

IVS Celestial Reference Frame (CRF) Committee

Terms of reference

1. Context

The celestial reference frame is a unique product of the VLBI technique which serves many research activities in geodesy and geophysics, for Earth orientation studies, and in astronomy and astrophysics. It is also essential for some other practical and societal applications like navigating spacecraft in the solar system. Since 1998 and the adoption of the International Celestial Reference Frame (ICRF), the VLBI frame has been recognized as a fundamental reference by the International Astronomical Union (IAU). Until very recently (2018), when the advent of the Gaia mission made possible the realization of a celestial reference frame in the optical band, it had no equivalent in astronomy. Even now in the Gaia era, the VLBI frame remains unique as the backbone to all activities pertaining to geodesy and the monitoring of the Earth orientation, and likewise for deep space navigation in the solar system.

The most recent realization of the International Celestial Reference Frame is ICRF3, adopted by the IAU in 2018, and in use since January 1, 2019 (Charlot et al. 2020). Unlike its predecessors, ICRF3 is a multi-frequency frame, the first of its kind, which provides source positions at three frequencies, S/X (2.3/8.4 GHz), K (24 GHz) and X/Ka (8.4/32 GHz). The two major blocks of S/X observations for ICRF3 come from IVS and from the Very Long Baseline Array (VLBA). IVS contributed to pushing the source position accuracy while the VLBA contributed to densifying the frame (i.e. bringing more, weaker sources in). It is worth pointing out that the 500 sources with the most accurate positions in ICRF3 have all been observed by IVS, as also do 93% (i.e. 282) of the 303 ICRF3 defining sources.

IVS has been essential to the realization of ICRF3. Likewise, it will remain essential for maintaining the frame and producing new realizations of the ICRF in the future. This necessitates that appropriate observing programs focused on the celestial frame and organized by IVS be continued and developed along the recommendations put forward in the IAU 2018 Resolution B2¹ on ICRF3. The future IAU Working Group on the ICRF (in the process of being set up) will aim at producing a fully-integrated multi-frequency celestial frame, including the three radio bands already in ICRF3 plus the Gaia optical band. The Celestial Reference Frame (CRF) Committee is being set up to ensure that S/X observing by IVS is aligned onto these goals and provides proper data for maintaining and developing the frame.

2. Role of the CRF committee

The CRF committee is an advisory group that makes recommendations to the IVS Directing Board on observing programs and strategies for the celestial reference frame. At the same time, it takes also an operational role for the implementation and monitoring of these programs. The details of the activities that will be pursued are the following:

- Identify the list of sources to be observed by IVS in agreement with the prescriptions of the IAU Working Group on the multi-frequency celestial reference frame. These could be ICRF3 defining sources, southern-hemisphere sources (both existing and new), sources observed at K band and/or X/Ka band but not at S/X band, sources detected by Gaia,... or any other source or block of sources of importance for the maintenance of ICRF3 and its further development.
- Design a proper strategy to have these sources observed by the IVS network. This includes in particular the identification of the session types in which the sources should be scheduled, the determination of the number of sessions necessary each year along with the data rates. In some

¹ The IAU 2018 Resolution B2 on the Third Realization of the International Celestial Reference Frame in particular resolves “that the organizations responsible for astrometric and geodetic VLBI observing programs (e.g. IVS) take appropriate measures to continue and develop such programs, at multiple radio frequencies and with a specific effort on the southern hemisphere, to both maintain and improve ICRF3.”

cases, technical recommendations may be made (e.g. increase in the data rates). Adjustment of the observing (array, correlator) may also be proposed if no proper IVS sessions are available. The committee may also develop recommendations on where to set up new IVS facilities (e.g. radio telescopes in the southern hemisphere) for further improving the celestial frame.

- Take an active role in the scheduling of the relevant observations. For dedicated astrometric sessions, the CRF committee will act as an IVS operations center for preparing the schedules of the actual observing sessions. For the other sessions, the role of the committee will be limited to making recommendations on the sources to be observed. In both cases, the committee will work closely with the IVS Coordinating Center and the Observing Program Committee. A close coordination with USNO and those in charge of the VLBA celestial reference frame sessions conducted under the USNO share of the observing time will also be sought.

Because of the nature of the sources to be observed, which have a wide range of flux densities, having proper sensitivity will be essential. It is thus anticipated that the network targeted for the observations will be the legacy network at first. At the same time, the potential of the VGOS network as a possible contributor to the celestial frame development in the mid-term should also be studied and assessed.

It is also to be pointed out that besides astrometric observations imaging should also be considered so that the structure of the sources and hence their suitability as reference frame sources may be assessed.

3. Organization

The CRF committee is composed of members selected among the IVS associate members by the IVS Directing Board on proposal by the Chair of the committee. Membership covers expertise about ICRF sources, scheduling and observing strategies, correlation, imaging and VGOS. The committee is limited to ten members for reasons of efficiency. The Chair is assisted by a co-Chair.

Changes in membership are proposed to the IVS Directing Board by the Chair of the committee, after discussion within the committee. The appointment of new members remains with the Directing Board.

The Chair and co-Chair are appointed for a term of one year, renewable. Appointment of a new Chair is made by the IVS Directing Board upon proposal by the outgoing Chair, in agreement with the rest of the committee. Appointment of a new co-Chair is made by the Directing Board upon proposal by the current Chair. The term of the co-Chair ends with that of the Chair.

The role of the Chair is to organize the work of the committee as defined above. The co-Chair should be closely associated so that he/she can take over in case the Chair is unavailable. Activities of the committee are monitored through regular teleconferences and occasional face to face meetings, the latter generally taking place at conferences where committee CRF members are present. The Chair distributes an agenda prior to each meeting and provides minutes of the meeting afterwards. External experts may be invited to attend CRF committee meetings, if needed, at the discretion of the Chair.

The Chair of the committee reports to the IVS Directing Board at regular intervals to coincide with Directing Board meetings. He/she prepares written reports about the activities of the committee for inclusion in the IVS biennial reports. Presentations may also be made in IVS-related conferences, such as the biennial IVS General Meeting.

Reference

Charlot, P., Jacobs, C. S., Gordon, D., Lambert, S., de Witt, A., Böhm, J., Fey, A. L., Heinkelmann, R., Skurikhina, E., Titov, O., Arias, E. F., Bolotin, S., Bourda, G., Ma, C., Malkin, Z., Nothnagel, A., Mayer, D., MacMillan, D. S., Nilsson, T., and Gaume, R.: 2020, A&A (in press), DOI: 10.1051/0004-6361/202038368.

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