Mapping Mango Structure on top of GAIA and ZTF TABLES

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IVOA

Two tables with time dependant measurements

Gaia light curve (GAVO format)

Param for the source (no variablity)

Variability with time for fields


```
▼<TABLE name="ndweeebwlapa" nrows="43">
 ▼<PARAM arraysize="19" datatype="char" name="source_id" ucd="meta.id;meta.main" value="6680733225618222592">
    <DESCRIPTION>Gaia DR2 source_id of the object</DESCRIPTION>
  </PARAM>
 ▼<PARAM arraysize="63" datatype="char" name="title" ucd="meta.title;obs" value="Gaia DR2 RP photometry time series for star 6680733225618222592">
    <DESCRIPTION>Publisher-assigned title of the data set</DESCRIPTION>
  </PARAM>
 ▼<PARAM datatype="double" name="ra" ucd="pos.eq.ra" value="307.65830193737">
    <DESCRIPTION>Gaia DR2 RA of source object</DESCRIPTION>
  </PARAM>
 ▼<PARAM datatype="double" name="dec" ucd="pos.eq.dec" value="-40.0037924124343">
    <DESCRIPTION>Gaia DR2Dec of source object</DESCRIPTION>
  </PARAM>
  <PARAM arraysize="238" datatype="char" name="legal" value=" If you use public Gaia DR2 data in a paper, please take note of `ESAC's guide`_ on how to acknowledge and cite it. .. _ESAC's guide:
  http://gea.esac.esa.int/archive/documentation/GDR2/Miscellaneous/sec_credit_and_citation_instructions/"/>
 ▼<FIELD ID="obs_time" datatype="double" name="obs_time" ucd="time.epoch" unit="d">
    <DESCRIPTION>Observation time (JD in barycentric TCB).</DESCRIPTION>
  </FIELD>
 ▼<FIELD ID="flux" datatype="float" name="flux" ucd="phot.flux;em.opt.R" unit="s**-1">
    <DESCRIPTION>Integrated flux in RP; Use -2.5 log10(flux)+zero point to convert to magnitudes, where zero point is 24.7619 for DR2 fluxes in RP in the Vega system.</DESCRIPTION>
  </FIELD>
 ▼<FIELD ID="mag" datatype="float" name="mag" ucd="phot.mag;em.opt.R" unit="mag">
    <DESCRIPTION>Magnitude in RP, Vega system. Converted from flux using the formula given there. If flux_error/flux<0.1, you can use 1.09*flux_error/flux as a good estimate for the error; else the
    distribution is so skewed that you should work with fluxes rather than magnitude.</DESCRIPTION>
  </FIELD>
 ▼<FIELD ID="flux_error" datatype="float" name="flux_error" ucd="stat.error;phot.flux;em.opt.R" unit="s**-1">
    <DESCRIPTION>Error in RP flux.</DESCRIPTION>
  </FIELD>
 ▼<DATA>
```

Two tables with time dependant measurements

- ZTF light curve with detection information (1)

Variability for source mixed with variabilty with time inside a source

```
<FIELD name="oid" datatype="long" ucd="meta.id" utype="Source.identifier">
  <DESCRIPTION>Object ID</DESCRIPTION>
</FIELD>
<FIELD name="expid" datatype="int" ucd="meta.id;obs.exposure">
  <DESCRIPTION>Exposure ID</DESCRIPTION>
</FIELD>
<FIELD name="hjd" datatype="double" ucd="time.epoch" unit="d">
  <DESCRIPTION>Heliocentric Julian date (computed from mjd and the mean ra and dec of the input catalog)</DESCRIPTION>
</FIELD>
<FIELD name="mjd" datatype="double" ucd="time.epoch;obs.exposure" unit="d">
  <DESCRIPTION>Modified Julian date</DESCRIPTION>
</FIELD>
<FIELD name="mag" datatype="float" ucd="phot.mag;em.opt" unit="mag">
  <DESCRIPTION>Magnitude</DESCRIPTION>
</FIELD>
<FIELD name="magerr" datatype="float" ucd="stat.error;phot.mag;em.opt" unit="mag">
  <DESCRIPTION>Uncertainty in mag measurement. Includes correction to conform to photometric repeatability RMS derived from "non-variable" population.</DESCRIPTION>
</FIELD>
<FIELD name="catflags" datatype="int" ucd="meta.code">
  <DESCRIPTION>Catalog flags for source from PSF-fitting catalog</DESCRIPTION>
</FIELD>
<FIELD name="filtercode" datatype="char" arraysize="*" ucd="instr.bandpass">
  <DESCRIPTION>Filter code (abbreviated name)</DESCRIPTION>
</FIELD>
<FIELD name="ra" datatype="double" ucd="pos.eq.ra" unit="deg">
  <DESCRIPTION>Right Ascension of source</DESCRIPTION>
</FIELD>
<FIELD name="dec" datatype="double" ucd="pos.eq.dec" unit="deg">
  <DESCRIPTION>Declination of source</DESCRIPTION>
</FIELD>
<FIELD name="chi" datatype="float" ucd="stat.parameter">
  <DESCRIPTION>Chi-squared of source</DESCRIPTION>
</FIELD>
<FIELD name="sharp" datatype="float" ucd="stat.parameter">
  <DESCRIPTION>Sharpness of source</DESCRIPTION>
</FIELD>
<FIELD name="filefracday" datatype="long" ucd="time.epoch;obs.exposure">
  <DESCRIPTION>Exposure file timestamp, with decimal representation YYYYMMDDdddddd: year, month, day, and fractional day </DESCRIPTION>
</FIELD>
```

Two tables with time dependant measurements

- ZTF light curve with detection information (2)

```
</FIELD>
▼<FIELD name="field" datatype="int" ucd="meta.id;obs.field">
  <DESCRIPTION>Field ID</DESCRIPTION>
 </FIELD>
▼<FIELD name="ccdid" datatype="unsignedByte" ucd="meta.id;instr.det">
  <DESCRIPTION>CCD number (1..16)</DESCRIPTION>
 </FIELD>
▼<FIELD name="qid" datatype="unsignedByte" ucd="meta.id">
  <DESCRIPTION>Quadrant ID (1..4)</DESCRIPTION>
 </FIELD>
▼<FIELD name="limitmag" datatype="float" ucd="phot.mag;em.opt;stat.max;instr.sensitivity;obs.exposure" unit="mag">
  <DESCRIPTION>Approximate 5-sigma limiting magnitude corresponding to epoch-based PSF-fit catalog</DESCRIPTION>
 </FIELD>
▼<FIELD name="magzp" datatype="float" ucd="phot.mag;em.opt;phot.calib;arith.zp;obs.exposure" unit="mag">
  <DESCRIPTION>Magnitude zeropoint from photometric calibration</DESCRIPTION>
 </FIELD>
▼<FIELD name="magzprms" datatype="float" ucd="stat.rms;phot.mag;em.opt;phot.calib;arith.zp;obs.exposure" unit="mag">
  <DESCRIPTION>RMS deviation in magnitude zeropoint</DESCRIPTION>
 </FIELD>
▼<FIELD name="clrcoeff" datatype="float" ucd="stat.fit.param;phot.calib;obs.exposure">
  <DESCRIPTION>Color coefficient from linear fit</DESCRIPTION>
 </FIELD>
▼<FIELD name="clrcounc" datatype="float" ucd="stat.error;stat.fit.param;phot.calib;obs.exposure">
  <DESCRIPTION>Color coefficient uncertainty from linear fit</DESCRIPTION>
 </FIELD>
▼<FIELD name="exptime" datatype="float" ucd="time.duration;obs.exposure" unit="s">
  <DESCRIPTION>Exposure time from scheduler</DESCRIPTION>
 </FIELD>
▼<FIELD name="airmass" datatype="float" ucd="obs.airMass">
  <DESCRIPTION>Airmass at approximately the center of the focal plane at time of exposure</DESCRIPTION>
 </FIELD>
▼<FIELD name="programid" datatype="int" ucd="meta.code.member;obs.exposure">
  <DESCRIPTION>Program ID</DESCRIPTION>
 </FIELD>
▼<DATA>
 ▼<TABLEDATA>
  ▼<TR>
    <TD>686103400034440</TD>
```

Mapping « mango » on top of these tables. Why ?

- Low level : reuse MCT and PhotDM
  - Measurements, errors
  - Coordinates
  - Coordinate systems
- High level : Split the table into Source data on one side and associated TimeSeries on the other side
  - Separate what is plotable against time and what is stable
  - For TimeSeries We use a tsdata toy datamodel derived from
- Let the dataprovider tables unchanged

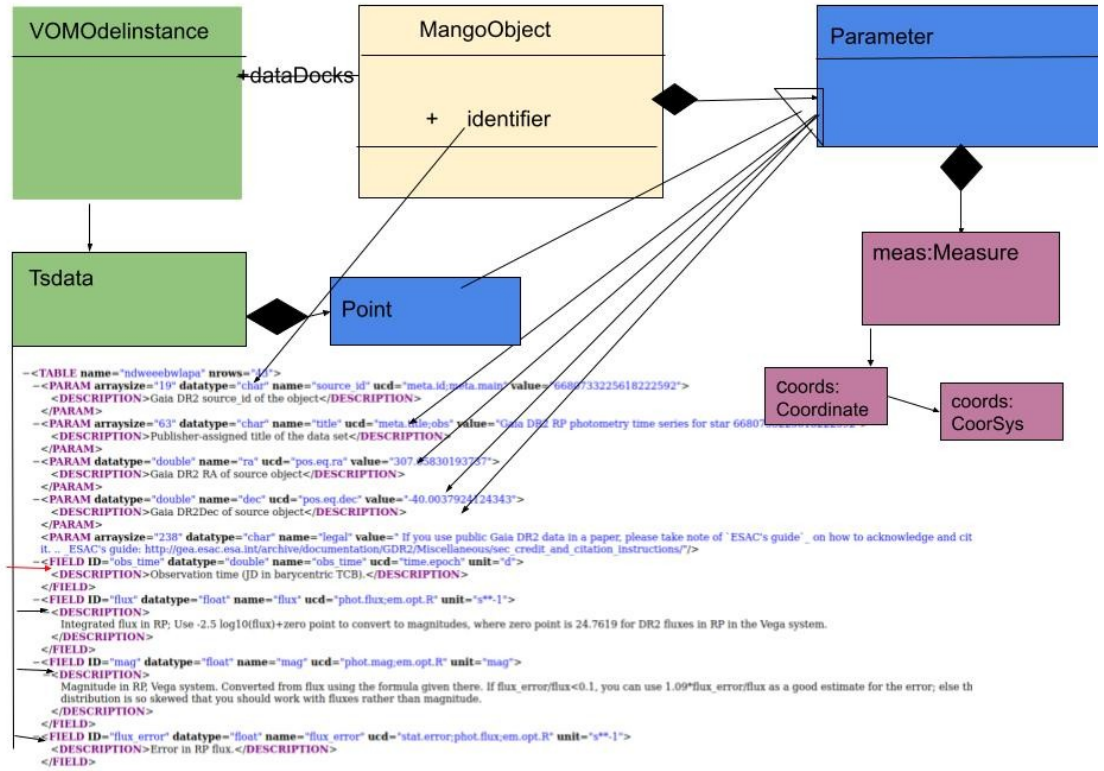
MCT, PhotDM in ModelInstanceInVOT

```
<!--
                    ZTF Photometric System zg filter
          -->
▼<INSTANCE ID="PhotSystem" dmrole="tsd:PhotSys" dmtype="coords:CoordSys">
 ▼<INSTANCE dmrole="tsd:[illegible]Frame" dmtype="coords:CoordFrame">
  ▼<INSTANCE dmrole="coords:[illegible]ordFrame.cal" dmtype="PhotDM:Photcal">
   ▼<INSTANCE dmrole="PhotDM:Photcal.zeroPoint" dmtype="PhotDM:ZeroPoint">
    ▼<INSTANCE dmrole="PhotDM:Photcal.magnitudeSystem" dmtype="PhotDM:MagnitudeSystem">
       <ATTRIBUTE dmrole="PhotDM:MagnitudeSystem.type" dmtype="ivoa:string" value="Vega"/>
     </INSTANCE>
    ▼<INSTANCE dmrole="PhotDM:ZeroPoint.flux" dmtype="PhotDM:Flux">
       <ATTRIBUTE dmrole="PhotDM:Flux.value" dmtype="ivoa:real" value="3963.97"/>
       <ATTRIBUTE dmrole="PhotDM:Flux.unit" dmtype="ivoa:string" value="Jy"/>
     </INSTANCE>
   </INSTANCE>
   ▼<INSTANCE dmrole="PhotDM:Photcal.PhotometryFilter" dmtype="PhotDM:PhotometryFilter">
      <ATTRIBUTE dmrole="PhotDM:PhotometryFilter.identifier" dmtype="ivoa:string" value="zg"/>
     ▼<INSTANCE dmrole="PhotDM:PhotometryFilter.spectralLocation" dmtype="PhotDM:SpectralLocation">
       <ATTRIBUTE dmrole="PhotDM:SpectralLocation.value" dmtype="ivoa:real" value="472.4"/>
       <ATTRIBUTE dmrole="PhotDM:SpectralLocation.unit" dmtype="ivoa:string" value="nm"/>
     </INSTANCE>
    </INSTANCE>
   </INSTANCE>
  </INSTANCE>
  <!--
                Time System . There are two of them. TimeSys is
                 -->
▼<INSTANCE ID="TimeSys" dmrole="tsd:TimeSys" dmtype="coords:Time
 ▼<INSTANCE dmrole="coords:TimeSys.frame" dmtype="coords:TimeFra
    <ATTRIBUTE dmrole="coords:TimeFrame.refPosition" dmtype="ivo
    <ATTRIBUTE dmrole="coords:TimeFrame.timescale" dmtype="ivoa:
    <ATTRIBUTE dmrole="coords:TimeFrame.refDirection" dmtype="iv
   </INSTANCE>
  </INSTANCE>
▼<INSTANCE ID="HelioTimeSys" dmrole="tsd:TimeSys" dmtype="coords
 ▼<INSTANCE dmrole="coords:TimeSys.frame" dmtype="coords:TimeFra
    <ATTRIBUTE dmrole="coords:TimeFrame.refPosition" dmtype="ivo
    <ATTRIBUTE dmrole="coords:TimeFrame.timescale" dmtype="ivoa:
    <ATTRIBUTE dmrole="coords:TimeFrame.refDirection" dmtype="iv
   </INSTANCE>
  </INSTANCE>
  <!--
                Space System . Simply barycentric, ICRS
                 -->
▼<INSTANCE ID="SpaceSys" dmrole="tsd:SpaceSys" dmtype="coords:Sp
 ▼<INSTANCE dmrole="coords:SpaceSys.frame" dmtype="coords:TimeFr
    <ATTRIBUTE dmrole="coords:SpaceFrame.refPosition" dmtype="iv
    <ATTRIBUTE dmrole="coords:SpaceFrame.spaceRefFrame" dmtype="
   </INSTANCE>
  </INSTANCE>
 </GLOBALS>
▼<TABLE_MAPPING tableref="Results">
  <!--
```

Everything for photometry encapsulated into
The mango parameter, measure and refernce to
PhotSys

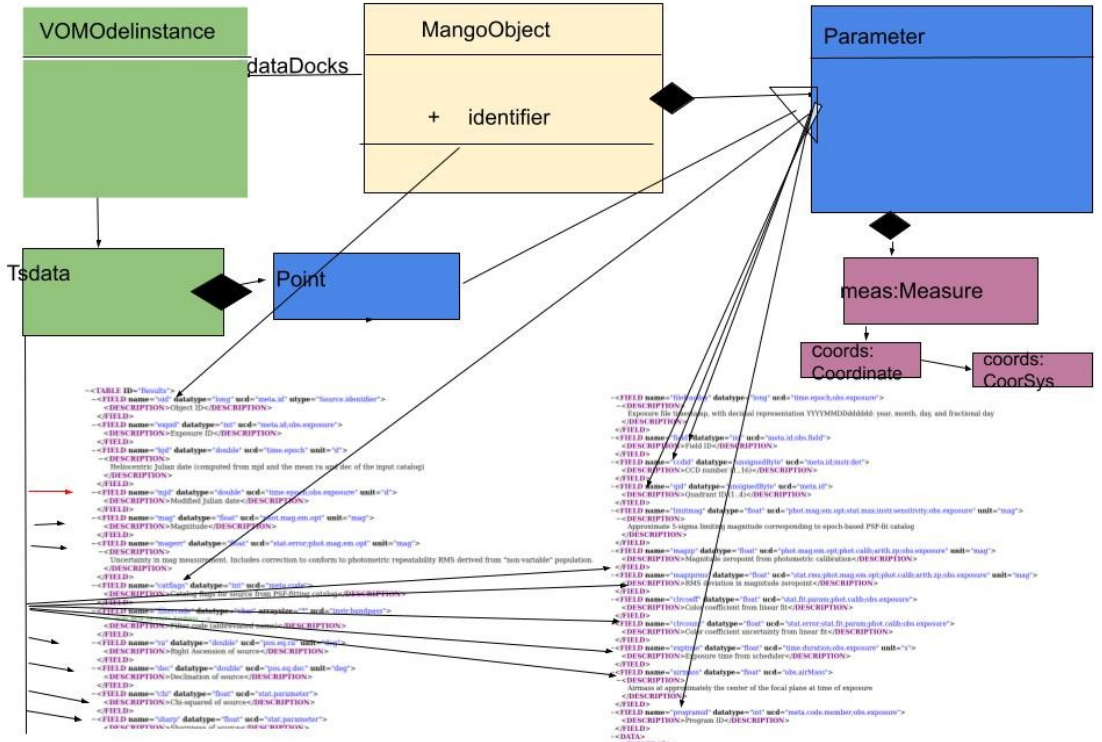
```
▼<INSTANCE dmrole="mango:associatedParameters" dmtype="mango:Parameter">
  <!--
                                                                                This paramete
                                                                                          -->
  <ATTRIBUTE dmrole="mango:Parameter.semantic" dmtype="ivoa:string" value="Magnitude"/>
  <ATTRIBUTE dmrole="mango:Parameter.ucd" dmtype="ivoa:string" value="phot.mag;"/>
  <ATTRIBUTE dmrole="mango:Parameter.description" dmtype="ivoa:string" value="This is the magnitude in the ZTF
  <!--
                                                                                The magnitude
                                                                                          -->
 ▼<INSTANCE dmrole="mango:Parameter.measure" dmtype="mango:PhotometryMeasure">
  ▼<INSTANCE dmrole="mango:PhotometryMeasure.coord" dmtype="mango:PhotometricCoord">
    <!--
                                                                                          -->
    <ATTRIBUTE dmrole="coords.Coordinate.cval" dmtype="ivoa:real" ref="mag"/>
    <INSTANCE dmrole="coords:Coordinate.coordSys" dmref="PhotSystem"/>
   </INSTANCE>
   <!--
                                                                                Here
                                                                                          -->
  ▼<INSTANCE dmrole="meas:Measure.error" dmtype="meas:Symetrical">
    <ATTRIBUTE dmrole="meas:Error.statError" dmtype="ivoa:real" value="magerr"/>
   </INSTANCE>
```

Mango View on top of Gaia light curve table



Source mango :Parameters point to PARAMS
Tsdata:Point point to variable FIELDS
Tsdata:Point derived from mango :Parameter (see README)

Mango view on top of ZTF detection table



Source mango :Parameters point to FIELDS varying only with source
Tsdata:Point point to FIELDS varying with time inside a source

Serialisation

- Gaia yaml serialisation
- ZTF Yaml serialisation

These yaml serialisations show sets of individual instances

- Conclusion :
  - Original table + Mango View & annotation (ModelInstanceinVOT)
  - → set of yaml instances of MangoObjects
- All material :
- https://github.com/ivoa/dm-usecases/tree/main/usecases/time-series/fb%2Bml-proposal