ALMA Software development

George KOSUGI: NAOJ, ALMA ICT-EA Manager
Contents

- ALMA Software Developments in EU (ESO)
- ALMA Software Developments in NA (NRAO)
- ALMA+ Software Developments in EA (NAOJ)
Development in EU (ESO)

- **ALMA Integrated Alarm System**
  - Monitor all components necessary for observation operation

- **ALMA Science Archive Enhancement**
  - Produce science ready data product

- **CASA HPC (High-Performance Computing)**
  - Process Multi-MS in parallel
ALMA Integrated Alarm System: Current Alarm displays
Alarm Panel mock-ups
Alarm Panel mock-ups: Building
Alarm Panel mock-ups: Observation
ALMA Integrated Alarm System Time-line

- Initial study completed at the end of June 2016
- 1st version delivery in late 2017
ALMA Science Archive Development

- Reimaging project
  - Run pipeline imaging on all calibrated MS for Cycle 0-3
  - Prototype is working for almost 300 MSs

- Pipeline reprocessing service (interface)
  - pipeline reprocessing with user specified parameters
  - prototype is working for VLA data

- ALMA Source list
  - provide a catalogue of all ALMA sources using the best data reduction and combining all observations of a source

- Supplemental information (T. Kobayashi’s talk)
CASA HPC (High-Performance Computing)

- Target computer systems
  - workstation: multi-core / local disk
  - cluster: many multi-core nodes / high-bandwidth network file system
- Partition the MS into sub-MSs (MMS: Multi-MS)
- Internal Parallelization or Parallel execution of CASA/tasks
- Next step
  - IF tclean parallelization
  - SD imaging parallelization
CASA HPC (Cont.)

3 EBs ~ 115GB total

not all steps are parallelised

80+ calls to plotms and gaincal

flagdata is ~6x faster

applycal and tclean are ~ 3x faster

tclean parallel is still under dev/test
Development in NA (NRAO)

- ADMIT
  - ALMA Data Mining Toolkit
- CARTA
  - The Cube Analysis and Rendering Tool for Astronomy
ADMIT: ALMA Data Mining Toolkit

- First-view science data products into Archive
- Python toolkit allows user to generate their own science products from cubes
ADMIT (Cont.)

Ingest
- Read in full window data cube: from FITS or CASA image
  - Output: CASA image and xml information

CubeStats
- Calculates statistics of data cube: RMS, Min, Max per channel, etc
  - Output: xml table, png’s

CubeSpectrum
- Makes Spectra which characterize the emission - used for LineID
  - Output: xml table, png’s

LineID
- Identify lines present in data cube: where, and which transitions
  - Output: xml table and png’s

LineCube
- Creates separate data cubes for each line found with transition or freq labeling
  - Output: “N” CASA images with xml information

Moment
- Creates clipped moment maps for each line (0, 1, 2... as requested)
  - Output: CASA images, png’s, xml information

Ingest
- Read in continuum map
  - Output: CASA image and xml information

SFind2D
- Find continuum sources to some selected depth
  - Output: xml table, png’s

CubeSpectrum
- Make Spectra at each continuum position
  - Output: xml table, png’s
**Conservative automated line ID**

**Source:** Low-mass Protostellar Outflow
**ALMA CYCLE 2**

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Figure 1: Example ADMIT output showing line identification and moment maps.
ADMIT (Cont.)

- **ON-line mode (Pipeline mode)**
  - ADMIT runs after QA2 and before archive ingestion
  - ALMA archive user can download ADMIT Product tarball

- **OFF-line mode (user creates data products)**
  - ADMIT Toolkit “add-on” will be available from CASA page
  - 1st version was delivered on 2016/5/1
  - Delivery to NRAO in 2016/11
  - ALMA Pipeline integration is NOT yet done
CARTA: The Cube Analysis and Rendering Tool for Astronomy

- Provide a replacement for the current CASA Viewer
- Visualization Challenges
  - Big data up to 1TB image cubes
  - Connection to HPC
- Pure Web application and Desktop Application
  - similar concept to what JVO-ALMA Collaboration does
    - Web QL / Vissage
CARTA 0.4 Beta Release
CARTA (Cont.)

Archive Integration
### ALMA Science Archive Query

#### New Button

**Download data**  
**Visualize Data**

#### Table 1

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Development in EA (NAOJ)

- Sakura
  - Astronomical Data Reduction HPC Library adapted for Recent CPU Architecture
- JVO (WebQL and Vissage)
- NAOJ Radio Science Archive
  - Give second life to Data
Sakura

- Astronomical Data Reduction HPC Library adapted for Recent CPU Architecture
  - Threading (Thread safe implementation)
  - SIMD (Single Instruction Multiple Data): Vectorization
- Already integrated into SD CASA
- Stand alone Sakura Library will be released in September
- Continue to add new algorithms
  - replace casacore modules partially in the future?
  - planning to implement Sparse Modeling
JVO (WebQL & Vissage)

- **WebQL**: Web based data viewer for evaluation, download, or cut-out (M. Ohishi's talk)
- **Vissage**: Desktop Application to examine downloaded data
NAOJ Radio Science Archive

- Data Archive and Delivery System (Adria) for NRO is under the development
- Start operation by next summer (Deliver raw data)
- ASTE raw data will also be ingested into Adria
- Plan to store VERA visibility FITS into Adria

NAOJ Radio Archive in 2yrs
NAOJ Radio Science Archive (Cont.)

- Reuse ALMA pipeline to NRO data
  - CASA processing of NRO data (K. Sugimoto’s talk)
  - Tuning of pipeline parameters are necessary
  - may need additional stages
  - Ingestion of pipeline reduced NRO data into Adria

- Same for ASTE data

- VERA team is developing automated data reduction system

NAOJ Radio Science Archive in ?? yrs
NAOJ Radio Science Archive (Cont.)

- NRO Data
- NRO Pipeline
- VERA Data
- VERA Pipeline
- ASTE Data
- ASTE Pipeline
- User
- JVO
Sample Pipeline processed NRO data
Acknowledgment

- Alarm: Erich Schmid, Maurizio Chavan (ESO)
- ALMA Archive: Felix Stoehr (ESO)
- CASA HPC: Sandra Castro, Just Gonzalez, Julian Taylor
- ADMIT: Jeff Kern (NRAO)
- CARTA: Erik Rosolowsky (Univ. Alberta)