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ACTIVITIES OF THE ICRS PRODUCT CENTRE (SYRTE, PARIS OBSERVATORY)

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Abstract.
We present the various activities of the International Celestial Reference System Product Center (ICRS-PC) hosted jointly at Paris Observatory and US Naval Observatory (Washington) in the frame of the IERS (International Earth Rotation and Reference System Service)

1 Introduction

At its 23rd General Assembly in August 1997, the International Astronomical Union (IAU) decided that starting from 1 January 1998, the IAU celestial reference system shall be the International Celestial Reference System (ICRS), in replacement of the FK5 (Fricke et al. 1988). The ICRS is accessible by means of coordinates of reference extragalactic radio sources (Arias et al. 1995), the International Celestial Reference Frame (ICRF). The ICRS complies with the conditions specified by the 1991 IAU Recommendations. Its origin is located at the barycenter of the solar system through appropriate modelling of VLBI observations in the framework of General Relativity. Its pole is in the direction defined by the conventional IAU models for precession (Lieske et al. 1977) and nutation (Wahr 1981). Its origin of right ascensions was implicitly defined by fixing the right ascension of 3C 273B (see Arias et al. (1995) for more details).

2 The activities of the ICRS Product Centre

In the following we present the various activities of the ICRS Product Centre of the IERS which is hosted both by the SYRTE at Paris Observatory and by the US Naval Observatory (Washington DC). It has two directors, one from each institution, presently R. Gaume(USNO) and J. Souchay (SYRTE), and the sharing of tasks is shared among the two institutions. They can be listed as in the following (for full bibliography, see IERS Annual report 2006, 2007).

2.1 Reference system and frame

• **Maintenance and extension of the ICRF**
We publish extensions to the ICRF consistent to the currently adopted ICRF, e.g. without changes in the positions of the 212 defining sources representing the core sources of the ICRF (Ma et al. 1998). Moreover we compare on a regular basis the VLBI catalogues of quasars obtained by different networks.
• **Investigation of future VLBI realizations of the ICRS**
Fundamental revisions to the ICRF will occur only when improvements in the quantity of data, together with modeling and data analysis strategies are sufficient to justify a complete reconstruction of the standard frame. The responsability for this decision lies with the appropriate IAU and IVS groups of experts, of which four reserchers of the ICRS PC at the SYRTE are members.

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• **Investigation of future non VLBI realizations of the ICRS**

Future astrometric satellite missions such as J-MAPS, SIM and GAIA, may provide fundamental reference frames more accurate than the current VLBI-based ICRF. Members of the ICRS Product Centre have direct ties to these programs, and are in a unique position to study these prospective reference frames.

2.2 Extragalactic radio-sources

• **Monitoring of structure to assess astrometric quality**

The task of imaging the sources (essentially quasars) from VLBI observations and evaluating their astrometric quality is shared between the USNO and Bordeaux observatory.

• **Maintenance of the time stability of the ICRF** Members of the SYRTE adress the time stability of the celestial reference frames and the effect on geodetic products. To do so they provide the time variation of the sources astrometric coordiantes (Lambert & Gontier 2008)

2.3 Link of other reference frames to the ICRS

• **Maintenance of the link to Hipparcos catalogue**

The location of Hipparcos axes is an object of particular attention, as well as the effect of Hipparcos proper motion uncertainties On example is the UCAC program which provides a link at the level of 1 mas.

• **Maintenance of the link to the solar dynamical reference frame through millisecond pulsar analysis**

Pulsar timing ia a very accurate way to positioning of the ecliptic with respect to the ICRF. Efforts have been recently developed in the frame of a PPF (Plan Pluri Formation) lead by A. Fienga (Besançon Observatory), in association with the Nancay radiotelescope where plusars are observed in a very regular basis, the SYRTE and the IMCCE (Paris Observatory).

• **Maintenance of the link to the solar system dynamical reference frame through observations of asteroids and planets**

Following the asteroids trajectories with respect to quasars enables one to get direct link between the dynamical system and the ICRF. Studies are done recently in order to make statistics of the close approaches between these two classes of objects and to observe these close approaches with middle size telescopes.

• **Maintenance of the link to the solar system dynamical reference frame through Lunar Laser Ranging analysis** The SYRTE has a long history of analysis of the Lunar Laser Ranging (LLR) observations done at CERGA (Grasse). When combiend with VLBI technique, the LLR technique is one of the most efficients ways to determine the orientation of the planetary reference frame relative to the ICRF. The ICRS PC gather the various data coming from LLR measurements.

3 Discussion and conclusion

Recent studies in the frame of the ICRS Product Centre at the SYRTE-USNO have begun in the scope of the GAIA mission. One of them is the preparation of a Large Quasar Astrometric Catalogue (Souchay et al. 2008), which contains 113 663 objects. It could serve as a kind of input catalogue for GAIA, to make statistics and to cross-identify the objects with the 200 000 quasars or more which will be observed by the astrometric space mission. Another study is the follow-up of the WMAP satellite which is located at the L_2 Lagrange point, as GAIA. Applying the same methods will allow a very accuarte astrometric determination of GAIA

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