Overview of current VO spectral applications in AstroGrid

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Overview

• AstroGrid workbench and the VO
  • PLASTIC tool interoperability

• Current Spectral Applications
  • New: VOspect
  • Wrapped: SPLAT-VO

• Future Capabilities
  • YAfit fitting tool
  • The need for Euro-VO DCA – see Mark Allen poster for overview
  • Your input please! – DCA WP3 (ESAC + Leicester)
AstroGrid workbench and the VO

- AstroGrid workbench
  - [http://www.astrogrid.org](http://www.astrogrid.org)
  - UK VO project since 2001
  - Work closely with Euro-VO partners in VOTech, DCA projects

- PLASTIC tool interoperability
  - Data discovery, access, manipulation
  - Pass data seamlessly between any VO enabled tools

- New VO specific spectral tools such as VOspec, YAfit fitting tools...

- Wrap existing tools: VO enable, e.g.
  - Aladin, Gaia for image analysis
  - TopCat for catalogues, cross matching
  - SPLAT-VO for spectra
AstroGrid workbench and the VO
AstroGrid workbench and the VO

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AstroGrid workbench and the VO
SPLAT-VO: a VO enabled Spectral Analysis Tool

• Graphical tool
• Direct SSAP queries to VO or receive from VO via PLASTIC
• Display, compare, modify and analyse spectra
• Read in, display & match multiple spectra in multiple formats
  • NDF, FITS, TEXT, NDX…

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SPLAT-VO: Transforms

• Spectral coordinate transforms between multiple input spectra as described in FITS WCS Paper III (Greisan+)
  • Wavelength
  • Frequency
  • Energy
  • Velocity

• Data value unit conversion as per FITS WCS Paper I (Greisan+)

• Flux conversion per unit frequency to/from per unit wavelength

• Convert between standards of rest
  • Topocentric, heliocentric, dynamic & kinematic local
SPLAT-VO: Query VO

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SPLAT-VO: Spectral Analysis

• Fit polynomial to selected parts of spectrum
• Simple mathematical operations between spectra
• Gaussian, Lorentzian and Voigt profile line fits
• Filter spectra, line shape window functions
• Wavelet denoising
• Database of laboratory line lists for identification
SPLAT-VO: Spectral Analysis

SEE DEMO
SPLAT-VO: TODO

• Current limitations
  • Query only with basic set of parameters – position & radius
  • Returned spectra may only be simple FITS or VOTables

• Future capabilities
  • Flux conversion to include magnitude and antenna temperature
  • Require additional metadata to fully describe inter-system transformations
  • Ongoing IVOA standard data model development required
YAFIT – Spectral Best Fitting Tool

• [http://www.star.bris.ac.uk/~mbt/yafit](http://www.star.bris.ac.uk/~mbt/yafit) - test version only, feedback welcome
• **Author Mark Taylor (Euro VO Tech, Bristol)**

• Requirements Overview
  • Best Fitting Tool is a task developed for Euro-VOTech project
  • What it has to do:
    • Fit observed SEDs to library of calculated model spectra
    • Observed SEDs are (so far) sets of photometry points
    • Output is (at least) identification of the model which fits obsns best
  • Calculations are quite straightforward
    • $\chi^2$ fitting
  • I/O and user interface are more involved
    • Input observed and model data come in many formats
YAFIT – Spectral Best Fitting Tool

One or more photometric spectra

Fit photo spectrum against each model

Array of model spectra

Select lowest \( \chi^2 \)

Best model fit to observation

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YAFIT – Input Data

1. An array of pre-calculated model spectra
   • Probably generated by some specialist code
   • Each model spectrum is flux as a function of spectral variable
     (various units on both axes)
   • Many variations of format (ASCII, VOTable, Galaxev, Starburst99, SVO, Pegase, . . .)

2. One or more observed set of photometric points
   • Each dataset contains a set of photometric observations
   • Each photometric observation (point) has:
     • Spectral axis value X: may be wavelength, frequency, various units
     • Spectral axis envelope X: spectral range corresponding to filter
       — model as spike, box, Gaussian, bandpass function, . . .
     • Flux axis value Y: may be flux in Jansky, other or magnitude scale
     • Flux axis error Y: lower and upper errors may be same or different

3. Dataset may have an associated redshift value

4. Many variations of format (ASCII tables, VOTables, SED DM serializations, . . .)
   (items greyed out are not currently implemented)
YAFIT – Output

Interactive display
- Graphics display
  - Observation points
  - Best fit model
  - Optionally other models
- Table display
  - Observation metadata
  - Model metadata
  - Fit statistics

Output table linking input observations with best fit models

<table>
<thead>
<tr>
<th>Input Metadata</th>
<th>Input Observations</th>
<th>Best Model</th>
<th>Fit Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA DEC</td>
<td>J Kerr</td>
<td>Model ID</td>
<td>Score</td>
</tr>
<tr>
<td>119.608 21.410</td>
<td>11.94 0.022 12.16 0.024</td>
<td>m05</td>
<td>0.05E8</td>
</tr>
<tr>
<td>53.094 -27.839</td>
<td>12.33 0.022 12.34 0.026</td>
<td>m29</td>
<td>2.15E9</td>
</tr>
<tr>
<td>213.870 -46.515</td>
<td>17.32 0.106 17.57 0.192</td>
<td>m13</td>
<td>1.20E8</td>
</tr>
<tr>
<td>204.143 -29.089</td>
<td>15.93 0.041 16.29 0.071</td>
<td>m44</td>
<td>3.40E9</td>
</tr>
</tbody>
</table>
YAFIT – Other Capabilities

Standalone observation viewer (**plotobs** command)

Standalone model viewer (**plotmodels** command)

Powerful expression language for unit conversions etc.
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