**VAMDC Workshop – Vienna 16 – 18 February 2011**

Summary of proposed changes to the XSAMS Schema

1. Refer to “sources” by element rather than attribute.

e.g.

<SomeData>

<Value>0.</Value>

<SourceRef>Bref1</SourceRef>

<SourceRef>Bref2</SourceRef>

…

</SomeData>

instead of

<SomeData sourceRef=”Bref1”>

<Value>0.</Value>

</SomeData>

This apparently makes it easier to refer to more than one source than an xs:IDREFS attribute type would and is easier for users to loop over.

1. Xsams.xsd in the vamdc-working subversion branch now has a targetNamespace:

<http://xsams.svn.sourceforge.net/viewvc/xsams/branches/vamdc-working>

To make this work and play nicely with unqualified attributes, all the attribute definitions have to be converted into ordinary simpleTypes. e.g.

<xs:simpleType name="methodRefType">

<xs:restriction base="xs:IDREF">  
 <xs:pattern value="M.+"/>  
 </xs:restriction>  
</xs:simpleType>

instead of

<xs:attribute name="methodRef">

<xs:simpleType>  
 <xs:restriction base="xs:IDREF">  
 <xs:pattern value="M.+"/>  
 </xs:restriction>  
 </xs:simpleType>  
</xs:attribute>

1. DataType is now a choice between a <Value>, <Accuracy> pair or <FitParameters>, in order that an item of data which is to be calculated from a given function may be specified. For example, a particular quantity, *D*, might be calculated from a function

*D = F(x, y; a, b, c) = ax2 + bxy + cy2*,

in which *x, y* are the function *arguments* and *a, b, c* function *parameters*. The function itself may be defined within the existing <Function> element; the DataType definition of *D* then takes the form:

<D>

<FitParameters functionRef=”**Ffunc**”>

<FitArgument units=”…”>

<Name>**x**</Name>

<LowerLimit units=”…”>…</LowerLimit> <UpperLimit units=”…”>…</UpperLimit>

</FitArgument>

<FitArgument units=”…”>

<Name>**y**</Name>

<LowerLimit units=”…”>…</LowerLimit> <UpperLimit units=”…”>…</UpperLimit>

</FitArgument>

<FitParameter name=”**a**”>

<SourceRef>…</SourceRef>

<Value units=”…”>…</Value>

<Accuracy>…</Accuracy>

</FitParameter>

<FitParameter name=”**b**”>

<SourceRef>…</SourceRef>

<Value units=”…”>…</Value>

<Accuracy>…</Accuracy>

</FitParameter>

<FitParameter name=”**c**”>

<SourceRef>…</SourceRef>

<Value units=”…”>…</Value>

<Accuracy>…</Accuracy>

</FitParameter>

</FitParameters>

</D>

1. A <NamedDataType> has been introduced, which extends <DataType> by adding an attribute, name.
2. The <States> tag has been changed to <Species>, for the love of God.
3. AtomicIonType and MoleculeType now carry a mandatory attribute, speciesID, matching /X.+/ which can be referenced elsewhere in the XSAMS document with the speciesRef attribute.
4. MolecularChemicalSpecies now contains the optional element InChI and mandatory element InChIKey for identification.
5. MolecularChemicalSpecies now contains an element MoleculeStructure containing the CML elements cml:atomArray and cml:bondArray identifying the molecular structure (connectivity and/or equilibrium atom *(x,y,z)* coordinates) and labelling the atoms for reference when giving e.g. hyperfine coupling quantum numbers. The CML elements reside in their own namespace (<http://www.xml-cml.org/schema>) which should be declared if used.
6. Two more `cases’ have been introduced within the case-by-case formulation for molecular states: those for open-shell, non-linear triatomic molecules (nltos) and open-shell, linear polyatomic molecules (lpos). The attribute group has been added to some symmetry elements for which it is relevant. Full documentation of the case-by-case Schemata is at <http://xsams.svn.sourceforge.net/viewvc/xsams/branches/ucl-branch/docs/cbc-doc-0.2.1.pdf>
7. An Environments element, at the top level of the XSAMS tree, has been introduced to describe one or more conditions of temperature, pressure and composition for reference. For example,

<Environment envID="**Eair**">

<Temperature>  
 <Value units="**K**">**298.**</Value>  
 </Temperature>  
 <TotalPressure>  
 <Value units="**atm**">**1.**</Value>  
 </TotalPressure>  
 <Composition>  
 <Species name="**N2**">  
 <MoleFraction>  
 <Value units="**unitless**">**0.79**</Value>  
 </MoleFraction>  
 </Species>  
 <Species name="**O2**">  
 <MoleFraction>  
 <Value units="**unitless**">**0.21**</Value>  
 </MoleFraction>  
 </Species>  
 </Composition>  
</Environment>

The species may also be referred to by speciesRef (see above), and composition specified by PartialPressure, MoleFraction, or Concentration.

1. Line broadening is contained within the Broadenings element, and consists of one or more of
   1. StarkBroadening
   2. VanDerWaalsBroadening
   3. NaturalBroadening
   4. InstrumentBroadening

Each Broadening references an environment (through the envRef attribute) and contains one or more Lineshape elements. Lineshapes are identified through the name attribute and contain one or more LineshapeParameter (of type NamedDataType) also named by attribute. Examples:

<StarkBroadening envRef="**EHe**">

<Lineshape name="**Lorentzian**">

<LineshapeParameter name="**gammaL**">

<SourceRef>**BStarkB**</SourceRef>

<Value units=”**A**">**0.008**</Value>

<Accuracy>**0.001**</Accuracy>

</LineshapeParameter>

</Lineshape>

</StarkBroadening>

For the Lorentzian HWHM given as a function of pressure and temperature:

*g*air(*p*, *T*) = *g*airref(*p*ref, *T*ref).(*p*/*p*ref).(*T*ref/*T*)n\_air

<VanDerWaalsBroadening envRef="**Eair**">  
 <Lineshape name="**Lorentzian**">  
 <Comments>**The temperature-dependent pressure broadening**

**Lorentzian lineshape**</Comments>  
 <LineshapeParameter name="**gammaL**">  
 <FitParameters functionRef="**FgammaL**">  
 <FitArgument units="**K**">  
 <Name>**T**</Name>  
 <LowerLimit units="**K**">**240**</LowerLimit>  
 <UpperLimit units="**K**">**350**</UpperLimit>  
 </FitArgument>  
 <FitArgument units="**K**">  
 <Name>**p**</Name>  
 <LowerLimit units="**atm**">**0.**</LowerLimit>  
 <UpperLimit units="**atm**">**1.2**</UpperLimit>  
 </FitArgument>  
 <FitParameter name="**gammaL\_ref**">  
 <SourceRef>**B\_HIT-HF-g\_air-2**</SourceRef>  
 <Value units="**1/cm**">**0.105**</Value>  
 <Accuracy>**0.0021**</Accuracy>  
 </FitParameter>  
 <FitParameter name="**n**">  
 <SourceRef>**B\_HIT-HF-n\_air-0**</SourceRef>  
 <Value units="unitless">**0.55**</Value>  
 <Accuracy>None</Accuracy>  
 </FitParameter>  
 </FitParameters>  
 </LineshapeParameter>  
 </Lineshape>  
</VanDerWaalsBroadening>

1. Basic types, VectorType and MatrixType have been introduced to represent Cartesian vectors and general matrices. e.g.

<Vector ref=”**…**” x3=”**0.**” y3=”**1.**” z3=”**-2.**”/>

<SomeMatrix units=”**…**” nrows=”**n**” ncols=”**n”** form=”**symmetric**”

values=”**real**”>

<RowRefs>**row\_1 row\_2 row\_3 … row\_n**</RowRefs>

<ColRefs>**col\_1 col\_2 col\_3 …col\_n**</ColRefs>

<Matrix>**0. 0. 1. -4. 2. … -3. 0.**</Matrix>

</SomeMatrix>

values can be real, imaginary or complex. form identifies the type of matrix (symmetric, skew-symmetric, diagonal, etc.) and hence the number of (whitespace-delimited) values it is necessary to give within the <Matrix> tag (e.g. *n*(*n*+1)/2, *n*, *n*2, etc.)

1. Basic types DataListType and LinearSequenceType represent simple lists of numerical data:

<DataList n=”**100**” units=”**Mb**”>**0. 0.13 0.12 0.08 …**

**1.20**</DataList>

<LinearSequenceType n=”**101**” a0=”**500.**” a1=”**0.1**”/>

The latter example represents the sequence (arithmetic progression):

500. 500.1 500.2 … 510.0

1. A DataSeriesType contains one of DataList, LinearSequence, or the name of an external file (containing the whitespace-delimited data in text format) along with either an ErrorList (giving accuracies for each data point) or a single Error (if the same accuracy applies to every data point).
2. A SimpleDataTableType contains one or more DataSeriesTypes called X and one or more DataSeriesTypes called Y.
3. An element, CrossSection, has been added to RadiativeType. It is an extension of SimpleDataTableType, with additional attributes to refer to species (speciesRef) and environment (envRef), and assigns vibrational bands through a BandAssignment element. E.g

<CrossSection id="azulene-paxs">  
 <SourceRef>**B\_TCSD1**</SourceRef>  
 <SpeciesRef>**X-CUFNKYGDVFVPHO-UHFFFAOYAT**</SpeciesRef>  
 <Description>Photoabsorption cross section of

azulene</Description>  
 <X parameter="**photon energy**" units="**eV**" id="**D-eV-series1**">  
 <LinearSequence n="**601**" units="**eV**" a0="**0.**" a1="**0.05**"/>  
 </X>  
 <Y parameter="**sigma**" units="**Mb**">  
 <DataList n="**601**" units="**Mb**">

**0 -1.3588884e-05 0.00029940086 0.0018259565 …84.611003**  
 </DataList>  
 <Error>**1.e-7**</Error>  
 </Y>

</CrossSection>

1. One or more BandAssignment elements identify broad features in the spectrum by their central position and width, and gives assignments by reference to the normal modes listed in MolecularChemicalSpecies. e.g.

<CrossSection>

... [Cross section data] ...

<BandAssignment name="**2v1+v2**">  
 <BandCentre>  
 <Value units="**1/cm**">**410**</Value>  
 <Accuracy>**2**</Accuracy>  
 </BandCentre>  
 <BandWidth>  
 <Value units="**1/cm**">**40**</Value>  
 <Accuracy>**5**</Accuracy>  
 </BandWidth>  
 <Modes>  
 <DeltaV modeID="**v1**">**2**</DeltaV>  
 <DeltaV modeID="**v2**">**1**</DeltaV>  
 </Modes>  
 </BandAssignment>

</CrossSection>

1. NormalModes resides within MolecularChemicalSpecies and lists the molecule’s normal mode frequencies, intensities, and displacement vectors. e.g.

<NormalModes electronicStateRef="**SX\_Azulene-1**">  
 <NormalMode id="**v1**" pointGroupSymmetry="**A1**">  
 <HarmonicFrequency>  
 <Value units="**1/cm**">**162**</Value>  
 <Accuracy>**1**</Accuracy>  
 </HarmonicFrequency>  
 <Intensity>  
 <Value units="**km/mol**">**0**</Value>  
 </Intensity>  
 <DisplacementVectors units="Å">  
 <Vector ref="**C1**" x3="**0.**" y3="**0.001**" z3="**0.0005**"/>  
 <Vector ref="**C2**" x3="**0.01**" y3="**-0.001**" z3="**0.0005**"/>  
 <Vector ref="**C3**" x3="**-0.005**" y3="**0.001**" z3="**0.**"/>  
 <!-- etc... -->  
 </DisplacementVectors>  
 </NormalMode>

</NormalModes>

1. The AnharmonicityTensor element, within MolecularChemicalSpecies is a MatrixType giving the anharmonicity tensor for the molecule. e.g.

<AnharmonicityTensor units="**1/cm**" nrows="**48**" ncols="**48**"

form="**symmetric**" values="**real**">

<RowRefs>**v1 v2 v3 ... v48**</RowRefs>  
 <ColRefs>**v1 v2 v3 ... v48**</ColRefs>  
 <Matrix>  
 **10.43 2.45 -4.01 0.49 -78.9 ... 12.4** </Matrix>  
</AnharmonicityTensor>

1. The PartitionFunctionType defines tables of temperature-dependent partition functions for atoms and molecules. The PartitionFunction element may be used within MolcularChemicalSpecies. e.g.

<PartitionFunction>  
 <T parameter="Temperature" units="K">  
 <DataList n="**15**" units="**K**">**100. .. 1500.**</DataList>  
 </T>  
 <Q parameter="Partition Function" units="unitless">  
 <DataList n="**15**" units="unitless">**56.432 154.342 ...**

**3445.321**</DataList>  
 </Q>  
</PartitionFunction>

1. MolecularState also has a StateExpansion element to give the coefficients of a linear expansion in terms of some basis. e.g.

<StateExpansion>  
 <Coeff stateRef="**Sbb1**">**0.7071**</Coeff>  
 <Coeff stateRef="**Sbb2**">**0.7071**</Coeff>  
</StateExpansion>

The basis itself is a list of MolecularState elements within Molecule. e.g.

<BasisStates>  
 <MolecularState stateID="**Sbb1**">  
 <dcs:QNs>  
 <dcs:v>**0**</dcs:v>  
 <dcs:J>**3**</dcs:J>

...  
 </dcs:QNs>  
 </MolecularState>  
 <MolecularState stateID="**Sbb2**">  
 <dcs:QNs>  
 <dcs:v>**0**</dcs:v>  
 <dcs:J>**4**</dcs:J>

...  
 </dcs:QNs>  
 </MolecularState>  
 </BasisStates>