The born investigator of the Heavens
Jacobus C. Kapteyn (1851–1922)

Pieter C. van der Kruit
Jacobus C. Kapteyn Professor of Astronomy
Kapteyn Astronomical Institute
University of Groningen, the Netherlands
www.astro.rug.nl/∼vdkruit

Groningen, Infoversum, January 21, 2015

Planetarium

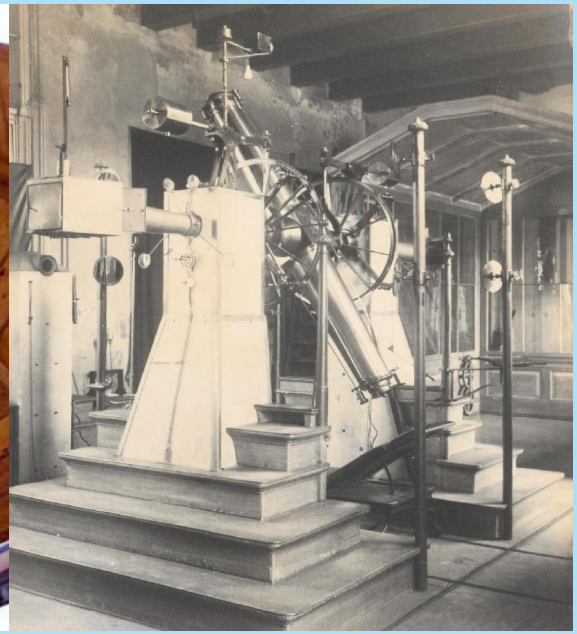
1. Show the sky on January 21, 2015. Start at 21:00 UT (22:00 CET). This has Orion in the south. Only stars brighter than magnitude 4 (as can be seen from city of Groningen).

2. Now show stars down to magnitude 6. Can be seen with naked eye at very dark spot. Explain magnitudes very briefly.

Star counts - all sky

Down to	
mag. 4:	550
mag. 6:	5,050
mag. 9:	350,000
mag 14:	15,000,000
mag 19:	440,000,000

Johannes Hevelius (Hewelke)
(1611-1682)
Mayor of Danzig, astronomer.



Early catalogues:

Name	Years	Limit	Stars
Bonner Durchmusterung	1852-1868	9.5	324,198
Südlicher Bonner Durchmusterung	1875-1886	10.0	133,659

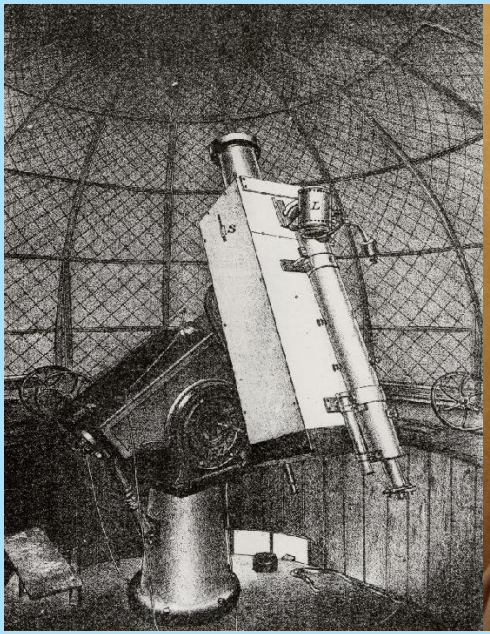
Planetarium

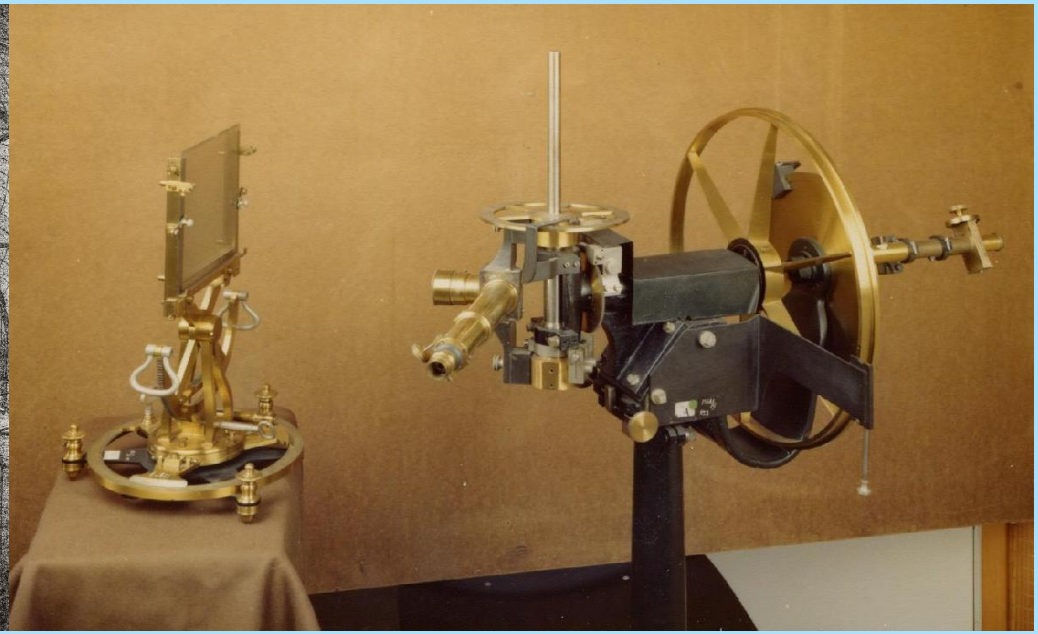
4. Show sky as in 2. but also diurnal motion. Next also show the meridian to illustrate positional measurements by meridian passage timing and altitude difference with pole.

5. Bonner Durchmusterung has stars down to magnitude 10, but complete to about m=9. Show the sky down to magnitude 9 (if possible)

6. Now stop diurnal and go back to 2. Then move to Cape Town (34 S, 18 E is good enough). This will show the southern sky. Point out Southern Cross and pointers.

7. Now turn around to face north. Orion re-appears but 'upside down'.



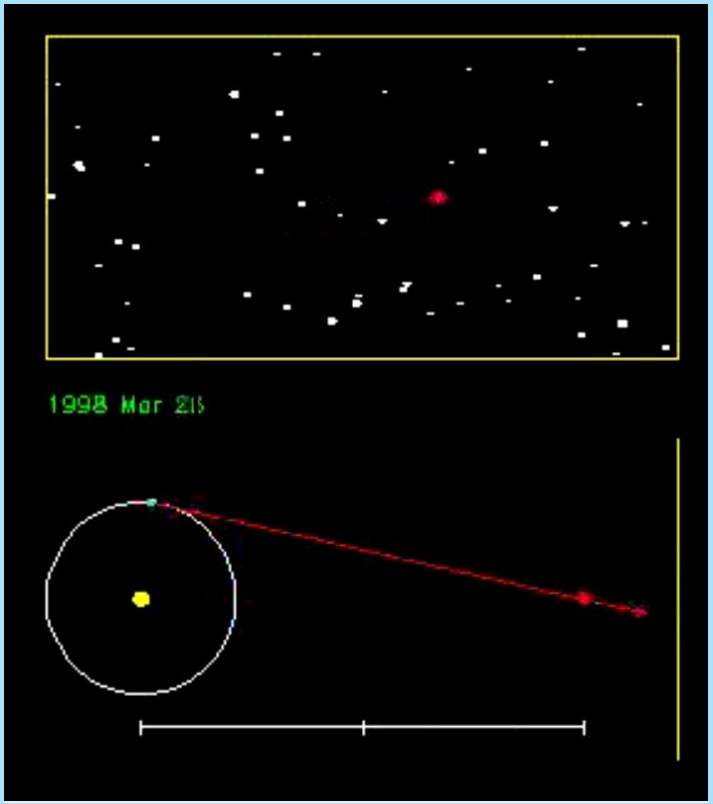


Early catalogues:

Name	Years	Limit	Stars
Bonner Durchmusterung	1852-1868	9.5	324,198
Südlicher Bonner Durchmusterung	1875-1886	10.0	133,659
Cape Photographic Durchmusterung	1886-1900	9.2	454,875
Cordoba Durchmusterung	1892-1914	10.0	613,953
Astronomische Gesellschaft Katalog 1	1861-1954	9.0	200,000

Annual parallax

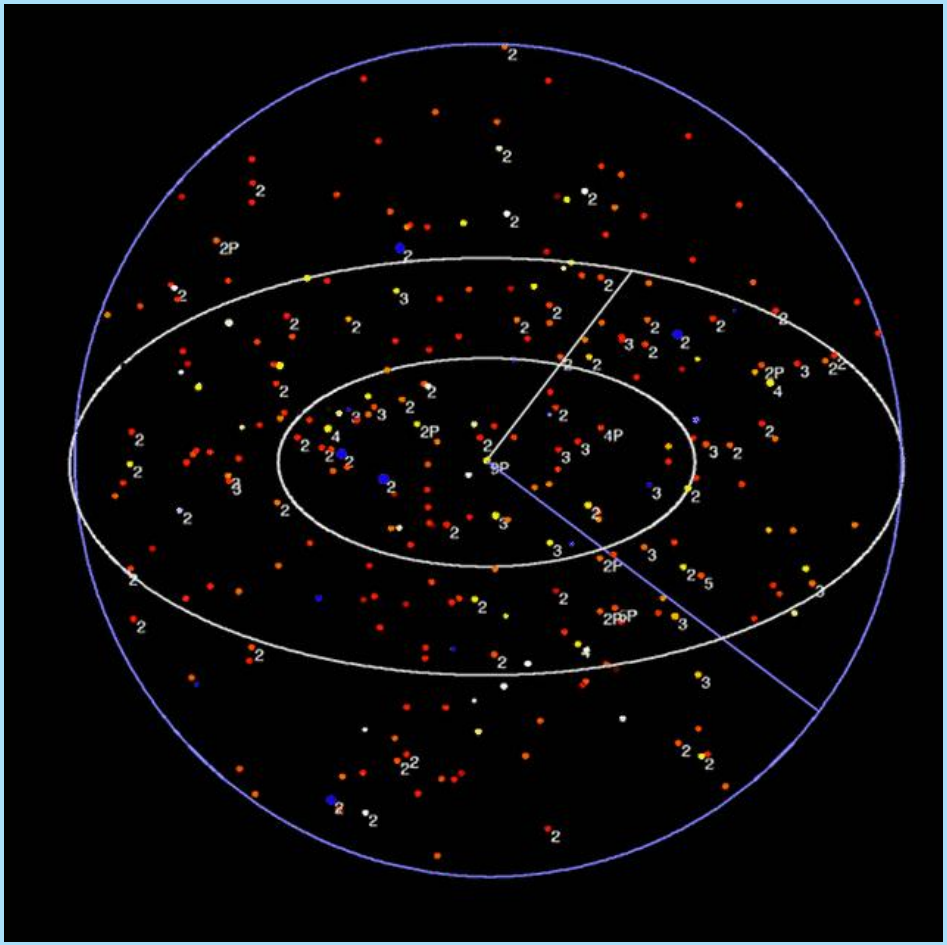
Nearby stars show a reflection of the annual motion of the Earth around the Sun compared to more distant background stars.



Annual parallax in space and on the sky

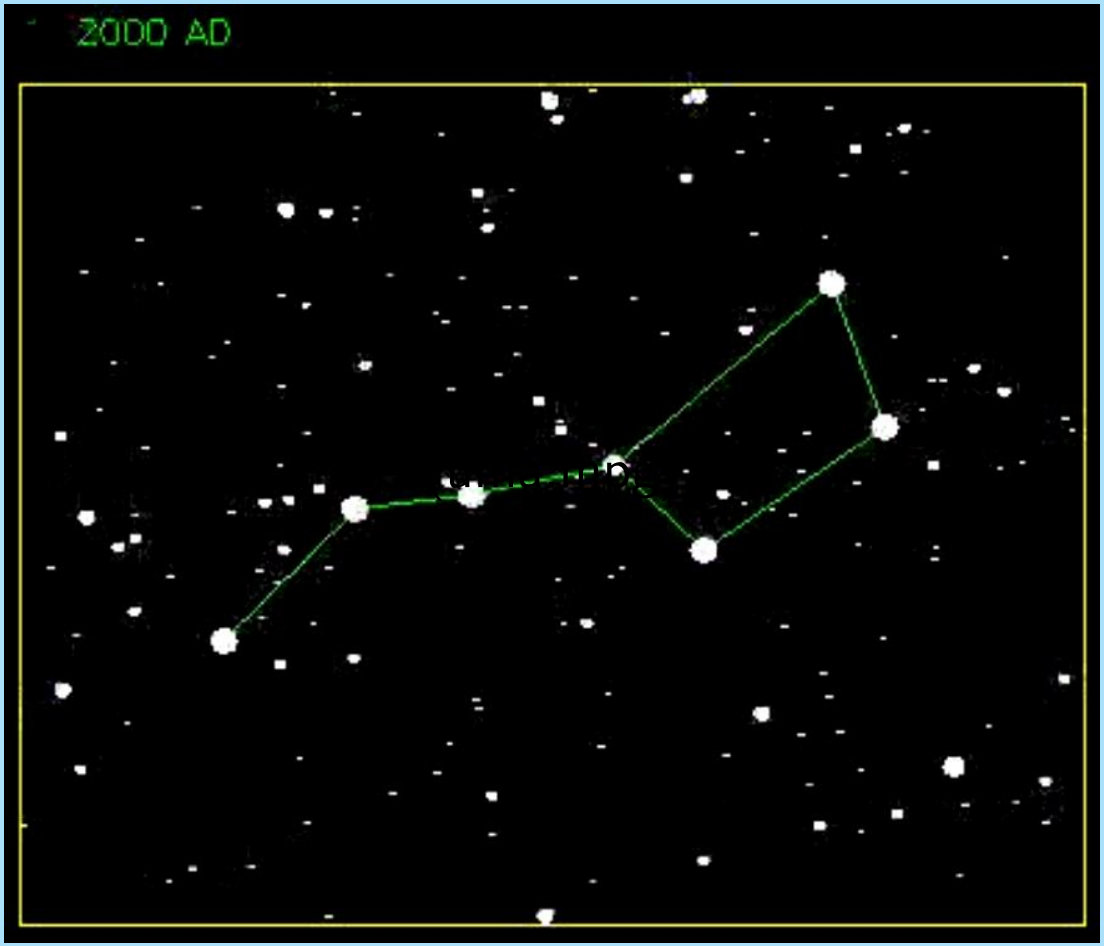
Kapteyn used meridian timing to measure parallaxes.

- Even for the nearest star, α Centauri, the resulting ellipse has a semi-major axis of less than a second of arc.
- A second of arc is a Euro at 4.95 km.
- Hipparcos parallax accuracy is about $0''.002$.
- There are only 271 stars systems for which the parallax exceeds $0''.1$.



Stars are generally too close to measure distances.

Proper motion



Big Dipper from 100,000 BCE to 100,000 CE.

Planetarium

10. Show proper motions over 100,000 years.
11. Point out Antapex in Canis Major.

Secular parallax

- The Sun moves with respect to other stars (20 km/s towards Apex near Vega and away from Antapex near Sirius).
- This can also be used to estimate distances statistically.
- This can be used to study the distribution of the stars in space.

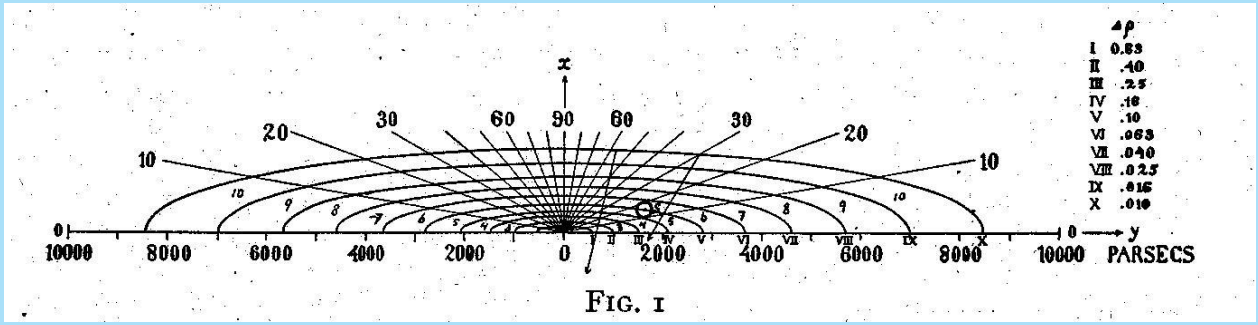
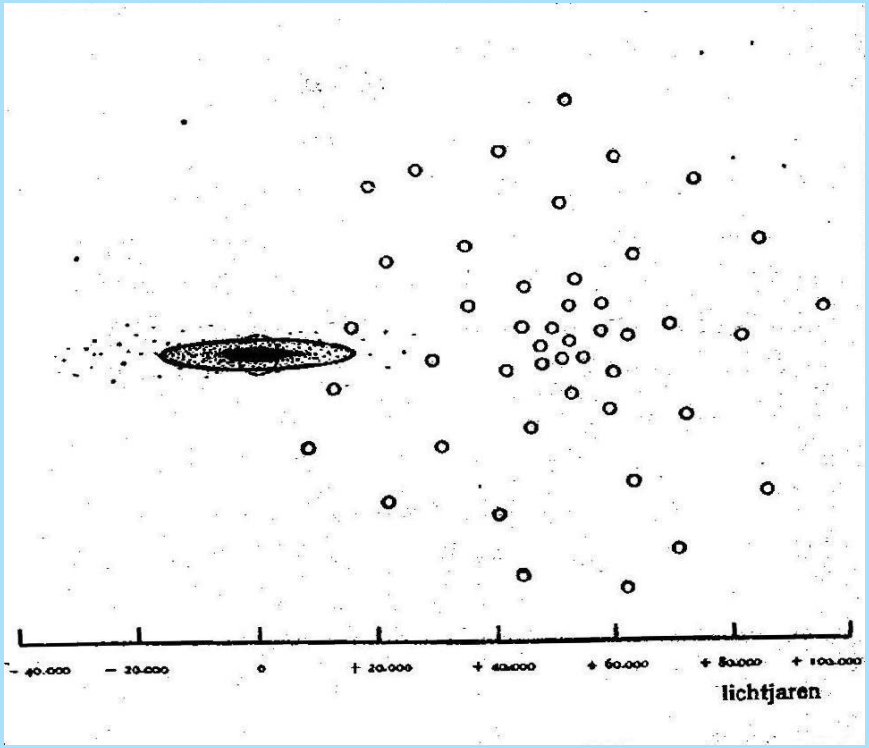


FIG. 1

Kapteyn's contributions

- Produced C.P.D.
- Discovered Star Streams.
- Organized Plan of Selected Areas.
- Drew attention to interstellar absorption.
- First model for distribution of stars in space ('Kapteyn Universe').
- Incorporated dynamics ('mechanics') in the model.
- Was an inspiring teacher (Jan Hendrik Oort).



- The model was wrong in the plane, excellent vertical.
- Oort found the correct solutions.

Kapteyn's Star

- In 1897 Kaptey found the then star with the largest proper motion.
- It moves at $8''.0$ per year.

1975

1990

1995

Kapteyn's Star

1975

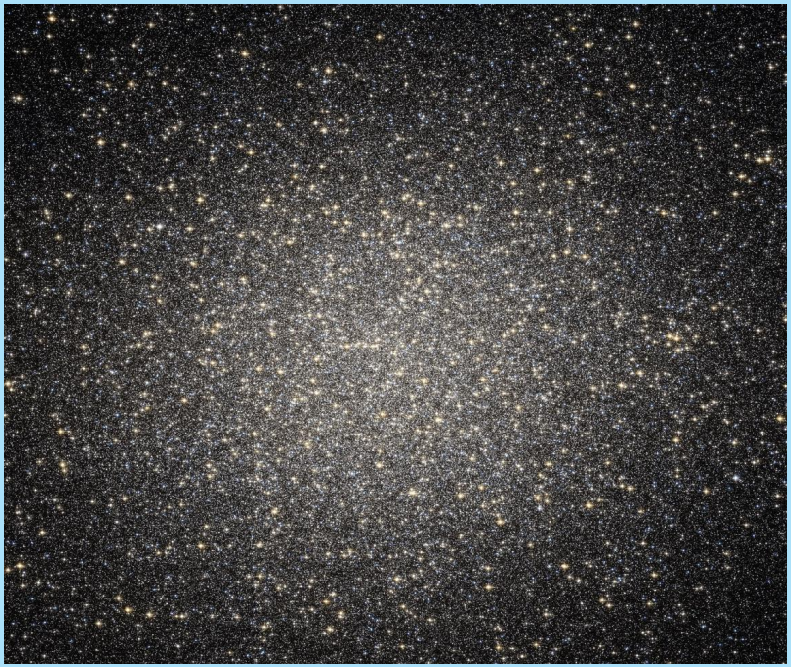
1990

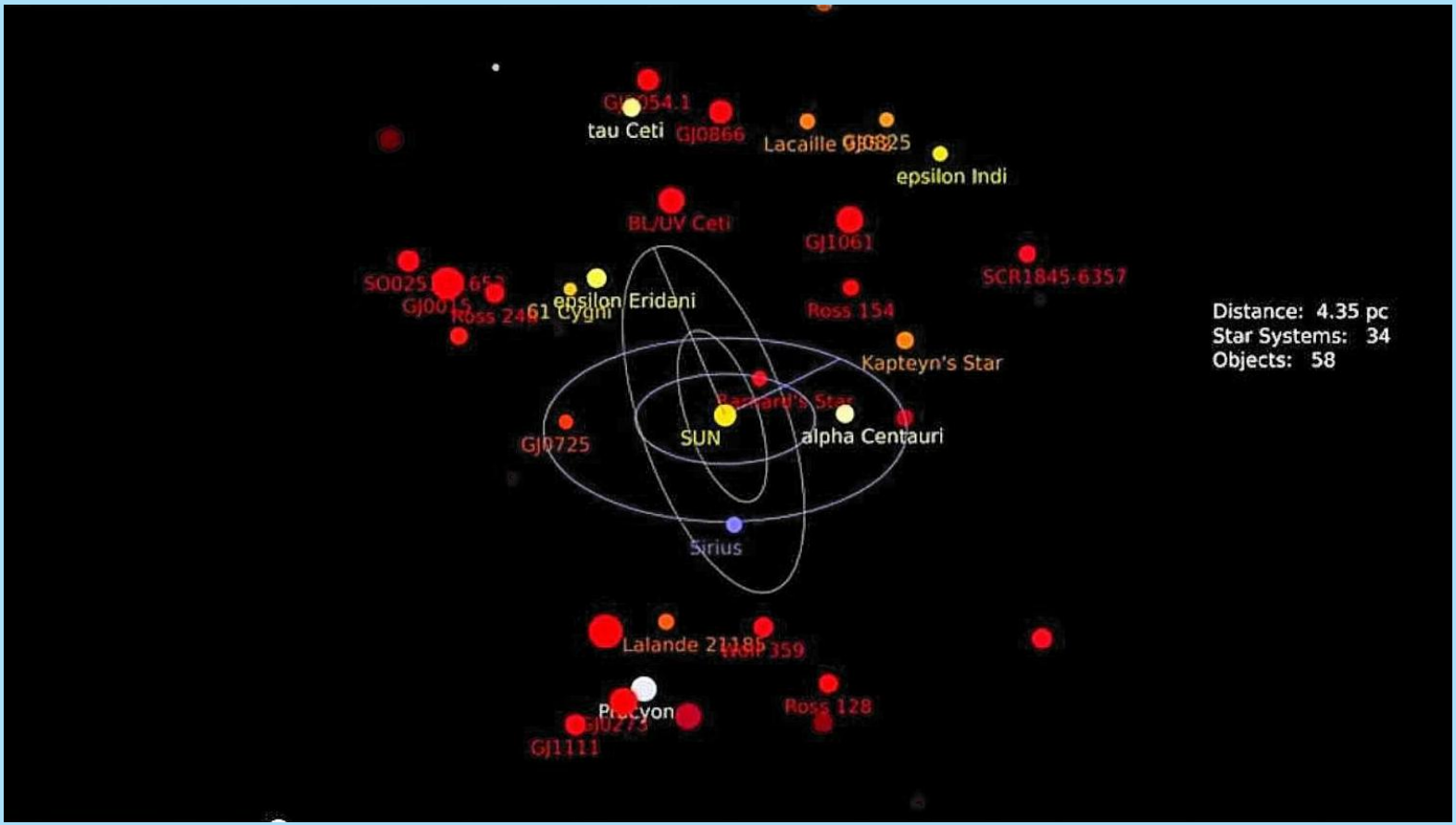
1996

Moved by 3 arcmin

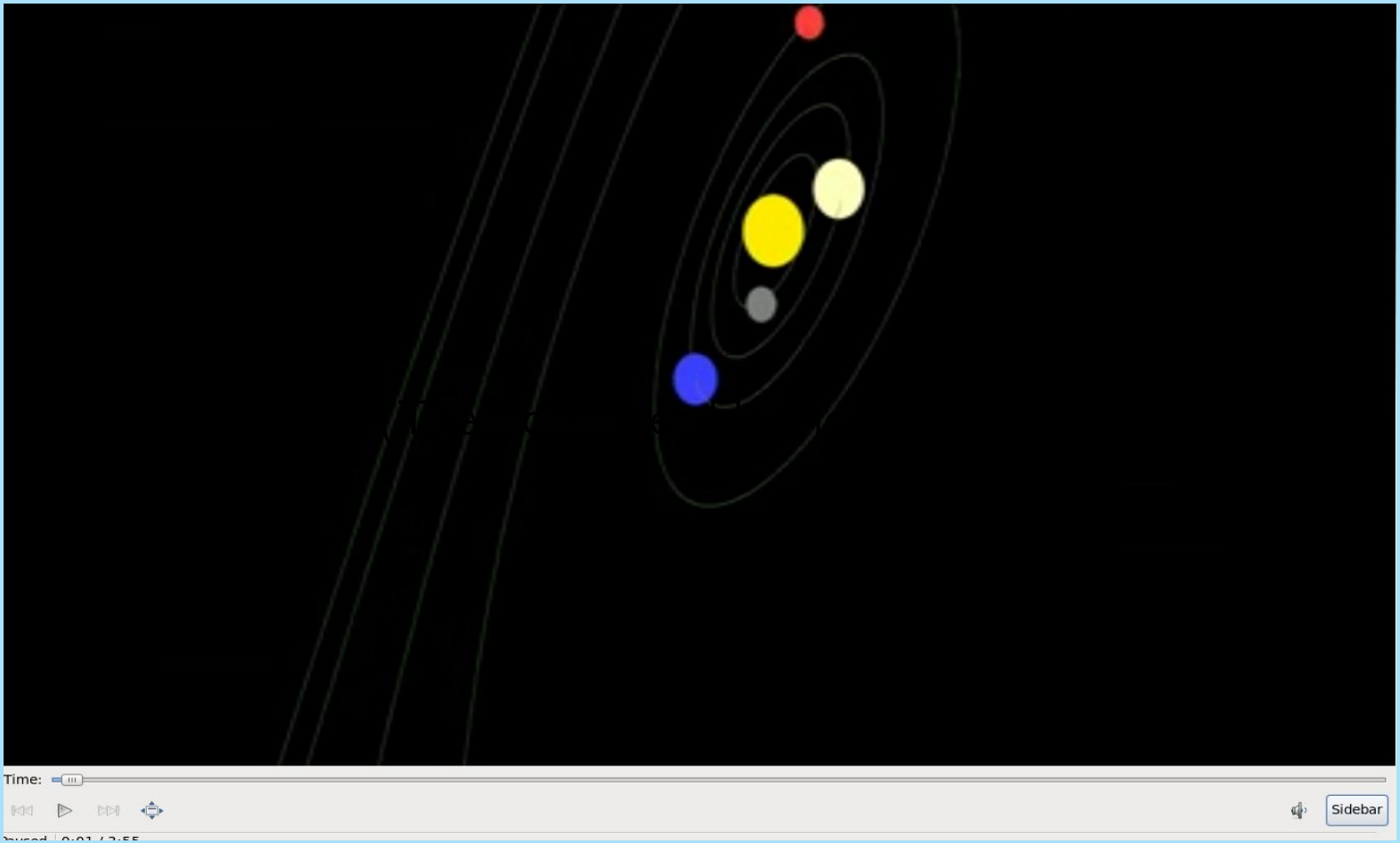
Digital Sky Survey

- Only at 12.8 lightyears.
- Only 24 star systems closer.
- Mass 0.27 $M_\odot$
- Speed 294 km/s.
- Almost no heavy elements (0.2%).
- Ancient star, age $\gtrsim$ 10 Gyr old.
- In spite of this two planets.
- Probably came from dwarf galaxy (now ω Cen).
- Was at 7.0 lightyears, 11,000 years ago.





The Solar Neightborhood out to 25 parsec = 85.5 lightyears.



The Solar Neightborhood out to 25 parsec = 85.5 lightyears.

THE END