

Theory in the Virtual Observatory

Overview

- The VO
- The IVOA
- Theory in VO
- Theory in the IVOA
- Example

The VO

- Broad goal
 - Make results of astronomical research, data *and* applications, more readily available to larger community, and create value-adding services.
- Facilitate:
 - communication of results
 - checking of results
 - use of results
 - comparison of different results
 - combination of different results to create new ones
- Through
 - online availability of datasets and applications
 - standardized publication and discovery mechanisms
 - standardized description (meta-data, FITS++)
 - standardized selection mechanisms
 - standardized form(at)s of *transmitted* data
 - value added services



- Registry
 - publication
 - discovery
- Data models
 - description (UCD)
- Query protocols
 - selection ([cone search](#), ADQL)
 - combination (XMatch)
- Data access protocols
 - retrieval (VOTable)
- Applications
 - user interfaces (Aladin)
 - visualisation (VOPlot)
 - webservices
 - analysis (...)



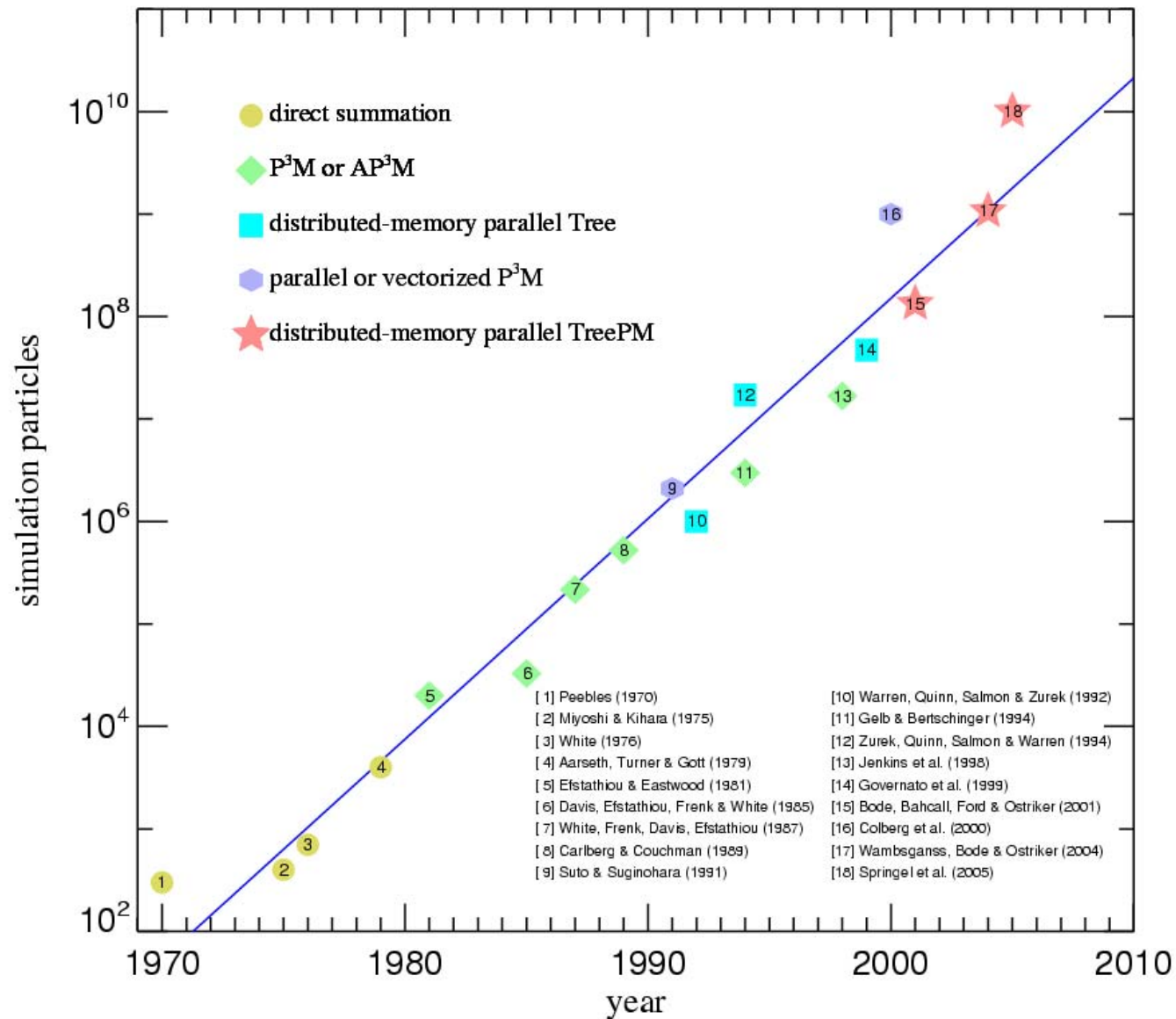
Theory in the VO

- Existing protocols not applicable
 - Position based queries
 - Combination of different archives less obvious
 - Need query-by-example type access
- Data models insufficient
 - New “observables”
 - Different “provenance”
 - Different characterization
 - More complex data structures
- Less well developed history of archiving
 - No FITS for simulations
- New use cases
 - Theorists : data mining simulation results
 - Observers : virtual telescope
- White paper (with Joerg Colberg)
 - making the case IVOA needs to pay special attention to theory.
 - Review some of arguments

Why publish simulations ?

- Same reasons as for observations:
 - Data too large to analyse all by simple methods
 - Allow independent checks of scientific results.
 - Allow further work by 3rd parties.
 - Improve refereeing process
 - Obey demands by journals
- Great benefits expected
 - Allow comparison observational results with simulations and *vice versa*

“Moore’s law” for simulations

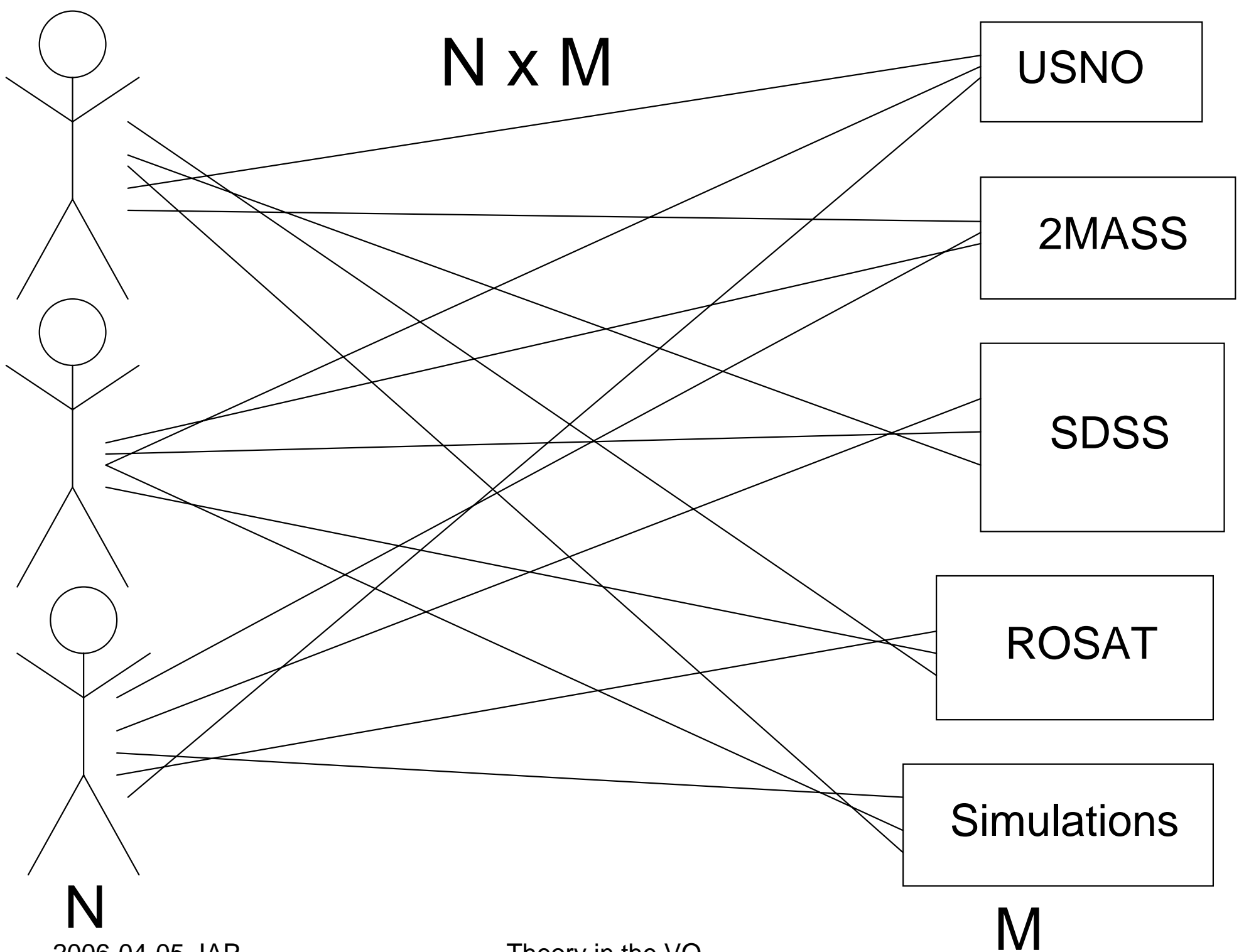


How to publish data in the VO ?

- Discovery
 - IVOA registry for resource metadata
 - Description of data products (data models)
- Retrieval
 - Standard protocols for querying, filtering (scs,siap,ssap,adql/SkyNode)
 - Standard formats for retrieved data products (VOTable ?)
- Manipulation: creating new data product on the fly
 - Cross-match
 - Virtual telescopes
- Re-publication
 - VO standards part of pipeline processing

Data model standards

- Describe data according to common language
- Why ?
 - Esperanto (= English ;-)
- How ? DM WG:
 - STC
 - Characterization
 - SED
 - Quantity
 - Observation
 - Now: Simulation
- May need unifying approach
 - Domain model for Astronomy (GL, Pat Dowler, Anthony Bandy)



$N \times M$

USNO

2MASS

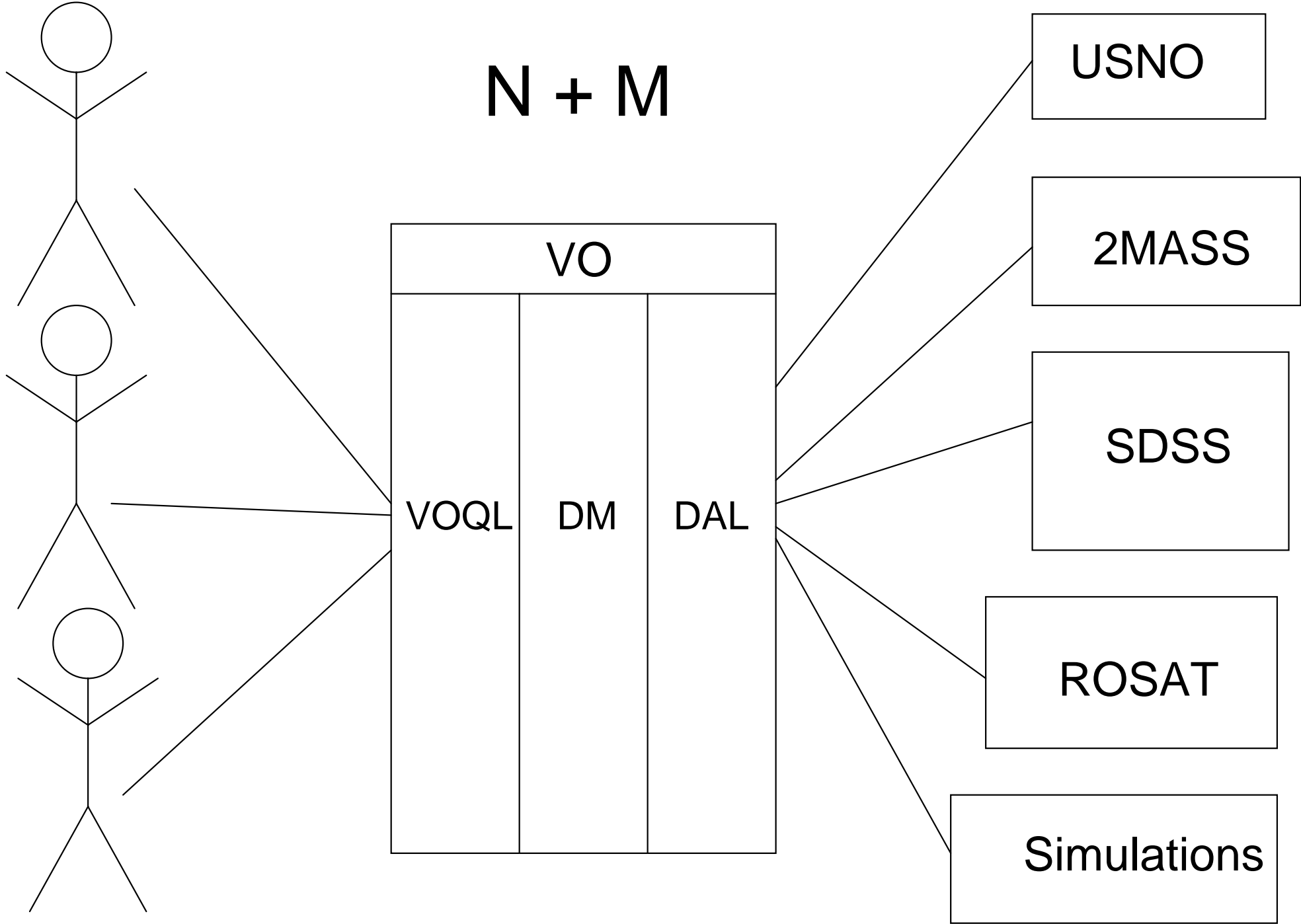
SDSS

ROSAT

Simulations

N

M



N + M

VO

VOQL

DM

DAL

USNO

2MASS

SDSS

ROSAT

Simulations

Which Simulation Data Products?

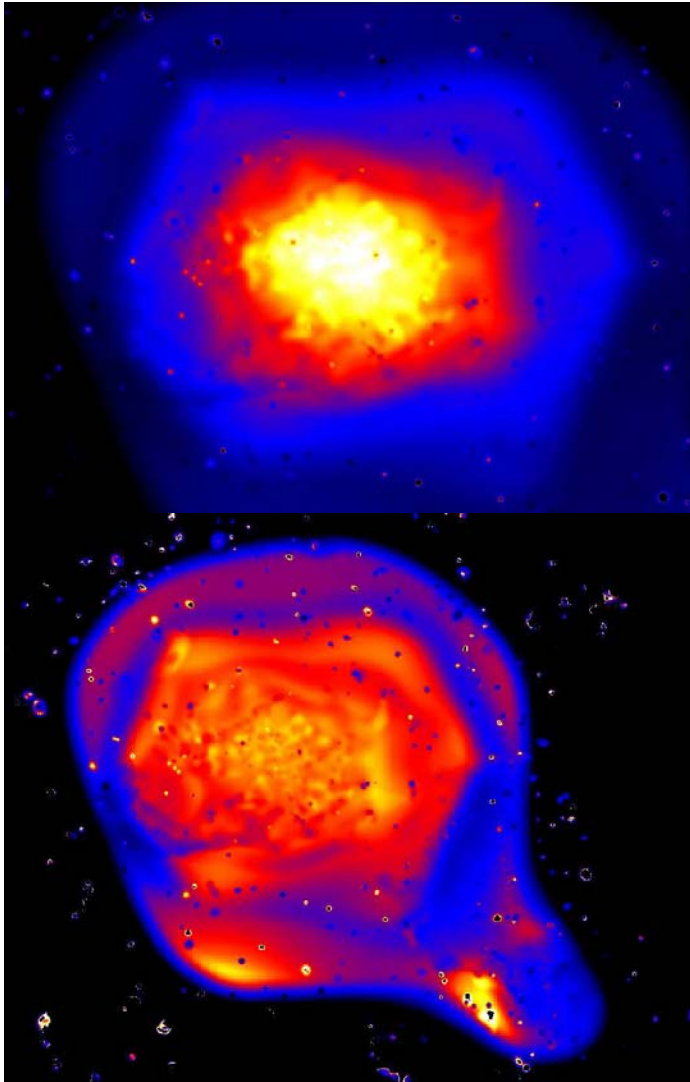
- Characterization by subject (scale)
 - Large: cosmological (CMB,LSS,Galaxy clusters)
 - Medium: galactic (Galaxy mergers, AGN jets, Galaxy composition models)
 - Small: stellar (supernovae, stellar atmospheres)
 - Tiny (Atomic and molecular databases)
- Characterization by algorithm and resulting data products
 - N-body
 - Grid
 - Synthetic spectra
 - ...
- Raw or postprocessed ?

Theory/observational interface

- Raw products for specialists only.
- Bridge gap between observers and theorists
- Two highly specialized disciplines
 - Very complex results requiring sophisticated analysis and comparisons to test theories and explain observations
 - Need to be an expert to translate theory data into observational terms and vice versa
- So let experts do so: "Virtual telescope"
 - Wrap simulations with services producing observation-like results
 - Include observational effects (PSF, seeing, noise, foregrounds)
 - Easier in this direction than the opposite way
 - Analyse results in same way as real observations
- Examples from [GAVO](#) ([Planck](#), [hydrosims](#))

Example: galaxy clusters

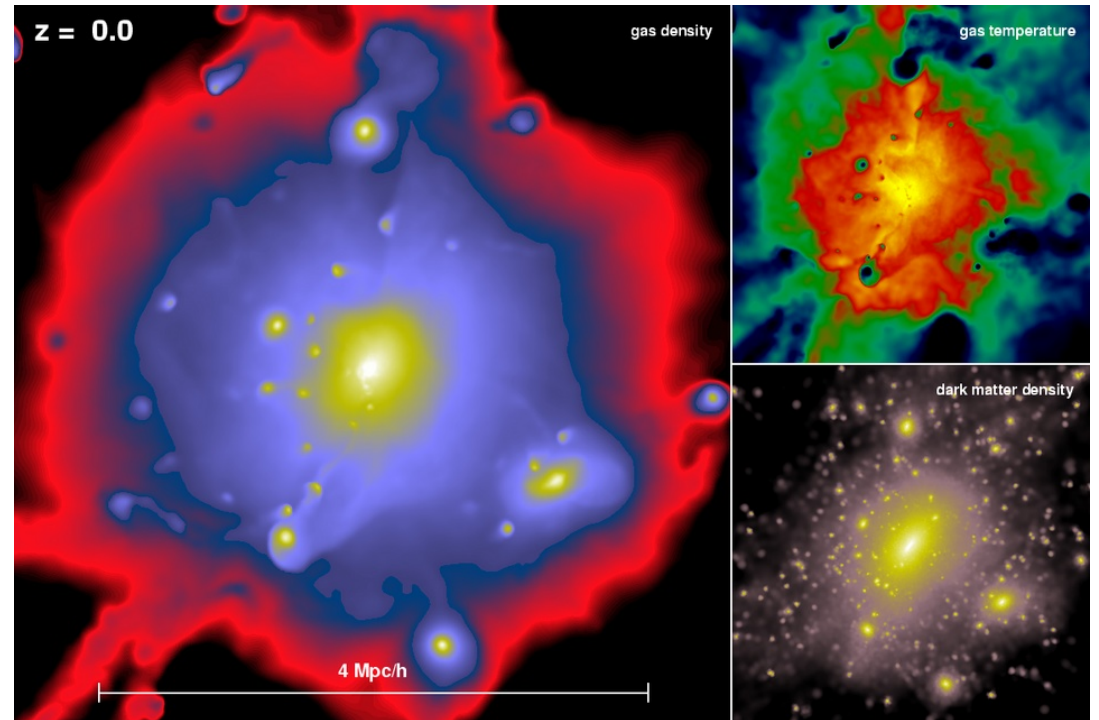
Observed



Thanks to Alexis Finoguenov, Ulrich Briel, Peter Schuecker, MPE)

2006-04-05, IAP

Simulated



Thanks to Volker Springel

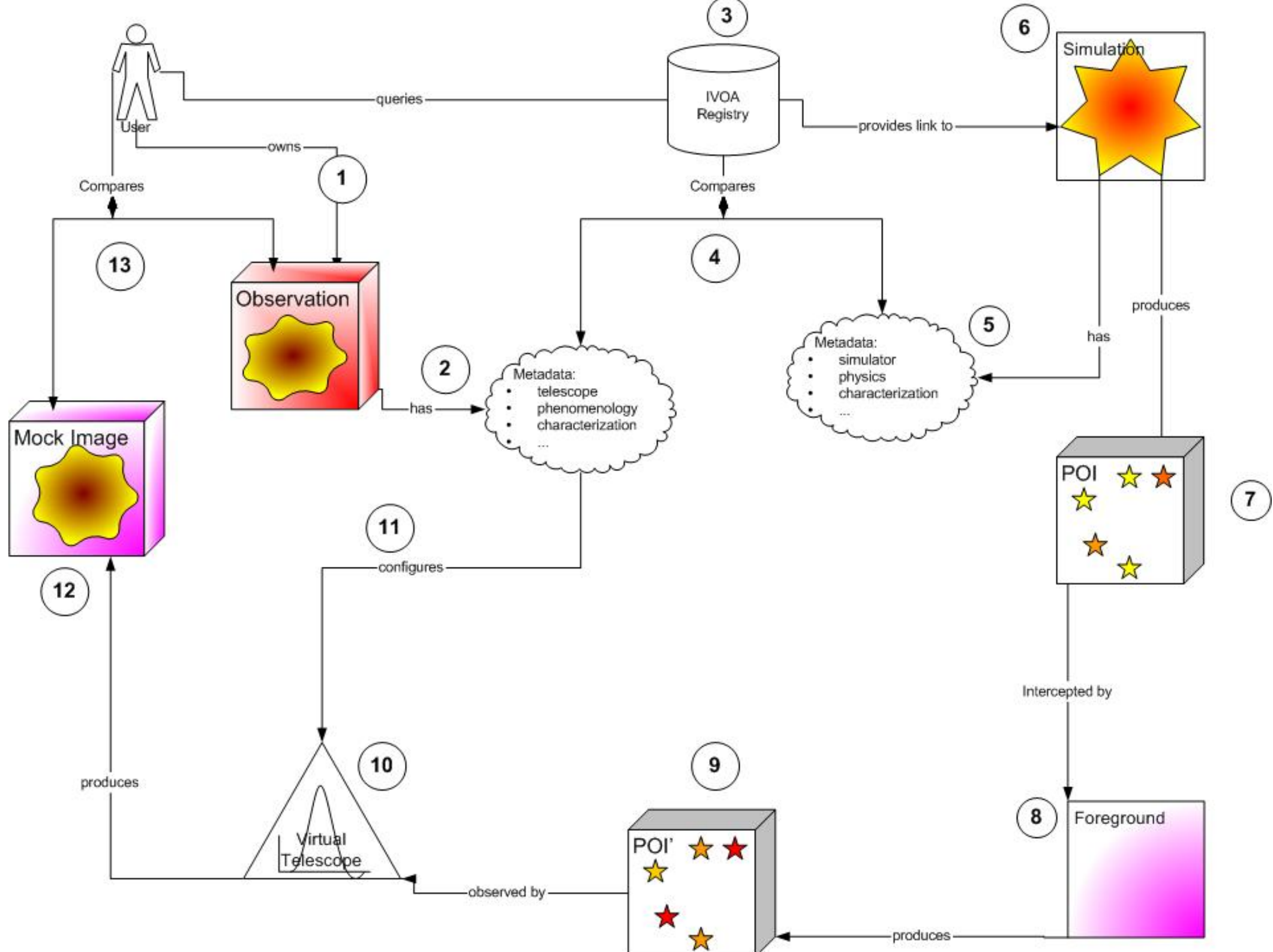
Theory in the VO

IVOA

- Theory interest group (since 2004) will:
 - Provide a forum for discussing theory specific issues in a VO context.
 - Contribute to other IVOA working groups to ensure that theory specific requirements are included.
 - Incorporate standard approaches defined in these groups when designing and implementing services on theoretical archives.
 - Define standard services relevant for theoretical archives.
 - Promote development of services for comparing theoretical results to observations and vice versa.
 - Define relevant milestones and assign specific tasks to interested parties.

Status

- National contacts
- "Formal" use case approach:
 - Extract requirements for WG
 - Communicate requirement
 - Do the work (likely)
 - Implement
- Progress monitored on [TWiki](#) pages
- Latest:
 - UCD list and simulation datamodel (Shaw et al)
 - First draft proposal for access protocol (SNAP)
 - Proposal for incorporation theory spectra in SSA
 - Suggestion to turn IG into WG



Goals

- Theory in VO potentially very interesting
- Requirements for success:
 - Active contributors
 - Standards
 - Implementations
 - Users
 - Science papers
- Means:
 - Email exploders work, but slowly
 - Workshops like this in general more effective
 - Should try to organize more of these