

This document captures proposed changes to the key LSST Database tables (Object, Source, FaintSource, DIASource) to make these tables aligned with the Level 1 and Level 2 data products outlined in the document written for Science Collaboration after the FRS meeting at UC Davis.

## Object

### Identifiers

```
objectId BIGINT NOT NULL      -- primary key
procHistoryId INTEGER NOT NULL -- for provenance tracking
iauId CHAR(34)
```

iauId is a IAU compliant name for the object. Example: "LSST-DR11 J001234.65-123456.18 GAL". The last 3 characters identify classification. Note that it will not accommodate multiple classifications.

### Best fitting model type for the object

Several types of object model will be fit to the measurements. This column specifies which model type gives the best fit. The number of all models will be small (few). We will be adding new models very infrequently.

Proposed convention: a model will be identified by two characters. We currently have two models: slowly moving point source (?PS?), and small galaxies (?SG?)

```
bestModel char[2]
```

### Multifit model parameters and covariance matrices

The model parameters include the most important object parameters - mean position, fluxes, shape parameters.

```
-- ra/dec and their errors are present in each model
-- expressed in degrees
raPS FLOAT
raSigmaPS FLOAT
decPS FLOAT
decSigmaPS FLOAT
raSG FLOAT
raSigmaSG FLOAT
decSG FLOAT
decSigmaSG FLOAT

-- only PS model has these
muRaPS DOUBLE, muRaSigmaPS FLOAT      -- expressed in miliarcsec per year
muDecPS DOUBLE, muDecSigmaPS FLOAT    -- expressed in miliarcsec per year
parallaxPS DOUBLE, parallaxSigmaPS FLOAT -- expressed in miliarcsec

-- Small dimension of the position error ellipse, assuming gaussian scatter
-- These are per model and per filter.
-- Name is a bit awkward, but we will eventually rename them
-- (they will become part of covariance matrix)
-- posErr expressed in arcsec. Theta expressed in degrees
uPosErrAPS FLOAT
uPosErrBPS FLOAT
uPosErrThetaPS FLOAT
```

```

uPosErrASG FLOAT
uPosErrBSG FLOAT
uPosErrThetaSG FLOAT

-- One flux + error per model per filter
uFluxPS FLOAT, uFluxSigmaPS FLOAT
uFluxSG FLOAT, uFluxSigmaSG FLOAT

-- First and second moments. These are per model per filter, all FLOATs
uIxPS, uIyPS, uIxyPS, uIxxPS, uIyyPS
uIxSG, uIySG, uIxySG, uIxxSG, uIyySG

```

Notice that we are proposing to use `?dec?` instead of `?decl?`. `?Dec?` is strongly preferred by astronomers. We will always have model type attached to the `?dec/decl?`, so the issue with `?dec?` being a reserved word in some RDBMSes goes away.

The moments are defined as:

- $I_x = \text{integral\_over\_footprint}[w(x-x_0,y-y_0)*f(x,y)*(x-x_0)]$
- $I_y = \text{integral\_over\_footprint}[w(x-x_0,y-y_0)*f(x,y)*(y-y_0)]$
- $I_{xy} = \text{integral\_over\_footprint}[w(x-x_0,y-y_0)*f(x,y)*(x-x_0)*(y-y_0)]$
- $I_{xx} = \text{integral\_over\_footprint}[w(x-x_0,y-y_0)*f(x,y)*(x-x_0)^2]$
- $I_{yy} = \text{integral\_over\_footprint}[w(x-x_0,y-y_0)*f(x,y)*(y-y_0)^2]$

Where:

- $x_0, y_0$  is the object center
- $w(x,y)$  is a weighting function
- $f(x,y)$  is the flux

## Elliptical equivalent to object footprint

The ellipse which gives the same weighted moments as the object

```

raFootprint FLOAT
decFootprint FLOAT
aFootprint FLOAT
bFootprint FLOAT
thetaFootprint FLOAT

```

## Bounding box for object

The smallest box on the sky that fully encloses the object footprint. This is what you need for a postage stamp. These ranges are for the center given by (ra, decl). *Need to decide for which model. Best?*

```

raRange FLOAT
decRange FLOAT

```

## Summary statistics for light curve variability

Still TBD. At least give variance around best fitting constant. Likely include Welch-Stetson statistics, or similar.

```
-- this is per filter, number of measurements in light curve
uNumObs INTEGER

-- Probability of variability in % (100% = variable object). Per filter
uVarProb TINYINT

-- Characteristic timescale of flux variations (measured in days). Per filter.
-- Tim: have we decided to keep it or to remove it???
uTimescale FLOAT
```

## Summary statistics for image model residuals

Still TBD. Goal is to provide useful parameters that can be selected on to find interesting objects such as lensing arcs

[TBD]

## Extendedness parameter

The probability that the object is a point source.

[TBD]

## Photometric redshift and associated PDF

The reported photo-Z will be the peak of the PDF. The full PDF will be included.

There will be a single Level 2 photo\_z information

This section will include info about redshift and info about probability distribution function

Redshift: ~20 columns. Same redshift for many objects, so normalize into separate Redshift table.

Probability distribution function: Not sure yet how to encode it, also not clear how many columns will be needed. Need to go back to the old email thread [Tim will try to find it]

What is currently in placeholder\_photoz is not very useful

## Segmentation info

Relationship to other Objects which are part of the same segmentation (deblending) tree

```
-- same as SDSS
parentId
nChild -- number of children
```

## Summary statistics

```
earliestObsTime
latestObsTime
```

## Columns to be removed

The following columns will be removed from the current (DC3b) schema:

- raFlux, declFlux + errors (The flux weighted position for (ra, decl), calculated from the first moment of the pixel values within the footprint.)
- apMag, petroMag (replaced with 1 magnitude per model)
- refrRaAstrom, refrDeclAstrom, errors (astrometric refraction)
- primaryPeriod, errors (summary period for all filters)
- all scalegrams 25 x 6 filters (they are currently in placeholder\_Object table)
- xFlux, yFlux, errors (The flux weighted position for (x,y), calculated from the first moment of the pixel values within the \* footprint)
- xPeak, yPeak ((x,y) position with the peak value in the footprint.)
- raPeak, declPeak
- raAstrom, declAstrom, errors
- xAstrom, yAstrom, errors
- cx, cy, cz, errors (this was introduced to speed up near neighbor queries)
- uAmplitude
- uPeriod

## FaintSource

## Source

## DIASource