VIRTUAL ASTRONOMICAL OBSERVATORY

VAO SIAv2 Prototype

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The VAO is operated by the VAO, LLC.

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Motivation

- Heidelberg
  - Call for creation of prototypes various approaches to cube data access
  - Data Providers: First show discovery and downloading of whole datasets
  - VAO response
    - Discovery and static download first priority
    - Sub-cube access (e.g. cutouts): as time allows
- VAO Project Goals
  - Demonstrate to the IVOA what an SIAv2 service would look like
    - Ability to see under the hood as well.
  - Exercise key science use cases to assess the standards
    - Provide feedback that can constructively inform further development of the standards
    - Focused selection of data based on coverage

The VAO approach to SIAv2

- See IVOA Twiki page: SIA2VAOPrototype
  http://wiki.ivoa.net/twiki/bin/view/IVOA/SIA2VAOPrototype
- Development “phases”
  - Initial Planning and setting scope (white paper)
    - Priority: discovery and static download
  - Updating the relevant documents: ImageDM and SIAv2
  - Implementation based on DALServer toolkit
  - Testing and evaluation of deployed prototype

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- Development “phases”
  - Initial Planning and setting scope (white paper)
  - Updating the relevant documents: ImageDM and SIAv2
    “Froze” documents to *baseline* version:
    - Key for testing/evaluation: what are we testing against?
    - Used a change control process to allow only critical changes
    - IVOA versions continue to evolve; thus, baseline is a minor fork.
      - SIAv2: VAO-SIA-2.0-20130830.pdf
  - Implementation based on DALServer toolkit
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  - Initial Planning and setting scope (white paper)
  - Updating the relevant documents: ImageDM and SIAv2
  - Implementation based on DALServer toolkit
    - DALServer: a Java-based toolkit developed by NVO/VAO
    - Collected wide variety of 2-D and N-D images
      - ALMA, VLA, JVLA, Heracles, OSIRIS (Keck), Califa, JCMT, JWST, CARMA
      - Traditional 2D images, 3D radio cubes, moment maps, sparse images, intergral optical spectrograph
      - Extracted/transformed FITS metadata, loaded into a database
        - Noted where we needed to "make things up" (mainly identifiers)
    - Deployed to server at NRAO
  - Testing and evaluation of deployed prototype

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  - Initial Planning and setting scope (white paper)
  - Updating the relevant documents: ImageDM and SIAv2
  - Implementation based on DALServer toolkit
  - Testing and evaluation of deployed prototype
    - Developed a set of Test Queries based on spec documents
      - Independent of implementation
      - Science-driven, focused on coverage: spatial, spectral, temporal, & polarization
    - Assembled Test Plan that included tests of compliance against our baseline documents
    - Tested for building and deployment on Linux/Apache/MySQL/Tomcat platforms

VAO Implementation

- Based on VAO baselines of ImageDM and SIAv2 documents
- Further limits on scope:
  - Synchronous version of service (**`/sync`**)
  - Focus is on **`REQUEST=queryData`**
  - Assume **`INSTERSECT=OVERLAPS`** (default)
  - Assume **`MODE=archival`**; i.e. return static images
- Supported Input parameters
  - Required parameters: **`POS`**, **`SIZE`**, **`BAND`**, **`TIME`**, **`POL`**, **`FORMAT`**
  - Some additional optional parameters support, but not tested
- Output columns:
  - Required and recommended columns supported
  - Note use of VOTable GROUPs to associate related columns

Results

- Deployed prototype service with base URL:
  http://vaosa-vm1.aoc.nrao.edu/ivoa-dal/siapv2/
- Report on IVOA TWiki page: SIA2VAOPrototype
  http://wiki.ivoa.net/twiki/bin/view/IVOA/SIA2VAOPrototype
  - Includes clickable test queries
- Source code available:
  - Browse on-line:
    http://dev.usvao.org/vao/browser/vao/prototype/dalserver/branches/siav2aproto
  - Download:
    http://dev.usvao.org/siav2/dalserver-siav2proto.1.tar.gz
  - "Friendly IVOAers" can build and deploy on own platform
    - Requires Apache, Java, Tomcat, MySQL, Python
    - See prototype/README

Feedback to standards development

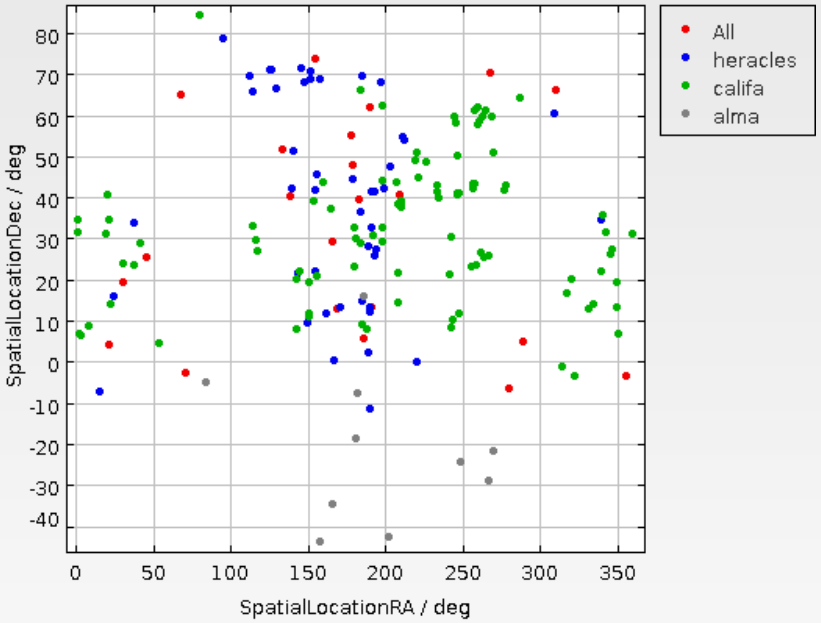
- General Assessments:
  - Successful demonstration of a service in the mode of SSA
  - Simple queries are compact, readable, and easily editable directly
  - Much improved metadata returned over SIAv1:
    - Can readily see what axes are found and in what order
    - Description of coverage is independent of the axes
      - E.g. Can see spectral coverage even if image does not formally have a spectral access
      - Does not depend on axis order, direction
    - Can determine what pixels measure (unit and UCD)
    - Can determine if dataset contains multiple image HDUs (Dataset.Image.Nsubarrays)
      - Browsing HDU metadata via Dataset.Image.Dataref not demonstrated
  - Flexible to complex, leading-edge N-D datasets
    - Proof of concept: study: applicable to x-ray event list

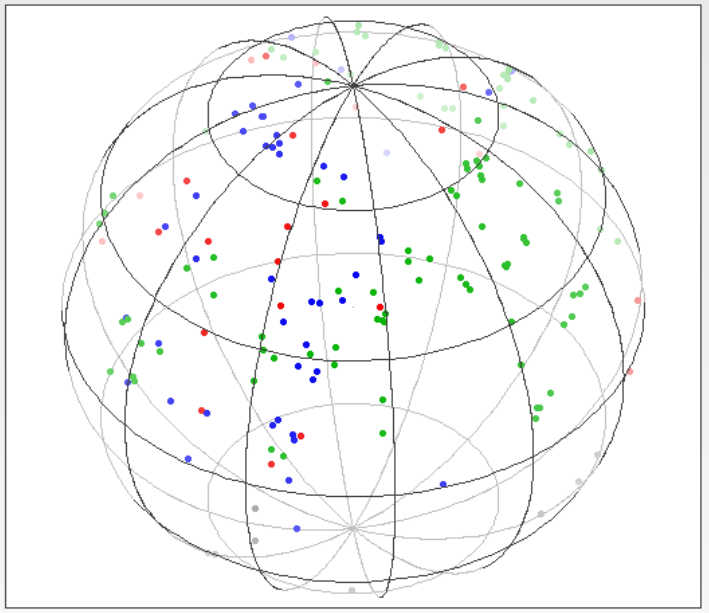
Feedback to standards development

- Various minor issues
  - Alternate Spectral coverage information (freq., energy, velocity) is useful to know
  - Make returning of Char.SpatialAxis.Coverage.Support.Area as “recommended”
    - STC-S description of spatial coverage
    - ImageDM needs clarification of UType definition
  - Metadata do not adequately identify compressed images
  - Consider search constraint on spectral line species
  - Make returning of Char.FluxAxis.Unit as “recommended”
  - Consider search constraint that tests pixel content
    - Against Char.FluxAxis.UCD? Char.FluxAxis.Unit?
    - Is SUBTYPE relevant?
    - Important for theory data: find theoretical optical depth images

Feedback to standards development

Distribution of test data collection





Returning spatial positions

- Current spec calls for positions to be an RA-Dec pair of numbers in single column
  - Image spatial center, lower & upper limits
- Cannot be interpreted by common tools
  - Requires tool understand DM to “know” pair is a position
- Better to render RA/Dec in separate columns
  - Need UTypes defined to identify components of position
  - Use GROUPs to associate RA and Dec components

Feedback to standards development

Handling unknown data in queries (NULLs)

- Consider query requesting data for time domain analysis: **/sync?REQUEST=querydata&TIME=1992-01-01/1997-01-01**
  - Current spec: if metadata for constraint is not known, the image should be returned in results
    - Thus, result contains (many) images that may not actually be within time range
    - Prototype: 4 images known to be in range, 290 returned
  - Rationale: don't let client miss potentially useful images
    - let client further filter on the client side
    - However, if time coverage is not known, client will be not be able to determine applicability post-query either
- Possible Solution
  - Extra parameter that provides a switch controlling whether to return images where information is unknown
  - Consider carefully what default behavior should be

SIAv2 in context of Cube Access

- What distinguishes SIAv2 from SIAv1
  - Full coverage querying; not just by position
  - Richer optional parameters that help refine queries:
    - Identifiers: Isolating specific images, collections, of source derivation
    - Processing levels, targets, sensitivity
  - Metadata model that is better suited to browsing N-d cubes
  - Sub-cube access (cutouts, subsetting, reprojections, …)
    - Client-directed “cutouts” separated explicitly from the discovery
    - Client uses the data returned in the discovery response to craft inputs into AccessData query
    - Allows for requesting richer transformations
  - Staging data on the server
    - Not currently specified

SIAv2 in context of Cube Access

- Potential for take-up
  - By clients
    - Parameter approach demonstrated to be convenient for human and agent clients alike
      - See PyVO Focus Demo
    - Small set of core discovery parameters
    - Common queries are compact, readable, editable
  - By data providers
    - SIAv1 has demonstrated large take-up
    - Small set of core metadata:
      - 6 required, others “strongly recommended” depending on the coverage of the data.
    - Aided if our approach is to adapt onto the metadata already maintained by data provider
      - As opposed to in effect requiring separately maintained database tables.