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## Annotated VOTable in VizieR

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and VizieR team !



# □ VizieR table curation



## Table content in input

- Space agencies : clean metadata
- Authors : minimal information gathered in ReadMe file + article

## CDS curation

- CDS Name convention : prefix ...
- DOI, ORCID
- UCD
- Photometry calibration and filter details
- Coordinate system: time+position
- Other added values: links, plots, ...

# □ Data description



## Where to get VizieR information ?

- **The web pages gather the whole information**
  - Identifiers, titles, authors, tables & columns description
  - Coordinate system are available in VizieR metadata
- **VO registry**
  - Identifiers, authors, data origin (article), keywords.... + tables description
  - NO coordinate system
- **VOTables output (ex: conesearch) describe tables/columns**
  - Coordinate system (COOSYS/TIMESYS)
  - no Photometric calibration metadata
  - No “standard” provenance information : DOI/bibcodes, authors...

# VOTable output



70% of the queries returned in VO format (VOTable)



```
<VOTABLE version="1.4" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="http://www.ivoa.net/xml/VOTable/v1.3">
  <DESCRIPTION>
    VizieR Astronomical Service
    Date: 2021-03-19T09:20:00
    Explanations and Statistics
    In case of problem, please contact us
  </DESCRIPTION>
  <INFO ID="VERSION" name="votable-version" value="1.99+ (14-Oct-2013)"/>
  <RESOURCE ID="JAJ_51332464" name="JAJ/133/2464">
    <DESCRIPTION>Parameters and abundances of nearby giants (Luck+, 2007)</DESCRIPTION>
    <COOSYS ID="J2000" system="eq_FK5" equinox="J2000"/>
    <TABLE ID="JAJ_133_2464_stars" name="J/AJ/133/2464/stars">
      <DESCRIPTION>Program star parameters</DESCRIPTION>
      <FIELD name="RAJ2000" ucd="pos.eq.ra" ref="J2000" datatype="double" width="11" precision="7" unit="deg">
        <DESCRIPTION>Right ascension (FK5, Equinox=J2000.0) (computed by VizieR, not part of the original data)</DESCRIPTION>
      </FIELD>
      <FIELD name="DEJ2000" ucd="pos.eq.dec" ref="J2000" datatype="double" width="11" precision="7" unit="deg">
        <DESCRIPTION>Declination (FK5, Equinox=J2000.0) (computed by VizieR, not part of the original data)</DESCRIPTION>
      </FIELD>
      <FIELD name="HD" ucd="meta.id;meta.main" datatype="int" width="6">
        <DESCRIPTION>The HD identification number</DESCRIPTION>
        <LINK href="http://vizier.u-strasbg.fr/viz-bin/VizieR-4?-info=XML&out.add=&-source=J/AJ/133/2464&corr=FK">
      </FIELD>
      <FIELD name="Vmag" ucd="phot.mag;em.opt.V" datatype="float" width="6" precision="3" unit="mag">
        <DESCRIPTION>Apparent V band magnitude</DESCRIPTION>
      </FIELD>
      <FIELD name="SpType" ucd="src.spType" datatype="char" arraysize="11">
        <DESCRIPTION>Spectral type (2)</DESCRIPTION>
      </FIELD>
      <FIELD name="plx" ucd="pos.parallax.trig" datatype="float" width="5" precision="2" unit="mas">
        <DESCRIPTION>Parallax</DESCRIPTION>
      </FIELD>
      <FIELD name="Dist" ucd="pos.distance;pos.heliocentric" datatype="float" width="5" precision="3" unit="pc">
        <DESCRIPTION>Distance from parallax</DESCRIPTION>
      </FIELD>
      <FIELD name="RV" ucd="spect.dopplerVeloc;pos.heliocentric" datatype="float" width="6" precision="2" unit="km/s">
        <DESCRIPTION>Radial velocity</DESCRIPTION>
      </FIELD>
      <FIELD name="e RV" ucd="stat.error" datatype="float" width="5" precision="2" unit="km/s">
        <DESCRIPTION>Error in RV</DESCRIPTION>
      </FIELD>
      <FIELD name="r RV" ucd="meta.ref;pos.frame" datatype="char" arraysize="1">
        <DESCRIPTION>[LFM] Source for RV (3)</DESCRIPTION>
      </FIELD>
      <FIELD name="Simbad" datatype="char" arraysize="6*">
        <DESCRIPTION>Simbad column added by the CDS</DESCRIPTION>
      </FIELD>
      <FIELD name="RA" ucd="pos.eq.ra;meta.main" ref="J2000" datatype="double" width="9" precision="5" unit="deg">
        <DESCRIPTION>Right Ascension (J2000) from SIMBAD (not part of the original data)</DESCRIPTION>
      </FIELD>
      <FIELD name="DEC" ucd="pos.eq.dec;meta.main" ref="J2000" datatype="double" width="9" precision="5" unit="deg">
        <DESCRIPTION>Declination (J2000) from SIMBAD (not part of the original data)</DESCRIPTION>
      </FIELD>
    </TABLE>
  </RESOURCE>
</VOTABLE>
```

Global metadata  
Provenance metadata  
Metadata to reuse data

Metadata (author, pub. Year) available in text, but not using a standard

Magnitude columns without system description

Group of columns describing the same measure

Added column, not part of original data

VOTable description

# □ Grouping columns by measure



ex: catalogue J/A+A/584/A5 (Evans , 2015)  
3 velocities RV1, RV2, RV3 each qualified with :

- An error column (e\_RV1)
- A number of observations used to compute the value (o\_RV1)

A parameter has frequently associated values, and we have adopted the rule of association with the *one-letter-underscore prefix*: if a column is obviously associated to another one — typically mean errors or uncertainty flags — we use one of the *underscore prefixes* listed in prefix.

### Conventions used for label prefix:

Symbol	Explanation
a_label	aperture used for parameter label
B_label	for an upper bound (maximal value) on parameter label
b_label	for a lower bound (minimal value) on parameter label
D_label	for a difference ( $\Delta$ ) on parameter label (e.g. $O-C$ )
d_label	for a number of degrees of freedom or for number of digits on p
E_label	mean error (upper limit) on parameter label
e_label	mean error ( $\sigma$ ) on parameter label
f_label	flag on parameter label
L_label	Likelihood on parameter label
l_label	limit flag on parameter label
m_label	multiplicity index on parameter label to resolve ambiguities
n_label	note (remark) on parameter label
o_label	number of observations on parameter label
q_label	quality on parameter label
r_label	reference (source) for parameter label
s_label	dispersion ( $\sigma$ ) on parameter label (the $\sigma$ of a mean of N values is equal to the dispersion divided by $\sqrt{N}$ )
u_label	uncertainty flag on parameter label
w_label	weight of parameter label
x_label	unit in which parameter label is expressed

[2015A&A...584A...5E](#) [ReadMe+ftp](#)  
[spectrum](#) [Similar Catalogs](#)

J/A+A/584/A5 Post annotation

l.J/A+A/584/A5/table2 Observational parameters of target stars[spectrum] (263 rows)

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Simple Constraint List Of Constraints Submit Reset All

Query by **Constraints** applied on Columns (Output Order: + o -)

Show	Sort	Column	Clear	Constraint	Explain (UCD)
<input type="checkbox"/>	<input type="radio"/>	recno	<input type="text"/>		Record number assigned by the VizieR team. Should Not be used for identification. ( <a href="#">meta.record</a> )
<input checked="" type="checkbox"/>	<input type="radio"/>	sp1	<input type="text" value="sp1"/>		<a href="#">spectrum</a> at 4375Å ( <a href="#">meta.ref.url</a> ) <span style="float: right;"><a href="#">spectrum</a></span>
<input checked="" type="checkbox"/>	<input type="radio"/>	sp2	<input type="text" value="sp2"/>		<a href="#">spectrum</a> at 4100+4700Å ( <a href="#">meta.ref.url</a> ) <span style="float: right;"><a href="#">spectrum</a></span>
<input checked="" type="checkbox"/>	<input type="radio"/>	AAO			AAOmega star number ( <a href="#">meta.id</a> )
<input checked="" type="checkbox"/>	<input type="radio"/>	RAJ2000			"h:m:s" <sup>(i)</sup> Right Ascension (J2000) ( <a href="#">pos.eq.ra;meta.main</a> )
<input checked="" type="checkbox"/>	<input type="radio"/>	DEJ2000			"d:m:s" <sup>(i)</sup> Declination (J2000) ( <a href="#">pos.eq.dec;meta.main</a> )
<input checked="" type="checkbox"/>	<input type="radio"/>	SpType		(char)	MK spectral classification ( <a href="#">src.spType</a> )
<input checked="" type="checkbox"/>	<input type="radio"/>	RV1			<a href="#">km/s</a> <sup>(n)</sup> Primary velocity ( <a href="#">phys.veloc;pos.heliocentric</a> )
<input checked="" type="checkbox"/>	<input type="radio"/>	e_RV1			<a href="#">km/s</a> <sup>(n)</sup> rms uncertainty on RV1 ( <a href="#">stat.error</a> )
<input checked="" type="checkbox"/>	<input type="radio"/>	o_RV1			<sup>(n)</sup> Number of measurements for RV1 ( <a href="#">meta.number</a> )
<input checked="" type="checkbox"/>	<input type="radio"/>	RV2			<a href="#">km/s</a> <sup>(n)</sup> Secondary velocity ( <a href="#">phys.veloc;pos.heliocentric</a> )
<input checked="" type="checkbox"/>	<input type="radio"/>	e_RV2			<a href="#">km/s</a> <sup>(n)</sup> rms uncertainty on RV2 ( <a href="#">stat.error</a> )
<input checked="" type="checkbox"/>	<input type="radio"/>	o_RV2			<sup>(n)</sup> Number of measurements for RV2 ( <a href="#">meta.number</a> )
<input checked="" type="checkbox"/>	<input type="radio"/>	Bin		(char)	Binary status ( <a href="#">meta.code</a> )
<input checked="" type="checkbox"/>	<input type="radio"/>	ONames		(char)	Other name(s) ( <a href="#">Note 1</a> ) ( <a href="#">meta.id;meta.main</a> )

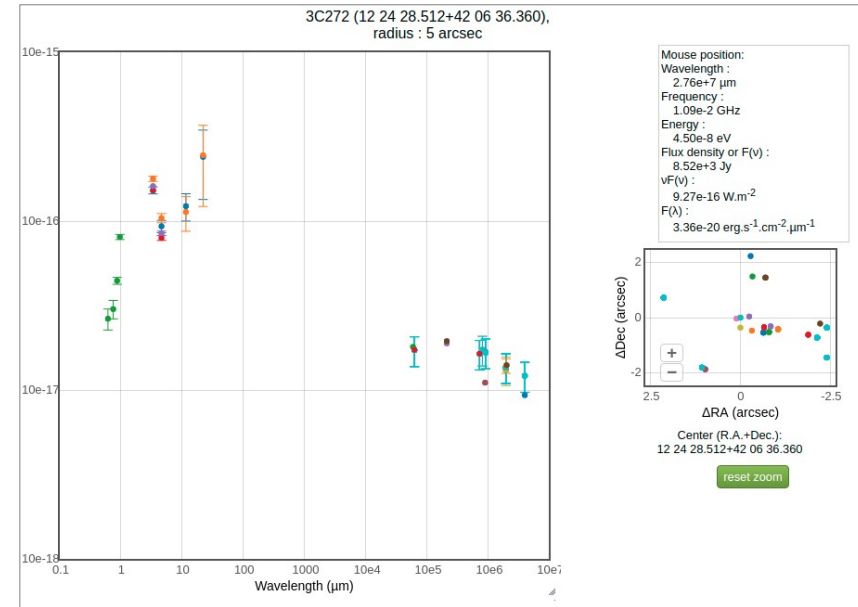
Usual mathematical functions may be specified in the label, with parentheses or a dot; for instance, the logarithm of the effective temperature could be labelled  $\log(Te)$  or  $\log_e Te$ .

# Photometry description



## Photometry viewer

- Compile sources coming from different catalogues/instruments and measured in different system
- Filters assigned by CDS to tables having magnitudes columns  
→ in order to compare data in a unified system (jsky)
- Filters are not part of the original data



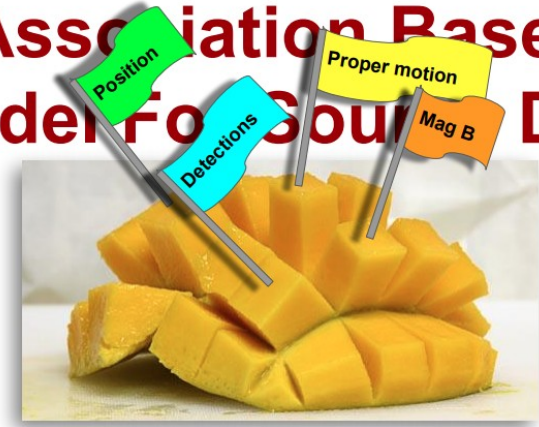
photid	fltrid	famid	ucdid	system	filter	lambda0 um	dlambda um	freq0 GHz	dfreq GHz	Fmag0 Jy	Ncat	Ntup	comment
302	1	0	929	ISAAC	SZ	1.061	0.1534	2.826e+05	4.085e+04	1.952e+03	0	0	<a href="http://www.eso.org/sci/facilities/paranal/instruments/isaac/inst/isaac_img.html">http://www.eso.org/sci/facilities/paranal/instruments/isaac/inst/isaac_img.html</a>
302	2	0	929	ISAAC	Js	1.243	0.1523	2.412e+05	2.956e+04	1.559e+03	1	74	<a href="http://www.eso.org/sci/facilities/paranal/instruments/isaac/inst/isaac_img.html">http://www.eso.org/sci/facilities/paranal/instruments/isaac/inst/isaac_img.html</a>
302	3	0	928	ISAAC	H	1.637	0.2879	1.832e+05	3.222e+04	1.025e+03	1	74	<a href="http://www.eso.org/sci/facilities/paranal/instruments/isaac/inst/isaac_img.html">http://www.eso.org/sci/facilities/paranal/instruments/isaac/inst/isaac_img.html</a>
302	4	0	927	ISAAC	NB207	2.069	0.0296	1.449e+05	2074	7.229e+02	0	0	<a href="http://www.eso.org/sci/facilities/paranal/instruments/isaac/inst/isaac_img.html">http://www.eso.org/sci/facilities/paranal/instruments/isaac/inst/isaac_img.html</a>
302	5	0	927	ISAAC	NB213	2.128	0.0311	1.409e+05	2059	6.863e+02	0	0	<a href="http://www.eso.org/sci/facilities/paranal/instruments/isaac/inst/isaac_img.html">http://www.eso.org/sci/facilities/paranal/instruments/isaac/inst/isaac_img.html</a>
302	6	0	927	ISAAC	Ks	2.152	0.2719	1.393e+05	1.76e+04	6.658e+02	4	36796	<a href="http://www.eso.org/sci/facilities/paranal/instruments/isaac/inst/isaac_img.html">http://www.eso.org/sci/facilities/paranal/instruments/isaac/inst/isaac_img.html</a>
302	7	0	927	ISAAC	NB217	2.168	0.0301	1.383e+05	1919	6.379e+02	0	0	<a href="http://www.eso.org/sci/facilities/paranal/instruments/isaac/inst/isaac_img.html">http://www.eso.org/sci/facilities/paranal/instruments/isaac/inst/isaac_img.html</a>
302	8	0	927	ISAAC	NB229	2.286	0.0324	1.311e+05	1859	6.065e+02	0	0	<a href="http://www.eso.org/sci/facilities/paranal/instruments/isaac/inst/isaac_img.html">http://www.eso.org/sci/facilities/paranal/instruments/isaac/inst/isaac_img.html</a>
302	9	0	926	ISAAC	NB328	3.275	0.0574	9.153e+04	1604	3.170e+02	0	0	<a href="http://www.eso.org/sci/facilities/paranal/instruments/isaac/inst/isaac_img.html">http://www.eso.org/sci/facilities/paranal/instruments/isaac/inst/isaac_img.html</a>
302	10	0	926	ISAAC	L	3.749	0.5768	7.998e+04	1.231e+04	2.472e+02	0	0	<a href="http://www.eso.org/sci/facilities/paranal/instruments/isaac/inst/isaac_img.html">http://www.eso.org/sci/facilities/paranal/instruments/isaac/inst/isaac_img.html</a>
302	11	0	926	ISAAC	NB380	3.803	0.0673	7.883e+04	1395	2.437e+02	0	0	<a href="http://www.eso.org/sci/facilities/paranal/instruments/isaac/inst/isaac_img.html">http://www.eso.org/sci/facilities/paranal/instruments/isaac/inst/isaac_img.html</a>
302	12	0	925	ISAAC	NB407	4.067	0.0751	7.371e+04	1361	2.131e+02	0	0	<a href="http://www.eso.org/sci/facilities/paranal/instruments/isaac/inst/isaac_img.html">http://www.eso.org/sci/facilities/paranal/instruments/isaac/inst/isaac_img.html</a>
302	13	0	925	ISAAC	NBm	4.656	0.1016	6.439e+04	1405	1.645e+02	0	0	<a href="http://www.eso.org/sci/facilities/paranal/instruments/isaac/inst/isaac_img.html">http://www.eso.org/sci/facilities/paranal/instruments/isaac/inst/isaac_img.html</a>
303	1	0	931	SOFI	Z	0.9	0.14	3.331e+05	5.182e+04		0	0	<a href="http://www.eso.org/sci/facilities/lasilla/instruments/sofi/inst/Imaging.html">http://www.eso.org/sci/facilities/lasilla/instruments/sofi/inst/Imaging.html</a>
303	2	0	929	SOFI	Js	1.24	0.16	2.418e+05	3.12e+04		1	59	<a href="http://www.eso.org/sci/facilities/lasilla/instruments/sofi/inst/Imaging.html">http://www.eso.org/sci/facilities/lasilla/instruments/sofi/inst/Imaging.html</a>
303	3	0	929	SOFI	J	1.247	0.29	2.404e+05	5.591e+04		6	368991	<a href="http://www.eso.org/sci/facilities/lasilla/instruments/sofi/inst/Imaging.html">http://www.eso.org/sci/facilities/lasilla/instruments/sofi/inst/Imaging.html</a>
303	4	0	928	SOFI	H	1.653	0.297	1.814e+05	3.259e+04		5	368889	<a href="http://www.eso.org/sci/facilities/lasilla/instruments/sofi/inst/Imaging.html">http://www.eso.org/sci/facilities/lasilla/instruments/sofi/inst/Imaging.html</a>
303	5	0	927	SOFI	Ks	2.162	0.275	1.387e+05	1.764e+04		5	354583	<a href="http://www.eso.org/sci/facilities/lasilla/instruments/sofi/inst/Imaging.html">http://www.eso.org/sci/facilities/lasilla/instruments/sofi/inst/Imaging.html</a>

# □ Annotate VOTable using Mango

## Mango Data-model

- Mango (L.Michel ET AL.) is a annotation Datamodel to describe sources and serializable in VOTable
- Annotation on existing VOTable
- A container of measure and associated data that enables to compose with generic measure or DataModel

## A Component and Association Based Model For Source Data



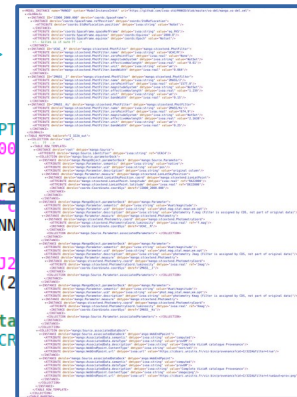
IVOA 2020 (L.Michel)

## Reasons of interests

- No mandatory attributes
- Highlight measures used in a table
- Generic measure
- Group columns describing the same measure (eg : value+error+flag)
- A photometric extension to complete Filter information

```
<?xml version="1.0" encoding="UTF-8"?>
<VOTABLE version="1.4" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns="http://www.ivoa.net/xml/VOTable/v1.3"
  xsi:schemaLocation="http://www.ivoa.net/xml/VOTable/v1.3 http://www.ivoa.net/xml/VOTable/v1.3">
  <DESCRIPTION>
    VizieR Astronomical Server cds:8082
  </DESCRIPTION>
  <INFO ID="VERSION" name="votable-version" value="1.99+ (14-Oct-2013)"/>
  ★
  <RESOURCE ID="yCat_1322" name="I/322A">
    <DESCRIPTION>UCAC4 Catalogue (Zacharias+, 2012)</DESCRIPTION>
    <COOSYS ID="J2000_2000.000" system="eq FK5" equinox="J2000" />
    <TABLE ID="I_322A_out" name="I/322A/out">
      <DESCRIPTION>Fourth U.S. Naval Observatory CCD Astrogra
      <FIELD name="UCAC4" ucd="meta.id;meta.main" datatype="c">
        <DESCRIPTION>UCAC4 recommended identifier (ZZZ-NNNNNN)
      </FIELD>
      <FIELD name="RAJ2000" ucd="pos.eq.ra;meta.main" ref="J2000">
        <DESCRIPTION>Mean right ascension (ICRS), Ep=J2000 (2
      </FIELD>
      <FIELD name="e_RAJ2000" ucd="stat.error;pos.eq.ra" data
        <DESCRIPTION>Mean error of RAdeg at mean epoch</DESCR
      </FIELD>
```

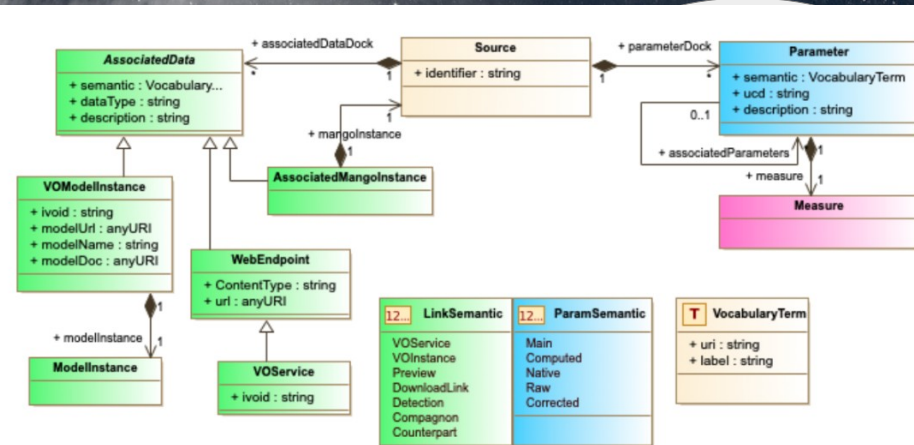
Mango annotation



# Prototype

## Mango output prototype

- piped workflow (Python script) taking a VOTable in input
- Use the Vizier nomenclature to associate columns



→ <http://viz-beta.u-strasbg.fr/viz-bin/Mango?-source=J/A+A/584/A5>

```

- <INSTANCE dmrole="mango:Source.parameters" dmtpe="mango:Source.Parameter">
  <ATTRIBUTE dmrole="mango:Parameter.instance" dmtpe="ivoa:string" value="main"/>
  <ATTRIBUTE dmrole="mango:Parameter.ucd" dmtpe="ivoa:string" value="phys.veloc;pos.heliocentric"/>
  <ATTRIBUTE dmrole="mango:Parameter.description" dmtpe="ivoa:string" value="main column"/>
- <INSTANCE dmrole="meas:Measure" dmtpe="meas:GenericMeasure">
  - <INSTANCE dmrole="meas:GenericMeasure" dmtpe="meas:GenericMeasure.coord">
    <ATTRIBUTE dmrole="meas:GenericMeasure.coord.value" dmtpe="ivoa:real" ref="RV1"/>
  </INSTANCE>
  - <INSTANCE dmrole="meas:Measure.error" dmtpe="meas:Error">
    - <INSTANCE dmrole="meas:Error.statError" dmtpe="meas:Symmetrical">
      - <INSTANCE dmrole="meas:Symmetrical.radius" dmtpe="ivoa:RealQuantity">
        <ATTRIBUTE dmrole="ivoa:RealQuantity.value" dmtpe="ivoa:real" ref="e_RV1"/>
      </INSTANCE>
    </INSTANCE>
  </INSTANCE>
</INSTANCE>
- <COLLECTION dmrole="mango:Source.Parameter.associatedParameters" dmtpe="mango:Source.Parameter">
  - <INSTANCE dmrole="mango:Source.parameters" dmtpe="mango:Source.Parameter">
    <ATTRIBUTE dmrole="mango:Parameter.instance" dmtpe="ivoa:string" value="main"/>
    <ATTRIBUTE dmrole="mango:Parameter.ucd" dmtpe="ivoa:string" value="meta.number;obs"/>
    <ATTRIBUTE dmrole="mango:Parameter.description" dmtpe="ivoa:string" value="number of observations"/>
  - <INSTANCE dmrole="meas:Measure" dmtpe="meas:GenericMeasure">
    - <INSTANCE dmrole="meas:GenericMeasure" dmtpe="meas:GenericMeasure.coord">
      <ATTRIBUTE dmrole="meas:GenericMeasure.coord.value" dmtpe="ivoa:real" ref="o_RV1"/>
    </INSTANCE>
  </INSTANCE>
</COLLECTION>
</INSTANCE>

```



# Expected



```
1 resource = getResource("http://.../votable...")
2 # print DOI, article, author, publication year
3 print (resource.provenance)
4
5 table = resource[0].table
6 for measure in resource[0].getMeasures():
7     if measure.type == __PHOT__:
8         photmeasure = MeasurePhot(measure)
9
10        # print the photometric columns
11        # with its error + associated columns (quality flags,..)
12        print(table[measure.columns])
13
14        # print filter metadata
15        print(photmeasure.fmag0)
16        print(photmeasure.zeropoint)
17        # Provenance info
18        print(photmeasure.provenance)
19
20        # transform main column to jsky using the filter config
21        phot_col = photmeasure.transform(unit='Jsky')
22        table.add_column(phot_col, name='phot')
23
24    elif measure.type == __TIME__:
25        timemeasure = MeasureTime(measure)
26        # transform main column to unit/system using TIMESYS
27        table.add_column(timemeasure.transform(unit='JD', system='UTC'), name='jd')
28
29    else : # __GENERIC__:
30        # print table with only the measured columns
31        # with error + associated columns
32        print(table[measure.columns])
33        print (measure.description)
34        print (measure.ucd)
35
36
37 # Make a plot
38 fig, ax = plt.subplots()
39 ax.plot(table['jd'], table['phot'])
40
```

Pseudo-code  
using a not  
existing API

## Current prototype use

- Vodmlinstance serialisation (L.Michel)
- Mango extension :
  - for photometry (mango:stcextend.Photometry – compliant with photDM)
  - For position (mango:stcextend.LonLatSkyPosition)
- Generic measure for other quantities (eg: velocity, proper motions, ..)

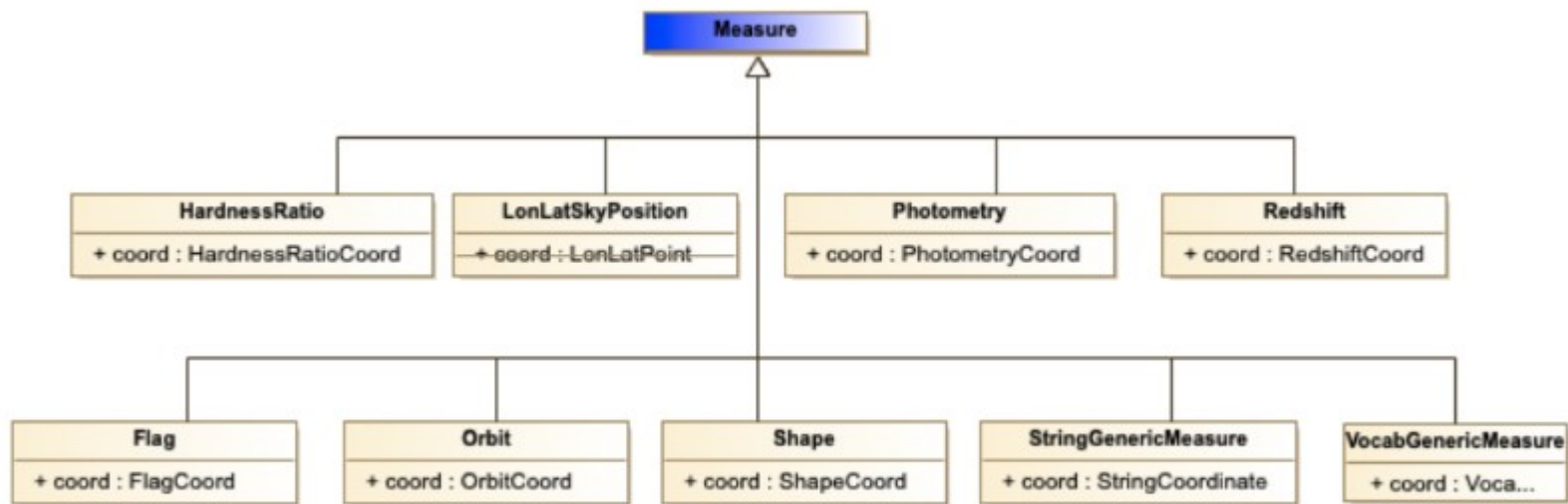


Figure 4: Mango extensions of Measure.



# Prerequisite to transform the prototype



- Requires a provenance information to describe (photometry) filter origin
- Minimal Provenance information (DOI, authors, date) would be appreciated!
- Requires clients
- Requires stable building block (use Mango extension)
- Output to be validated (VO validator)