# Inter-Agency Space Debris Coordination Committee

# Recommendation for the optical observations data exchange format

**Issued by IADC Working Group 1**

# 1 Format Requirements

Basic format requirements:

- the possibility of presenting observations at all orbits: from LEO to GEO, HEO and higher orbits like circumlunar ones;
- presentation of all data necessary for further analysis of observations;
- convenience of computer processing.

The following additional requirements follow from the basic requirements:

- the ability to record time tags with a minimum step of no more than 0.001 s or even 0.0001 s (to ensure the accuracy of observing LEO objects);
- inclusion of information about the color band of observations;
- inclusion of information about the corrections that were made with the observations;
- inclusion of information on the precision of the obtained observations (this is especially important for photometric observations);
- each observation should contain the maximum amount of information;
- it is desirable that the format supports JSON, KVN or XML data representation.

## 1.1 Possible format prototypes

For IADC tasks (observation of space debris and other near-Earth artificial objects), the TDM format seems to be the preferred data format. The existing version of this format can already be used for the exchange of positional observations. But for photometric observations, in our opinion, it is not suitable, because we IADC did not find in the Blue Book tags for designating photometric bands (filters) and options for correcting photometric observations describing.

## 1.2 Suggestions for making additions to the TDM format

Suggestions for making changes to the TDM METADATA section are presented in Table 1, similar to the tag description tables in the Blue Book. All tags are used in both KVN and XML versions of the format.

**Table 1:** Recommended changes to the TDM METADATA section

| Keyword | Description | Normative Values / Examples | N/E | Mandatory |
|---|---|---|---|---|
| ASTRONOMY_PHOTOMETRY_FILTER | photometrical filter | CLEAR<br>JC_V<br>RECTANGULAR_V<br>GAIA_G<br>SDSS_R' | E | Yes |
| EXPTIME | exposure in sec | 0.01 | E | No |
| NORMALIZATION_ABSORPTION | data normalization for atmospheric absorption if any | Yes<br>No | N | No |
| NORMALIZATION_DISTANCE | data normalization for standard slant range (if yes, then the standard range is indicated in kilometers) | 1000 | E | No |
| NORMALIZATION_PHASE_ANGLE | data normalization for standard phase angle (if yes, then the angle is indicated in degrees) | 60 | E | No |
| ASTROMETRY_CAT | astrometric reference catalogue | UCAC5<br>GAIA DR2 | E | No |

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| | | UCAC5 | | |
|---|---|---|---|---|
| PHOTOMETRY_CAT | photometric reference catalogue | UCAC5 GAIA DR2 NOMAD | E | No |

COMMENTS: PHOTOMETRY_FILTER – which filter was used for the observations. Accordingly, CLEAR are observations without a filter; JC - filters in the Johnson Cousins system; RECTANGULAR - "rectangular" filters, as, for example, in [1] and so on. IADC recommends to add all used filters to this column. An alternative possibility (instead of introducing a new keyword) is to add "photometric" values to the "RECEIVE_BAND" keyword, but, in our opinion, this option is not very convenient to use.

If observations are carried out simultaneously using several filters, then for each filter a separate TDM file is generated with the corresponding keyword PHOTOMETRY_FILTER value in the METADATA section.

Table 2 presents the proposed change in the TDM DATA section.

**Table 2:** Recommended changes to the TDM DATA section

| Keyword | Description | Normative Values / Examples | N/E | Mandatory |
|---|---|---|---|---|
| SIGMA_MAG | Magnitude uncertainty | 0.2 | E | No |

Other information required for data exchange (such as sensor names/IDs, their location, and equipment used) shall be described in a supplementary ICD.

# References

[1] E. Cordelli, P. Schlatter, T. Schildknecht, " Simultaneous multi-filter photometric characterization of space debris at the Swiss Optical Ground Station and Geodynamics Observatory Zimmerwald," in *Proceedings of the Advanced Maui Optical and Space Surveillance Technologies Conference*, Wailea, Maui, Hawaii, 2018.