AIPS++, NRAO, ALMA, etc.

Brian Glendenning, NRAO

Wim & Me

- Me:
  - Radio Astronomer gone bad (did not finish Ph.D)
  - NRAO lifer
    - 1990 – 1992 : AIPS (Workstation graphics, etc.; VAX/VMS transition)
    - 1992 – 1998: AIPS++
    - 1998 – 2012: Head of MMA then ALMA software (international team)
    - 2012 – present: NRAO head of "data management and software"
- Relation with Wim
  - Consumer of his software (1980s VLA pipeline)
  - Review subject (AIPS++, ALMA)
  - Colleague (AIPS++ coding)
  - Friend

Greetings from NRAO!

- I sent an email to NRAO scientific staff asking for funny stories
  - Nobody had any! (Spoiler alert: me either)
  - Wim's cigar smoking did receive some comment!

- A number of people did ask me to pass on their warm regards:
  - Tony Beasley, Miller Goss, Ed Fomalont, Barry Clark, Ken Kellermann

(1980s) NRAO Pipeline

- Retrospective "lessons learned" written up in a very interesting memo: "Whatever happened to the Pipeline", VLA Computer Memorandum #172 (Duquet, 1984)

    - In 1981, Dr. Wim Brouw, Director of Netherlands Foundation for Radio Astronomy, devoted a year's leave of absence (spent at the VLA) to the sole purpose of writing the full Pipeline software.

    - I cannot imagine (wanting) any Observatory Director today doing this

- I used this software in the mid-1980s for spectral line data

    - At the VLA site (pre-AOC)

    - When it worked, it was an amazing spectral line map-making machine (for state of the art 256^2 and even 512^2 planes)

    - When it didn't work, there was little hope you could "unstick" it

        - Unless Pat Palmer was also visiting!

    - Amazing! Incomprehensible! (*i.e.,* Wim!)

(Will we ever learn?)

LESSONS LEARNED

Three basic lessons that should be remembered while drawing up long range computer plans emerge from our examination of the pipeline experience. They are these:

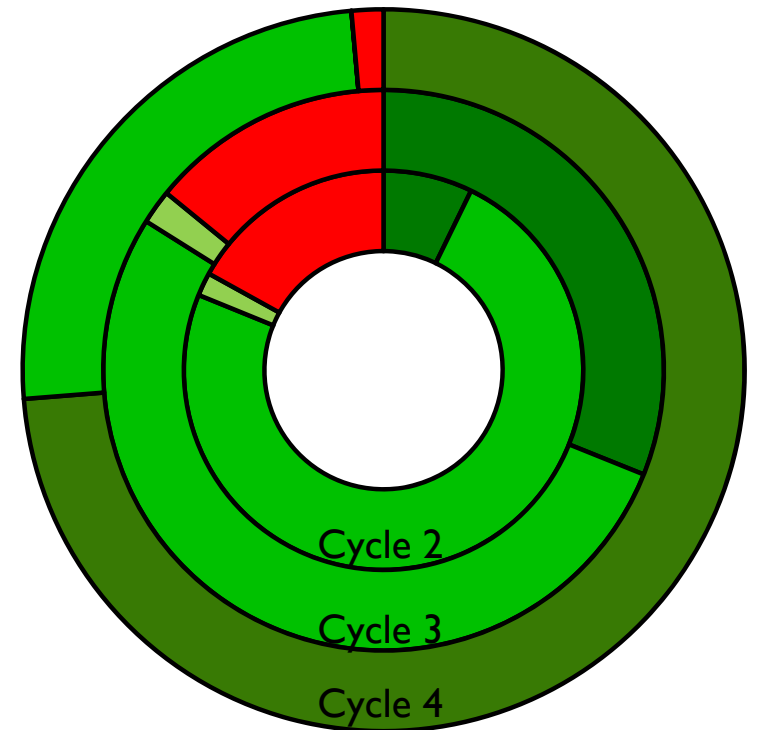1 - Requirements Grow

2 - Systems Degenerate

3 - Complexity Costs

13

Pipelines 30 years later …
Calibration

- Calibration pipelines for both ALMA and VLA continue in production
  - ALMA focus on number passing w/o intervention
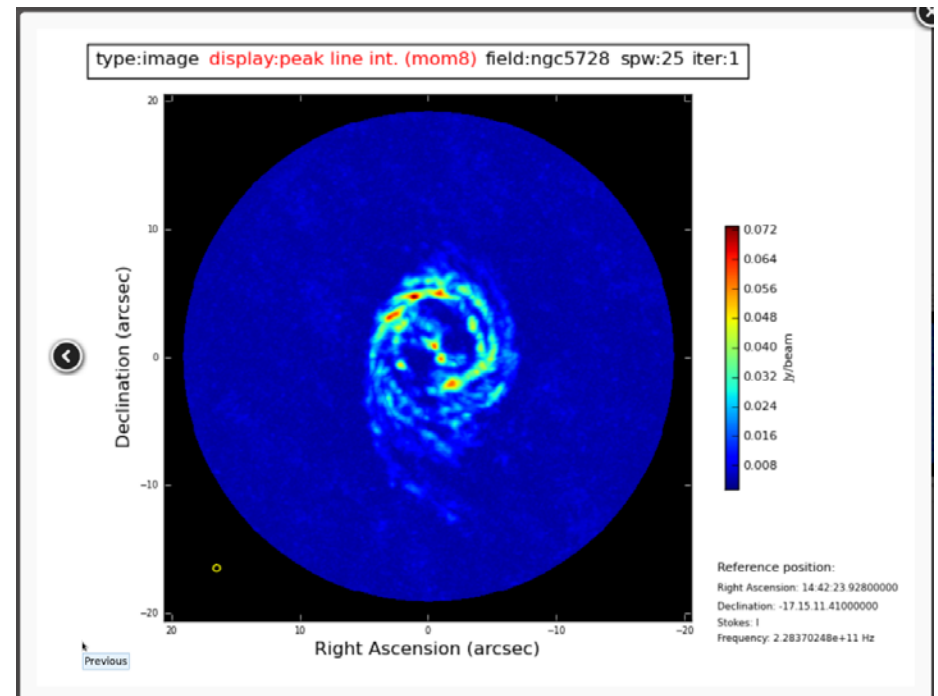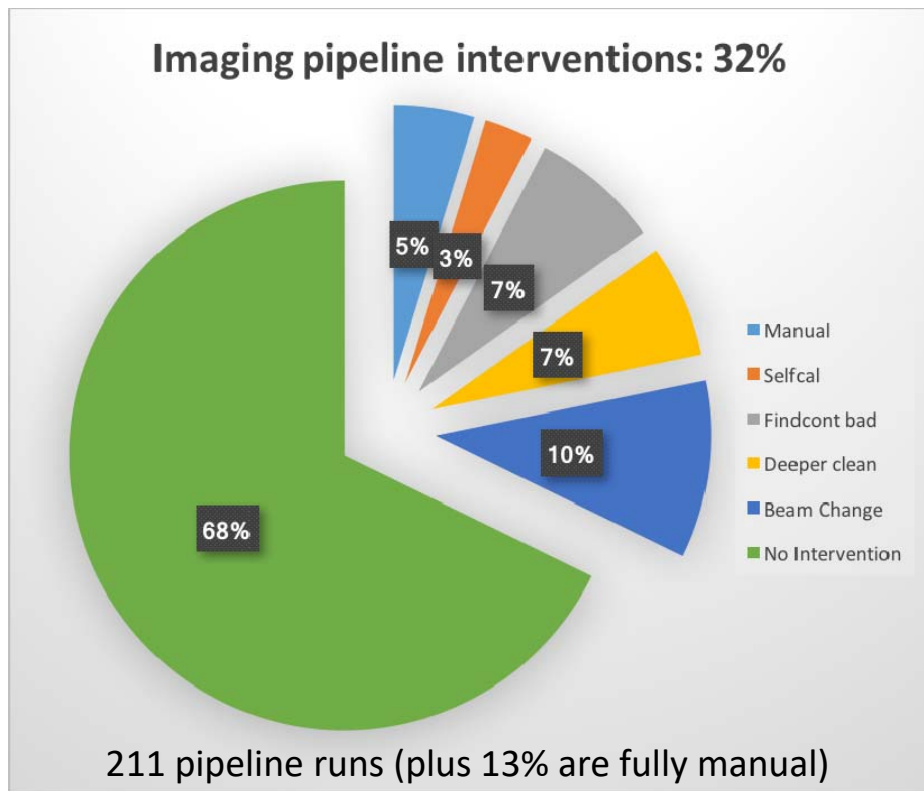 - VLA focus on VLASS, adding polarization

ALMA Calibration Pipeline

Cycle 2
Cycle 3
Cycle 4

■ No Intervention ■ Intervention
■ Tweaked ■ Sent to Manual

Pipelines
ALMA Imaging

- ALMA imaging pipeline in production use for Cycle 4
    - Pipeline estimated to be 3-4x faster than manual processing

Imaging pipeline interventions: 32%

- 5%
- 3%
- 7%
- 7%
- 10%
- 68%

- Manual
- Selfcal
- Findcont bad
- Deeper clean
- Beam Change
- No Intervention

211 pipeline runs (plus 13% are fully manual)

type:image display:peak line int. (mom8) field:ngc5728 spw:25 iter:1

Declination (arcsec)

Right Ascension (arcsec)

Reference position:
Right Ascension: 14:42:23.92800000
Declination: -17.15.11.41000000
Stokes: I
Frequency: 2.28370248e+11 Hz

Previous

Cycle 4 Imaging Pipeline result towards NGC5728 that was delivered as part of a PI science observation. **No human intervention was used to generate the image.** *Full calibration and imaging took 17 hours.*

AIPS++

1994 Review

- Wim was a member of the review panel
  - We believe that success of the AIPS++ Project is critical for the mid- and long-term future of radio astronomy research and that technical expertise is available in sufficient quality and quantity to assure this success.
  - But: The AIPS++ project has not been, and is not, managed in any conventional sense of the word (Ouch!)
- Lead to some fundamental restructurings and improvements, but in retrospect they should have been even stronger

AIPS++

Colleagues

- As no good deed ever goes unpunished, after serving on the AIPS++ review panel Wim became an AIPS++ developer with no formal management authority
  - Weird!
- He came to Socorro (1995? For some months?)
  - Our friendship started in this period (also our with our wives)
- Wim and I worked in (relatively) separate areas of the code case
  - Wim: Fundamental astronomy, fitting, modeling, …
  - Me: Coordinate systems, Image access, system stuff, …
- Much of this code is still in everyday use as base modules of *casacore*

AIPS++

Evolution

- AIPS++ continued on for some years, writing some good software, filling some valuable niches (e.g., Parkes multi-beam), but failing to acquire a substantial user base

- NRAO withdrew from AIPS++ consortium (2003) for good reasons (governance; focus on ALMA, EVLA) but probably with poor diplomacy

- Like Gaul, AIPS++ ended up divided into three parts:
  - *casacore* – A *lingua franca* for most connected element interferometers (not all, e.g. IRAM PdBI)
  - *casa* – An NRAO lead consortium developed package aimed primarily at ALMA and the VLA, but supporting on a best-efforts basis some other telescopes
  - A small constellation of other specialist packages, notably *Megtrees*

CASA Status

Download Statistics

- Based on Download statistic usage of CASA continues to increase

- Strong signal of those releases containing pipeline vs. those that do not
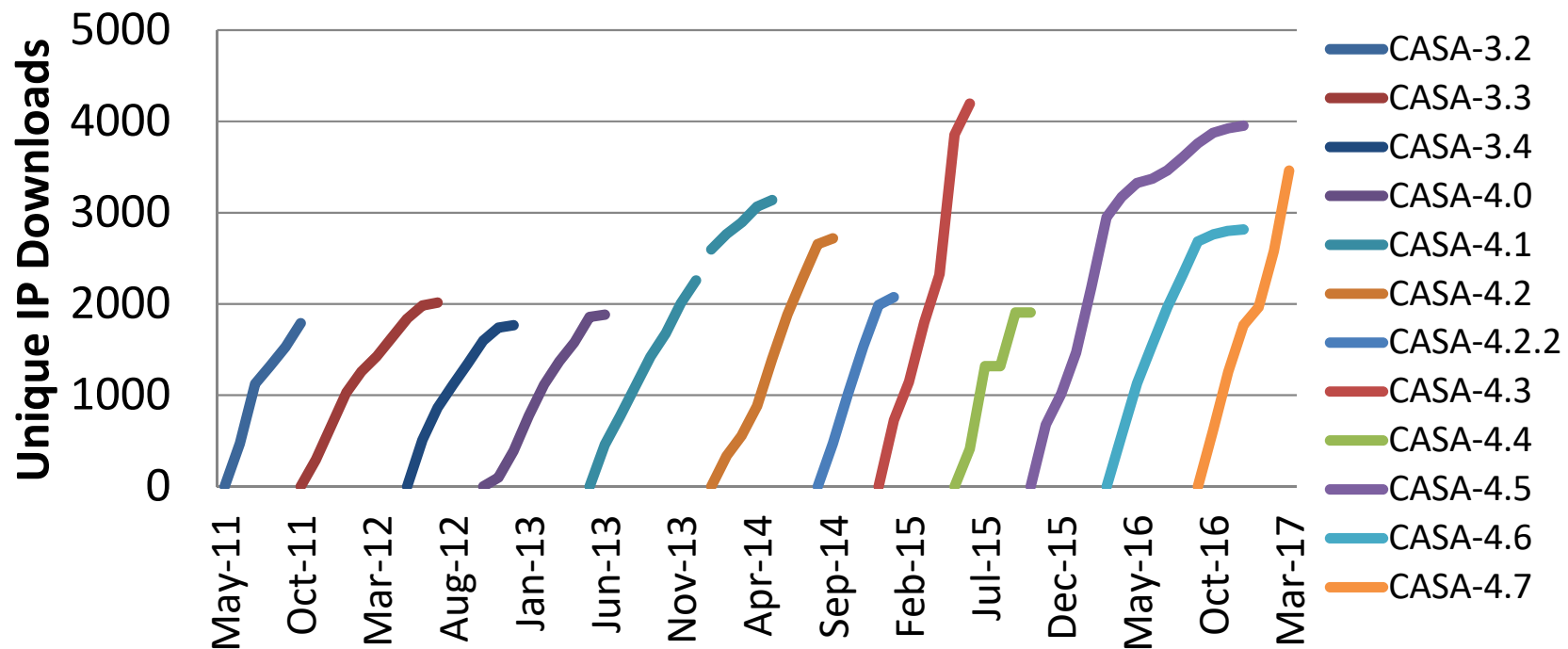
CASA Status
Development Team

- International development and commitment is strong

- Current worldwide effort is 31.5 FTEs
  - 19 FTE from NRAO
  - 5.5 FTEs are dedicated to automated pipeline production for ALMA and VLA

- An additional ~11 FTEs support the CASA project at NRAO
  - Project Scientists
  - Scientific Testing
  - Verification Testing
  - Education & Helpdesk

FTE Contribution by Agency

NRAO ESO

NAOJ ASIAA
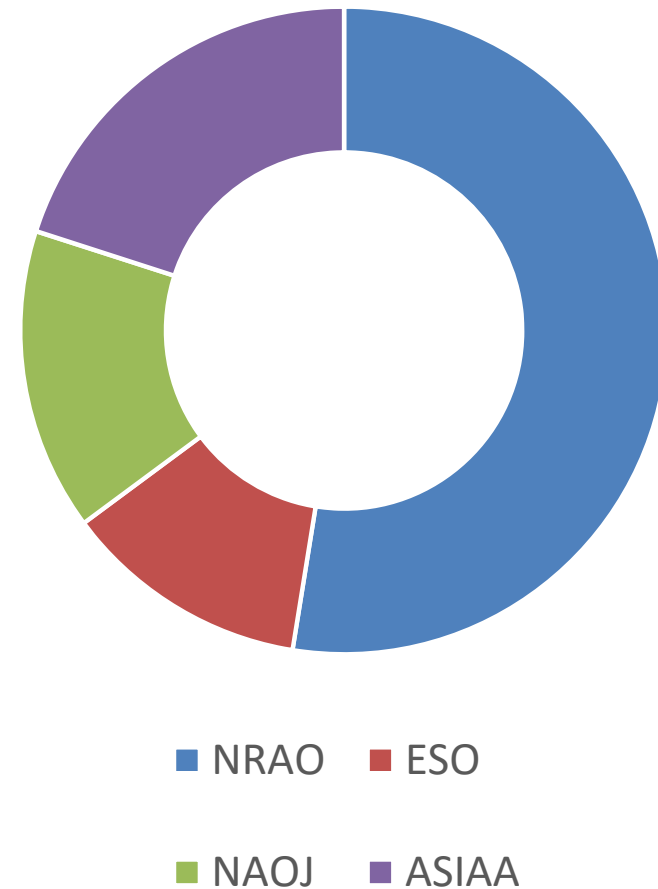
AIPS++

Some general comments

- It has more-or-less, via a painful path, fulfilled its original mandate
  - Heavily used user package; R&D and telescope operations infrastructure
- Having a nearly static (i.e., stable) *casacore* platform has been very helpful (very old *MeasurementSets* are still readable!)
- A weaker open-source license might have been a problem given the unhappiness at the time of the dissolution of the AIPS++ consortium
- *casacore* is now much older (25y) than AIPS was (13y) when it was decided to start AIPS++
  - Showing its age in some areas
  - Toe-in-the-water agreement between NRAO/SKA for next-generation casacore (MSv3)

ALMA

- I could not have successfully lead ALMA software without the experience of AIPS++ (many good lessons and anti-lessons)
  - Wim provided me very helpful input on European astro-politics – I had not worked with many of the institutes before (Japan joined a bit later, ALMA was initially bilateral)
- ESO hired Wim as a consultant to get independent advice on my proposals for the (then very controversial) role of AIPS++ inside ALMA
  - Confidential, but must have been OK!
- In 2008 new ALMA Director Thijs de Graauw wanted to understand the status of ALMA computing (= software)
  - Pre-commissioning phase, science staff was nervous
  - (Scientists seem prone to software conspiracy theory: "it will never work because of fundamental flaw X")

ALMA (2)

- Appointed a review panel, Chair = Wim
  - (Tony Willis was a member)
- ALMA Newsletter #1: `The panel was impressed with the work accomplished and felt that there were no major technical feasibility concerns`
  - (Wim did however rake us over the coals for considering a billion and 10^9 to be synonyms)
- This was very helpful; a "fundamental rework" recommendation would have been very painful and put us on the ALMA critical path

Wim & Me ++
(sorry)

- Recognizing that the items in this talk are a minor part of Wim's overall career, nevertheless:
  - 30+ years ago Wim and others implemented a VLA pipeline that we are only now exceeding
  - Wim provided an important "management steering" function for ALMA and AIPS++ that (positively) impacts >1000 radio astronomers even after all this time
  - Wim's *casacore* code provides core package functionality and is in daily use by essentially all ALMA users, most VLA users, and many users of most other interferometers
- I am personally very grateful for Wim's work and friendship
  - I don't know if he considers himself my mentor, but I consider myself his protoge

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