New Infrastructure to Support TDA and MMA at the Keck Observatory and the Keck Observatory Archive

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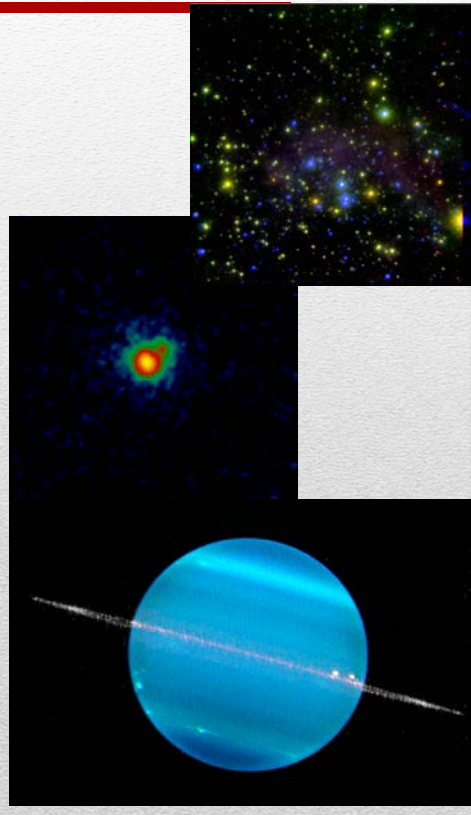
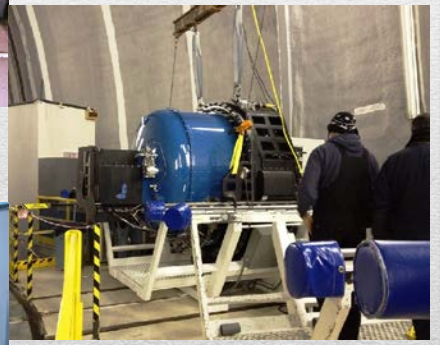
The Observer Owns The Night

- The “Keck Advantage” has produced wonderful science but has its consequences:
  - Difficult for others to analyze and reduce data.
  - Inefficiencies in observing.



Data Not Intended for Archiving

- Keck began operations in 1994, just before the age of modern archives.
- Instruments built independently by different teams.



KOA: Community Access to a World Class Telescope

- KOA marries WMKO's expertise with **instrumentation and observatory operations** with IPAC's expertise with **data management and archiving.**
- KOA opened for business in 2004.
  - **Focus on creating coherent, consistent data sets for each instrument.**
  - Archives raw data for all 12 WMKO instruments since 1994 (50 TB).
  - Returns, where possible, optimum set of calibration files and browse quality reduced products.

https://koa.ipac.caltech.edu

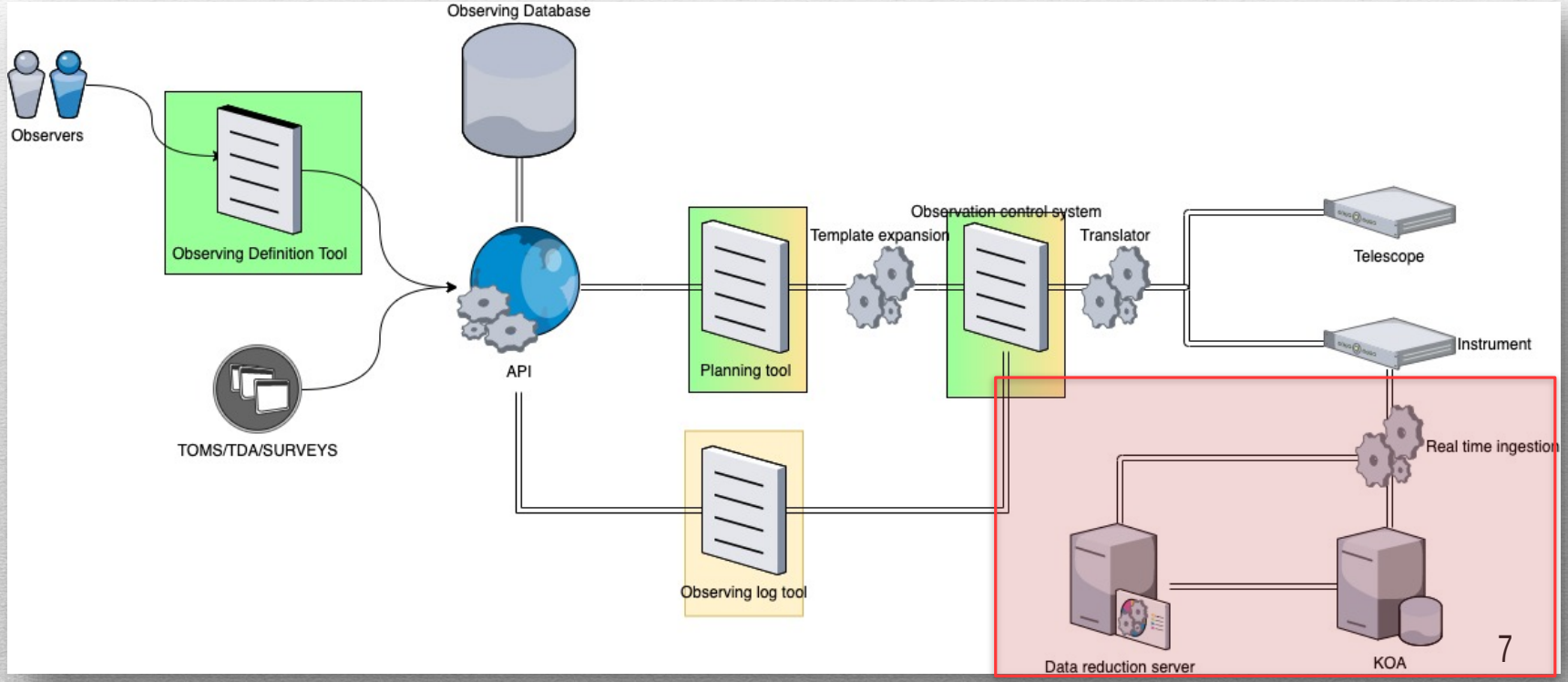
New Infrastructure for Science Ready Products

- "**New Infrastructure to Support TDA and MMA at the Keck Observatory and the Keck Observatory.**" O'Meara et al. (2019) Activity, Project and State of Profession White Paper, submitted to Decadal Survey.
- See also " Infrastructure and Strategies for Time Domain and MMA and Follow-Up." (2019) Miller et al.

Requirements for Support of MMA and TDA

- Consistent acquisition of calibrated data at the telescope.
- Complete metadata in raw and reduced data.
- Data reduction pipelines (preferably facility managed).
- Fast archiving of raw and reduced ingestion and availability.
- Discoverable and accessible data.

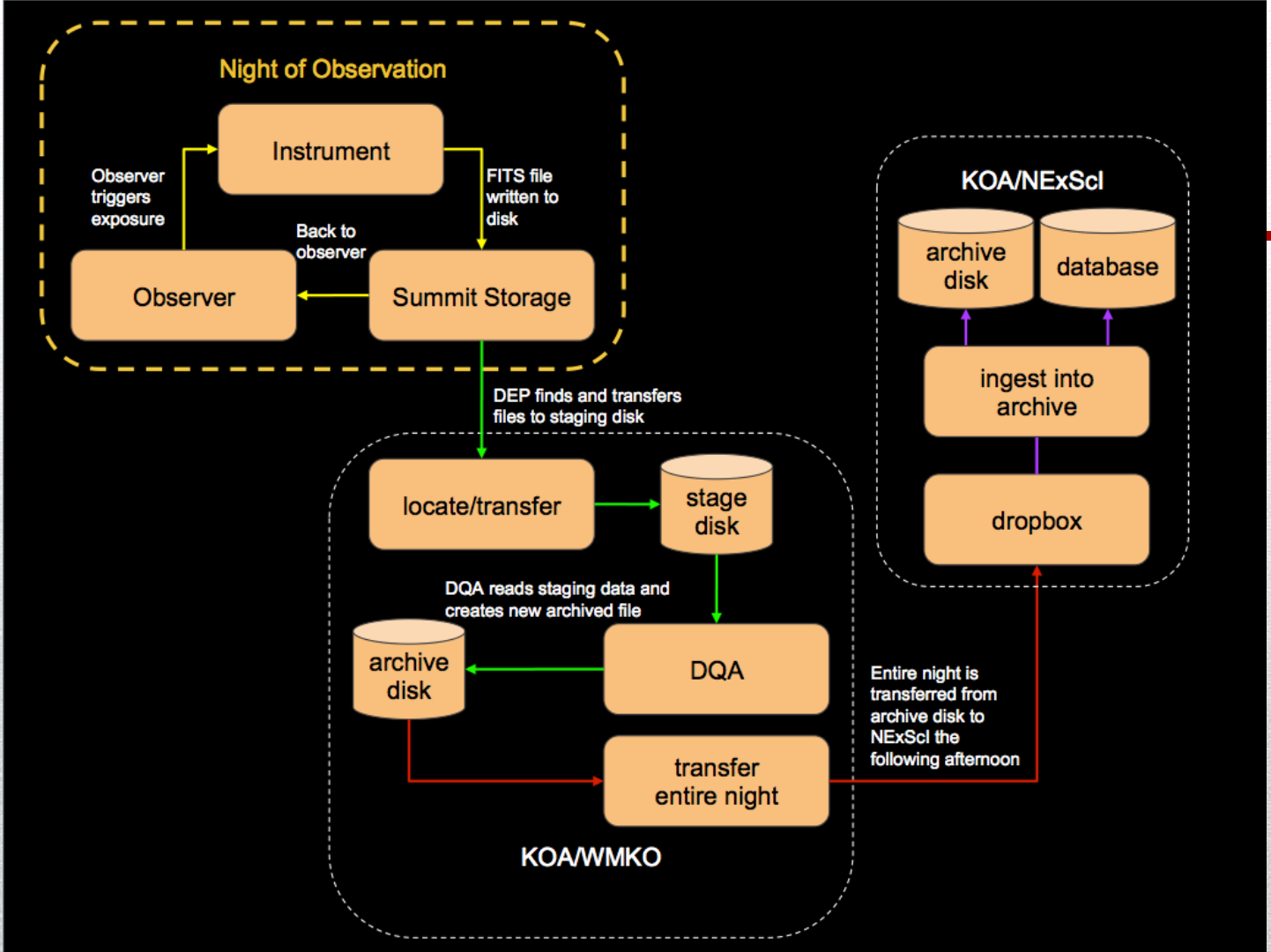
Preliminary Design of WMKO Data Services Initiative



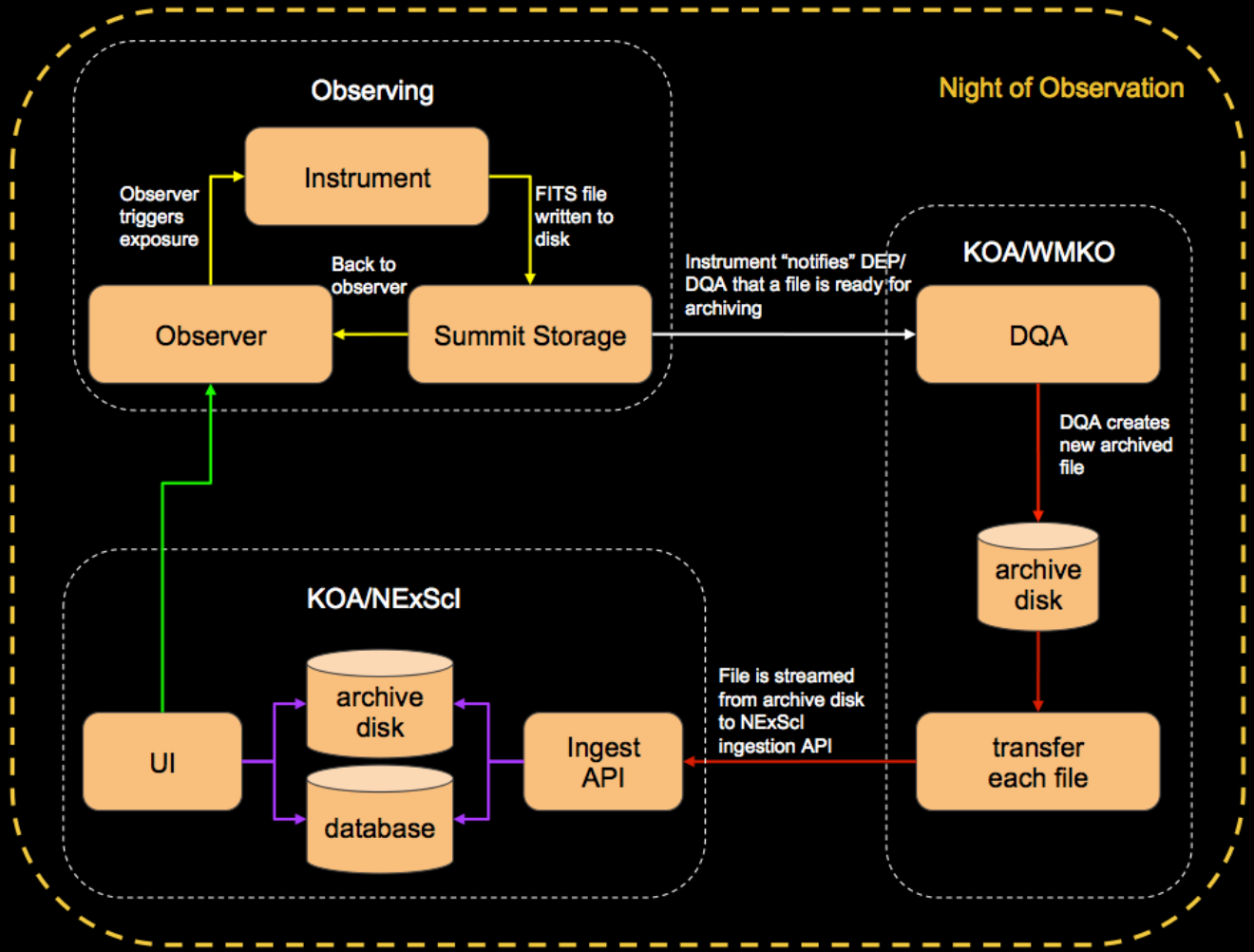
Status of Data Services Initiative

- Exposure Time Calculators: available for about half of the instruments
- API and Database: design phase.
- Planning tool and observing control system: design phase
- DRP framework: passed PDR, prototype being tested
- Real time ingestion: design phase
- Archive: API and Python query tools in development and testing

Old


Night of Observation
Instrument
Observer triggers exposure
FITS file written to disk
Back to observer
Observer
Summit Storage
DEP finds and transfers files to staging disk
locate/transfer
stage disk
DQA reads staging data and creates new archived file
archive disk
DQA
transfer entire night
KOA/WMKO
KOA/NExScI
archive disk
database
ingest into archive
dropbox
Entire night is transferred from archive disk to NExScI the following afternoon

New

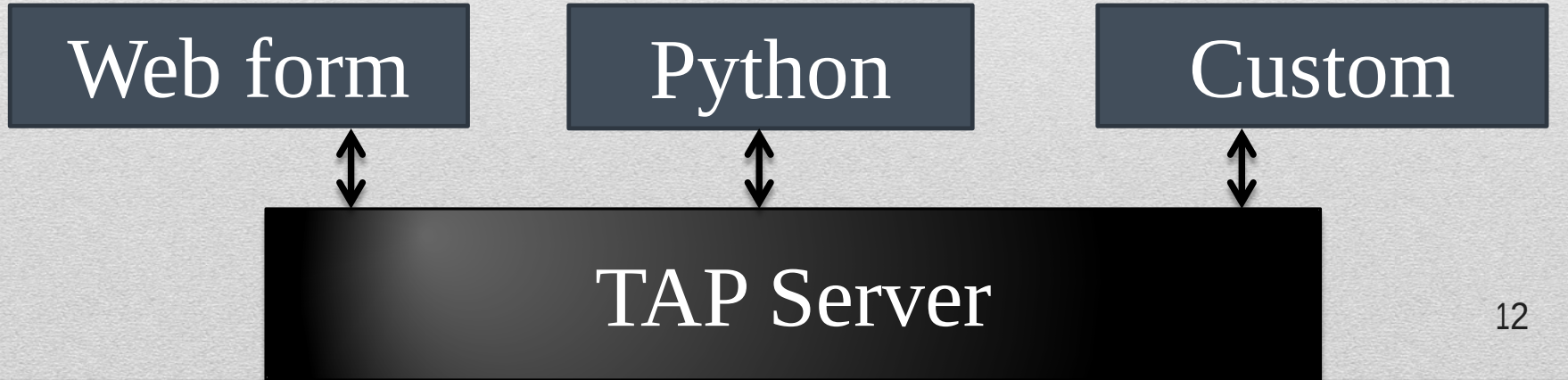

Observing
Night of Observation
Instrument
Observer triggers exposure
FITS file written to disk
Back to observer
Observer
Summit Storage
Instrument "notifies" DEP/ DQA that a file is ready for archiving
KOA/WMKO
DQA
DQA creates new archived file
archive disk
KOA/NExScI
archive disk
UI
Ingest API
database
File is streamed from archive disk to NExScI ingestion API
transfer each file

Current NExScI User Services

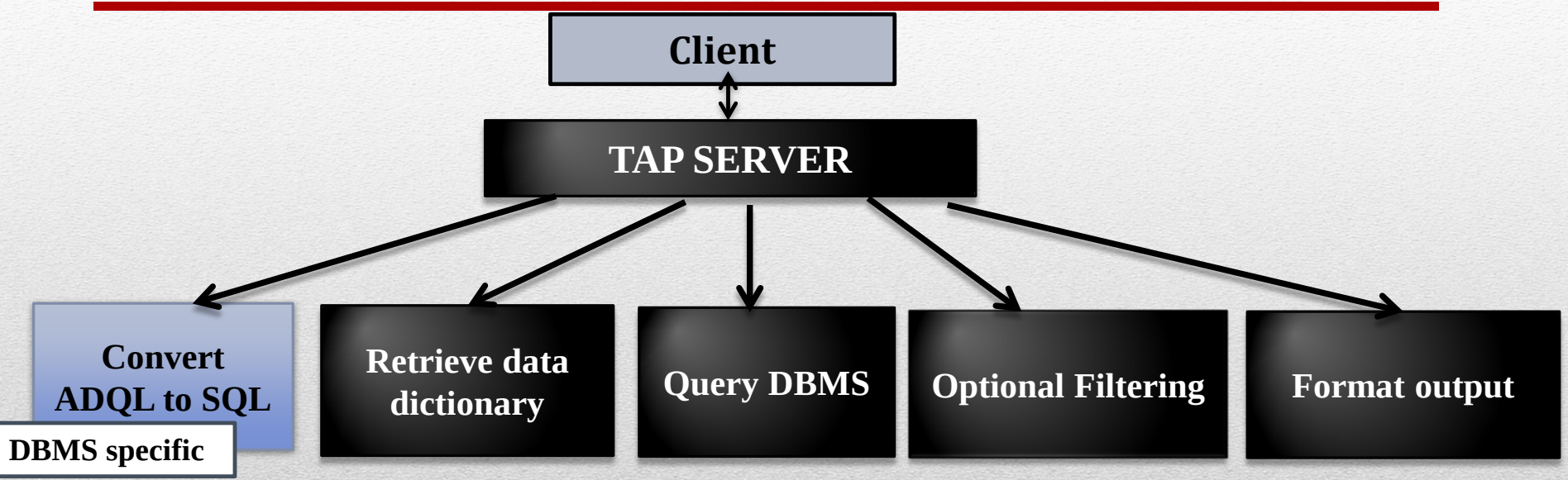
- Web-based search engines and Solar System Search Service.
- Table of released observations(web, CSV, IPAC format).
- VO Simple Image Access Protocol (SIAP) v2 Program Interface.
- **All built atop the Science Information System developed for IRSA – C, Java, Javascript**.

Future KOA End User Services

- New architecture API based - VO Table Access Protocol
  - Flexibility for archive.
  - Data discovery through VO.
  - Synchronous and asynchronous queries.
  - Proprietary authentication.
  - VOTable, CSV, column delimited data.



Python-based TAP Server



- Open source (BSD 3-clause license).
- Ready to deploy for NEID archive
- In KOA test bed => Deploy early 2020

Summary Points

- WMKO and KOA are developing a new data services model to benefit MMA/TDA and PIs
  - Uniformly acquired and calibrated data.
  - Facility data reduction pipelines.
  - Fast ingestion into archive.
  - Modern interfaces.