Experiments about 3-band merging in XXL

Usage of ultrasoft X-ray data

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Abstract. I report on a preliminary exercise of using the ultrasoft (0.3-0.5 keV) band data in addition to the customary soft and hard bands for band merging, using current Xamin 3.3 data. There is a limited increase of ambiguous cases, which are however manageable. The procedure cannot be brought to an end, because of missing information about rate-flux conversion factors and position error vs rate dependency.

Key words: LSS; XXL

1. Introduction

Starting with version 3.3, Xamin results (i.e. FITS catalogues per field) started to be supplied in *three* energy bands (with the *ultrasoft* band A, i.e. 0.3-0.5 keV, supplied in addition to the customary soft and hard bands, aka B and CD). However, for backward compatibility with the XMM-LSS (Chiappetti et al., 2013), the A-band catalogues were stored away in the data product repository but weren't advertised nor used in database ingestion (Chiappetti , 2013).

In view of a future release 3.4 of Xamin, I decided to experiment with the ingestion and usage of band A *from the current 3.3 release*, in order to assess the *changes required in the procedure*, the eventual *missing information* and possible *side effects*.

The experiment was run on the northern data (i.e. the equivalent of `north33` and related tables).

2. The modified procedure

The database population (or *ingestion*) for the X-ray tables customarily occurs in the following steps:

- creation of database tables
- ingestion of individual band tables
- band merging
- post-merging steps (inclusive of flux calculation)
- overlap-removal and catalogue generation

The very last steps are not considered here since they act on the result of the previous steps taking the entire content, for which the addition of the ultrasoft band is not relevant.

2.1. Table creation

Customarily there were three database tables for one release (e.g. 3.3) in a given area (i.e. north or south). These were two *individual band tables* (e.g. `north33b` and `north33cd`) and one *band merged* table (e.g. `north33`). Overlap-free `VIES`s (e.g. `XXLN`) are outside the scope of the present report.

Customarily the layout of those tables (and the administrative registration of their columns necessary for release via the ~~**DART**~~▷ user interface) was *copied* from an existing dataset. So for instance `north33` inherited from `jan11`, while `south33` just inherited from `north33`.

For the present experiment this step was arranged manually, without administrative registration, just creating an ultrasoft band table `north33a`, and a variant band merged table `test33` mimicked on `north33`.

`north33a` has exactly the same layout of the existing B and CD band tables.

`test33` has the same layout of `north33`, with the following additions and changes:

- columns for total counts, core radius, detection likelihood, extension likelihood, count rate, flux and flux flag have been added for band A
- hidden columns for band A coordinates and exposures (in the 3 cameras) have been added
- columns have been added at the end of the column list (the order in which they are presented to the user will be controlled otherwise)
- the columns `id` and `class` have been changed from 6 to 9 characters and from 3 to 3 characters to cope with 3 bands

2.1.1. Future changes

For the future (3.4) ingestion one should adapt the existing `create-saclay-band` script (inclusive of administrative registration) to deal with 3 bands instead of 2, to add band A specific columns to the band-merged table, and possibly also to add columns associated to the double-source fit.

In addition the script should allow to specify as a parameter the start value for the `seq` numbering (`north33` and `south33` used the same start at 200001, which proved incovenient). The new release will use separate numbering for the north and south area (of course in ranges disjoinct from numbering used in previous versions).

2.2. Single band ingestion

The existing ingestion script could be adapted rather easily to 3-band operation (since it is just a *foreach* loop on a list of bands).

Since the band A XAMIN FITS catalogue files are already available, it has been just a matter of ingesting the relevant content into `north33a`.

2.2.1. Future changes

A version of the script `bandingest3.csh` is ready with the relevant sections commented out (just decomment to activate). The auxiliary extraction script `prepopulate-saclay33.awk` shall be transformed in a 3.4-specific version adding the new columns (double fit) provided by XAMIN 3.4.

2.3. Band merging

Juda León se dio a permutaciones
De letras y a complejas variaciones
J.L.Borges, cit. in U.Eco, Foucault's Pendulum, 6

It has been relatively easy to adapt the current band merging script operating on 2 bands, in such a way to support a third band. In fact there was already an earlier test version used for XMM-LSS `nov04` version (10 years ago !) supporting *five* energy bands (A, B, CD, C, D).

Essentially the script starts taking all possible permutations of distances of pointlike and extended positions (remember that the ingestion steps has used the standard recipe to classify a detection in a single band as *pointlike or extended* !) within a correlation radius (for which I use the customary $10''$).

While the old script used two permutations (B,CD and CD,B), this one uses 6 (A,B,CD; B,A,CD; B,CD,A; CD,B,A; A,CD,B; CD,A,B) ... much less than 120 used in the `nov04` version.

The `id` of an association is here a 9-character string composed of 3 3-digit identifiers (the per-field XAMIN `BOX_ID`, i.e. the individual band `id`) in the format `uuussshhh`. If one object is not detected in a band, the relevant portion (`uuu` for ultrasoft, `sss` for soft and `hhh` for hard) is set to `000`. Otherwise it is the zero-padded value of the individual band `id`.

Then the script consideres the duplicated cases having some common identifiers and removes the redundant cases (those with less band components). For instance entries `000096084` and `000097084` will be kept while `000000084` will be removed. The residual cases with common identifiers are provisionally flagged as *ambiguous* (`suspect=2`).

The so-called *PEPE classification* is here a three-letter code `class`. So for instance `PPP` means detected as pointlike in all three bands, `--P` means detected as pointlike in the hard band, `EE-` detected as extended in the ultrasoft and soft bands, etc. During this stage a temporary *reclassification flag* is computed. Mixed cases (like the customary `-EP` or `-PE` but also new combinations like e.g. `EEP` or `PPE`) are reclassified, so that *sources detected as extended in the B band are considered extended and sources detected as pointlike in the B band are considered pointlike*. Parameters (position, rates etc.) are taken from the individual band tables according to the reclassification.

Then the final (non astrometrically corrected coordinates) are taken from the "best band" (the one with the highest detection likelihood).

For multiple band detections parameter `maxdist` is the largest of the inter-band distances (A,B; A,CD; B,CD) between the chosen (band) coordinates. If `maxdist` is larger than $10''$ (our correlation radius), the source is flagged `suspect=1`. This occurs typically only for reclassified sources (only in such case for the original 2-band processing).

Because of the previous usage of the `suspect` flag, this can assume values 1 (excessive inter-band distance), 2 (ambiguous association) or 3 (both cases).

The `reclass` flag at the end also assumes values 0-3 but with the following meaning (only the former two cases were possible with 2 bands):

- 0 means bona fide extended or bona fide pointlike (not reclassified)
- 2 means reclassified as extended or reclassified as pointlike (this applies to the traditional cases `-EP`, extended, and `-PE`, pointlike, but now also to `EEP`, `PEE`, `PEP`, `PE-`, considered extended and `EP-`, `EPE`, `EPP`, `PPE`, considered pointlike)
- 1 means "funny cases" detected in the ultrasoft and hard band but not in the soft band with consistent classification `P-P` or `E-E` (this latter case is considered extended).
- 3 is for "funny cases" which are also incosistent, like `E-P`.

But for the specific changes due to the presence of 3 bands, this is the same procedure used for 2 bands. The

side effects of the presence of a third band are discussed in section 2.4.

2.3.1. Future changes

A version of the script `bandmerge3.csh` is ready. It will just be necessary to remove the artifact used to name a different output table (`test33`) and to revert to the old scheme where the input tables are named as the output table plus a band suffix (e.g. `north34`, `north34a`, `north34b`, etc.).

2.4. Merging results

Table `test33` contains 27388 sources instead of 26555 in `north33`. Of these 21726 aren't detected at all in band A, so should be identical to what contains in `north33`. Respectively 5500 pointlike and 162 extended sources are detected *also or exclusively* in band A. Actually those detected *only* in band A are just 167 `P--` and 74 `E--`.

Looking at the *best band* `bandid`, 18318 sources are soft (vs 18552 in `north33`), 7718 are hard (vs 7808) and just 1101 are ultrasoft (`bandid=1`. In addition there are 251 cases flagged `bandid=0` (vs 195) which are the famous NaN detection likelihood which should greatly reduce with XAMIN 3.4. They include 69 `--P` and 2 `-E-` present in `north33` with the corresponding classification (no ultrasoft counterpart). 66 ultrasoft-only `P--` are new, while the 108 `-P-`, 4 `PP-` and 2 `PPP` correspond to 121 `P-` and 3 `PP` in `north33`. The few discrepancies are due to possible ambiguities.

In fact one can attempt to match `test33` with `north33` on the common part of the *id* i.e. `ssshhh`. However this operation should not be done at the present stage, because `north33` has been already passed through the so called "divorce" procedure to solve ambiguities (described in the next section 2.5).

For instance in field `XXLn000-11a` one has cases `006010016` and `006010015`. The second one matches `north33 010015` but the first one fails to match the divorced `000016`.

On the other and in field `XXLn000-09a` one has three cases `002003003`, `003003003` and `003004003`. The latter matches `north3333 004003`, but both the former two match the divorced `003000`! This seems to indicate there will be cases needing a *divorce a trois*!

Anyhow for the 26424 cases where the north33 `id` matches the `ssshhh` portion of the `test33` id, the parameters for the common bands match. There can be differences in best band (and therefore in the chosen coordinates, max inter-band distance and spurious classification), but in principle the new procedure looks promising.

2.5. Post-merging steps

The traditional post-merging steps have been the following (Chiappetti , 2013):

− tentative resolution of ambiguous cases
− computation of position errors and fluxes
− generation of band-to-band correlation tables
− astrometric corrections

The latter two steps are trivial extensions and won't be discussed here in detail. The generation of position errors and fluxes depends on unknown parameters outside of my control as discussed in section 2.5.4.

2.5.1. Ambiguity resolution for 2 bands

For XAMIN 3.3 this was handled by three scripts `divorce-hard`, `divorce-soft` and `repoint-partner`. They dealt only with ambiguities flagged `suspect=2`.

In `north33` the `suspect=1` cases were limited to 2+4 reclassified `EP` and `PE` with `maxdist` in the range 10-14″ (and just 2+1 cases for `south33`), so these were left alone. No cases were flagged `suspect=3`.

The "divorce" procedure were introduced after the change of the band merging correlation radius from 6″ (which proved to be too small) to 10″. Essentially if there was an ambiguous couple with `ids ssshhh` and `ssskkk` with the same soft counterpart, and both `maxdist` were below 6″ or above 10″ the ambiguity was considered irrecoverable. On the other hand if one was below and the other one above, the closest couple was trusted, and the farthest one (say `ssskkk`) was "divorced" into a hard-only `bandid=3 000kkk`.

Similary for an ambiguous couple `ssshhh` and `rrrhhh` with the same hard counterpart, the farthest one of a 6″/10″ couple is "divorced" into a soft-only `bandid=2 rrr000`.

The "divorce" procedure keeps track of what has done resetting the `suspect` flag. A positive value contains the `seq` of the other source in an ambiguous couple. A negative value is used for divorced entries (it contains the `seq` of the former ambiguous correspondant *changed of sign*). For irrecoverable ambiguities a final script `repoint-partner` takes care of resetting `suspect` to `seq` for both elements of a couple.

Anyhow the number of ambiguities was rather limited (a total of 114 cases, i.e. 57 couples, of which 42 divorced for `north33`, 107 cases of which 40 divorced for `south33`).

2.5.2. Ambiguity resolution for 3 bands

The introduction of a third band causes an increase in the number of ambiguous associations. There are a total of 398 non-zero `suspect` in `test33`. Of these 155 are `suspect=1` (excessive `maxdist`), 188 are `suspect=2` (ambiguities with same counterpart in 1 or 2 bands), and 55 are `suspect=3`

(combination of both cases). This is less than 1.5% of the sources, still a limited number, but enough to constitute a nuisance.

The `suspect=1` can be further split this way:

- 130 cases flagged `suspect=1` and `reclass=0`. They are all PPP with `maxdist` between 10 and 16.9″. Most of them have the soft band as preferred band. Only 9 are ultrasoft and 4 hard. One could look at the (A,B), (A,CD) and (B,CD) distances and see which of them are below 6″, but there is a large variation of cases
- 24 cases flagged `suspect=1` and `reclass=2`, further divided as follows
-    1 with best band the hard band, classified PEP (extended), with distances (A,B)=7.8″, (B,CD)=4.8″ and (A,CD)=12.7″!
-    9 with best band the soft band, and reclassified extended. One is a -EP formerly present as such in `north33`. Two are PE- and the rest EEP or PEP with worse `maxdist` of 18″.
-    14 with best band the soft band, and reclassified pointlike. Two are "former" -PE, three EP- and the rest mostly EPP, rarely PPE. `maxdist` usually in physiological range up to 12-13″, at worse 15.6″, but for a pathological case with 26.8″!
- a single case is flagged `suspect=1` and `reclass=3`, it is the E-P mentioned above, `id=032000038` in XXLn999-05, with a `maxdist` of 61.7″ (sic!).

The two pathological cases however do not depend on the presence of band A. What happens for those is that some of the distances (typically the pointlike positions in different bands) are within the 10″ radius, but the pointlike-extended distance in one given band is excessively high (namely in this case 23.8″and 53″!).

This is something intrinsic to Xamin and not specific of the A band. In fact one can compute per band the average extended-pointike distance, the maximum one, and the number of cases where such distance is above 6 or 10″(in absolute number and as percentage of the total number of detections in the band). This is tabulated here:

Band	average	max	above 10″	above 6″
A	1.16″	57″	73 (1%)	180 (3%)
B	1.27″	110″	297 (1%)	590 (3%)
CD	1.56″	86″	278 (2%)	668 (5%)

One concludes that sometimes Xamin moves the extended position quite a lot from the pointlike one, but this is independent of the band. It wasalready present in the current `north33` for the B and CD bands. Will it be different for Xamin 3.4 ?

Anyhow, this recommends to leave the `suspect=1` alone, flagged, without "divorcing" them.

The situation for the `suspect=2` and `suspect=3` is more tricky.

- there are 5 `suspect=2` with `reclass=2`, 2 are "former" -EP reclassified extended. which could be handled by the old "hard divorce"; 3 are EPP reclassified pointlike, one couple and a single, but they all pair with another couple of `suspect=3`
- there are 183 `suspect=2` with `reclass=0` further divided in
-    48 cases not detected in the ultrasoft band. Most are couples which could be handled by the old divorce procedure, one is a triple which also could be handled by the old procedure, but one single -PP matches with a `suspect=3` EPP on the hard component.
-    41 cases are two-band non-hard detections (i.e. bands A and B). Most are couples for which one could mimic the 2-band divorce procedure adapting it to the ultrasoftand soft bands, but one single PP- matches with a `suspect=3` PPP on the ultrasoft component.
-    94 cases are PPP: many look plain couples (but how can one write a divorce procedure for 3 bands ?) but several are singles which match a `suspect=3` PPP
- there are 5 cases flagged `suspect=3` and `reclass=2`, all classified EPP, one single and two couples all paired with the `suspect=2` mentioned above
- there are 50 cases flagged `suspect=3` and `reclass=0`, all classified PPP, of which there are 8 couples with both elements `suspect=3`, while the other 34 are usually singles (in two cases a couple) paired with the `suspect=2` mentioned above

The rather clear indication is that whatever divorce procedure is applied, it should act jointly on the `suspect=2` and `suspect=3`.

One can hence provide an alternate classification as follows:

- 50 cases are "traditional 2-band" (-EE, -EP, -PP) cases which could be handled by the existing "soft" and "hard" divorce procedures (no ultrasoft band involved). 22 cases share the same soft counterpart (11 couples, 7 to be divorced), 28 share the same hard one (14 couples, 12 to be divorced)
- 41 cases are "modified 2-band" (PP-), of which 40 are couples involving the soft and ultrasoft band: 6 share the same soft counterpart (3 couples, 1 to be divorced); 34 share the same ultrasoft one (17 couples, 9 to be divorced). For these one could adapt the existing divorce scripts to the new bands.
- the residual 41st case has `id=001185000` and shall be treated in conjunction with the 3-band case `id=001176163` in same field XXLn001-02. The PP- has a `maxdist` of 2.6″ and is OK. The PPP shall be divorced into a soft/hard -PP.
- 152 cases are 3-band EPP and PPP. They can be combined together, giving rise to 178 combinations (taking only the 3-band) or 182 (if one allows also 2-band cases). The 4 cases in excess are the mentioned couple in XXLn001-02, and another one in XXLn000-22z,

made of an `EPP 110129091` and a `-PP 000130091`. In the latter case the appropriate action would be to split the `EPP` into an ultrasoft `PE-` and a `-PP`.

Considering the 178 combinations, they can be divorced both on the fact that one `maxdist` is below 6″ and the other one above, as well as on the fact one case is tagged `suspect=2` and the other one `suspect=3` (i.e. `maxdist` is in excess of 10″).

There are cases having the same hard component (6), the same ultrasoft component (10), the same ultrasoft and soft one (46), the same soft and hard (34) or the same ultrasoft and hard (82). One has to look at the three distances (A,B), (A,CD) and (B,CD).

One sees that there are 59 distinct pointings involved. In most cases each pointing has just one couple of merged sources. 27 of the "simple couples" are candidates for divorce, 7 are to be left alone as "classical" undecidible ambiguities (both `maxdist` are either above or below 6″). 6 couples have both cases with `suspect=3` i.e. `maxdist` above 10″ because two of the three distances are OK for merging, but the third one results in excess. These cases are also undecidible ambiguities.

There are pointings with apparent quadruples, but these are actually independent couples (10 to be divorced, 7 classical ambiguities, and 1 `suspect=3` undecidible ambiguity).

One is left with 5 pointings with more complex cases. In one (for field XXLn000-55z) there are two normal couples (one to be divorced, one `suspect=3` ambiguity) plus a more complex case.

All complex cases are worth to be described in some detail (I will call "detections" those in the individual bands, and mark them with the corresponding portion of the `id`, e.g. A=`uuu`, B=`sss`, CD=`hhh`; I will call "merged sources" the entries with an individual `seq`). Here are the cases:

– XXLn000-09a: A=2 A=3 B=3 B=4 CD=3 5 detections, 3 merged sources. `003004003` and `003003003` shall be retained (associated and ambiguous). The third one shall be divorced into a single ultrasoft.
– XXLn000-31a: A=89 A=90 B=153 B=168 CD=137, 5 detections, 4 merged sources. Two combinations `090168137` and `089153137` shall be retained. Since they exhaust all detections, the two remaining merged sources (all `suspect=3`) can be deleted as redundant.
– XXLn000-44b: A=138 B=138 B=139 CD=101 CD=102 5 detections, 3 merged sources. `138138102` definitely retained. `138139101` is only marginally acceptable (one `maxdist` just above 10″) but should be retained, despite being `suspect=3`. The third merged sources has the B,CD distance in severe excess of 10″, and can be deleted as redundant, as all detections are assigned.
– XXLn000-55z: A=3 B=4 B=10 CD=2 CD=3 5 detections, 4 merged sources. `003010003` and `003004002` can be retained. Since they exhaust all detections, the

two remaining merged sources (all `suspect=3`) can be deleted as redundant.
– XXLn999-09: A=29 B=36 B=37 CD=39 CD=40 5 detections, 3 merged sources. `029037040` shall be retained, another `suspect=3` combination shall be divorced into `000036038`, and the third case, also `suspect=3`, can be deleted as redundant.

In conclusion cases can be definitely solved by manual inspection and editing, but it looks not obvious to automatize the *entire* procedure in a set of scripts.

It is easy to handle the 2-band divorce (both for the old soft/hard case and the new ultrasoft/soft case). One divorces 12 hard, 6 hard/soft, 1 soft/ultrasoft and 8 ultrasoft cases. The only anomaly is that one had expected 7 hard/soft cases, but this is due to a "crossed triplet" in XXLn000-67z: `000133150` and `000132149` correctly remain, while `000133149` is divorced as `000000149` ... which is redundant with respect to the retained cases, and shall be deleted. This is not surprising and not due to the presence of the ultrasoft band: the same manual deletion was done already for `north33`!

Concerning the 3-band divorce procedure, one shall consider as candidate for divorce the cases where, in a couple sharing part of the `id`, one `maxdist` is below 6″ and one above, as well as when one is `suspect=2` and the other one `suspect=3` (this repeats and reinforces the previous condition with a threshold of 10″). The element with lower `maxdist` is considered the primary (undivorced), while the other one is candidate for divorce. One should consider in which bands the common detection is. So a case having a common ultrasoft and soft detection will result in the divorce of an hard-only source (etc.), a case having only ultrasoft detection will result in the divorced of a soft-hard source (etc.), plus all necessary adjustments to the various database columns.

Unfortunately the situation is slightly more complicated, for instances there are 63 couples candidates for divorce, but they correspond only to 54 distinct primaries. Or of a total of 182 3-band ambiguities, they cover 154 distinct sources. 54 are flagged primaries, 62 candidates for divorce, and 54 not obviously disposed of. Some 20 are recognised as unsplit, so one can inspect and spot the troublesome cases, which concentrate in 6 pointings, and predict a disposition for them. This foresees potential "orphans" to be ckeared manually.

After the procedure is run one finds 78 "normal ambiguities" (both `maxdist` above or below 6″) and 164 cases to be manually inspected. It is immediate to find that most are ordinary couples, so one is left only with 7 pointings with 19 cases. A thorough inspection shows that the choice is sometimes different from the one foreseen, but should be assumed as anyhow acceptable because all detections in individual band are preserved. Anomalies fall in three cases:

- in 4 cases the source receives an inusitate `class='---'`. These entries shall be deleted
- in 3 cases there is a redundant entry with less bands (e.g. `000139000` along with `000139101`). These too shall be deleted.
- as a result of deletions some sources point to a deleted entry and shall be relinked together (see partner repointing below).

The final step of the procedure shall be "partner repointing" for the intrinsically ambiguous cases (sources sharing the same countepart in 1 or 2 bands which have not been divorced because `maxdist` are both below $6''$, or both above $6''$; exceptionally above $10''$ if former `suspect=3`). A procedure "complementing" the divorced cases can be easily written. As a result of divorce and partner repointing one has that:

- `suspect` positive and greater than 1 points to the `seq` of a "repointed partner" or the secondary modified partner of a divorced couple.
- `suspect` negative flags the source as divorced, and points to the `seq` (changed of sign) of the original partner.

As a result one shall not have any source left with `suspect between 2 and 3`, nor can `suspect` point to a no longer existing (deleted) source. In practice one has to check, and manually repoint the very few exceptions (one cases concerning the mentioned "crossed triplet" in XXLn000-67z, 4 cases deriving from the effects of deletions after the 3-band divorces).

2.5.3. Final statistics

After the divorce procedure, the working copy of `test33` contains 27380 sources, to be compared with 26555 in `north33` (both figures include spurious cases).

Of these 26475 (corresponding to 26469 distinct `north33`) are definitely in common, i.e. a three-band `id` like `uuussshhh` or `000ssshhh` matches exactly a 2-band `id` like `ssshhh`

There are just 6 couples which generate a multiplicity 2 association. They are former `suspect=2` ambiguities with identifiers of the form `aaassshhh` and `bbbssshhh`, i.e. the same old `north33` source matches two different ultrasoft components. All but one couple are `maxdist> 6''`, 2 couples are `PP-`, the rest `PPP`. These few multiple associations are to be considered normal.

There are 86 cases of `north33` sources without a direct match on the 2-band identifier. In 50 cases there is however a match on the soft band identifier, and in the rest on the hard band identifier. Most cases are `suspect=1` (i.e. `maxdist` is above $10''$, because one of the AB, ACD, BCD distances is an "occasional result" of the match on the other two). The rest are divorced cases. Here are some examples:

- `sss`000 is now `uuusss`hhh (i.e. P- into PPP) like `028`000 is now 022`028`025 in XXLn998-07a. This occurs in the majority of soft cases.
- `ssshhh` is now `uuusss`kkk i.e. the ultrasoft compnent pulls in a different hard component, like `142`140 is now 130`142`141 in XXLn000-67b and another
- `039`030 divorced as 000`039`000 in XXLn094-03
- `129`091 divorced as 110`129`000 in XXLn000-22z
- 000`hhh` being now `uuusss`hhh (i.e. -P into PPP) occur in the majority of hard cases.
- two PP divorced into --P
- one PP now -PP with a different soft component after divorce 129`091` is now 000130`191` in XXLn000-22z
- one PP now PPP with a different soft component after divorce

All these cases are also perfectly understandable.

The cases of `test33` sources with no direct match in `north33` are 905. Of these 853 are just *new ultrasoft only* sources (779 `P--` and 74 `E--`).

The 52 cases remaining are those matching either on the soft identifier or on the hard one, all `suspect=1` or divorced, and correspond to the cases already mentioned.

So at the end everything is fine.

2.5.4. Future changes

For what concern *divorce* four scripts to manage the 2-band cases ("classical" B/CD and new A/B) are ready and tested (`divorce.a.sql`, `divorce.ab.sql`, `divorce.bcd.sql`, `divorce.cd.sql`) to replace the old scripts. In addition there is a cumulative script handling 3-band divorce as described just above (`divorce.a.trois.sql`), and a cumulative script handling the "repointing" of undivorced partners (`repoint-partner-3band.sql`) and replacing the old script, which also have been tested. As said above, some manual fixes will be anyhow needed after running them.

For what concern *position error and flux computation* this cannot be currently performed until somebody from the XAMIN developers supplies the following information:

- a verification that the tabulation of position errors vs count rate range reported in Table 4 of Chiappetti et al. (2013) is applicable to band A.
- the appropriate rate-flux Conversion Factors for band A, like the ones in Table 3 of Chiappetti et al. (2013).

The commands to create the band-to-band correlation tables are trivial, and similarly the changes to the `astrocorrect.awk` to apply astrometric correction to the band A table.

3. Conclusion

The usage of the ultrasoft band in 3-band merging is a viable procedure. The changes to the existing procedure

are manageable. The most difficult aspect to handle is the introduction of an increased, though still limited, number of ambiguous cases (because a match between two of the bands AB, ACD, BCD may fail on one on the three). Again this is manageable with a somewhat painful manual inspection and some very limited manual edit.

Currently there are two missing items to bring the procedure to an end, i.e. the official Conversion Factors from count rate to flux for the ultrasoft band, and the verification of the position error to rate tabulation.

It is not planned to release a 3-band catalogue based on Xamin 3.3, but this could be considered when the future 3.4 version data will be ingested.

References

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