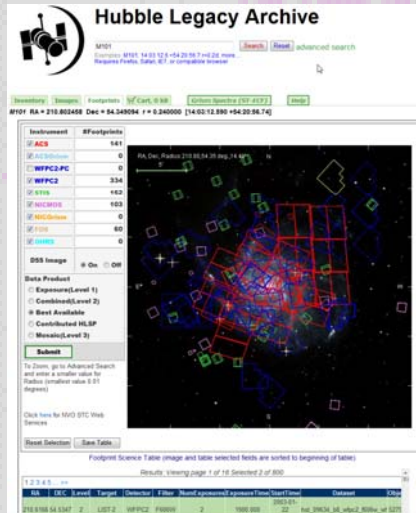


# HLA Footprints for Multipurpose Science

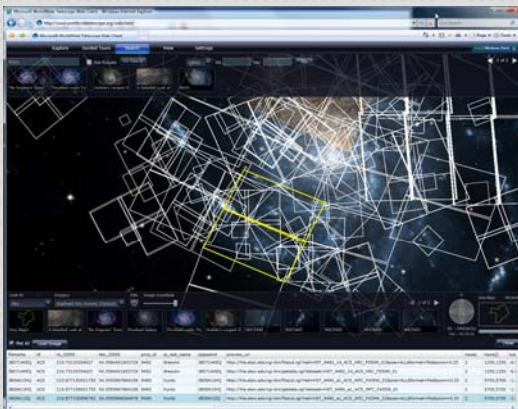
Gretchen Greene, Stephen Lubow, Tom Donaldson, and Kim Gillies (Space Telescope Science Institute)  
Tamas Budavari and Alex Szalay (Johns Hopkins University [JHU])



## Archive Footprints

- Sky Region Outlines of observation apertures or combined coverage
- Image background with multi-color Digitized Sky Survey (DSS 2)
- Displays HIERARCHY of science observation products:
  - Exposures
  - Combined Sequential Exposures
  - Mosaics **\*NEW for ACS\***
  - High Level Science Products
- Table of exposure/product science properties (a.k.a. metadata)
- IVOA standard DAL service with Space Time Coordinate footprints
- ys

## World Wide Telescope with HLA Footprints

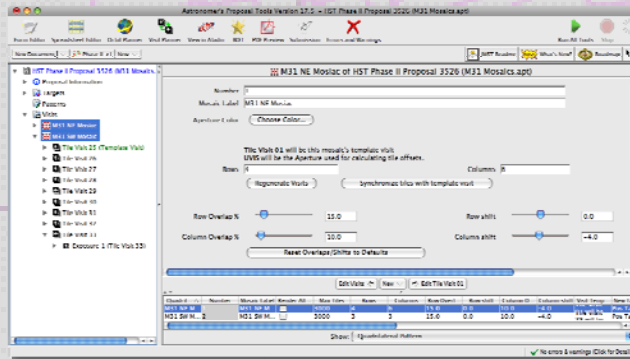


Aladin Search Results provide Graphical Visualization of HLA Observed Footprints overlay with Planned Observation Footprints

## ABSTRACT

Footprints from the science observations of the Hubble Space Telescope are defined by a set of hierarchical geometric regions of instrument coverage; exposures, combined observations, high level science products, and mosaics. In the growing global community of networked applications, the science end-user has several use cases for visualizing and accessing footprint data including scientific proposal preparation, research and analysis of generated science products, and interoperability between archives for correlation of coverage. The Hubble Legacy Archive (HLA) at Space Telescope Science Institute, in coordination with ESO-ECF and CAD, has developed a web based science user interface built on a VO service oriented architecture system to enable varying levels of astronomical community access to science products derived from the HST archive. In this ADASS poster paper we describe new features and technologies for the HLA footprint component web browser visualization tool and the underlying footprint services utilized by the HST Astronomers Proposal Tool (APT) in compliance with an IVOA standard data access protocol. The service infrastructure is based on a high performance spherical geometric model developed by Johns Hopkins University (JHU) and database search algorithms co-developed by STScI and JHU.

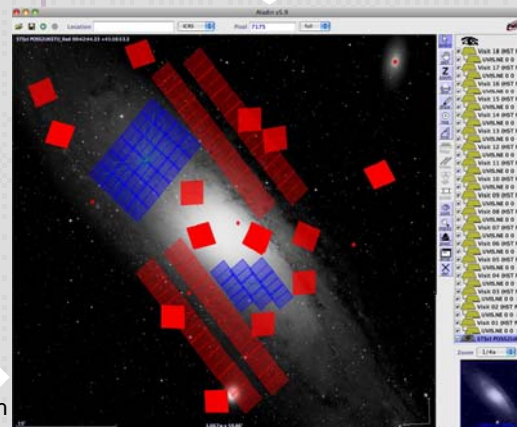
## Proposal Planning Observation Footprints



APT interfaces to VO Standard SIA services Accessed through Aladin contain HLA Footprint STC descriptions



HLA Observed Footprints Help Astronomers Plan where to place New Observation apertures

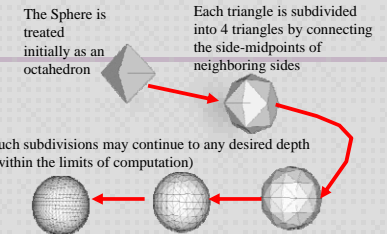


## Uses JHU Spherical Geometric and HTM Library

- A mathematically accurate library for performing geometric operations on defined region celestial areas
- Compute Region Bounding Circles and Region convexes for instrument apertures with HTM index
- Region operations with C# assembly
- SQL Server Database + .NET
  - Query Optimizer Index built on HTMID
- HTM Search Functions

## Hierarchical Triangular Mesh (HTM)

- Nearest neighbor
  - Bounding Circles
  - Range Query
- Tessellation of the sphere in triangles allowing spatial indexing by location on the sphere.



## Advanced Concepts

- Using archive footprints, compute the groups of intersecting exposures for mosaics
- Algorithm: friends-of-friends
- Area computations



- Region intersections between archives:
  - Search for centers within polygon region
  - Unions, Intersections and Areas combined with standard VO STC RegionTypes

## References

- Gray, J., Szalay, A.S., Thakar, A.R., Fekete, G., O'Mullane, W., Nieto-Santesteban, M.A., Heber, G., & Rots, A.-H. 2004, There Goes the Neighborhood: Relational Algebra for Spatial Data Search, ArXiv Computer Science e-prints, arXiv:cs/0408031
- Szalay, A.S., Gray, J., Fekete, G., Kunszt, P.-Z., Kukol, P., & Thakar, A. 2007, Indexing the Sphere with the Hierarchical Triangular Mesh, ArXiv Computer Science e-prints, arXiv:cs/0701164