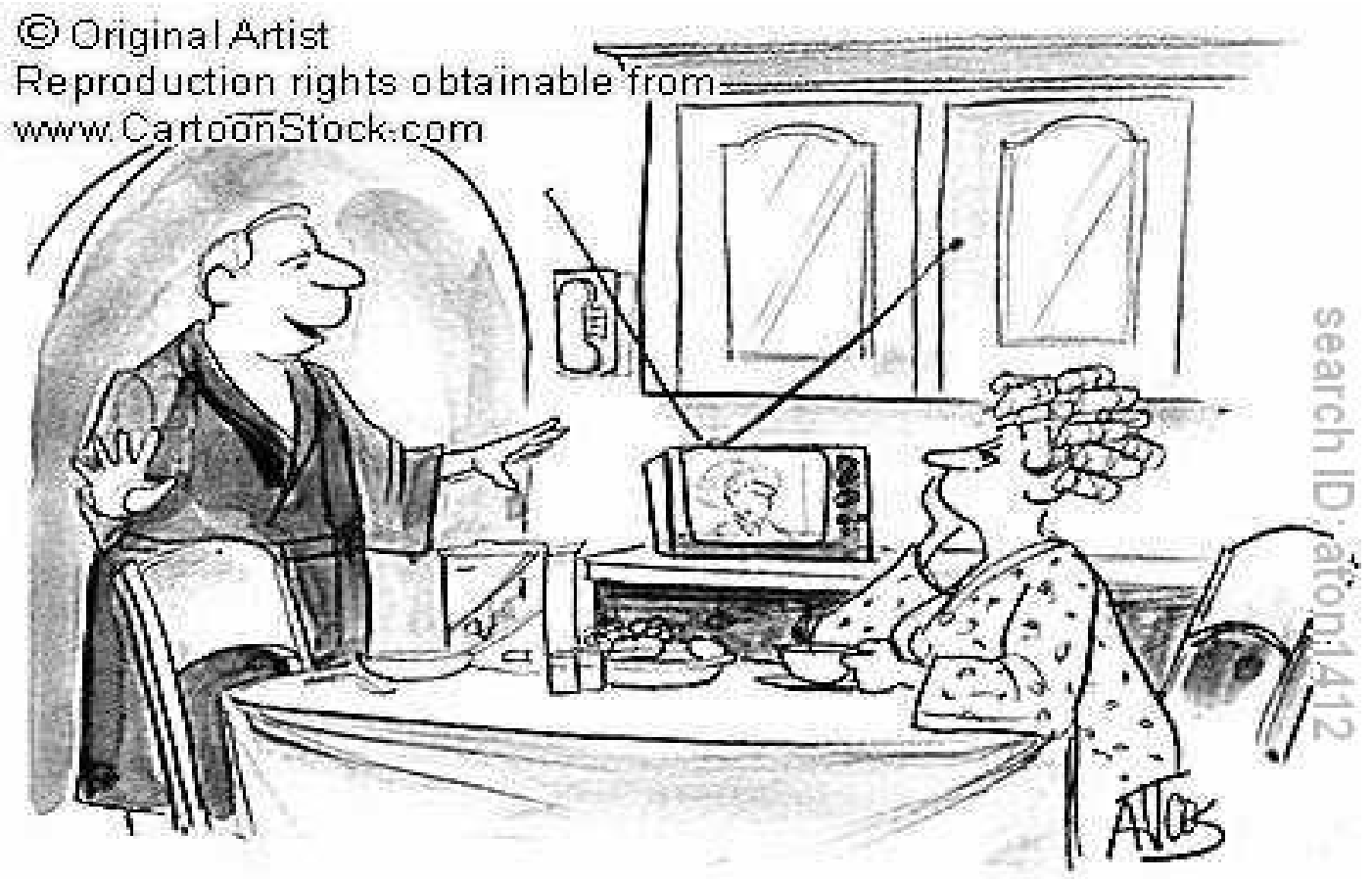
What we are trying to achieve...

Jan Noordam

ASTRON, Dwingeloo
noordam@astron.nl

The Vision Thing



A glut of radio telescopes

- We used to build one per 10 years
  - Cambridge, WSRT, VLA, ATNF, GMRT, ...
-
- Now we build 10 simultaneously
  - LOFAR, ASKAP, MEERKAT, MWA, LWA, PAPER, PAST, EVLA, eMERLIN, WSRT/Apertif, ..., SKA
-
- While user-developers have disappeared..

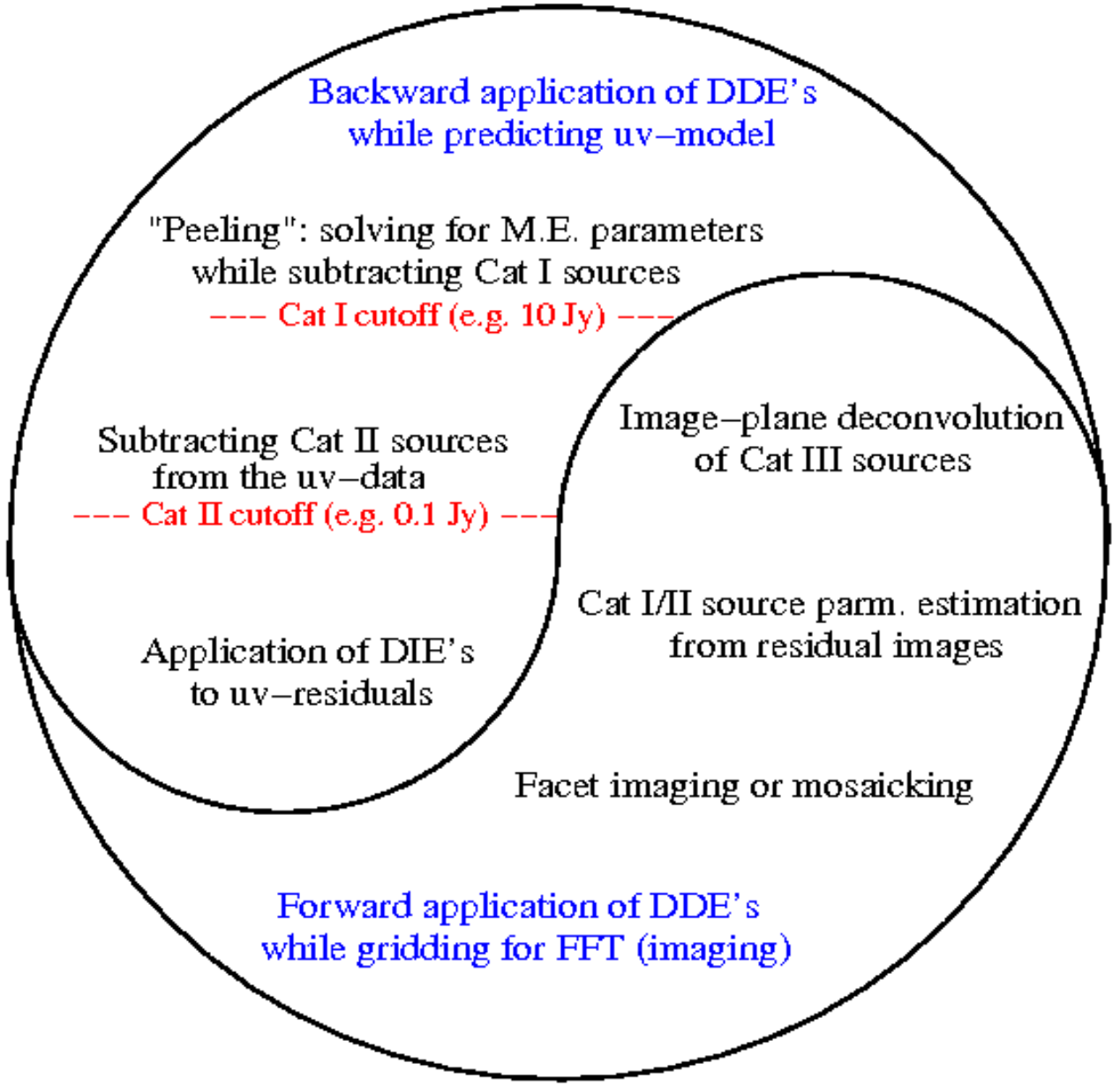
Ridiculous Expectations

-
-
- The EoR will be detected next year...
- Using AIPS ...
-
-

Reality Check

- It took 36 years to reach the WSRT noise
  - on 3c84, dominating, DR = 2.000.000:1
  - all 4 polarizations
  - It is still the only one
  - It is a much simpler telescope
  - It is much more carefully engineered
- 2GC is sufficient for the WSRT, but barely
- There were still some user-developers around in those days, with time to spare

3rd Generation Calibration (3GC)



4 Generations of Calibration

- 1GC (<1980): Reliance on instrumental stability for over up to 12 hours
- 2GC (>1980): Selfcal for Direction Independent Effects (DIE)
- 3GC: Direction-Dependent Effects (DDE)
  - Many more parameters (information?)
  - Much more processing...
- 4GC: Statistical analysis of the residuals

A Small Problem

So who is going to do all this?

For all these telescopes?

Buy them a drink sometime...

- AIPS, MIRIAD, NEWSTAR, DIFMAP (all frozen)
- Missing: Wim Brouw and Martin Shepard
- 62, 55, 53, 65, 64, 67, 49

Le Shit ...

- Will hit the fan, slowly but soon
- Should lead to many job opportunities
- Should lead to a greater variation of jobs
- There will be lots of niches for everyone

I caused 2.4 packages

- NEWSTAR (1)
  - One glorious user, highest DR in the business
  - Implemented by Wim Brouw and Marco de Vos
- AIPS++ (0.5)
  - Widely used modules (mostly written by Dutchmen)
  - The process produced the Measurement Equation
- MeqTrees (0.9)
  - The jury is still out
  - Implemented (mostly) by Oleg Smirnov

The Lessons of History

Those who do not learn the lessons of history

are doomed to repeat them

Winston Churchill (who else?)

Great Leaps Forward

- 500 BC: Alphabet and cheap paper
- 1500 AD: Book printing (and reformation)
- 1850 AD: Industrial schools
- 2000 AD: Internet ...

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Everything always happens for the wrong reasons

The purpose of this Workshop

It is the start of a process:

To gather the clever (and hungry) user-developers from all over the world

(including the smaller institutes!)

and give them the language, the tools and the motivation to work together

The idea is to increase the Rate of Evolution of radio astronomical calibration by a (very) large factor

- Rapid experimentation (TTU)
- Lots of hungry people
- Working together

The Grand Scheme of Things

- Converging forces on the 3 pillars:
  - Calibration (MeqTrees)
  - Imaging (led from Australia)
  - Data Handling (always neglected)
-
- Telescope production systems
  - might accept TDL scripts?
  - LOFAR/BBS could do it (tree-like)

So what does it take?

A Common Language

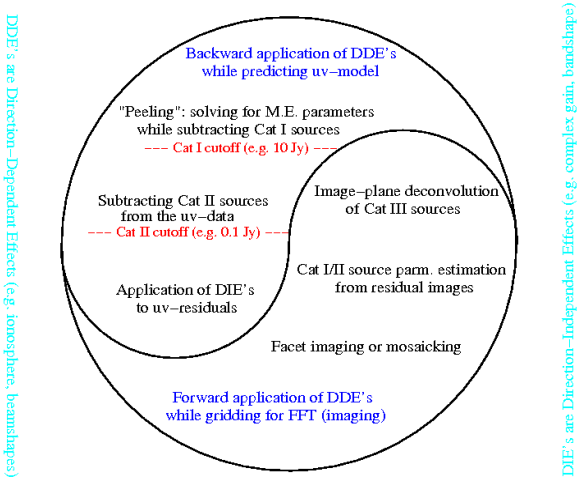
- The Measurement Equation
  - full-polarization (matrix) formalism
  - complete (as far as we know)
  - one of the fruits of the AIPS++ process
- Calibrating the new telescopes without an explicit M.E. should be unthinkable
- Added advantage: Modularity
  - can concentrate on 2x2 Jones matrices

Common Tools

- MeqTrees
- TDL scripts
- Script Exchange Mechanism
- makems, antconfig, ...
- PURR logs
- SSSC
- ....

Substance

- We have a lot of god calibration ideas
  - LOFAR calibration scheme
  - EJones
  - MIM
  - UVBrick
  - …



- But there is room for many more
- And ideas do not implement themselves…

Psychology
(What's in it for me?)

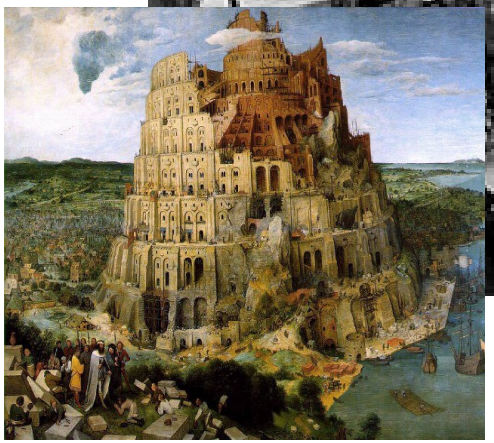
- Idealism
- Jobs
- Fame
- A sense of belonging
- Lots of niches

- freedom
- productivity
- friendly competition
- saving the skin of your leaders
- ....

How can we work together?

- Divide up the work
- Concentrate on your own bit
  - (Get others to do the difficult bits)
- Make sure that the bits inter-operate
- Build on each other (cannibalize)
- Make sure that it gets to the users
- Do rapid experiments (attention-span)

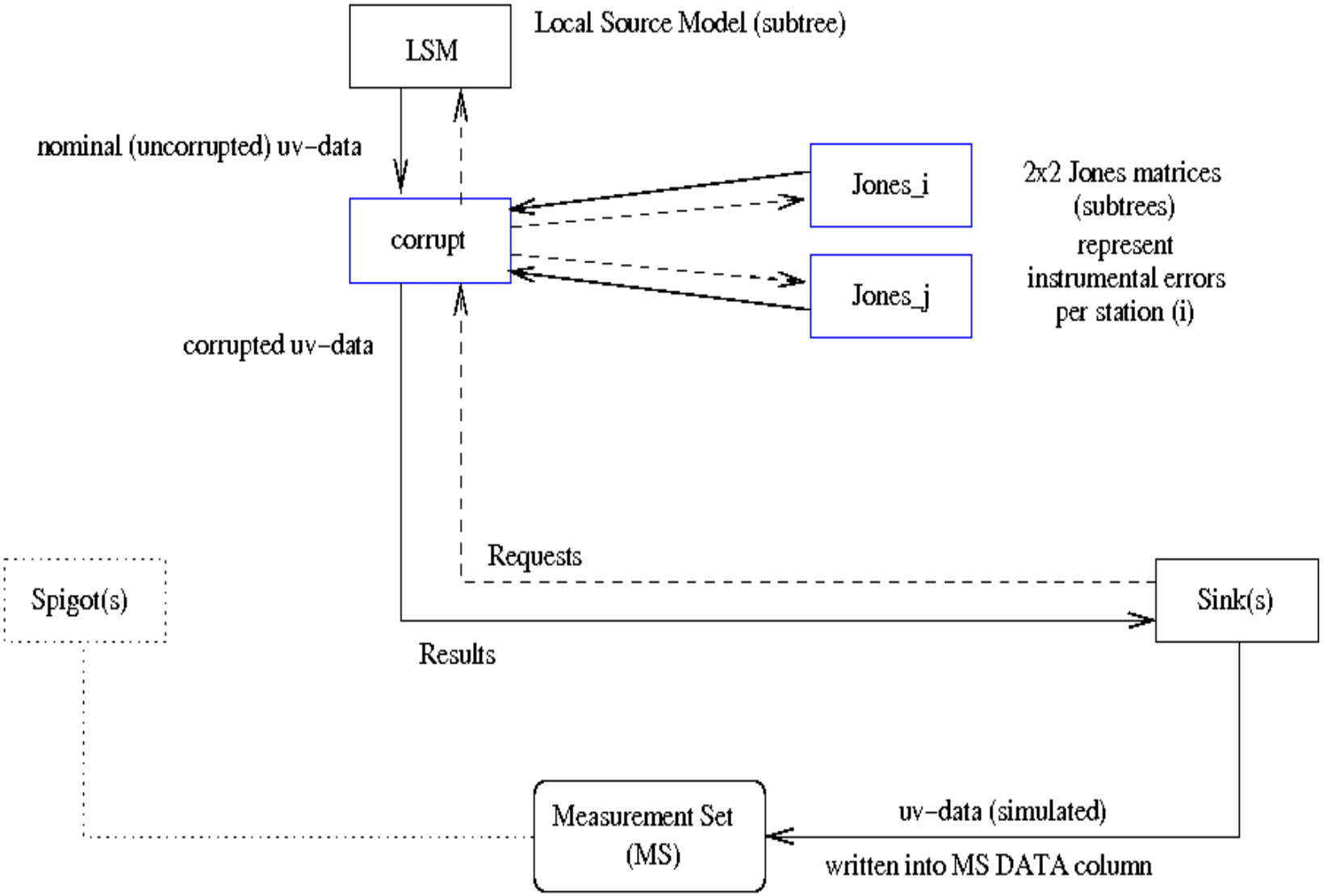
The Model



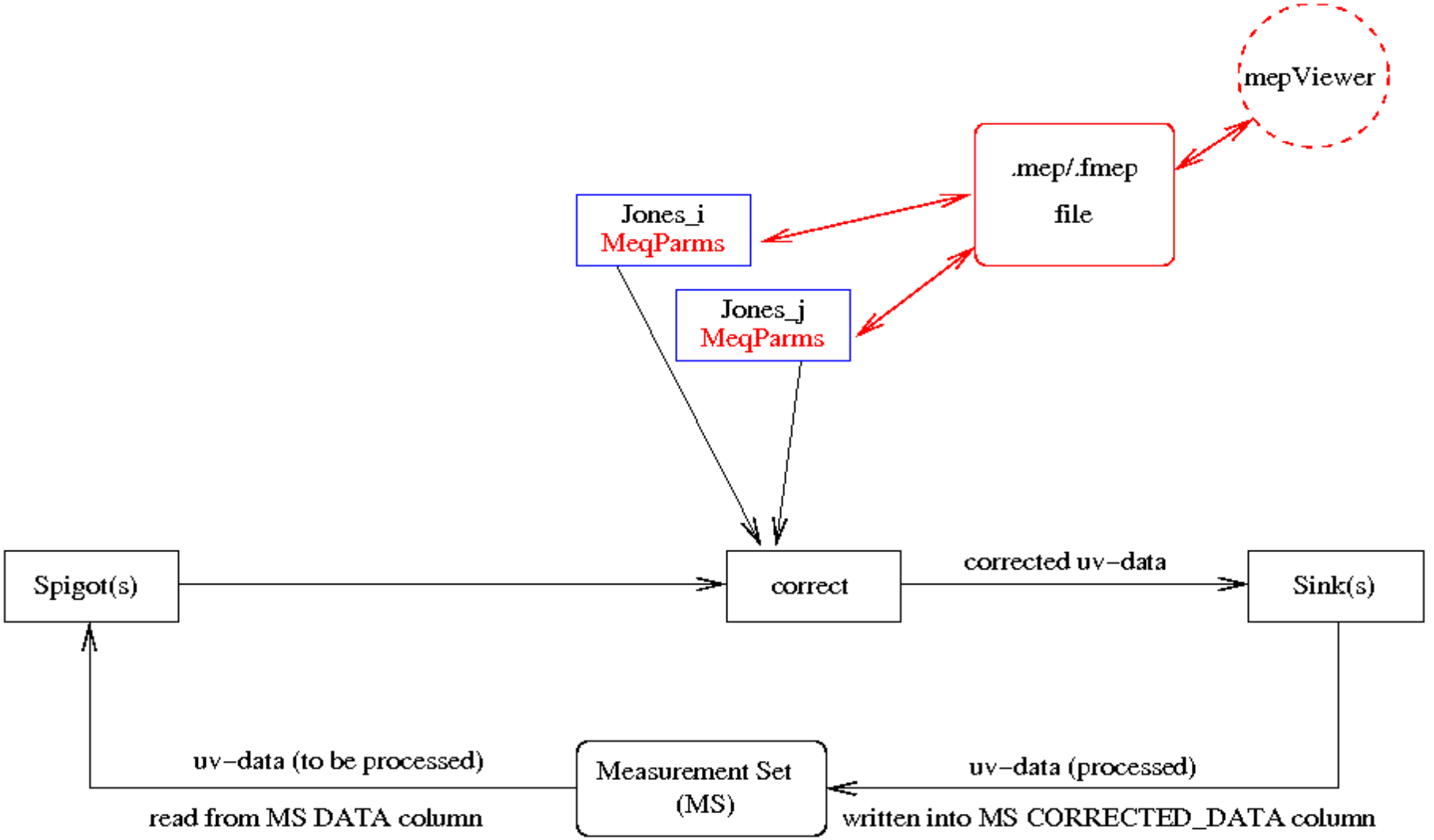
Modularity

- The following 5 slides show block diagrams of processing scripts
- They cover a large fraction of what users might want to to to their data
- They can be applied to data from different telescopes by just replacing the Jones matrices
- Can things be more modular than that?

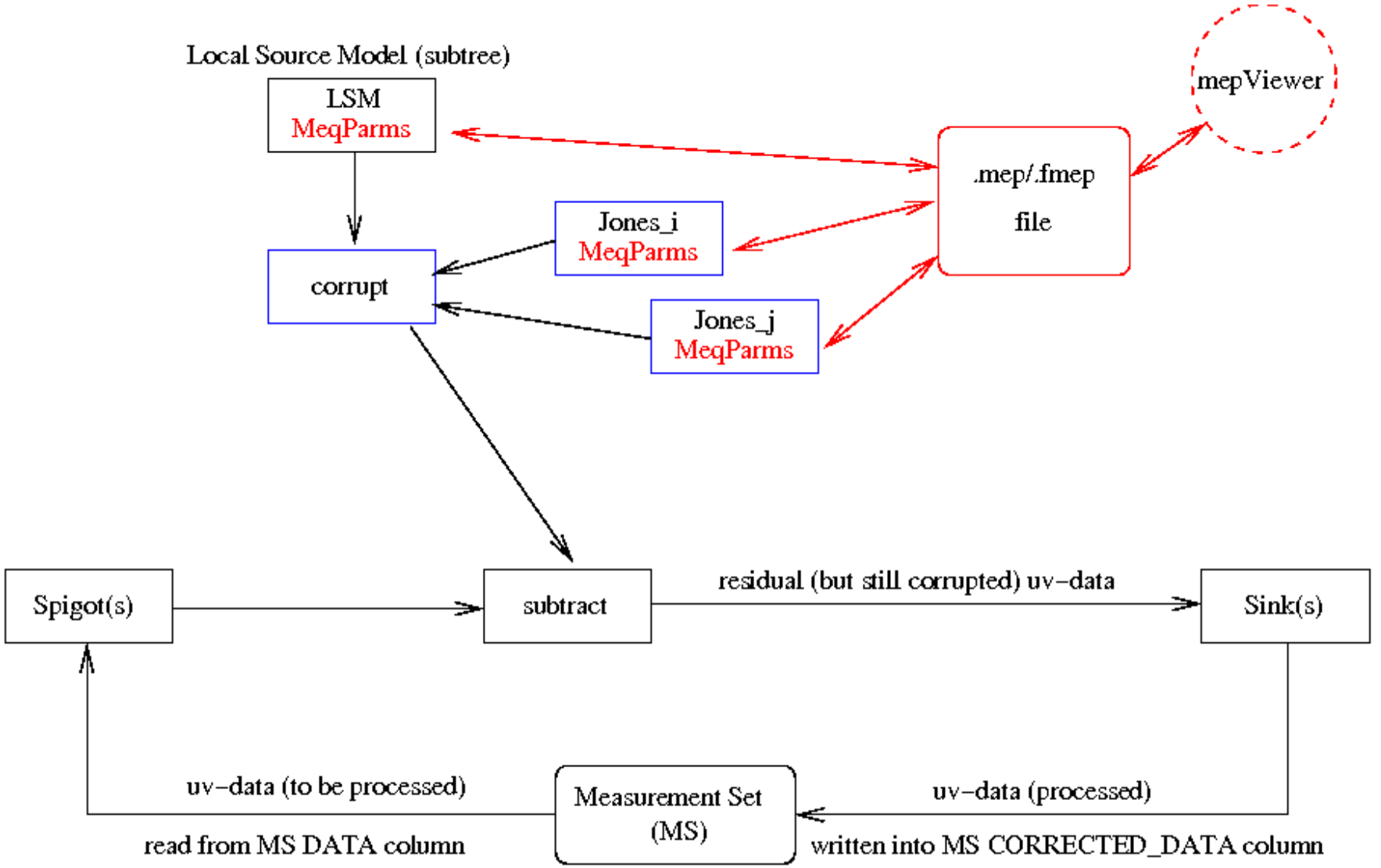
Simulation


LSM
Local Source Model (subtree)
nominal (uncorrupted) uv–data
corrupt
Jones_i
Jones_j
2x2 Jones matrices
(subtrees)
represent
instrumental errors
per station (i)
corrupted uv–data
Requests
Spigot(s)
Sink(s)
Results
Measurement Set
(MS)
uv–data (simulated)
written into MS DATA column

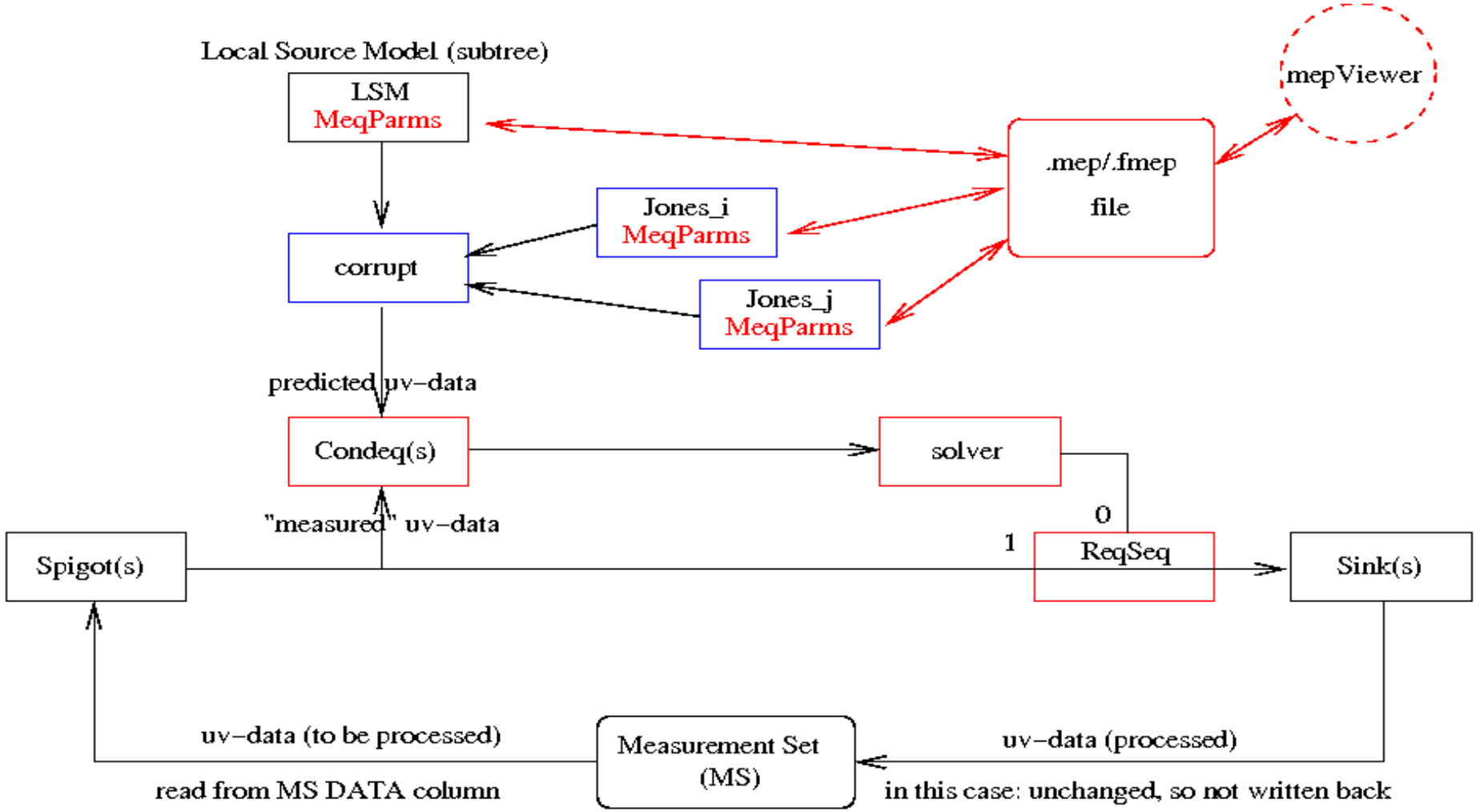
uv-data correction



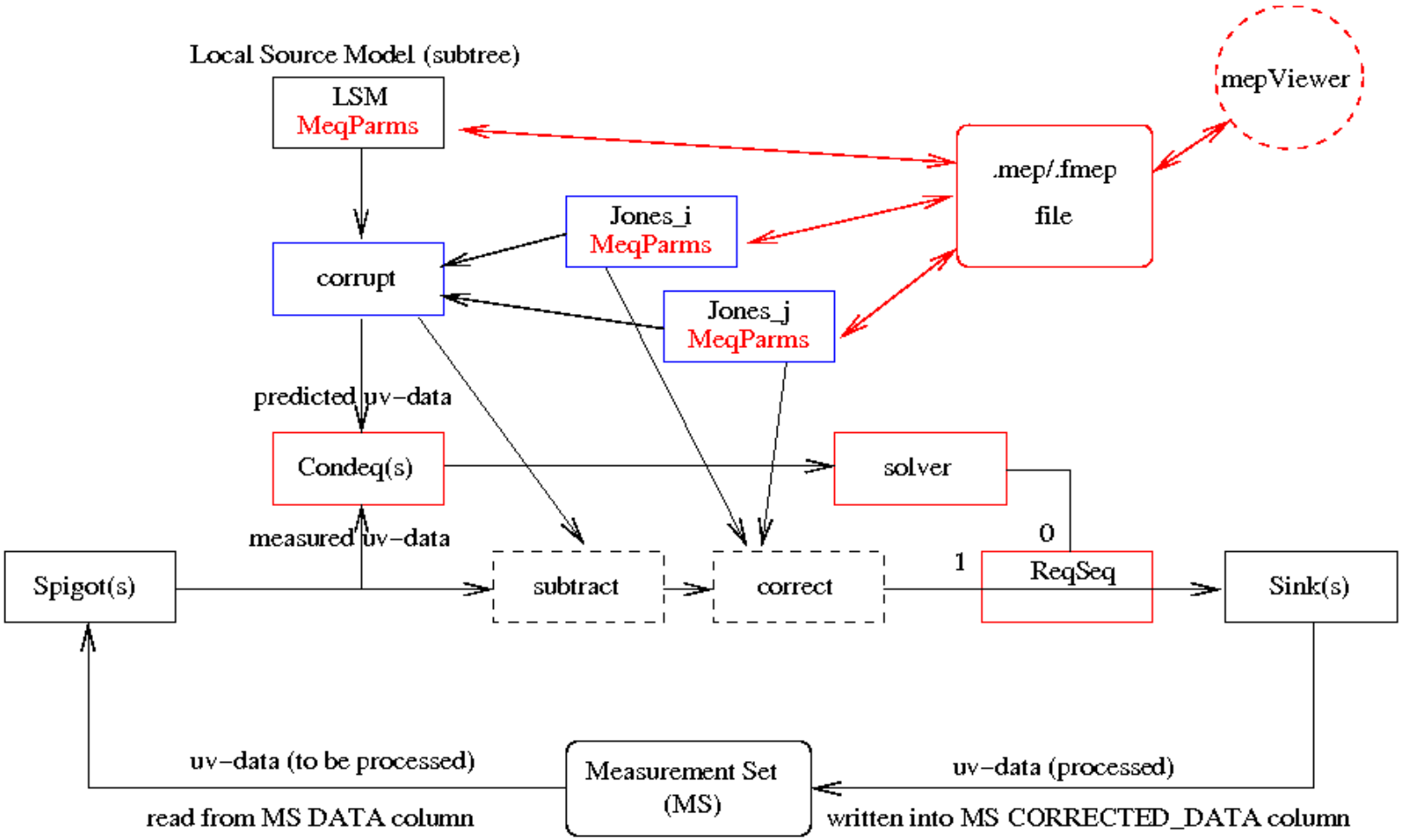
Source subtraction

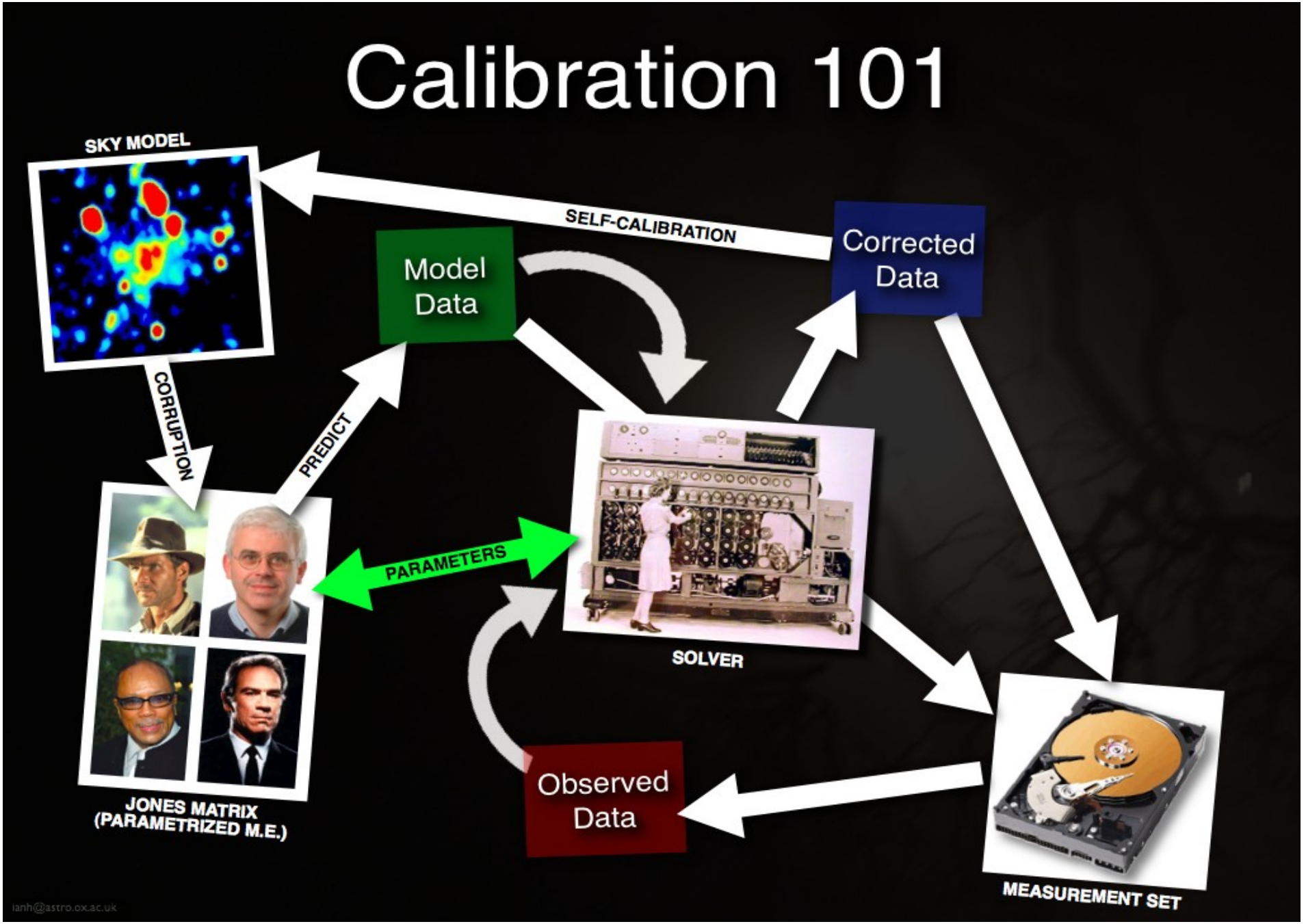


Solving for M.E. parameters



solve-subtract-correct (peeling unit)




Calibration 101
SKY MODEL
SELF-CALIBRATION
Corrected Data
Model Data
CORRUPTION
PREDICT
PARAMETERS
SOLVER
JONES MATRIX (PARAMETRIZED M.E.)
Observed Data
MEASUREMENT SET
ianh@astro.ox.ac.uk

So, let's start with a Jones Repository

- A collection of TDL scripts that define Jones matrices for all telescopes
  - WSRT, Apertif, (E)VLA, ATCA, LOFAR, ...
- Especially Ejones
  - Everybody in the world has an Ejones (station beamshape) problem
- Can have multiple versions (e.g. with different parameterizations) for the same instrument. Etc

Script Exchange

- How to locate them?
- How to judge them?
- How to use them in your tree
- How to cannibalize them for your own use
- How to make your scripts available?
-
- Let's start now!

Visualization jam-session

Role Model?

Finding your Niche

- Many people can participate
- On many different subjects
- It all fits together and is very modular
- Everything you do will be available to everyone else, including the end user(!)
- Just find your niche (a list exists)...
- ... and join in the fun

We (you) are the Future