

Astrometric education in China†

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Abstract. With measuring precision on the order of milli-arcseconds for ground-based survey facilities or even micro-arcseconds for space astrometric satellites, the importance of astrometric education continues to be important. The content of astrometric courses in China during the past fifteen years is reviewed and the current astrometric courses for undergraduate and graduate students at universities and observatories in China are presented. Finally the improvements of astrometric education in content and teaching methods are suggested.

Keywords. astrometry, sociology of astronomy, education

1. Introduction

Astrometry is a branch of astronomy dealing with the precise measurements of the positions of celestial objects. With measuring precision on the order of milli-arcseconds for Hipparcos and ground-based survey facilities such as LSST, Pan-STARRS, or even micro-arcseconds for space astrometric satellites such as Gaia, SIM a new era of astrometry has entered. For example, photographic plate is replaced by the CCD detectors; transit circles and astrolabes are replaced by optical interferometers, and the optical reference frame, which was used for almost a hundred years, is replaced by the extragalactic reference frame. Data must be processed in the general relativistic framework and new definition of the ecliptic, models of precession and nutation are used. Finally, the study of the structure and kinematics of the Galaxy by means of stellar proper motions and positions is also included in astrometry. As a consequence of these changes, astrometric education faces new challenges.

2. Current astrometric courses

Astrometric education is implemented at 4 Universities: Nanjing University, Beijing Normal University, University of Science and Technology of China, as well as Beijing University where there are under graduate and graduate students learning astrometry. The astrometric courses for graduate students are set up at 4 observatories: Shanghai Astronomical Observatory(SHAO), Purple Mountain Astronomical Observatory, National Astronomical Observatories and National Time Service Center(Bai, 2006). Due to historical reasons the research field of astrometry in China includes two aspects: (a) the mechanism of Earth Rotation, plate motions etc., and (b) the determination of stellar positions and proper motions. In the past fifteen years the former has become an independent discipline, named Astro-geodynamics and the latter includes a wider range of astrometry, such as observations and studies of the solar system objects, the structure and kinematics of our Galaxy.

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86% and 35% of graduate students at SHAO and Nanjing University(2003-2007) have not had a prior astronomical education, so the required courses: Introduction of astronomy, Introduction of astrometry which is similar Spherical Astronomy(at Nanjing University the content of these is included in the course of Astronomical reference frame), Measuring data analysis and processing. The elective courses are galactic astronomy, general relativity, and the theory of artificial satellite orbits. 82% and 40% of PhD students at SHAO and Nanjing University have a good background in astronomy and usually there is no special courses for them. The supplementary education for graduate students are seminars which are given by foreign and domestic experts each week. Summer schools have been held abroad and at the domestic locations, since it is the best way for PhD students to receive a systematic astrometric education in short time. For example, an astrometric summer school at Yale university was held in 2005, VLBI techniques and applications was held at Shanghai in 2007, a Chinese–French spring school will be held in 2008. In addition, the individual courses such as atmospheric refraction, radio astronomical method and technique etc. are given to individual students.

3. Suggestion

Due to the retirement of lecturers and the development of new techniques since the 1990s, it is important to update our teachers' knowledge and to produce new textbooks. After the publication of vectorial astrometry written by C.A. Murray, good textbooks or reference books have not appeared for more than 15 years. This has encouraged some professional researchers who are retired to write textbooks or reference books, such as *Modern Astrometry* (Kovalevsky, 1995), *Astrometry of Fundamental Catalogues* (Walter & Sovers, 2001), *Introduction of Fundamental Astrometry* (Kovalevsky & Seidelmann, 2003), *Astrometric method - past, present and future*(Li et al. 2006).

We feel that teaching methods should be changed to compensate the lack of good textbooks and professional courses. Several methods are suggested such as: (a) Share the teaching materials. We recommend these to be written in English since it is then possible to share the materials over the internet, as done by Drs. Fukushima, Tom Loredano and Phil Gregory who have put their materials of statistical mathematics on web sites. (b) Summer school. The lectures should be given by outstanding teachers and experts in the field. The teaching materials would then serve as a textbook or reference book to be published in the future. It has been proven that this is an effective and fast method for attaining results in short time. (c) Education over the network. This method is often used in amateur education such as television programs, education demonstrations but it needs to be run by an organization to obtain adequate support, however, the latter is difficult to obtain. (d) Seminars. International cultural and scientific exchange and collaboration are often carried out between the countries. It is a good method to expand the knowledge and learn new techniques. This method has been used many years at various institutes and proved successful.

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