

# Astrometry during the past 100 years

Erik Høg Niels Bohr Institute, Copenhagen

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ABSTRACT: Reports from 2008: *Astrometry and optics during the past 2000 years*, are available at [www.astro.ku.dk/~erik/History.pdf](http://www.astro.ku.dk/~erik/History.pdf) . - Here are now further *contributions to the history of astrometry related to space astrometry*. The development of photoelectric astrometry is followed from an experiment in 1925 up to the Hipparcos satellite mission in the years 1989-93. This period continues with my proposal in 1992 for CCD astrometry with a scanning satellite called Roemer, which led to the Gaia mission due for launch in 2013. Lectures on astrometry are described. - Further installments are planned.

The *short* file at [www.astro.ku.dk/~erik/History2.pdf](http://www.astro.ku.dk/~erik/History2.pdf) of 4 pages contains a table of contents and an overview with links to the individual reports.

The *big* file at [www.astro.ku.dk/~erik/History2All.pdf](http://www.astro.ku.dk/~erik/History2All.pdf) of 11MB will print on 8+46 pages. It contains a table of contents, an overview with links, and all the new reports.

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## Overview with links

No. 3.2 – 2011.01.27, update from a version of 2008.05.27:

### Miraculous approval of Hipparcos in 1980: (2)

ABSTRACT: The approval of the Hipparcos mission in 1980 was far from being smooth since very serious hurdles were encountered in the ESA committees. This process is illuminated here by means of documents from the time and by recent correspondence. The evidence leads to conclude that in case the approval would have failed, Hipparcos or a similar scanning astrometry mission would never have been realized, neither in Europe nor anywhere else.

[www.astro.ku.dk/~erik/HipApproval.pdf](http://www.astro.ku.dk/~erik/HipApproval.pdf)

No. 10 - 2011.03.26:

### Astrometry Lost and Regained

#### From a modest experiment in Copenhagen in 1925 to the Hipparcos and Gaia space missions

ABSTRACT: Technological and scientific developments during the past century made a new branch of astronomy flourish, i.e. astrophysics, and resulted in our present deep understanding of the whole Universe. But this brought astrometry almost to extinction because it was considered to be dull and old-fashioned, especially by young astronomers. Astrometry is the much older branch of astronomy which performs accurate measurements of positions, motions and distances of stars and other celestial bodies. Astrometric data are of great scientific and practical importance for investigation of celestial phenomena and also for control of telescopes and satellites and for monitoring of Earth rotation. Our main subject is the development during the 20<sup>th</sup> century which finally made astrometry flourish as an integral part of astronomy through the success of the Hipparcos astrometric satellite, soon to be followed by the even more powerful Gaia mission.

[www.astro.ku.dk/~erik/AstromRega3.pdf](http://www.astro.ku.dk/~erik/AstromRega3.pdf)

No. 11 - 2011.04.06:

### Roemer and Gaia

ABSTRACT: During the Hipparcos mission in September 1992, I presented a concept for using direct imaging on CCDs in scanning mode in a new and very powerful astrometric satellite, Roemer. The Roemer concept with larger aperture telescopes for higher accuracy was developed by ESA and a mission was approved in 2000, expected to be a million times better than Hipparcos. The present name Gaia for the mission reminds of an interferometric option also studied in the period 1993-97, and the evolution of optics and detection in this period is the main subject of the present report. The transition from an interferometric GAIA to a large Roemer was made on 15 January 1998. It will be shown that without the interferometric GAIA option, ESA would hardly have selected astrometry for a Cornerstone study in 1997, and consequently we would not have had the Roemer/Gaia mission.

[www.astro.ku.dk/~erik/RoemerGaia.pdf](http://www.astro.ku.dk/~erik/RoemerGaia.pdf)

No. 12 - 2011.01.15: On the website of the Niels Bohr Institute:

## Surveying the sky

“An astrometric experiment in 1925 was the beginning of a development which Erik Høg, Associate Professor Emeritus, took part in for 50 years. A scientific highlight is the star catalogue Tycho-2 from the year 2000, which describes the positions and movements of 2.5 million stars and is now absolutely essential to controlling satellites and for astronomical observations.”

In English: <http://www.nbi.ku.dk/english/www/> and in Danish: <http://www.nbi.ku.dk/hhh/>

and

## En landmåler i himlen

In Danish: En artikel i tidsskriftet KVANT, oktober 2010, om 50 års arbejde

Erindringer om 50 år med astrometrien, der begyndte ved en høstak syd for Holbæk og førte til bygning af to satellitter. Et videnskabeligt højdepunkt er stjernekatologet Tycho-2, der nu er helt uundværligt ved styring af satellitter og ved astronomiske observationer.

[www.astro.ku.dk/~erik/kv-2010-3-EH-astrometri.pdf](http://www.astro.ku.dk/~erik/kv-2010-3-EH-astrometri.pdf)

No. 13 - 2011.03.26:

## Lectures on astrometry

Overview, handout, abstracts at: [www.astro.ku.dk/~erik/Lectures2.pdf](http://www.astro.ku.dk/~erik/Lectures2.pdf)

### Brief overview :

**Lecture No. 1.** 45 minutes

#### **Astrometry Lost and Regained**

**From a modest experiment in Copenhagen in 1925  
to the Hipparcos and Gaia space missions**

The lecture has been developed over many years and was held in, e.g., Copenhagen, Vienna, Bonn, Düsseldorf, Vilnius, Oslo, Nikolaev, Poltava, Kiev, Thessaloniki, Ioannina, Athens, Rome, Madrid, Washington, and Charlottesville - since 2007 in PowerPoint. Revised in 2009 and with the new title *Astrometry Lost and Regained* it was held in Heidelberg, Sct. Petersburg, Rio de Janeiro, Morelia, Mexico City, Beijing, Montpellier, Groningen, Amsterdam, and Leiden.

**Lecture No. 2.** 45 minutes

#### **Hipparcos - Roemer - Gaia**

The lectures briefly outlines the development of photoelectric astrometry culminating with the Hipparcos mission. Development of the Gaia mission beginning in 1992 is followed in detail.

The lecture has been held since 2010 in Toulouse and at ESTEC in Holland.

**Lecture No. 3.** 45 minutes. Suited for a broad audience, including non-astronomers

**The Depth of Heavens - Belief and Knowledge during 2500 Years**

The lecture outlines the structure of the universe and the development of science during 5000 years, focusing on the distances in the universe and their dramatic change in the developing cultural environment from Babylon and ancient Greece to modern Europe.

The lecture was first held in 2002, and since 2007 in PowerPoint. Held in Copenhagen, Vilnius, Nikolaev, Athens, Catania, Madrid, and Paris

Handouts at: [www.astro.ku.dk/~erik/DepthHeavens2.pdf](http://www.astro.ku.dk/~erik/DepthHeavens2.pdf)  
and [www.astro.ku.dk/~erik/DepthHeavens.pdf](http://www.astro.ku.dk/~erik/DepthHeavens.pdf)

An article with the same title as the lecture appeared in Europhysics News (2004) Vol. 35 No.3. Here slightly updated, 2004.02.20: [www.astro.ku.dk/~erik/Univ7.5.pdf](http://www.astro.ku.dk/~erik/Univ7.5.pdf)

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**Lecture No. 4.** 45 or 30 minutes.

**400 Years of Astrometry: From Tycho Brahe to Hipparcos**

The four centuries of techniques and results are reviewed, from the pre-telescopic era until the use of photoelectric astrometry and space technology in the first astrometry satellite, Hipparcos, launched by ESA in 1989.

The lecture was presented as invited contribution to the symposium at ESTEC in September 2008: **400 Years of Astronomical Telescopes: A Review of History, Science and Technology**. The report to the proceedings is included as No. 8 among the "Contributions to the history of astrometry".

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Further installments in preparation: On the Hipparcos mission studies 1975-79 and on the Hipparcos archives.

*Best regards*

*Erik*

*<http://www.astro.ku.dk/~erik>*