

## **The NASA Navigator Program Ground Based Archives at the Michelson Science Center: Supporting the Search for Habitable Planets**

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### **Abstract.**

At ADASS XIV, we described how the W. M. Keck Observatory Archive (KOA) re-uses and extends the component based architecture of the NASA/IPAC Infrared Science Archive (IRSA) to ingest and serve level 0 observations made with HIRES, the High Resolution Echelle Spectrometer. Since August 18, the KOA has ingested 325 GB of data from 135 nights of observations. The architecture exploits a service layer between the mass storage layer and the user interface. This service layer consists of standalone utilities called through a simple executive that perform generic query and retrieval functions, such as query generation, database table sub-setting, and return page generation etc. It has been extended to implement proprietary access to data through deployment of query management middleware developed for the National Virtual Observatory. The MSC archives have recently extended this design to query and retrieve complex data sets describing the properties of potential target stars for the Terrestrial Planet Finder (TPF) missions. The archives can now support knowledge based retrieval, as well as data retrieval. This paper describes how extensions to the IRSA architecture, which is applicable across all wavelengths and astronomical datatypes, supports the design and development of the MSC NP archives at modest cost.

## 1. Goals of the Michelson Science Center (MSC) Navigator Program (NP) Archive

The Michelson Science Center (MSC)<sup>1</sup> is charged with providing the long-term data archiving capabilities for the National Aeronautics and Space Administration (NASA) Navigator Program (NP), whose goal is to detect and characterize planets like Earth around stars other than the Sun and to understand the formation and history of planetary systems in our galaxy. The charter of the archive is to

- Curate and serve data from all NP facilities
- Provide access to data in support of NP missions
- Support science analysis and observation planning, and
- Provide capabilities and tools for accessing data from NP missions for use by the astronomical community.

## 2. Datasets in the MSC NP Archive

The MSC NP Archive will curate and serve the following datasets:

- Level 0 observations made with W. M. Keck Observatory Single Aperture High Resolution Echelle Spectrograph (HIRES)
- Data in support of NP missions: the Space Interferometry Mission (SIM) Preparatory Data (astrometric grid and guide stars) and the Terrestrial Planet Finder (TPF) Preparatory Science Data
- Data from NP supported Interferometers: the Large Binocular Telescope Interferometer (LBTI), the Keck Interferometer (KI), the Palomar Testbed Interferometer (PTI) and the Space Interferometry Mission (SIM)

These datasets will be archived and served through re-use and extension of the architecture used by the NASA Infrared Processing and Analysis Center (IPAC) Infrared Science Archive (IRSA)<sup>2</sup>. In this paper, we discuss progress on this goal with reference to the following data sets: Keck HIRES data, the SIM Grid Stars, TPF Preparatory Science data and the LBTI data. The Keck Interferometry data are served currently through a dedicated interface, and migration to a common architecture with the other data sets is in the planning phases.

## 3. The Architecture of the NASA IPAC Infrared Science Archive

IRSA employs a highly extensible and reusable component-based architecture called the *Infrared Science Information System (ISIS)*. Web services are built by plugging together libraries and stand-alone service-layer components. Each of these components has a standard interface that communicates with other components via an executive library and generally fulfills one general function; new modules are added as needed to satisfy the requirements of new data sets.

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<sup>1</sup><http://msc.caltech.edu>

<sup>2</sup><http://irsa.ipac.caltech.edu>

The architecture is optimized for astronomical spatial searches and complex, general queries. Despite its name, ISIS is unrestricted by wavelength and type of mission, whether survey or observatory (pointed). It currently supports access to data from the Two Micron All-Sky Survey (2MASS), the Infrared Astronomical Satellite (IRAS), the Midcourse Space Experiment (MSX), Submillimeter Wave Astronomical Satellite (SWAS), the Infrared Space Observatory (ISO), the Infrared Telescope in Space (IRTS), the Spitzer Space Telescope, and the Hubble Treasury program *COSMOS*. ISIS is interoperable with remote datasets and is VO-compliant, and offers two main benefits to the deployment of new archives:

- It controls maintenance costs
- It enables rapid deployment of new user applications, including web-based interactive interfaces, and HTTP and VO-compliant program interfaces.

#### 4. Application of ISIS to the MSC NP Archive

##### 4.1. The StARS Project

StARS (Stellar Archive and Retrieval System) is a program to compile as much information as possible on potential TPF and SIM targets, specifically photometry, spectroscopy, variability, metallicity, distances, and ages of nearby Main Sequence stars. Its main goal is to support choosing the best potential TPF and SIM targets, and is a collaborative effort between the StARS team, IRSA and MSC. Users query StARS through a web interface that sits atop the ISIS architecture, through which users issue queries on position and parameters. This interface is built dynamically from configuration files that specify stellar parameters; updates to these parameters then enable the interface to be rebuilt with no programming. Figure 1 illustrates this architecture.

##### 4.2. The SIM Grid Stars

SIM requires an astrometrically stable set of stars. A total of approximately 8000 K giant stars have been selected as candidates, now undergoing radial velocity screening. The dataset includes photometry, positions, proper motion, extinction, distances, metallicities, and spectroscopy.

The user interface is an extension of IRSA's general catalog query interface, and written as a thin front-end that accepts input and prepares the query for submission to ISIS. The catalog data have been ingested, and the spectral data are scheduled to be delivered in October 2005.

##### 4.3. The Keck Observatory Archive and the Large Binocular Telescope

The design of the W. M. Keck Observatory Archive (KOA) has been described in Berriman et al. (2005) and will not be described in detail here. ISIS has been extended to support dynamic ingestion of data and metadata delivered from the telescope to the archive at MSC, user authentication, proprietary data access policies, and matching calibration files with science files. The LBTI is under construction at the University of Arizona, and it will deliver the data to MSC for curation. Data transfer and ingestion into the archive follow the same

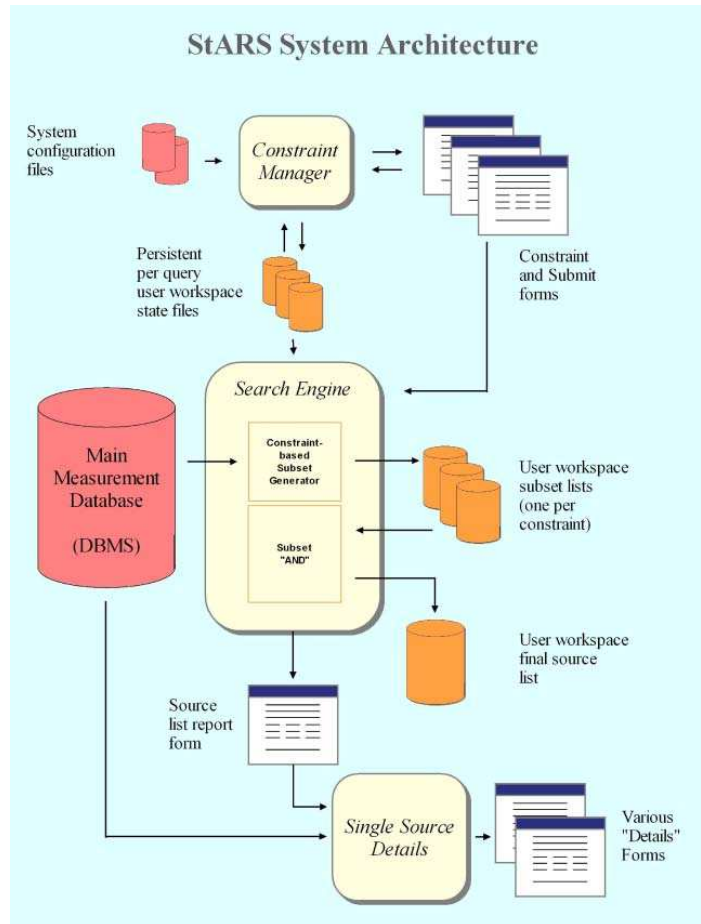


Figure 1. The Architecture of the Stellar Archive and Retrieval System.

model as KOA, and therefore the LBTI Archive will re-use the KOA transfer and ingestion architecture.

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## References

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