Searching for transits with WTS

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WFCAM Transit Survey

- Project on UKIRT telescope
  - UKIRT is operated in queue mode, WTS is a fallback programme
  - Runs since 2007, till 2012
- Targets low mass stars, J band
  - 4 fields, observed usually at the beginning of nights
- Long time range, few epochs with big gaps, faint objects
  - 03h: 300 07h: 365 17h: 380 19h: 1000

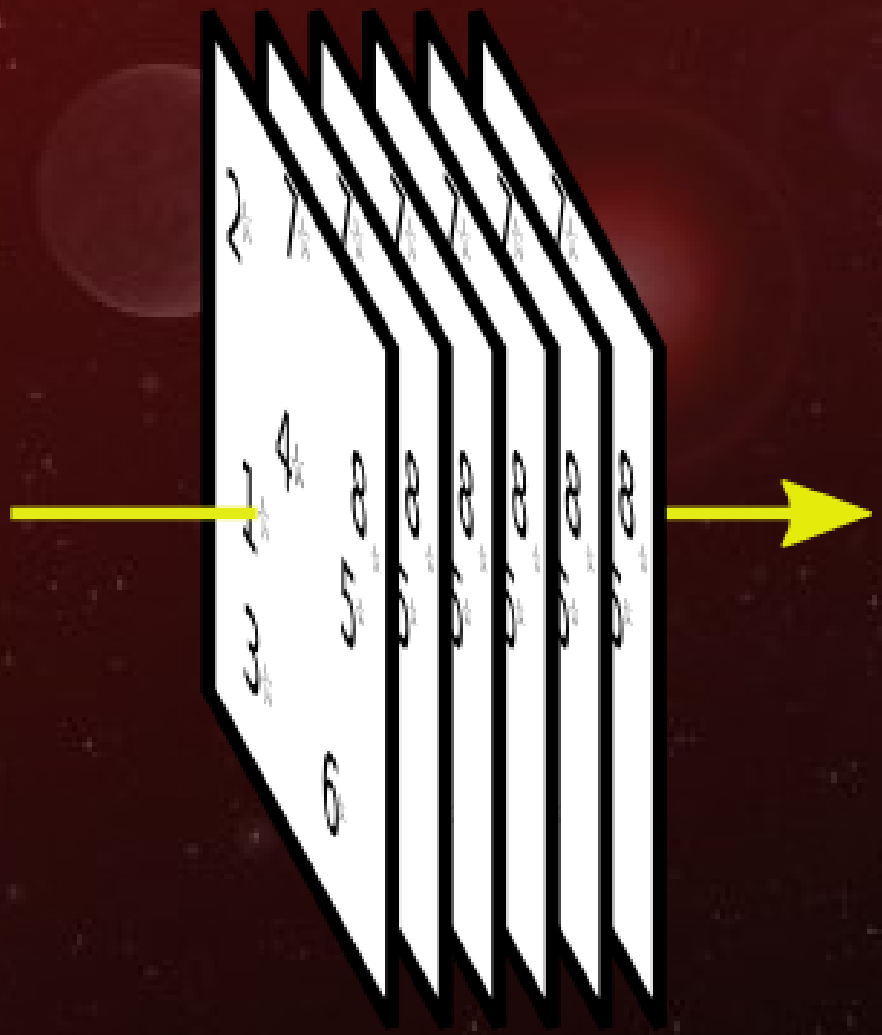
Images → LCs → Candidates

- UKIRT WFCAM images processed in Cambridge
  - basic reduction by CASU
  - WTS specific processing based on CASU tools
- Release to the RoPACS Network
  - WTS images re-processed → lightcurves
  - Transit search (occfit) → candidates
- Follow-ups, various studies in the Network

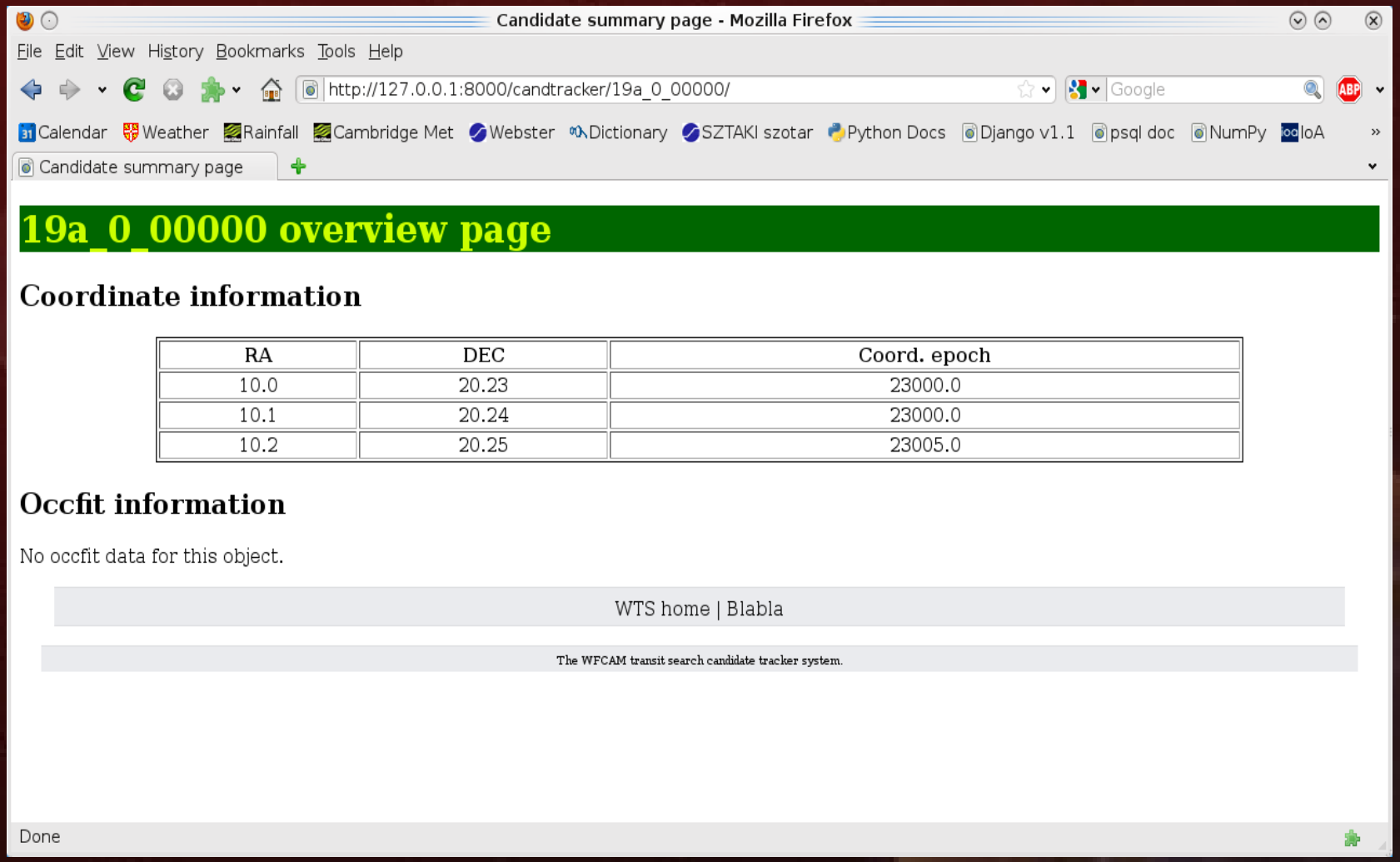
Tasks

- Pipeline development
  - built from existing low-level components
  - continuous improvement for releases
  - ensure quality and reproducibility
  - support for follow up steps
- Sensitivity analysis
  - mapping observational results onto theory
  - improvement in processing

Pipeline: light curve production



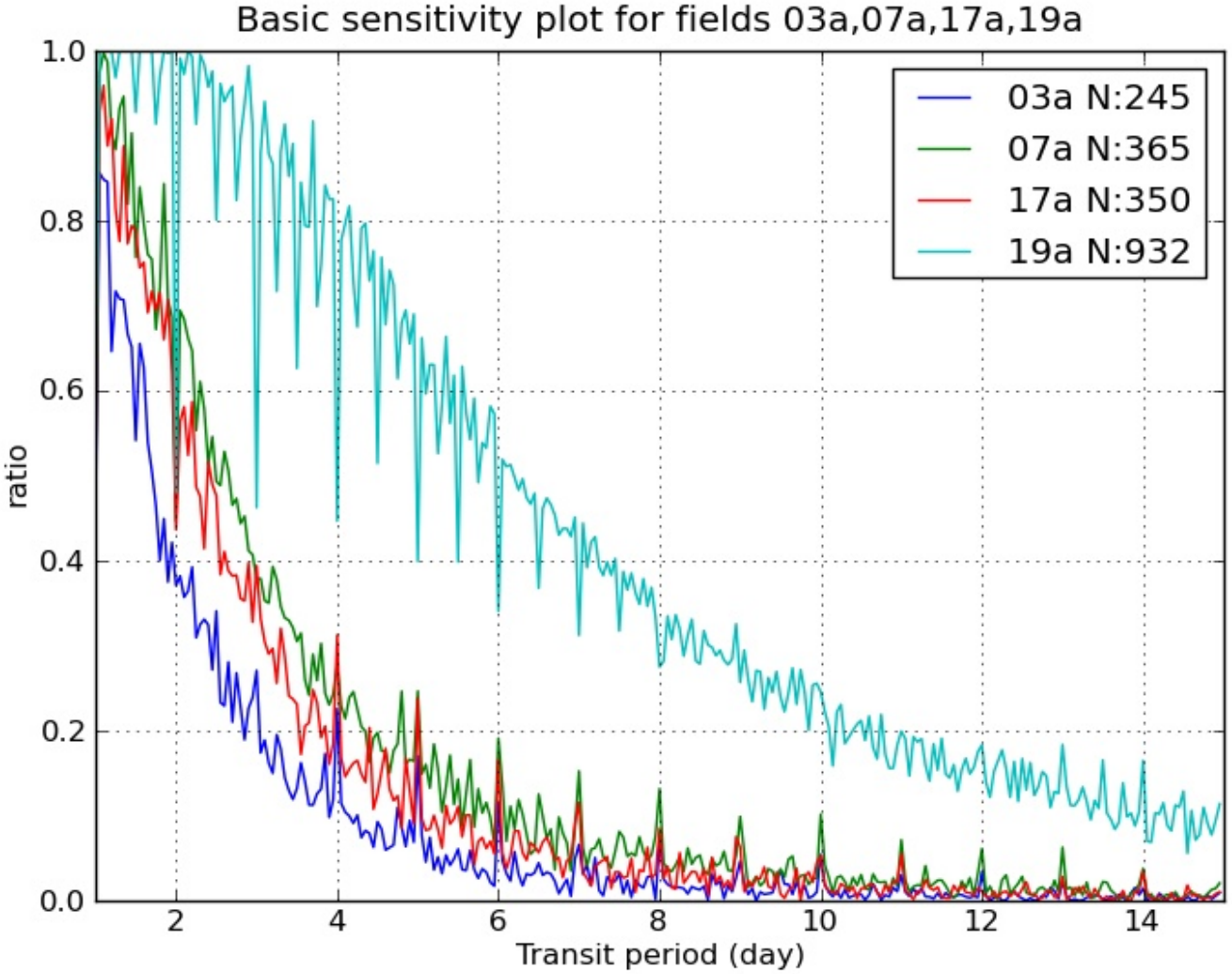
- Input:
  - Reduced WFCAM images
  - Master frame / catalogue
- Postprocessing
  - normalization
  - seeing correction
  - outlier filtering
  - possible others


Candidate summary page - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://127.0.0.1:8000/candtracker/19a_0_00000/
Google
Calendar Weather Rainfall Cambridge Met Webster Dictionary SZTAKI szotar Python Docs Django v1.1 psql doc NumPy IoA
Candidate summary page
19a_0_00000 overview page
Coordinate information
RA DEC Coord. epoch
10.0 20.23 23000.0
10.1 20.24 23000.0
10.2 20.25 23005.0
Occfit information
No occfit data for this object.
WTS home | Blabla
The WFCAM transit search candidate tracker system.
Done

Sensitivity analysis

- Insert transit signals into real data
  - Includes all the noise, systematics, detection difficulties
  - Include host-planet system parameters
    - Detection or non-detection contributes to systems statistics
  - Monte Carlo approach: drawing system parameters, calculate transit shape, add to a “flat” M dwarf lightcurve

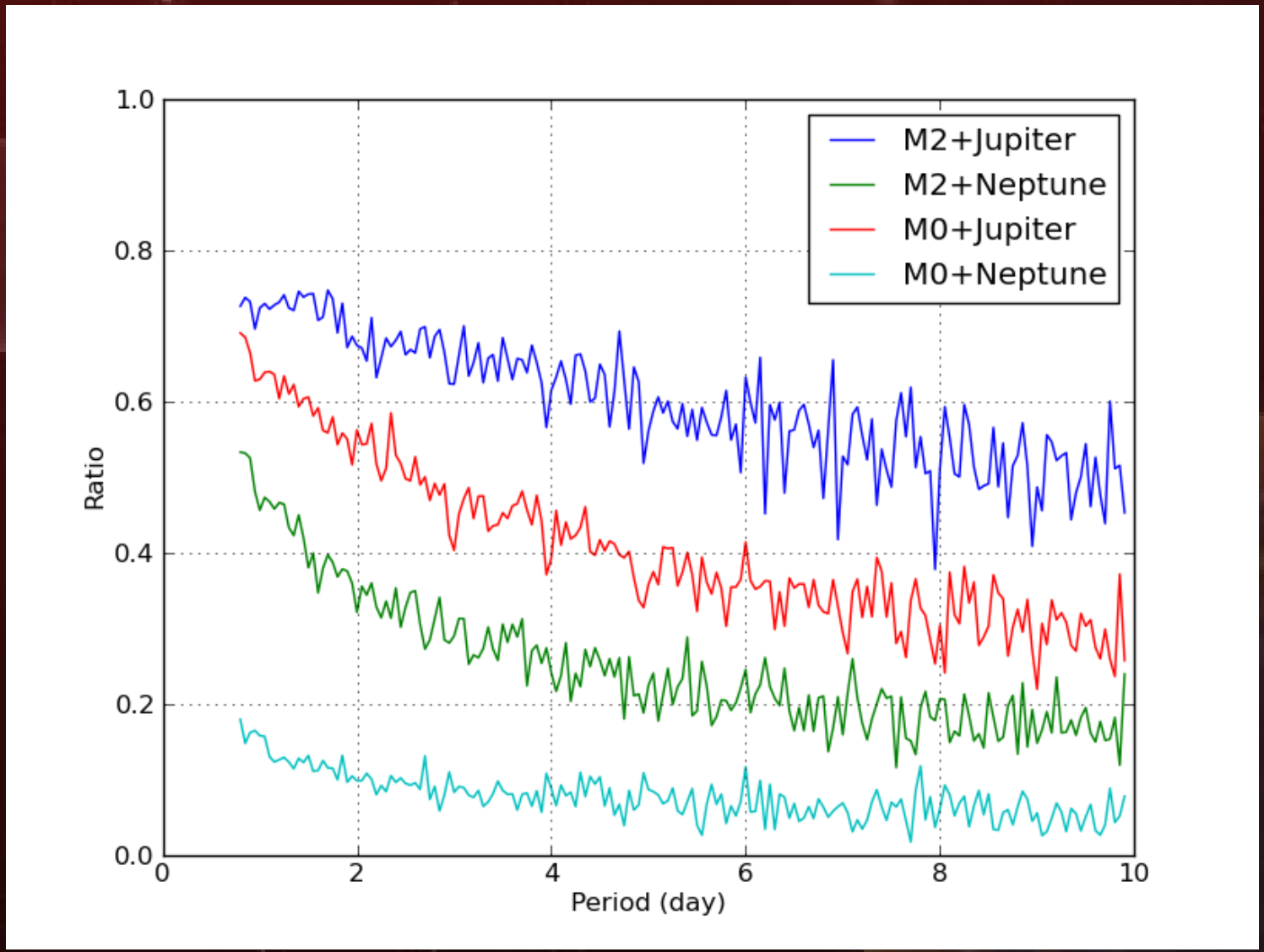
Sensitivity analysis 1



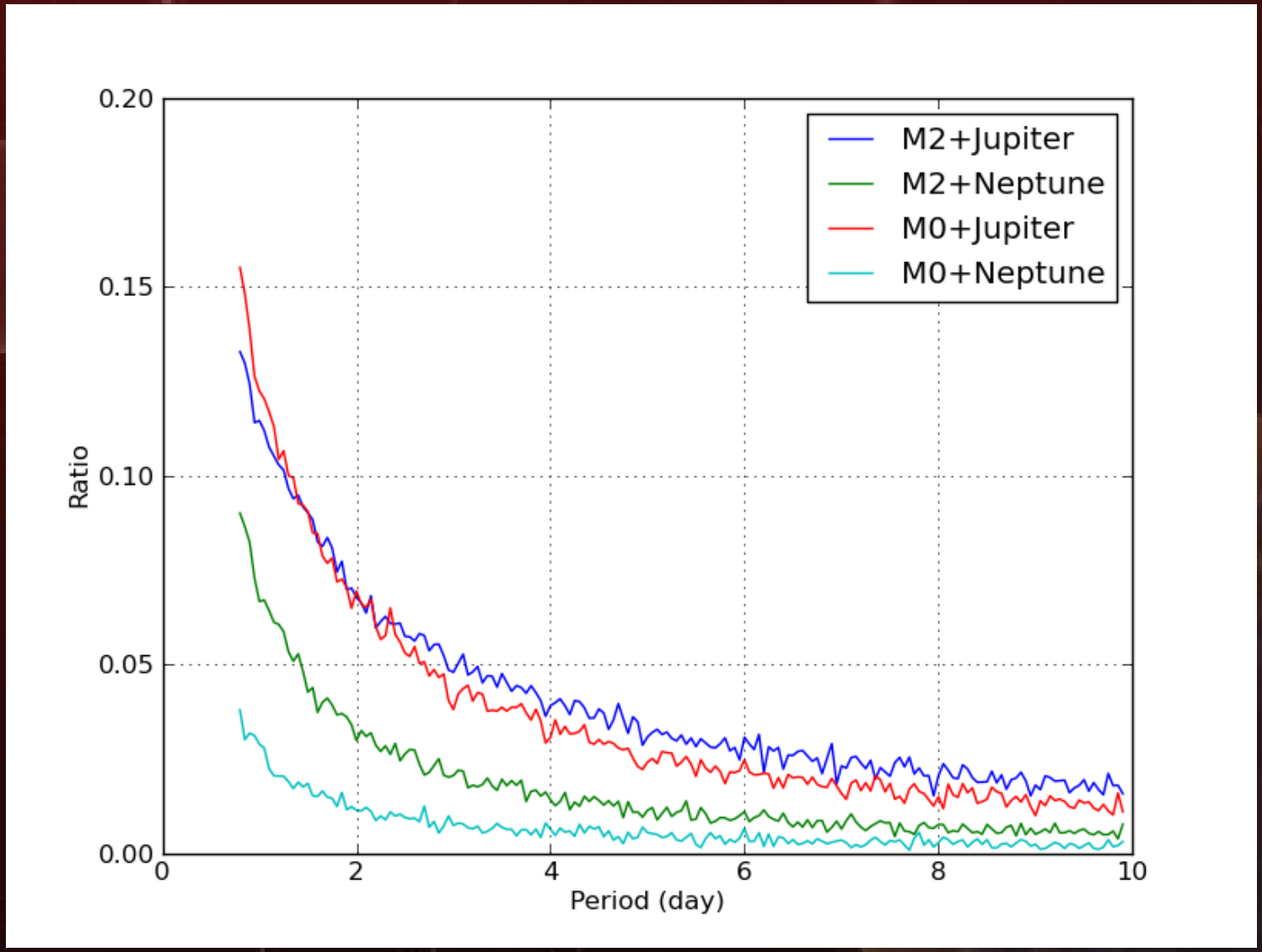
Sensitivity analysis 2

Ms	Rs	Mp	Rp	True positive	Recovery fraction
0.4	0.4	1.0	1.0	0.85	0.92
0.4	0.4	0.35	0.6	0.81	0.72
0.6	0.6	1.0	1.0	0.87	0.82
0.6	0.6	0.35	0.6	0.51	0.41

Sensitivity analysis 3a



Sensitivity analysis 3b

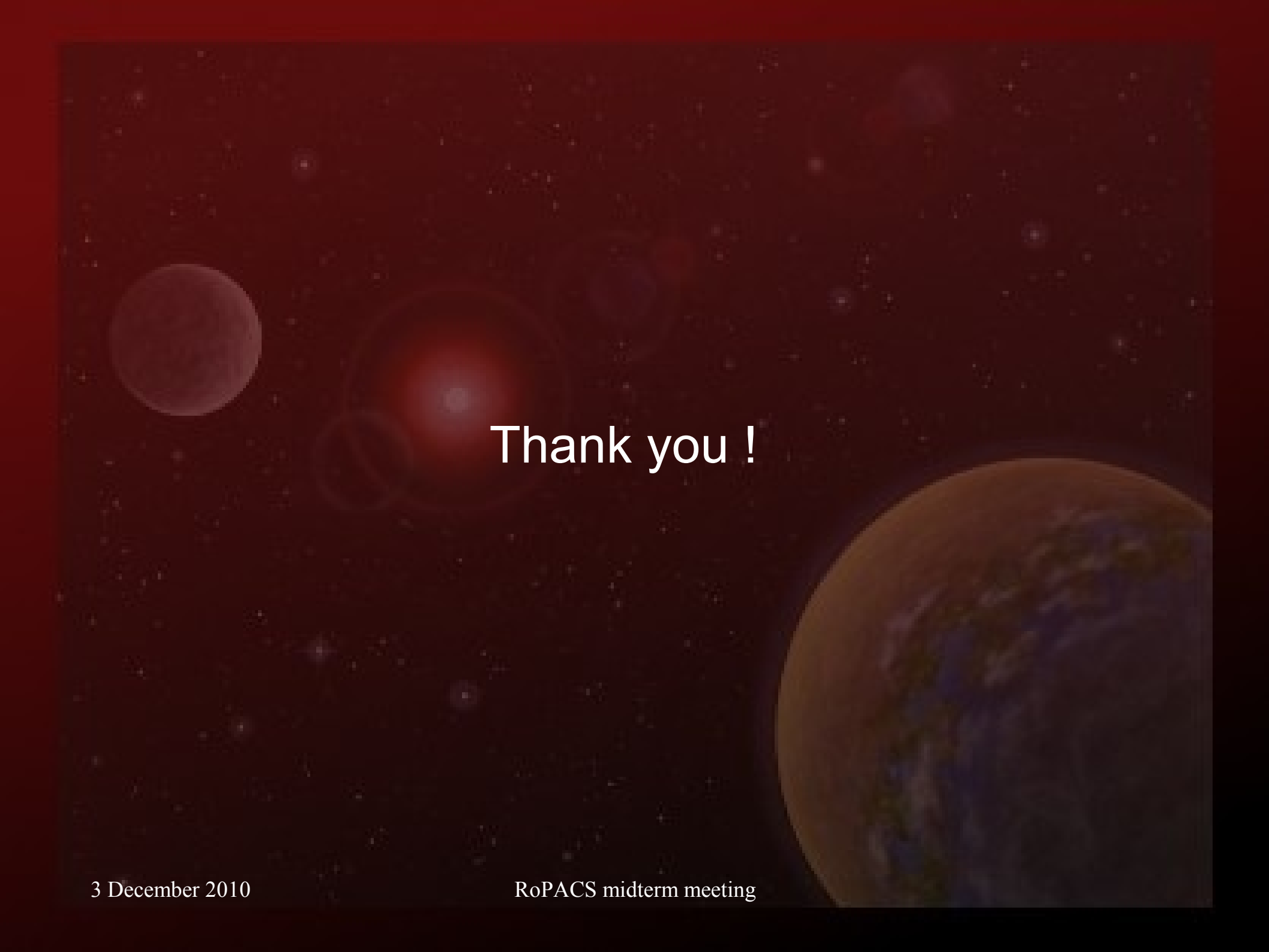


Sensitivity analysis 4

- Expected number of a certain system if all M dwarf had one, multiply by:
  - transit probability (geometry)
  - true positive ratio
  - number of M dwarf stars in our fields
- If we detect none → constraint on system occurrence

Future

- Short term goals:
  - publish results
  - prepare new release
- Long term:
  - follow up and confirmation steps → find planets


Thank you !

Field of view: 1.6 sq deg per field
Exposure: 10s
Cadence: 16min

M dwarfs J=16: 6000

exoplanets.org
exoplanet.eu

All: 452 planets,
Transiting: 79 planetary systems