- KP9 (Galaxy Properties)
  - *Measure physical properties of low z galaxies (structure, local SFH)*
  - Perhaps use our results to correct biases in unresolved galaxy pop?
  - *Correlate with spectroscopic data and environmental measures to deduce how and when various galaxy types were established*
  - Incorporate multi-wavelength ancillary imaging as much as possible
  - *Envisioned projects largely based on complete 3pi survey*
- Heckman, Thilker, Zheng, Lucey, Tully, Meurer, Vinsen -- others very welcome!

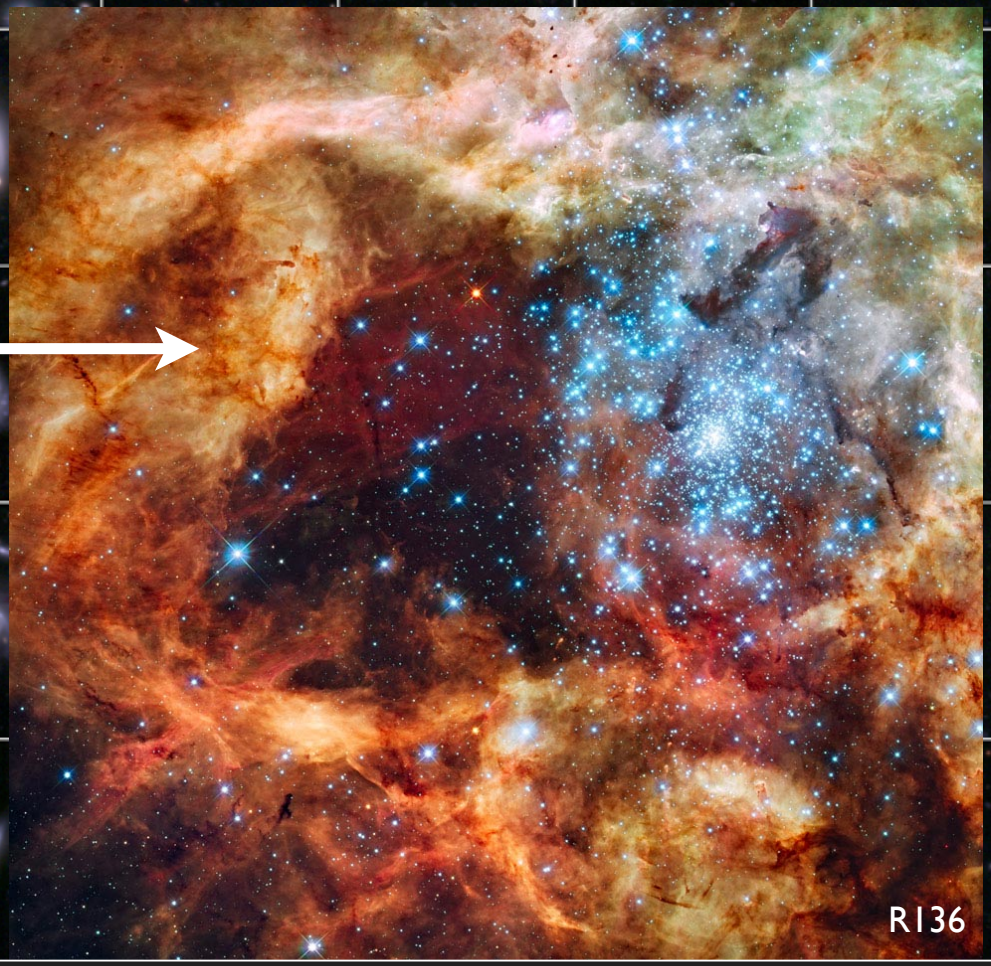
Other KPs?

David Thilker
Johns Hopkins

Pan-STARRS
PS1 Science Consortium

Durham
9 Jan 2013

Galaxies in PS1 MD04



At kpc scales dust and young stars pose an interpretational challenge requiring a multi-wavelength approach

- Simple science goals (yet neither achieved in vast numbers)
  - *Unbiased stellar mass maps*
    - Recoverable with two optical colors and luminosity (Zibetti+'08), but we can do better with Pan-STARRS1
  - *Recent SF distribution*
    - Generations used Hα imaging (biased at low rates)
    - 1st order answer from *grizy* but with signif. uncertainty
    - UV and IR data needed to truly constrain "recent" and embedded contributions, respectively

David Thilker
Johns Hopkins

Pan-STARRS
PS1 Science Consortium

Durham
9 Jan 2013

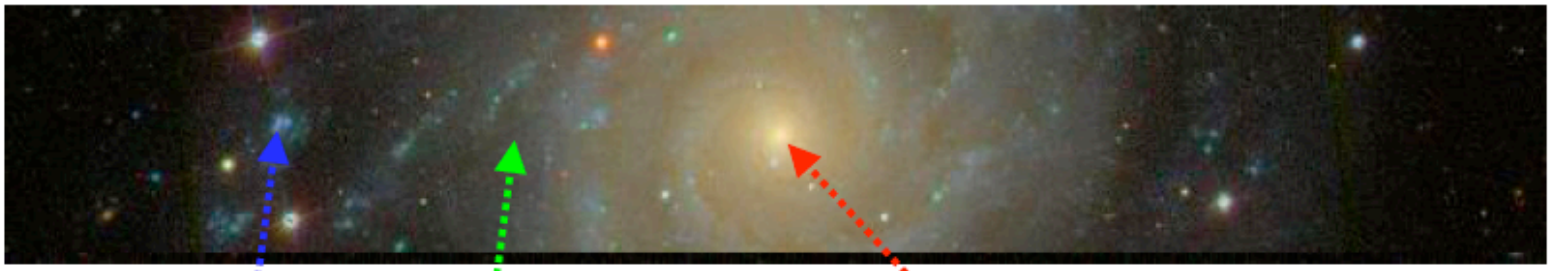
Pan-STARRS1 Optical Galaxy Survey (*POGS*)

- Meant to supersede common nearby galaxy catalogs - UGC, ESO, RC3
- All sky ($\delta > -30^\circ$) coverage from PS1 3pi
- Dual-selection by isophotal size and magnitude
  - plus distant comparison sample
- Fundamentally *panchromatic* (UV-opt-IR)
- Pixel SED fitting for resolved physical interpretation
  - maps of stellar mass, SFR, age, extinction, etc.
- Detailed multi-wavelength parametric galaxy decomposition
  - "meaningful" bulge/disk ratios, scalelengths, break radii

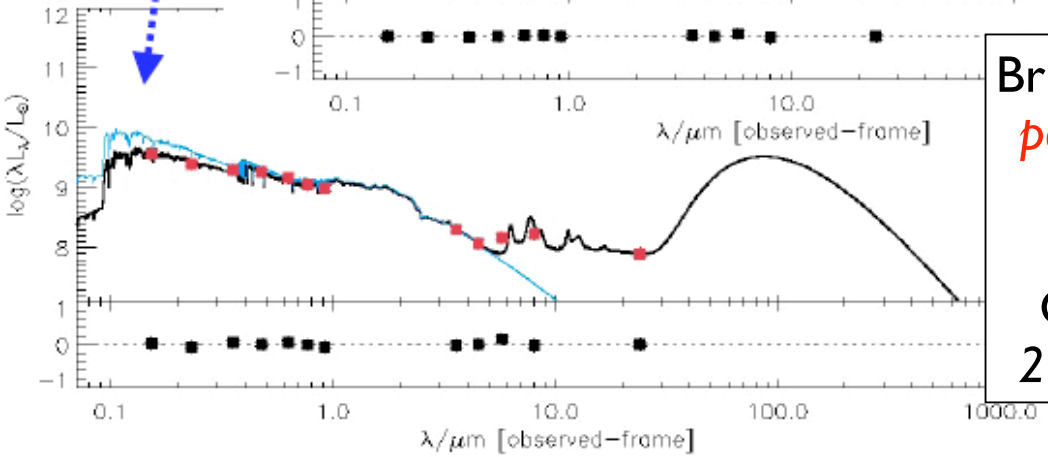
For each galaxy!

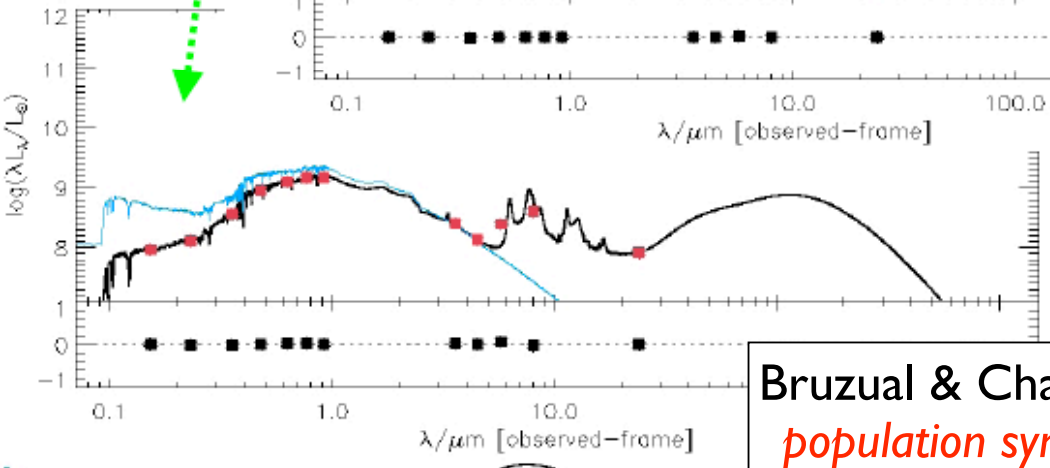
Hawaiian POGS

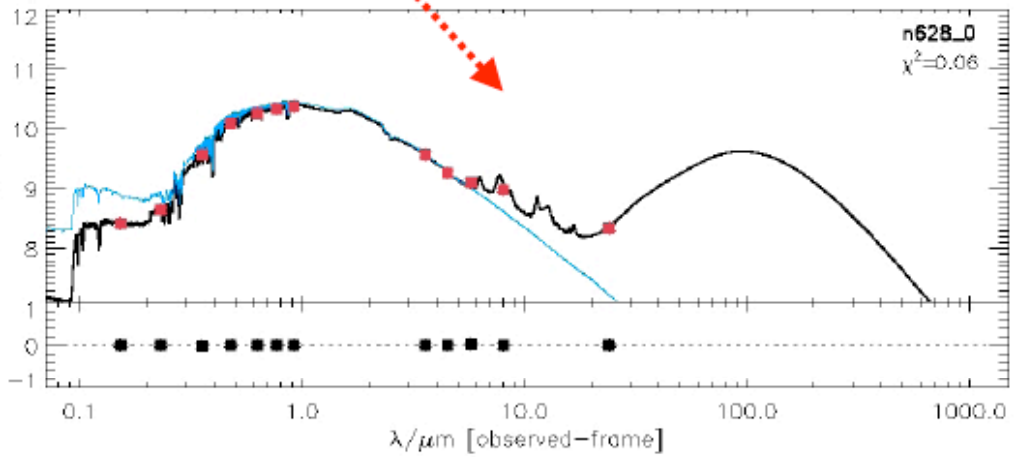
- Citizen-scientist involvement in multiple ways



MAGPHYS
da Cunha et al. '08
UV-IR SED modeling







Bruzual & Charlot (2003)
population synthesis with realistic SFHs

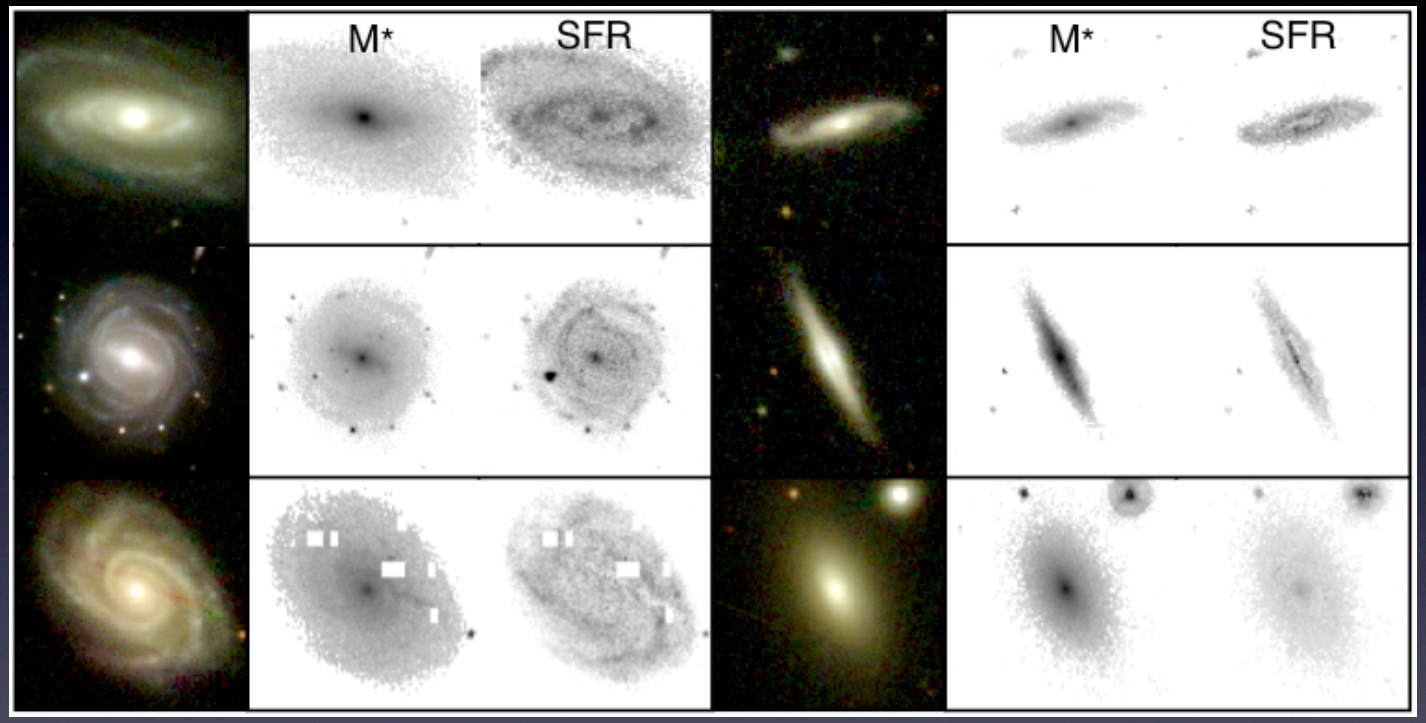
Charlot & Fall (2000)
2 component dust model

- MAGPHYS takes brute force approach to UV-IR SED fitting
  - Compares data to each possible model in large multi-dimen. parameter space
  - Allows estimation of marginalized probability distribution for each param.
  - But far too compute intensive to do pixel-based fits on a single machine
    - Several minutes per pixel-SED fitted
    - Faster alternatives involving Markov-Chain techniques being investigated
- Distributed computing / citizen-science allows SED processing
  - Project server + MAGPHYS wrapper now up and running! (thanks to Kevin Vinsen)
  - We feed multi-extension FITS files w/ res. matched panchromatic images per galaxy
  - Running development sample galaxies on Amazon before a move to "local" server

David Thilker
Johns Hopkins

Pan-STARRS
PS1 Science Consortium

Durham
9 Jan 2013

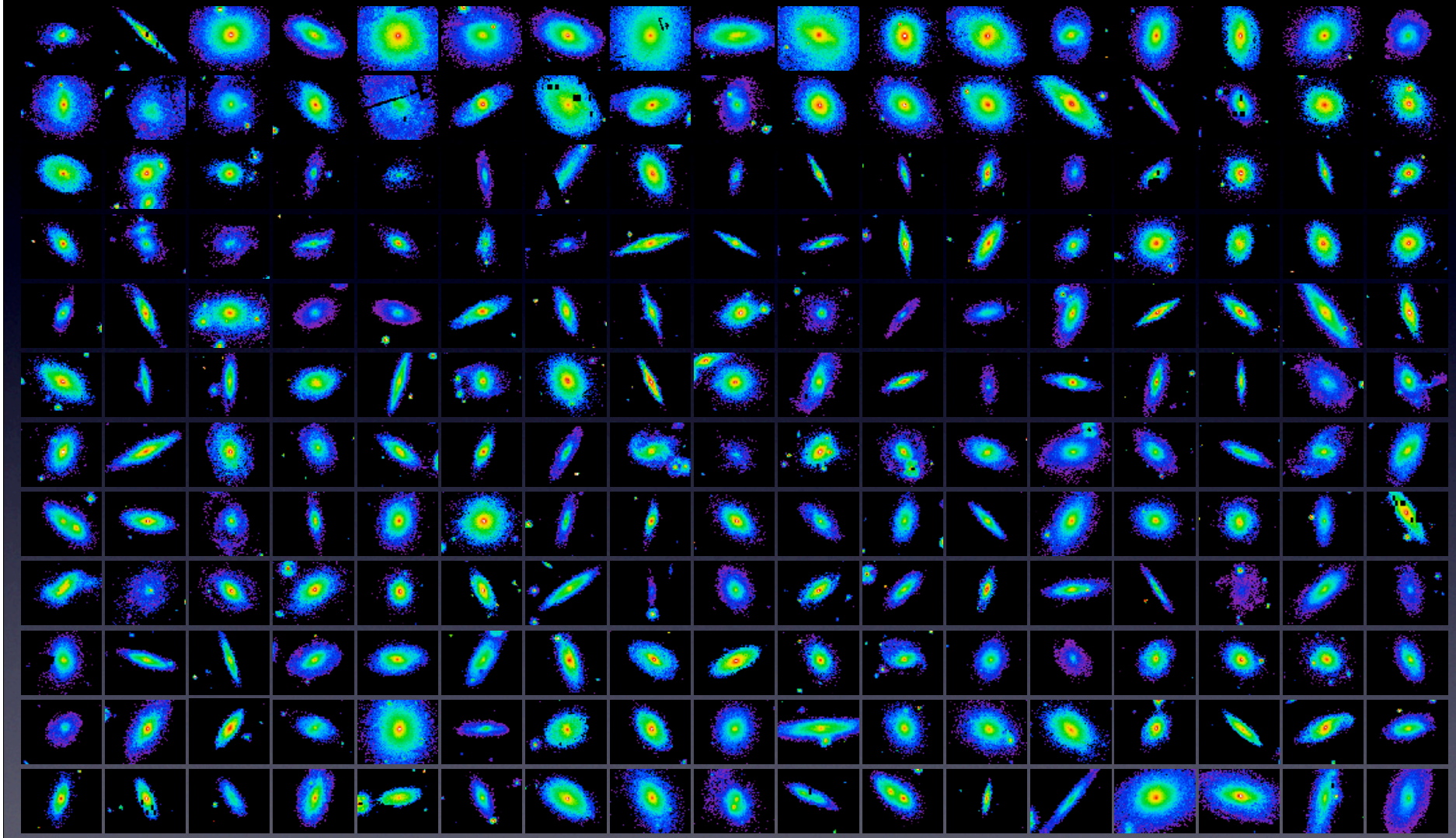


- Since the August Durham meeting, we started processing SAS2 galaxies
  - first just a few targets...

David Thilker
Johns Hopkins

Pan-STARRS
PS1 Science Consortium

Durham
9 Jan 2013

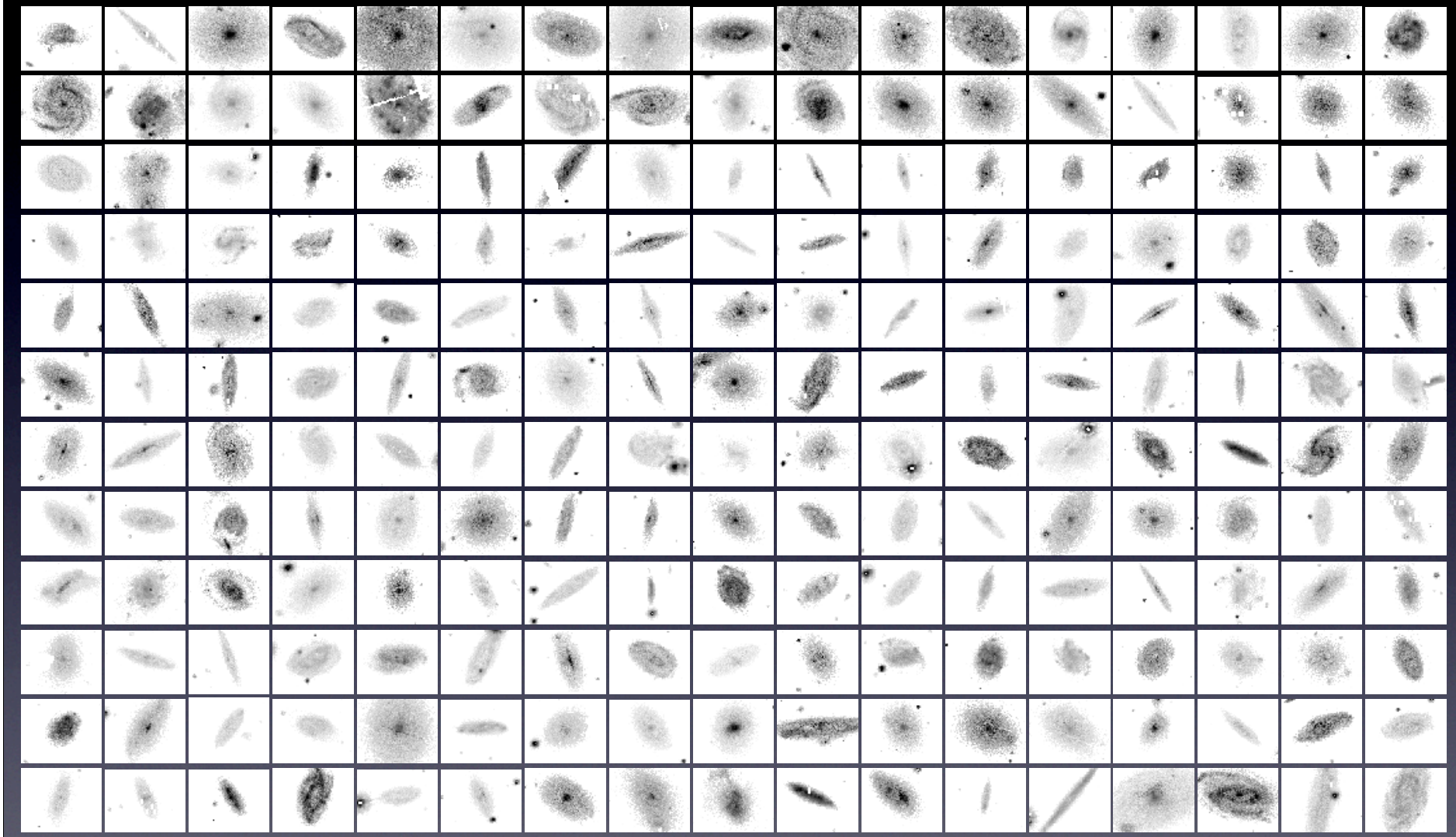


- then a flood of SAS2 galaxies - log (Mstar)

David Thilker
Johns Hopkins

Pan-STARRS
PS1 Science Consortium

Durham
9 Jan 2013



- then a flood of SAS2 galaxies - log (SFR_0.1Gyr)

- POGS galaxy sample (actually one nearby and one distant)

Sample	Selection	N(galaxies)	pixel-SED bands
UV+opt+IR base	*D25* > 1 arcmin	~ 30,000 (total)	GALEX *FUV, NUV*; [SDSS *u*] ; PS1 *grizy*, WISE *W1, W2, W3, W4*
	$r < 18$ ABmag + $0 < z < 0.025$		
Distant comparison	GAMA spec-*z* or PS1 photo-$z < 0.25$	>200,000	*ugrizYJHK*

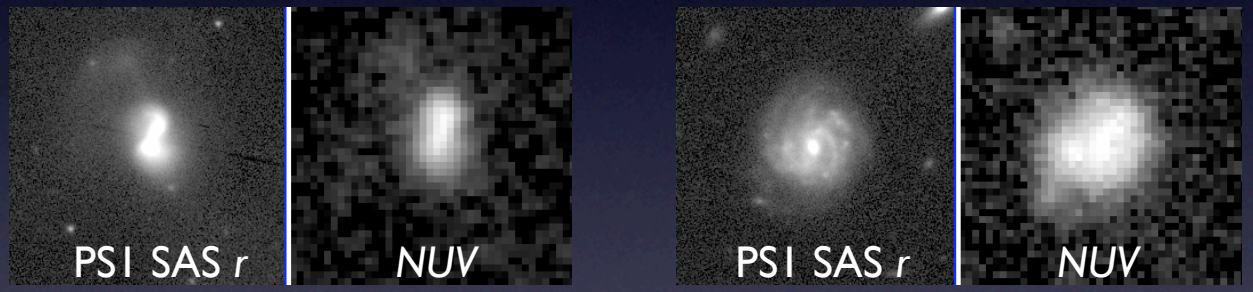
- Estimated pixel tally and processing strategy (feasible with volunteer growth)
  - 100 Million 1.5" pix for "base" sample targets
  - ~900 Million 0.5" pix for distant comparison
  - Will start with performance tests, then GAMA while waiting for 3pi, then base sample and eventually distant sample (to the level quoted above within ~3 yrs)

- POGS data sources
  - 1" / Optical (grizy) ... PS1 3pi survey

More?
  - 1.3" / Optical (u-band) ... SDSS DR9, including Stripe 82 (when available)
  - 5" / FUV, NUV ... GALEX (various surveys)
  - 6" / 3-22 micron ... WISE (all-sky release)
  - (Special cases) Spitzer (SINGS, SFRS, S^4G) and Herschel (KINGFISH)
- Implication is that the base sample POGS pixel SED fitting will likely be at ~ 6" FWHM resolution
  - However, images at full resolution will be served to archive users

- Subset of POGS bands
  - PS1 data only - attempt constraint of limited parameter set
    - 5x resolution improvement --- dramatically more galaxies become practical

1'x1' FOV

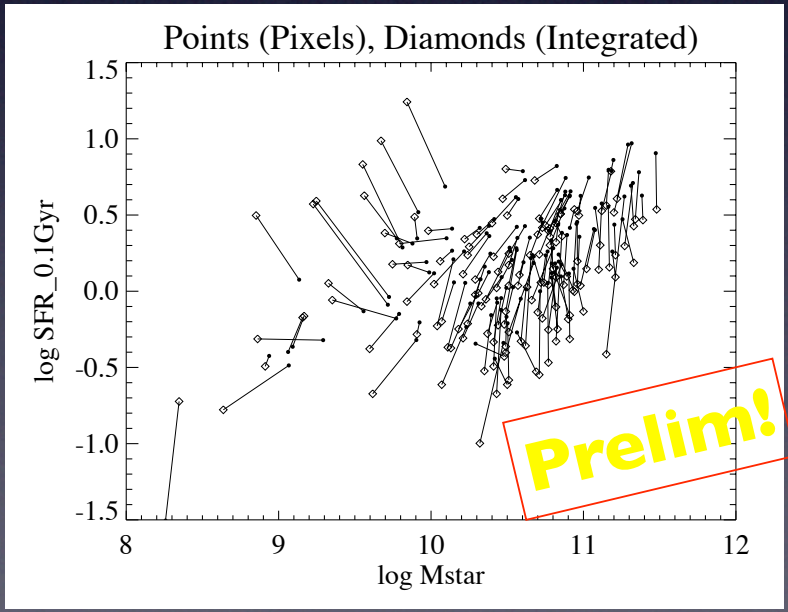


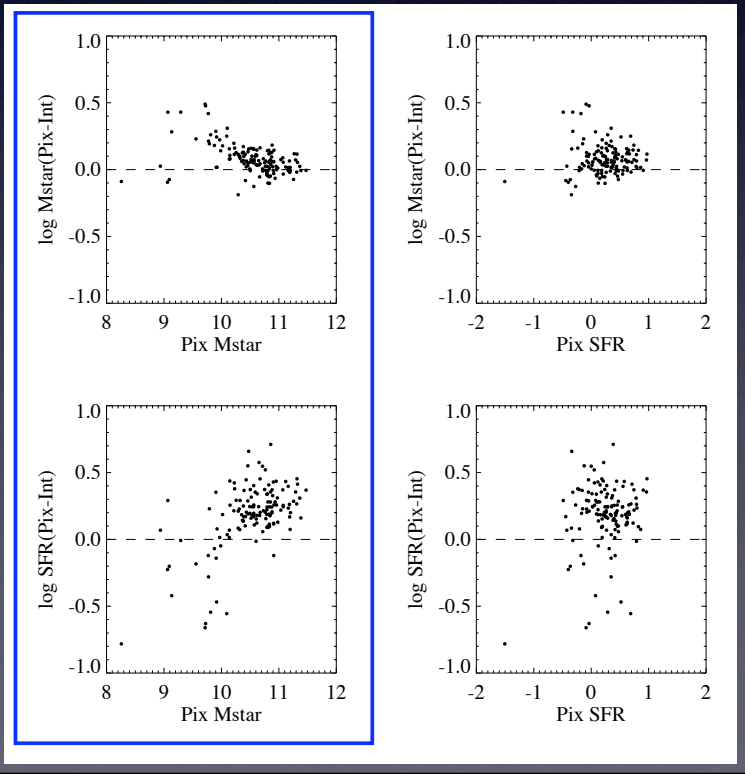
David Thilker
Johns Hopkins

Pan-STARRS
PS1 Science Consortium

Durham
9 Jan 2013

- Performance tests
  - MAGPHYS assumes closed box scenario / no radiation transfer to surroundings
  - Test 1 - Integrated fit versus sum(resolved pixels) — significant changes & trends!
  - Test 2 - Ladder of resolution choices for inter-comparison
  - Test 3 - Wavelength coverage biases





David Thilker
Johns Hopkins

Pan-STARRS
PS1 Science Consortium

Durham
9 Jan 2013

- BOINC project web interface (google "SkyNet POGS")

theSkyNet POGS - the PS1 Optical Galaxy Survey

David Thilker | log out

About theSkyNet POGS - the PS1 Optical Galaxy Survey

theSkyNet POGS is a research project that uses Internet-connected computers to do research in astronomy. We will combine the spectral coverage of GALEX, Pan-STARRS1, and WISE to generate a multi-wavelength UV-optical-NIR galaxy atlas for the nearby Universe. We will measure physical parameters (such as stellar mass surface density, star formation rate surface density, attenuation, and first-order star formation history) on a resolved pixel-by-pixel basis using spectral energy distribution (SED) fitting techniques in a distributed computing mode. You can participate by downloading and running a free program on your computer.

theSkyNet POGS is based at The International Centre for Radio Astronomy Research.

- Images you have processed
- Images for all the Galaxies used in the survey
- [Link to page describing your research in detail]
- [Link to page listing project personnel, and an email address]

Join theSkyNet POGS - the PS1 Optical Galaxy Survey

- Read our rules and policies
- This project uses BOINC. If you're already running BOINC, select Add

User of the day

rillian
I crunch for Ukraine

News

2,000+ Galaxies still in the pipe
There are still 2000+ galaxies in the pipeline 2 Jan 2013 | 22:47:09 UTC · Comment

Major Outage
We lost the Gluster Filesystem for about 4 hours this afternoon

Hopeful it is all better now 19 Dec 2012 | 8:39:59 UTC · Comment

Short outage this morning
There will be a short outage this morning whilst I add another 200GB to the database 10 Dec 2012 | 1:25:18 UTC · Comment

500,000 Areas
We've just gone past 500,000 areas

David Thilker
Johns Hopkins

Pan-STARRS
PS1 Science Consortium

Durham
9 Jan 2013

http://23.23.126.96/pogs/

BOINC: compute for science

BOINC

Search

BOINC is a program that lets you donate your idle computer time to science projects like SETI@home, Climateprediction.net, Rosetta@home, World Community Grid, and many others.

After installing BOINC on your computer, you can connect it to as many of these projects as you like.

You may run this software on a computer only if you own the computer or have the permission of its owner.

Download BOINC
7.0.31 for Mac OS X (Intel only) (5.93 MB)

After downloading BOINC you must **install** it:

- Save the file to disk.
- Double-click on the file icon.

System requirements · Release notes · Help · All versions · Version history · GPU computing

Cross-platform BOINC project manager software available
POGS-specific requirements = (Linux, OS X 10.5, Windows)

David Thilker
Johns Hopkins

Pan-STARRS
PS1 Science Consortium

Durham
9 Jan 2013

Project status

http://23.23.126.96/pogs/

David Thilker | lo

Server software version: 25897 / 4 Jan 2013 | 17:53:26 UTC

Server status

Program	Host	Status
data-driven web pages	ip-10-80-75-121	Running
upload/download server	ip-10-80-75-121	Running
scheduler	ip-10-80-75-121	Running
feeder	ip-10-80-75-121	Running
transitioner	ip-10-80-75-121	Running

Computing status

Work	#
Tasks ready to send	1,236
Tasks in progress	12,990
Workunits waiting for validation	1
Workunits waiting for assimilation	2
Workunits waiting for file deletion	1
Tasks waiting for file deletion	3
Transitioner backlog (hours)	0

Users	#
with recent credit	869
with credit	1,142
registered in past 24 hours	3

Computers	#
with recent credit	2,106
with credit	3,221
registered in past 24 hours	12
current GigaFLOPs	11,234

Tasks by application

application	unsent	in progress	avg runtime of last 100 results in h (min-max)	users in last 2
fitsedwrapper	1,470	12,937	3.14 (0.14 - 21.89)	330

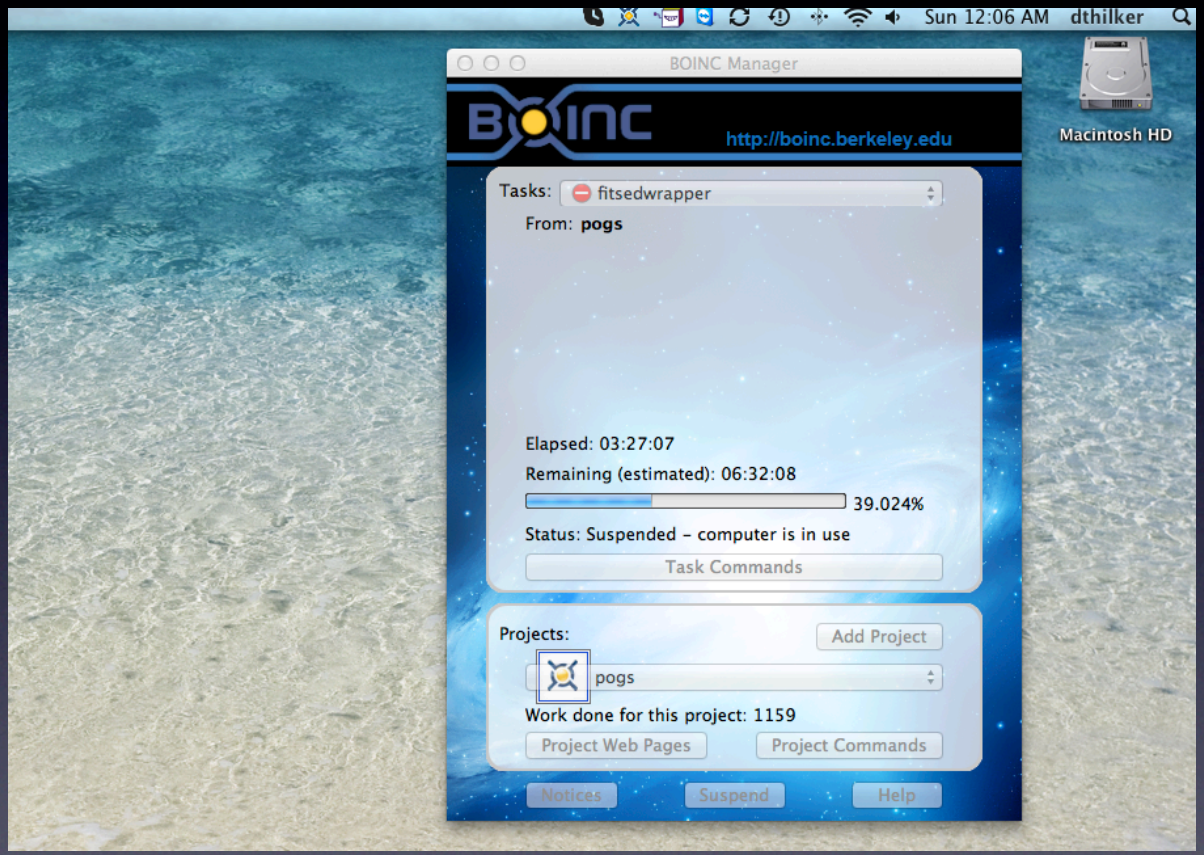
Web-based status for whole project + record of personal efforts
Recruitment of testers has been phenomenal

David Thilker
Johns Hopkins

Pan-STARRS
PS1 Science Consortium

Durham
9 Jan 2013

http://23.23.126.96/pogs/



BOINC status window shows local status on client computer

David Thilker
Johns Hopkins

Pan-STARRS
PS1 Science Consortium

Durham
9 Jan 2013

NativeBOINC

Native port of the BOINC client for Android devices and not only :)

START PAGE
LATEST NEWS
DOWNLOAD
INSTALLING
FOR USERS
DEVELOPMENT
STATISTICS
SEND QUESTION
NOTIFY BUG
THANKS FOR
ABOUT ME
NEWS FEED

Host statistics for theSkyNet POGS

Project statistics | Host statistics | User statistics | Team statistics

Please select interesting project: theSkyNet POGS

Following statistics certains only Android devices. In other words we counts credits, RAC, ranks for only Android devices, computes total credits, RAC for users and teams based on Android devices. All informations was fetched from project sites and publicly available.

Total count: 31

last month	last week	last day	Rank	CPU type	# CPU	Owner	Total credits	Credit/ day	Credit/ week	Credit/ month	RAC
New	0	0	1	ARMv7 Processor rev 2 (v7l) @1620MHz	2	matszpk	6894.15	318.60	1699.20	6894.15	265.89
New	New	1	2	ARMv7 Processor rev 9 (v7l) @1300MHz	4	mimo	5177.25	477.90	5177.25	5177.25	386.49
New	1	1	3	ARMv7 Processor rev 9 (v7l) @1700MHz	4	mimo	4743.60	0.00	0.00	4743.60	113.73
New	2	0	4	ARMv7 Processor rev 0 (v7l) @1400MHz	4	Spade Ace	2955.90	177.00	1239.00	2955.90	160.29
New	1	0	5	ARMv7 Processor rev 3 (v7l) @1000MHz	2	Coleslaw	2743.50	159.30	460.20	2743.50	100.58
New	3	0	6	ARMv7 Processor rev 0 (v7l) @1600MHz	4	kelvin_maximus	2398.35	0.00	0.00	2398.35	76.42
New	18	1	7	ARMv7 Processor rev 1 (v7l) @1024MHz	1	amazing	2292.15	168.15	2141.70	2292.15	158.05
New	3	1	8	ARMv7 Processor rev 0 (v7l) @1600MHz	4	Karri	2239.05	0.00	0.00	2239.05	39.40
New	7	1	9	ARMv7 Processor rev 1 (v7l) @1200MHz	2		1893.90	159.30	1424.85	1893.90	128.40
New	3	1	10	ARMv7 Processor rev 0 (v7l) @1608MHz	2	Chugumoto	1858.50	0.00	150.45	1858.50	75.40
New	3	0	11	ARMv7 Processor rev 2 (v7l) @1512MHz	2	Spade Ace	1442.55	0.00	0.00	1442.55	34.30
New	New	6	12	ARMv7 Processor rev 0 (v7l) @1600MHz	4	kelvin_maximus	1424.85	504.45	1424.85	1424.85	109.16
New	4	1	13	ARMv7 Processor rev 1 (v7l) @1400MHz	2		1309.80	0.00	0.00	1309.80	20.26
New	4	1	14	ARMv7 Processor rev 0 (v7l) @1400MHz	4	Daniel Carrion	1283.25	0.00	0.00	1283.25	24.31
New	4	1	15	ARMv7 Processor rev 1 (v7l) @1024MHz	1	m.mitch	1212.45	0.00	0.00	1212.45	29.82
New	4	1	16	ARMv7 Processor rev 0 (v7l) @1400MHz	4	Daniel Carrion	1177.05	0.00	0.00	1177.05	14.82
New	4	1	17	ARMv7 Processor rev 9 (v7l) @1300MHz	4	JCDK	1123.95	0.00	0.00	1123.95	17.69

http://nativeboinc.org/

POGS "BOINC Android" client up and running!
Pan-STARRS crunching on your phone or tablet.

David Thilker
Johns Hopkins

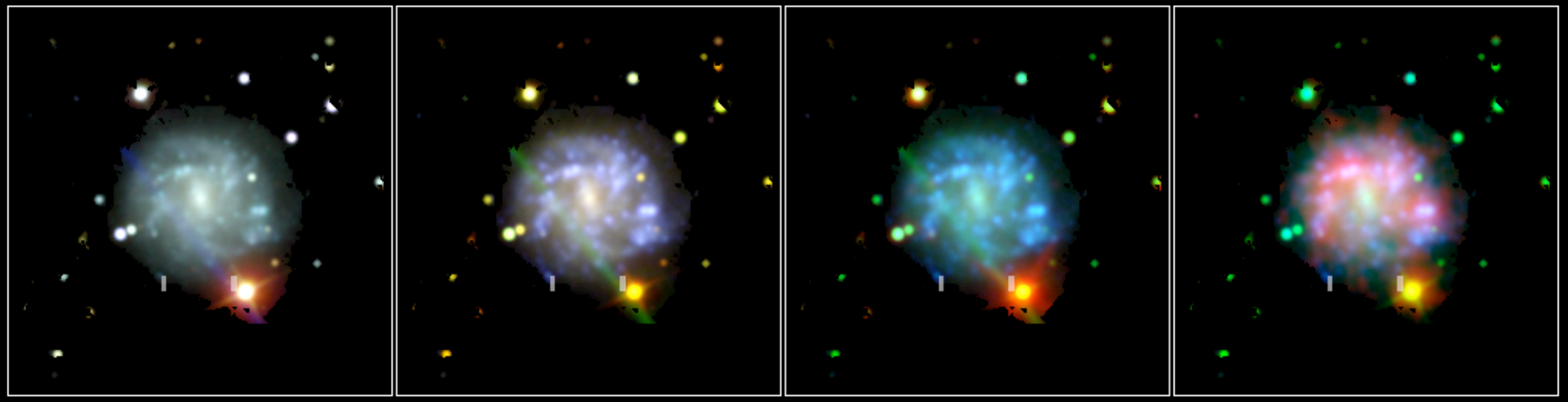
Pan-STARRS
PS1 Science Consortium

Durham
9 Jan 2013

http://23.23.126.96/pogs/

theSkyNet POGS - the PS1 Optical Galaxy Survey

The bright square or rectangular areas are those where you have been credited with the processing.



Stamp collection incentive for volunteers -- Galaxy images with the locations processed by their computer(s) marked

And now the parameter maps are also displayed!

David Thilker
Johns Hopkins

Durham
9 Jan 2013

- Example science applications of POGS pixelSED fits
  - Build-up of disks, spheroids / age of bars (JHU)
  - Mass modeling for SFL and rotation curve interpretation (ICRAR)
  - Hierarchical SF - demographics, clustering of young regions (JHU)
  - PAH emission vs. local environmental conditions (12 micron W3)
  - Resolved gas-to-dust analysis (WALLABY@ASKAP + WNSHS)
- Upcoming "crowd sourcing" project extension (a la GalaxyZoo)
  - Galfit to be done on mass map, defining structures - then "colored" using pixelSED models integrated in areas of feature dominance (disk, bulge, bar)
  - Interactive vetting of multi-wavelength galfit models against color imaging

David Thilker
Johns Hopkins

Durham
9 Jan 2013

- Tully, Meurer, Tonry and collaborators:
  - A Catalog of Galaxy Distances using the T-F relation
    - Uniform, deep photometry for nearby galaxies, coupled with rotation curve information
    - 3pi completion + sky background restoration essential
- Image stacking analysis (proposed by A. Ferguson + S. Zibetti)
  - color and luminosity measurement of stellar halos
  - link halo to galaxy properties
  - outer disk profiles

David Thilker
Johns Hopkins

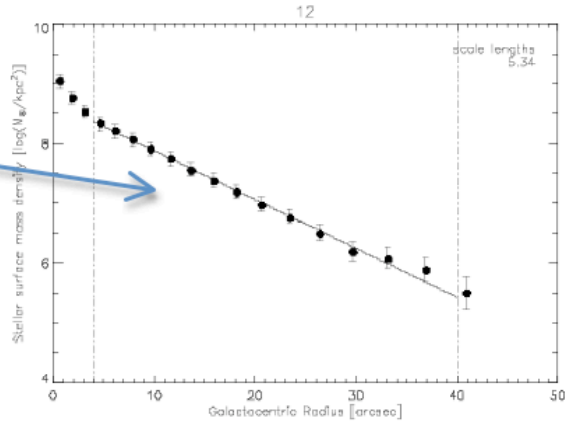
Pan-STARRS

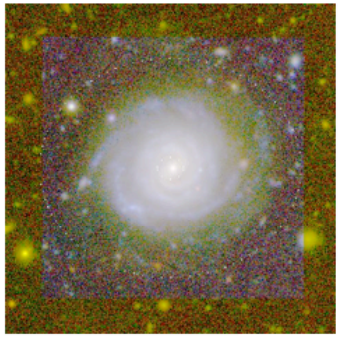
Durham
9 Jan 2013

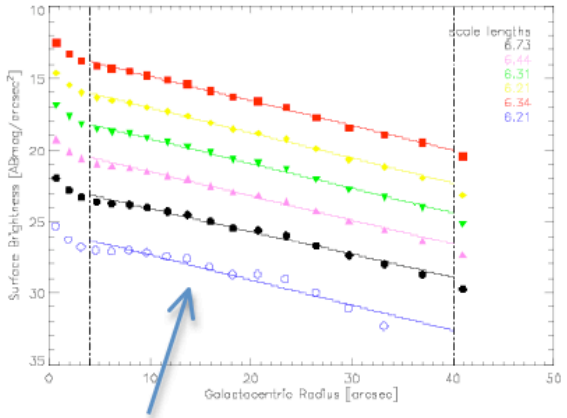
Zheng+, PS1 MDS disk mass profiles

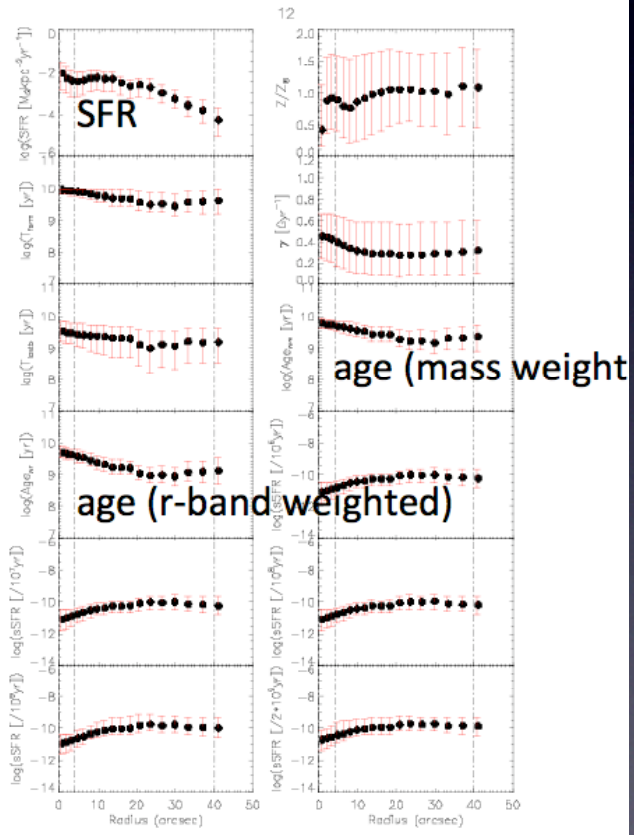
Type I Stellar mass radial profile

stellar mass profile
single exponential









Surface brightness (from top to bottom: y z i r g u)

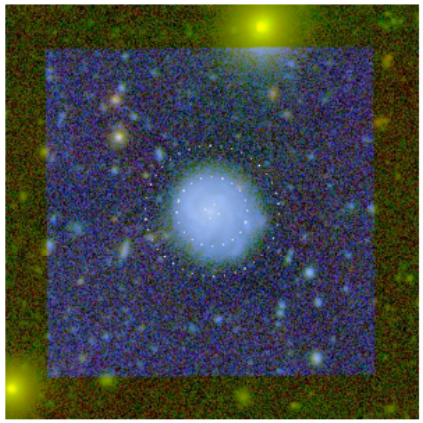
David Thilker
Johns Hopkins

Pan-STARRS

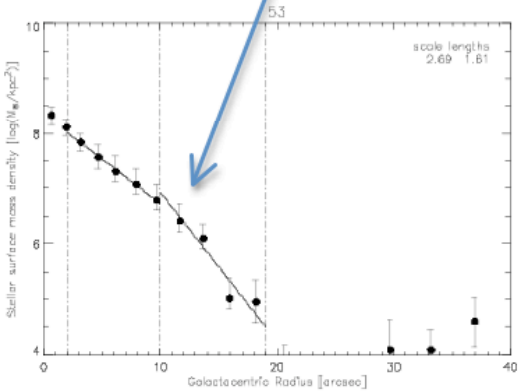
Durham
9 Jan 2013

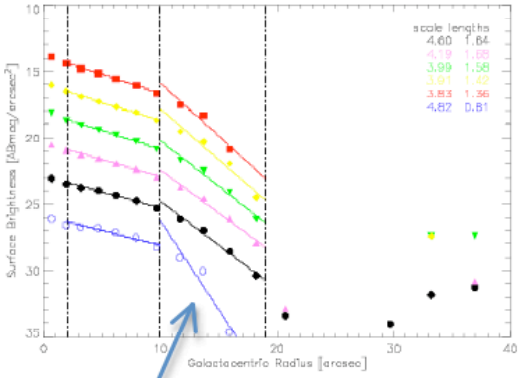
Zheng+, PS1 MDS disk mass profiles

Type II

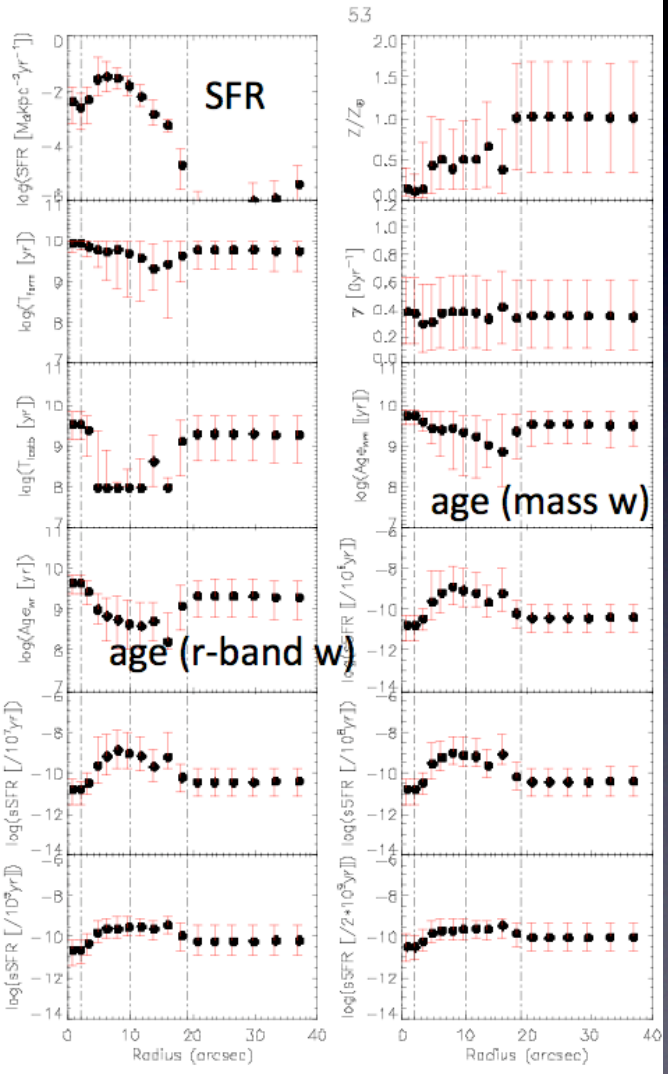


stellar mass profile
down bending





Surface Brightness



David Thilker
Johns Hopkins

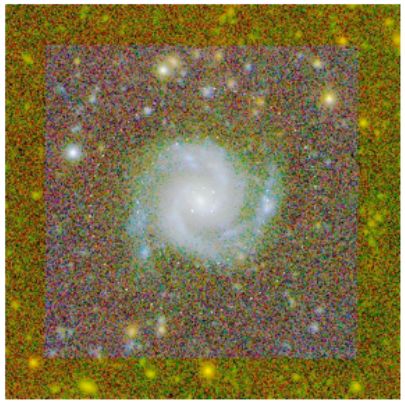
Pan-STARRS

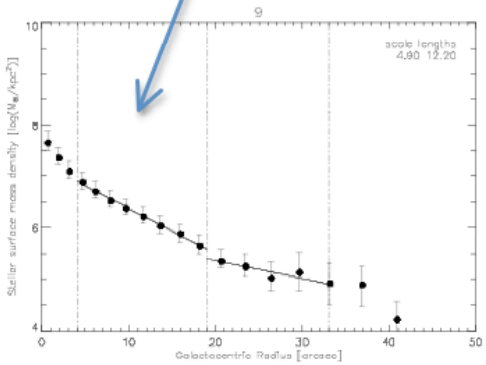
Durham
9 Jan 2013

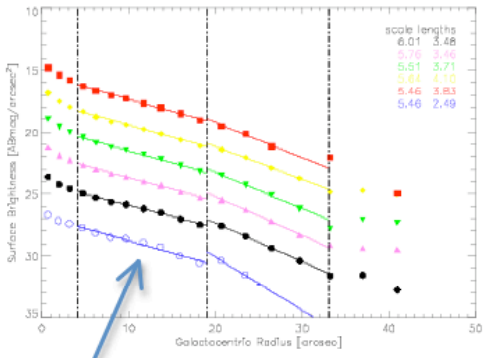
Zheng+, PS1 MDS disk mass profiles

Type III

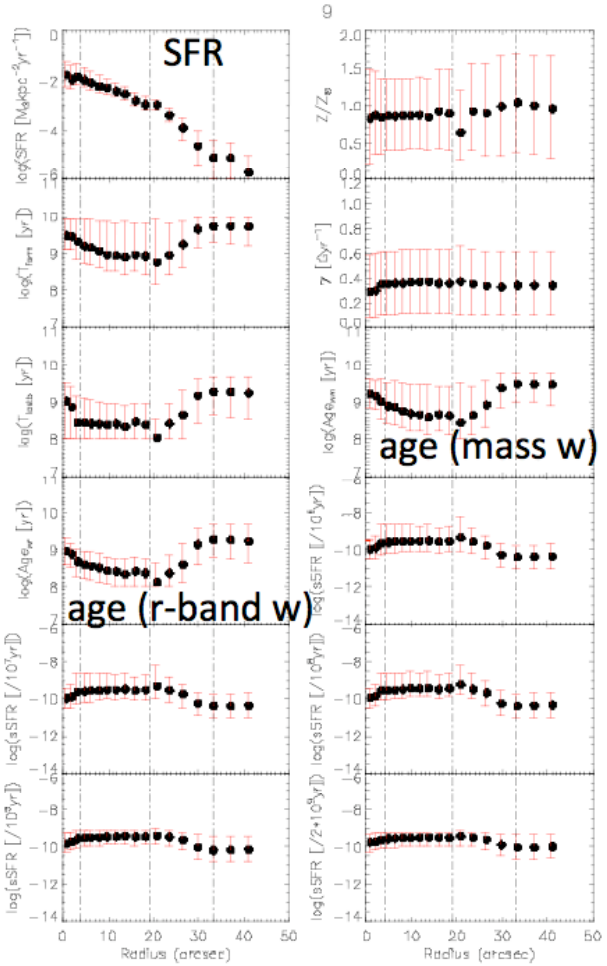
stellar mass profile
up bending







Surface Brightness



David Thilker
Johns Hopkins

Pan-STARRS

Zheng+, PS1 MDS disk mass profiles

Durham
9 Jan 2013

Stellar mass manifests differently from SB because different star formation history and dust attenuation changes the 'mass-to-light ratio'.

Stellar mass radial profiles also have 3 types, consistent with PT06, but up-bending profiles are more often than PT06.

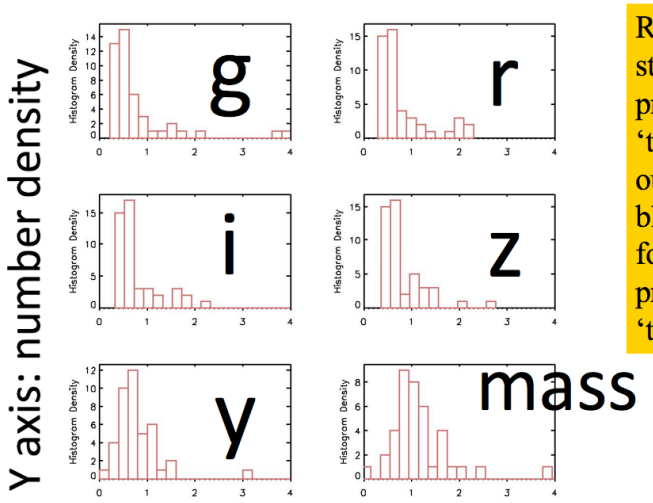
Star formation radial profiles is more likely to turn down comparing to the stellar mass profiles.

The outer disk seems more likely to be dominantly formed by stellar migration. Presence or lack of XUV-disk SF is not adequately addressed by these data.

We are planning to study for trends in the ancillary profiles in relation to the position of the mass breaks.

In the future, we also plan to use the PS1 3pi data, this will bring in many more galaxies and also allow incorporation of GALEX data.

(outer-inner) disk scale length ratio



Redder bands and stellar mass radial profiles tend to 'turn up' in the outer disks. Whilst bluer bands and star formation radial profiles tend to 'turn down'.

David Thilker
Johns Hopkins

- "Pan-Squared Project" (lead: Heckman)
  - mine PS1 imaging of SDSS main galaxy sample
  - many aspects now incorporated into POGS
- "Pan-STARRS High-Redshift Galaxies Project" (H. Ferguson)
  - distr. of (*M*, *SFR*, morphology | z_{phot})
  - PS1 MDS focused
  - blends with KP12 -- some results already shown here
    - distinction between KPs presumably unnecessary
- KP5 -- MW hot white dwarf census (Bianchi, Long, Thilker)
  - GALEX-PS1 stellar matched catalog -- color selection
  - IFMR constrain by comparing counts to MW models

- Backup slides

David Thilker
Johns Hopkins

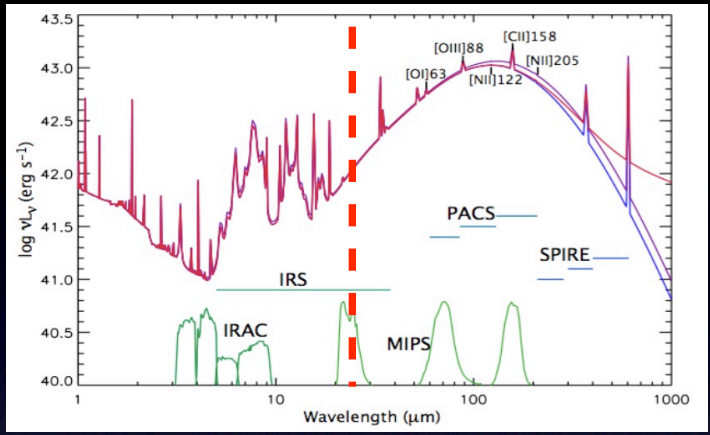
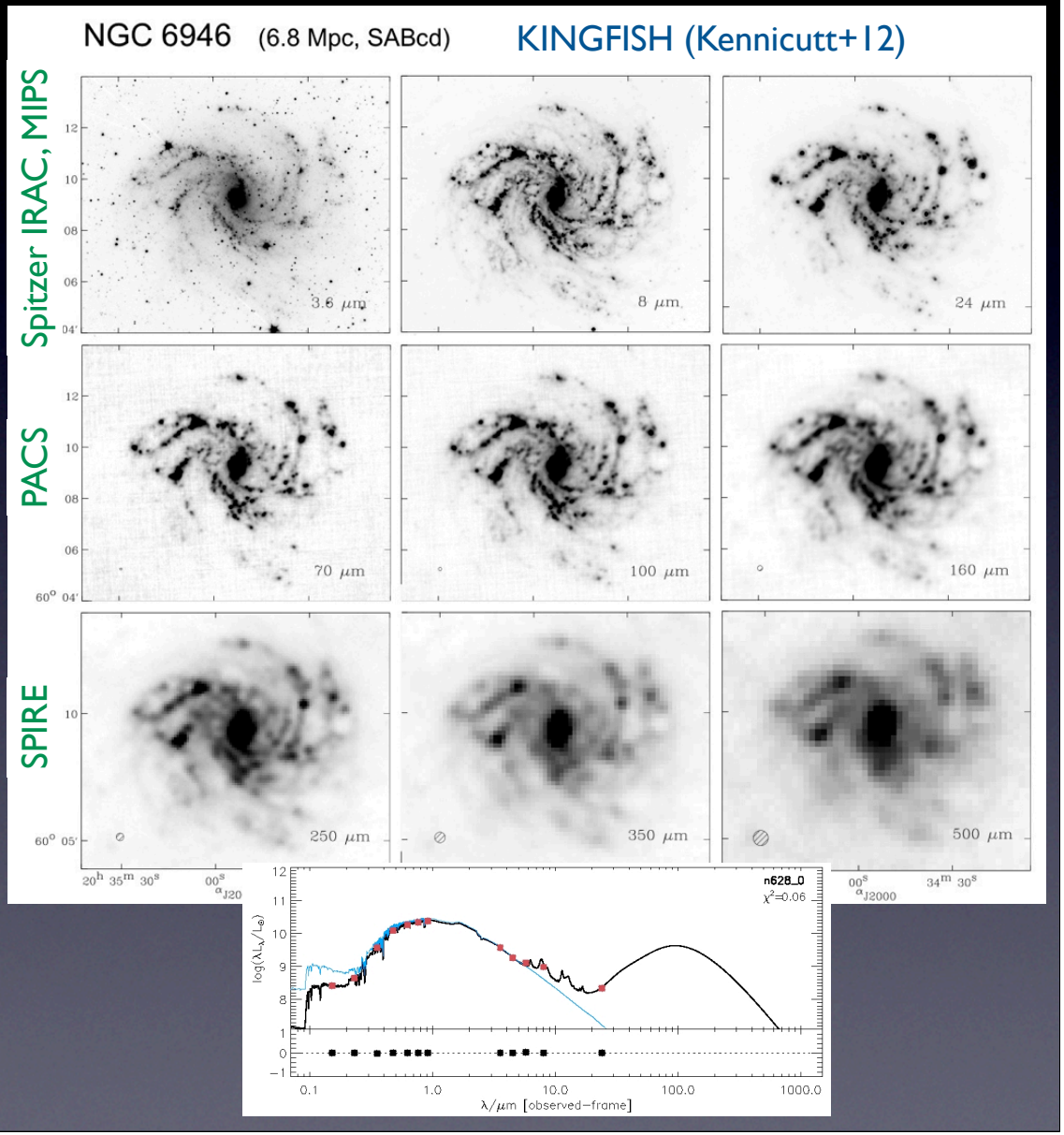
Durham
9 Jan 2013

- Robustness tests using Alpha version results
  - Add full set of input SFH model parameters to output! (NOW DONE)
  - Solution degeneracy concerns (IN PROGRESS)
    - output 2D probability distribution functions for key parameters
    - "n" best fit solutions - corresponding to different χ^2 minima in param. space
  - Long wavelength dependence (PREPPING DATA)
  - Limited subset of bands
  - Physical scale lower limit
  - Adaptive smoothing or PCA-based smoothing (to IMPLEMENT)
- Initial suite of papers coming ... participation welcome!

David Thilker
Johns Hopkins

Pan-STARRS
PS1 Science Consortium

Durham
9 Jan 2013



- POGS SED coverage will end at 22 microns (WISE W4 band) leaving dust model params largely unconstrained
  - How accurate are stellar parameters determined in this limit?
  - Use Herschel (KINGFISH) data to check empirically