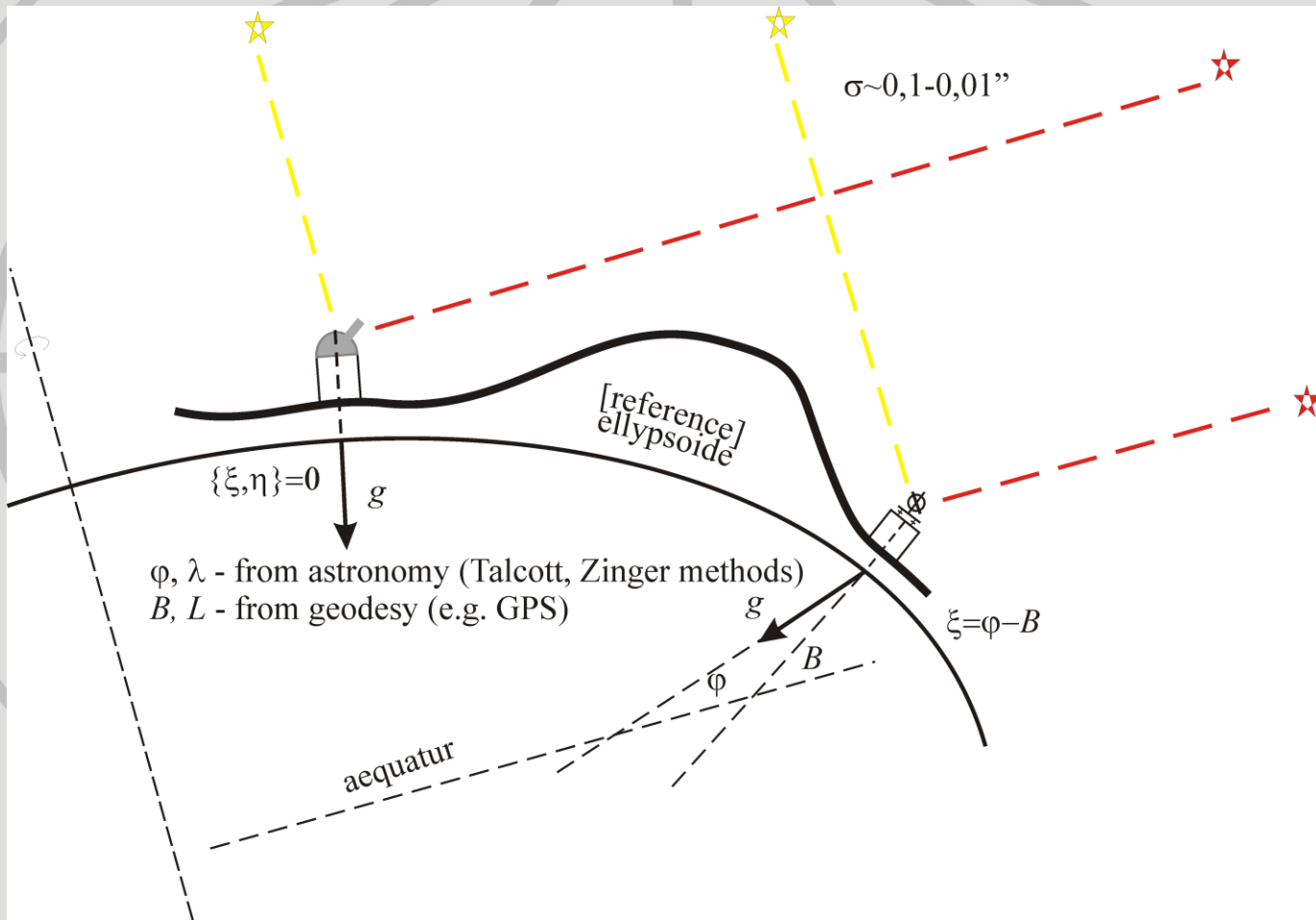
# Distribution of duties between astrometry and geodesy

- Geodesy
  - The main directions:
    - Normals to ellipsoid (don't cross in his centre)
    - Plumb-lines (don't cross in centre of masses)
  - The main tasks:
    - Establishing of terrestrial system connected with geocentre (geometrical method)
    - Earth gravitational field (physycal method)

# Former astrogeodetic connection

Astrogeodetic and gravimetric measurements allowed to establish ellipsoid for  $(\varphi, \lambda) \rightarrow (B, L)$  (semimajor axe  $a_e$  and flatness  $1/\alpha$  of ellipsoid need for precise satellites orbit modeling)

- “normal field” in geodesy – ellipsoidal, but in celestial mechanics – spherical
- Astrogravimetric leveling allowed to transfer  $\zeta$  (for reduction to ellipsoid)



Reference ellipsoid → mean/main Earth ellipsoid

# Revolution in astrometry



- “Nothing will remain the same as it was before” [Walter and Sovers, Astrometry of fundamental catalogues. The evolution from optical to radio reference frames]

# Revolution in astronomy

## The arguments

- Increased of accuracy of radioastrometrical measurements
- Declared absence of proper motions
- The low value of atmospheric refraction, especially with VLBI

## Problems

- New system is not connected with ecliptic and equator (vernal point)
- Unsolved question with radioobservations of Soon and Solar system bodies

## Paradox

- more easily to connect between (quasi)inertial reference system with TRF, that with one celestial [Robertson 1981]

# Problem of origin

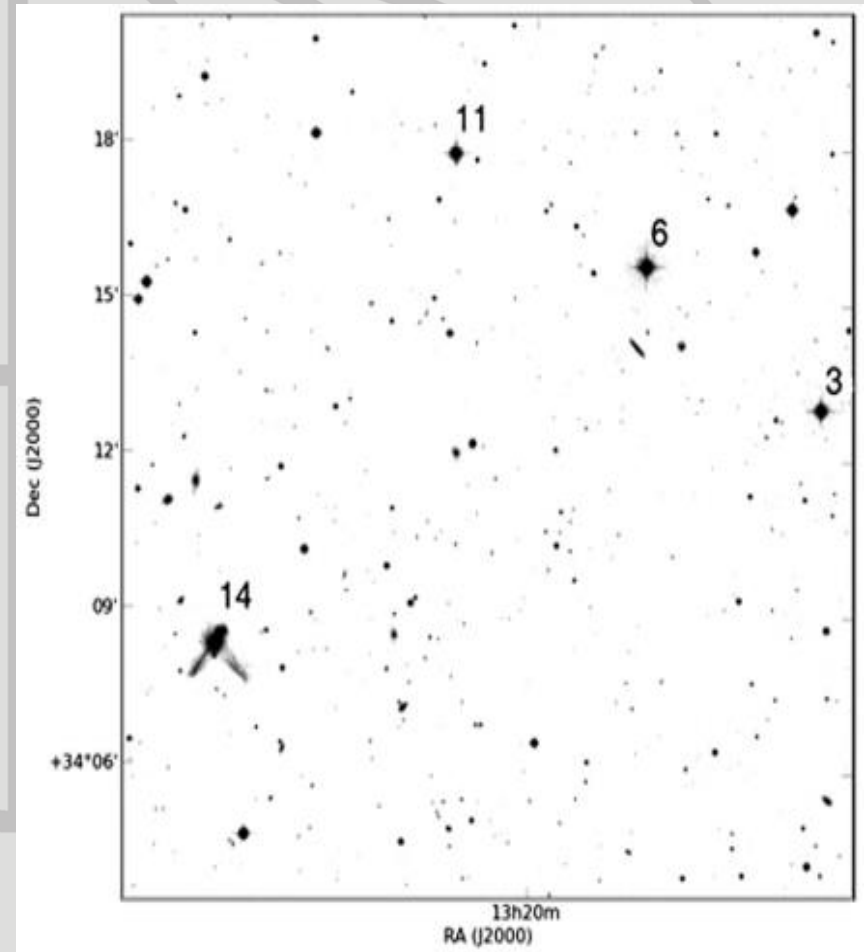
- Transitions from barycentre ICRS to the Earth center is difficult because nobody can observe from the centers of Earth and Sun
- For this transition we need 4 models (E-M orb. motion, M. rot., E. rot., pole motion). Transition from triad connected with barycenter to other triad performs with relativistic effects.
- These corrections follow from impossibility of making measurements from origins
  - For rotating motion studies is required a triad X,Y,Z and point, center of masses (unobservable, but computed by relativistic hypothesis, periodically updated and complicated)
  - Problem: quantity of parameters to determine grow up, but quantity of independent equations is too small
  - Position of centre of CF is indeterminate, accuracy of arc measurements will 0,000 001” (!)
    - star observations: place origin in any point of Earth
    - quasars observations: place origin in any point of terrestrial orbit



# Establishing of radiosystem

- Question of coincidence of optical- and radiosources
  - $\Delta RA = 01^m 32^s$
  - $\Delta DEC = -15'32''$
- Question on the radiorefraction

See *Lipovka A., Lipovka N.*  
On the transition to the  
radio system coordinates  
ICRF

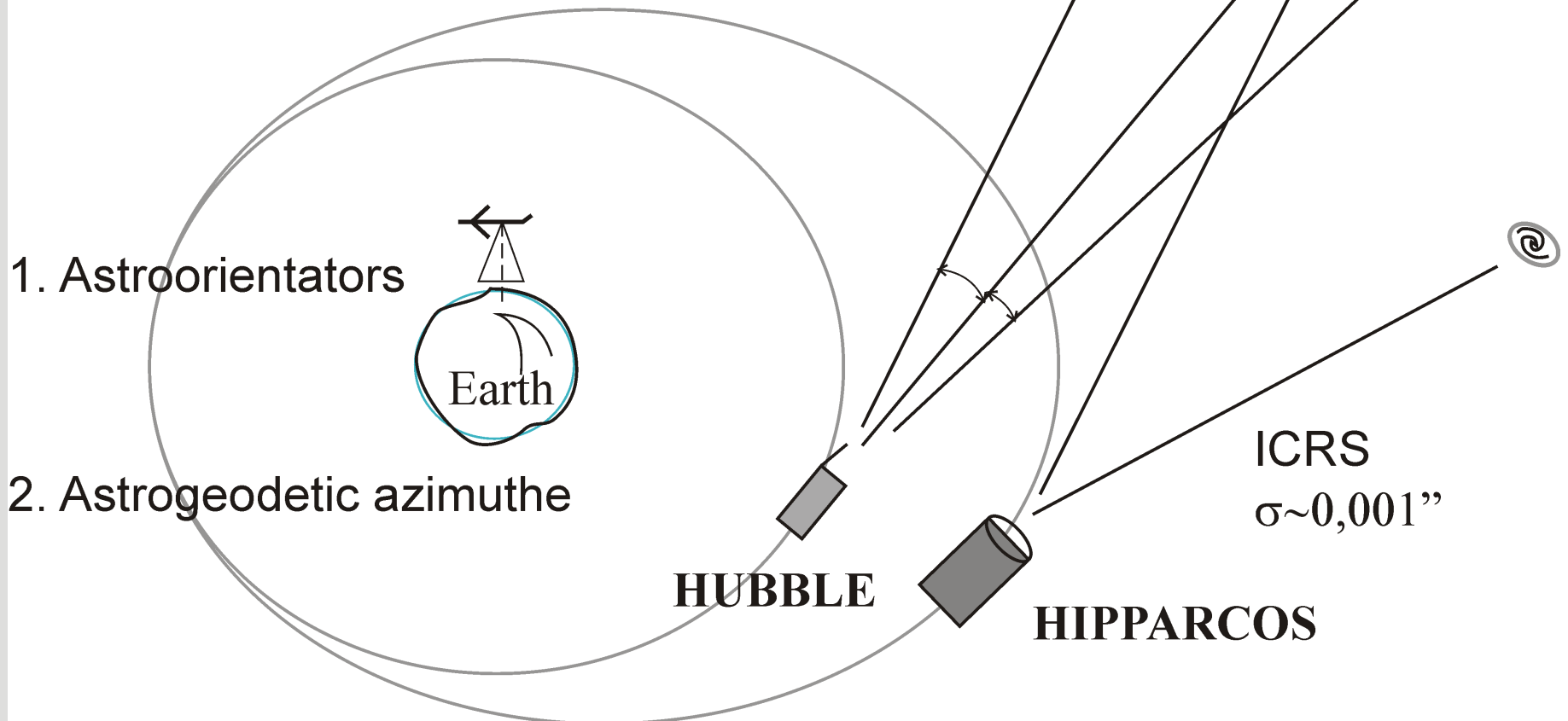


# Geodesy problems

- Old problems (astronomy is no more needed):
  - Determination of LAT and LONG (time)  
(but **is desirable** periodically control)
  - Projection of geod. measures on ref.-ellipsoid for further adjustment
- Rests 2+1 problem:
  - Astroorientation systems for photosurvey
  - Astronomical azimuth (for ballistics)
  - Rotations of **plumb-line** ( $\Delta\xi, \Delta\eta$ ) - can be solved by only geod. and grav. meas., but more complicated...  
} ?

*Radiosources are unobservable from points of geodetic net.*

# New reality



On the astrometric  
satellite height  $\{\xi, \eta\} = 0$   
and no refraction

# Conclusion

- In postrevolutionary situation the original empirical relation between the three branches of the same science is disturbed
  - Astronomy
  - Geodesy
  - Gravimetry
- Pulkovo!
- It is necessary to save the any empirical connection between them