Structural Parameters in Coma Legacy Survey

Leiden Astro-WISE meeting

2008 April 1

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Topics

1. Coma ACS structural analysis plan
2. Results to date
   - Sextractor photometric errors: realistic estimates
   - Structural parameter errors
     - Comparison GALFIT vs GIM2D
- Usefulness of Astro-WISE

Coma Structural Analysis Working Group (SAWG)

Marc Balcells (Chair)	IAC	Organization. Galaxy synthetic models
Rafael Guzmán	UFL	GIM2D
Carlos Hoyos	UFL/UAM	GIM2D
Reynier Peletier	Groningen	GALFIT
Gijs Verdoes Kleijn	Groningen	GALFIT
Harry Ferguson	STScI	Insert models into images
Derek Hammer	Hopkins	Catalogs

SAWG mission

Provide photometry and structural parameters of given catalogs

- ***Input***: catalogs provided by Catalogs Team
  - SAWG contribution to catalog generation:
    - Subtracting bright galaxies
    - Detection efficiency. Spurious sources. Photometric errors.
- ***Output***: catalog of photometry and structural parameters

Increasing levels of structural analysis…

- Mag, Color
- Mag, Color, Elipticity, PosAng, Reff
  - Sersic vs curve-of-growth
- add Isophotal profiles (eg GALPHOT)
- add Concentration-Asymmetry (CAS; GINI etc)
- add Sérsic model: μ_e, R_e, n
- add B/D; Sersic Parameters; Disk Parameters
  - Sersic+expon model
    - 1D vs 2D
      - GALFIT vs GIM2D
- add nuclear components
- add bars
- add lopsidedness

Three stages

- Balcells & Peletier 2007 "*The Structural Analysis of the Coma ACS Legacy Images*"
  - Three Phases
    - Phase 1: SExtractor
    - Phase 2: GALPHOT isophotal analysis
    - Phase 3: 2D models (GALFIT, or GIM2D), fixed centers
      - Pure Sersic: I, B, Re, nSer
      - Sersic+Expon: Ie, Re, nSer, mu0, h
      - Sersic+Expon+NuclearComp: Ie, Re, nSer, mu0, h, Inuc, Bnuc
- Public catalog
  - Coma Paper II, The Catalog (Derek Hammer et al. 2008)
    - SExtractor-based
    - MAG_AUTO (I, B), Flux radius, elipticity, pos angle
    - Realistic errors from simulations of injecting synthetic sources into ACS images.
- Out of scope
  - Asymmetries; bars; truncations; anti-truncations; dust; color gradient; companions

SExtractor catalog errors

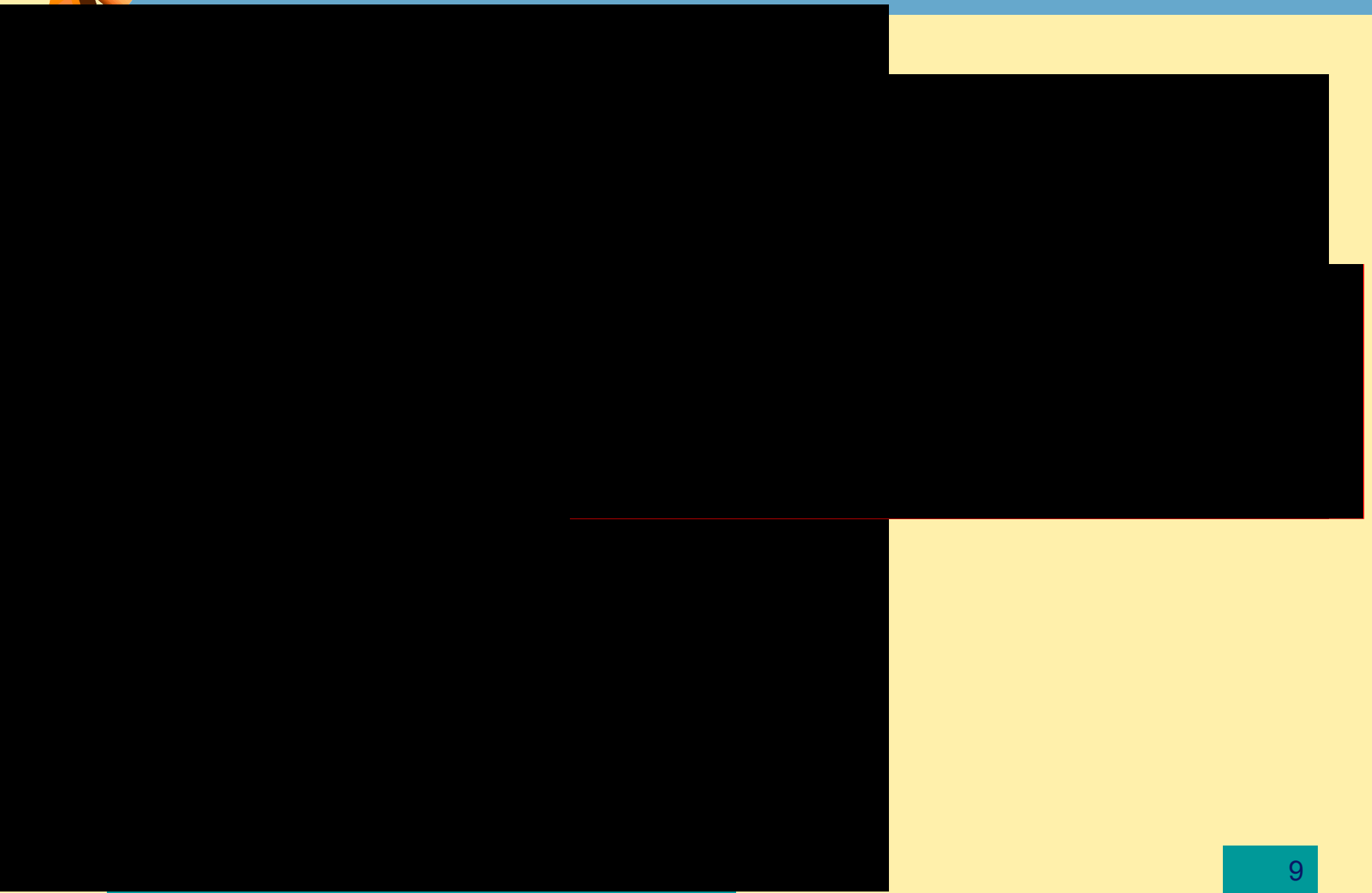
- SExtractor errors : two problem areas
- Poisson errors based on background noise, underestimated when noise correlated
  - Charge transfer efficiency
  - Reduction: rebinning, convolving
- Some flux always missing
  - ~0.1 mag
- Simulations to address both problems

Synthetic image experiments

- Multi-dimensional problem
  - Mag, R_{eff}, n_{Ser}, eps
- Models randomly sampling this space
- About 300,000 models per band

- Techniques
  - Models by GALFIT
  - SExtractor run, destroy original model
  - CONDOR distributed software, ~180 linux workstations at IAC
  - Expensive, convolution with ACS psf.

Wings of stellar PSFs: King (1971)



Missing flux - PSF convolution

- PSF extended wings
- About 0.05 mag
- May be added as an aperture correction

- Does not show up in simulations if model PSF is truncated to ~4-5 FWHM

Missing flux - SExtractor truncation

- eps < 0.4

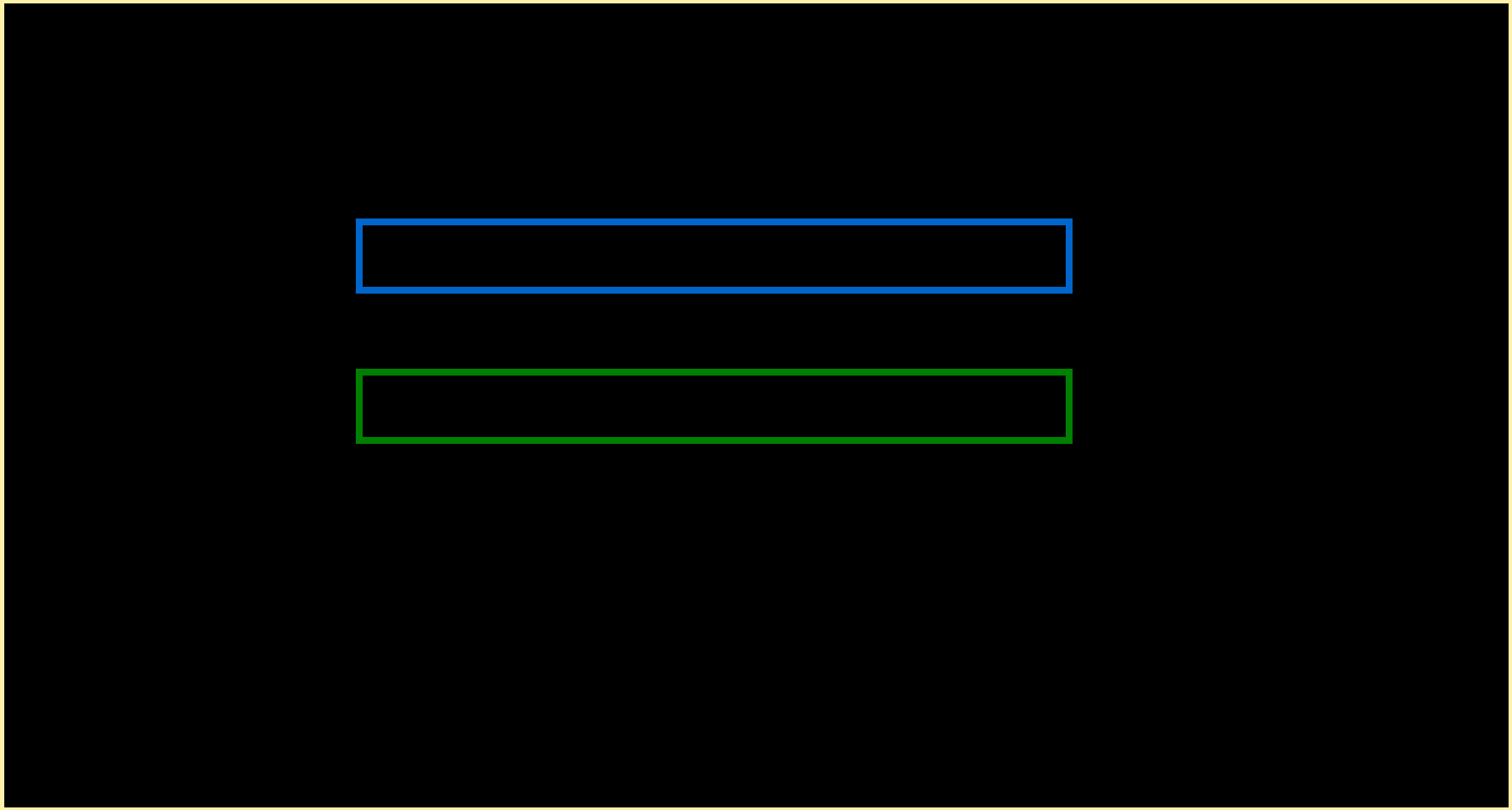
0.4

- n_{Ser} > 2.5

n_{Ser} < 2.5

eps >

SExtractor cuts at 2.5 R_1



eps < 0.4
> 0.4

eps

outside 2.5 R_1

n_{Ser} > 2.5

n_{Ser} < 2.5

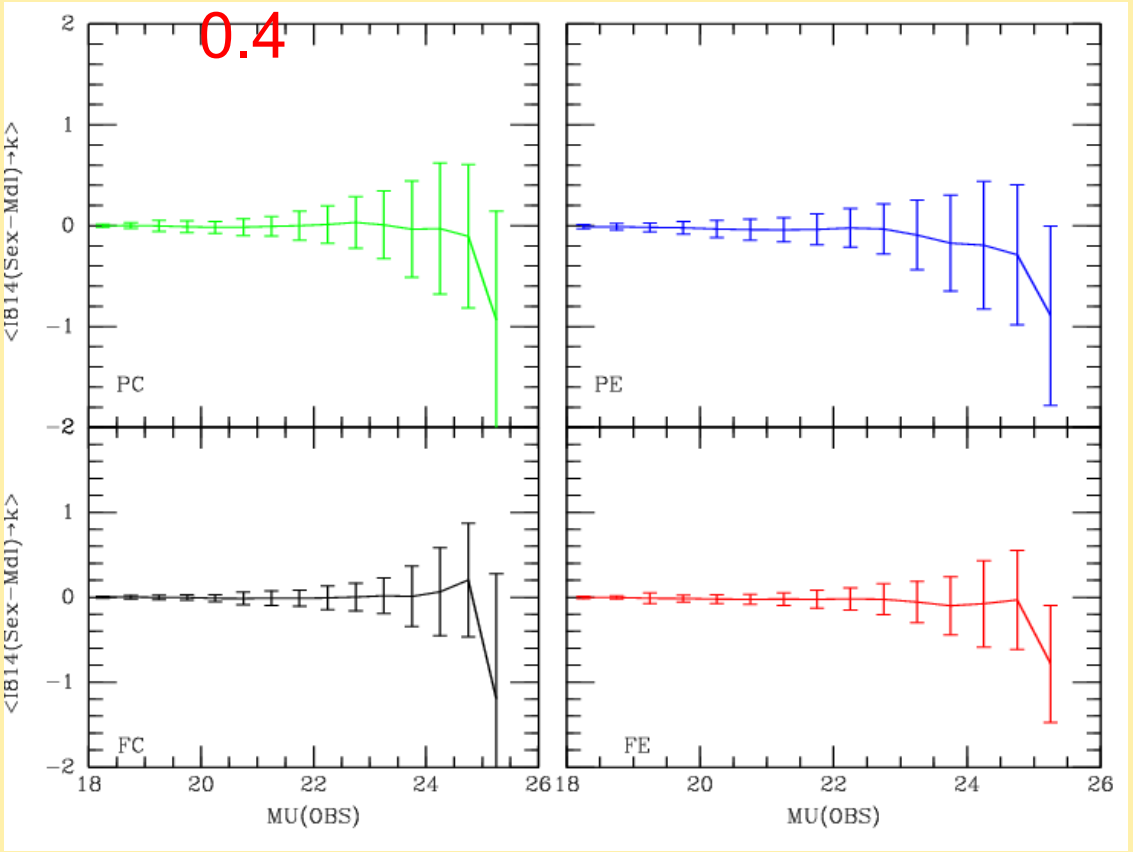
- Offsets disappear
- errors at faint mu are symmetric

SExtractor errors after aperture corrections

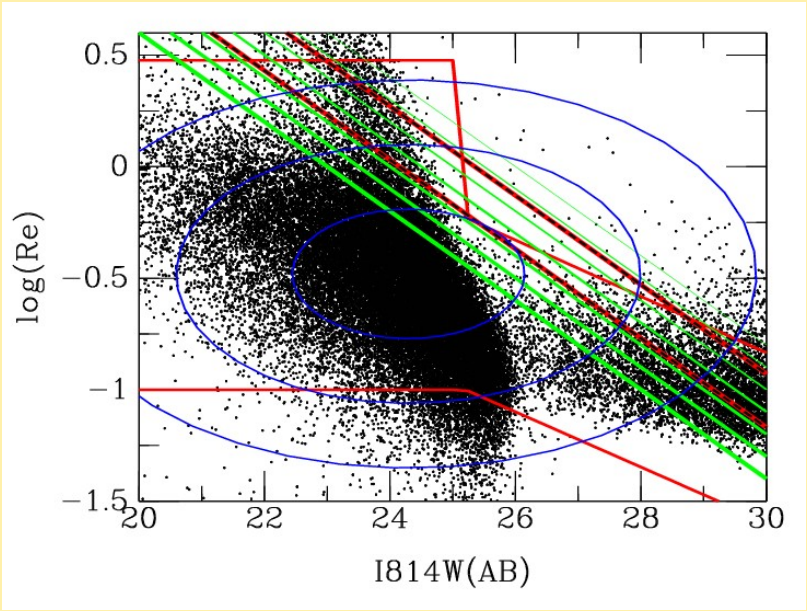
eps < 0.4 eps > 0.4

$n_{Ser} > 2.5$

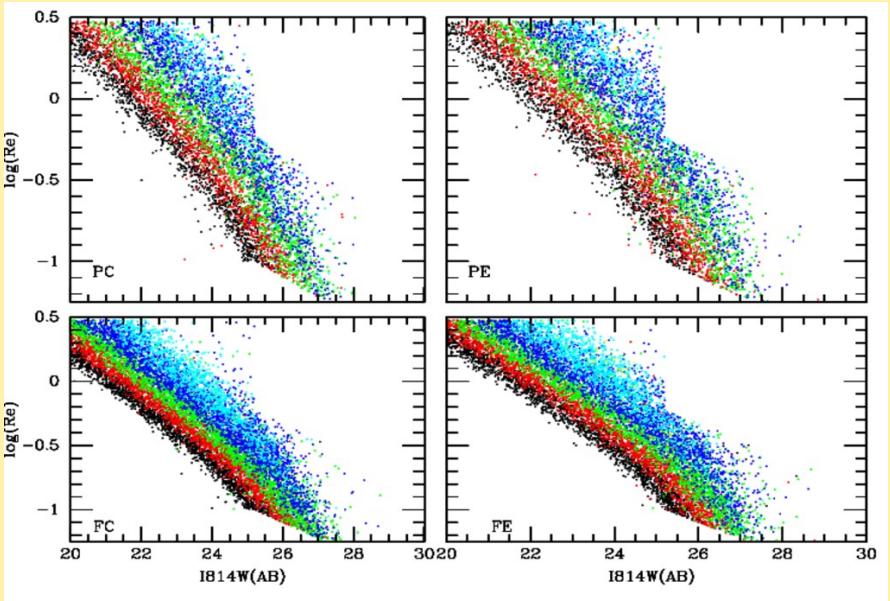
$n_{Ser} < 2.5$



- Region of interest in mag-Re diagram:



- Detection efficiency mag vs Re diagram

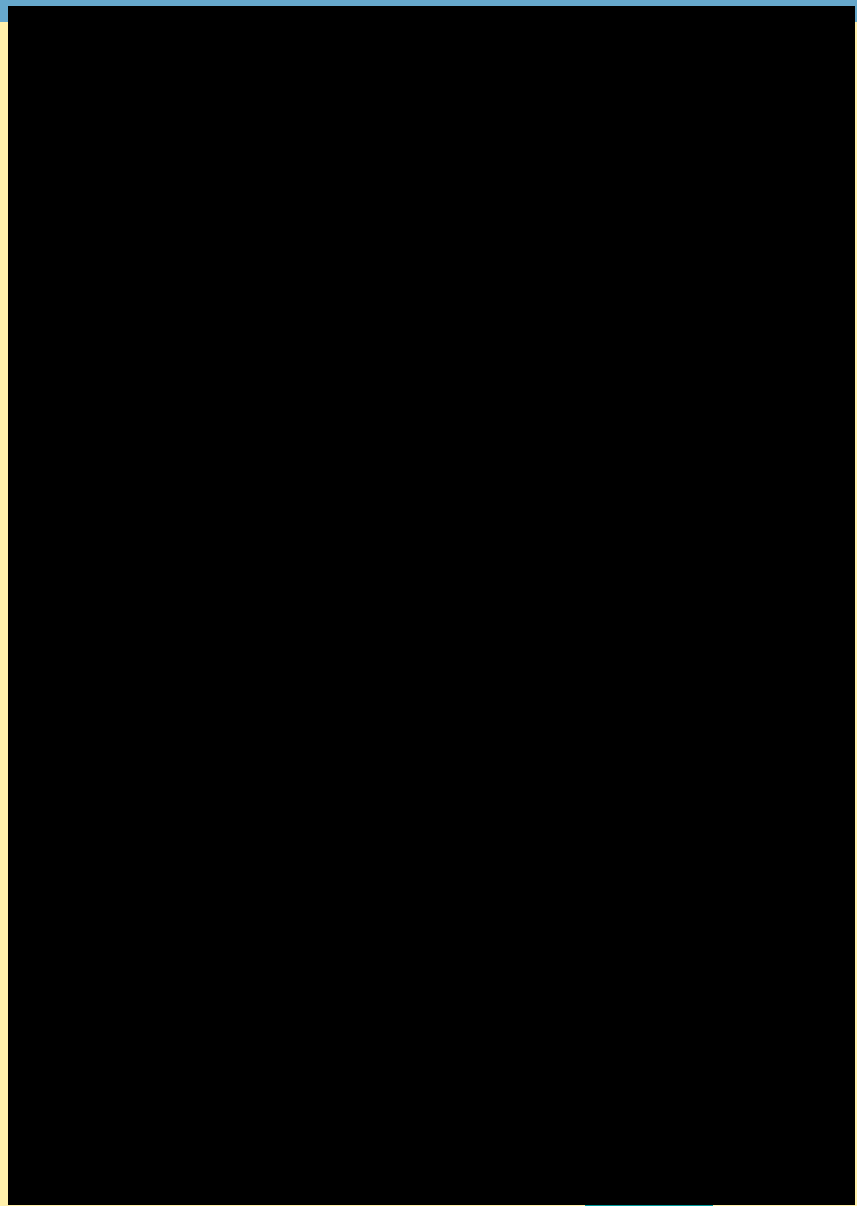


Choosing a code for 2D structural modeling

- Two codes optimized for automatic fitting
  - GIM2D (Simard et al 2003)
  - GALFIT (Peng et al. 2002)
- A recent comparison
  - Haussler et al 2007 (astro-ph/0704.2601) GEMS team
- Conclude:
  - both codes deemed good
  - Devil is in the details - devil is in the sky!
  - Issue with companions / masking nearby objects / fitting simultaneously
- Us: our own tests. First step has been with exactly same models as in GEMS paper.

Experiments with GEMS models

- Two images from GEMS
  - Disk0001 (expon profiles)
  - Bulge0001 (deV profiles)
- Sextractor (Hoyos)
- GALFIT (Verdoes, Peletier)
- GIM2D (Hoyos, Guzman)



Our conclusions

- We reproduce conclusions of Haussler et al (2007)
- GIM2D can be better than reported by Haussler et al. at the expense of more manual intervention
  - But GIM2D is an automatic code
- GALFIT advantage is that it can fit more than two components
  - Sersic, Expon, Nuclear source

Astro-WISE

- Used by Groningen team

- Could other teams have done their simulations using Astro-WISE??
  - Eg Carlos Hoyos, from Madrid, fitting Gim2D
  - Me: provide IRAF scripts to generate 1000's bulge-disk models into Coma ACS images in astro-WISE

Is use of Astro-WISE desirable …

- … for entire Coma-ACS team?
- YES…
- Pros
  - Making processes more systematic,
  - Pre-plan steps
  - Quality control
  - History, memory of previous steps
- Difficulties
  - Find your way especially as you come into the system
- Wishes
  - Be able to operate on the data stored in Astro-WISE with or own codes

Astro-WISE for newcomers…

- … like me and most in the Coma Survey
- People coming from outside:
  - Want to get their thing done
    - Without having to read (much) documentation
- The all-familiar IRAF case…

- You can flat-field, copy and display an image the first day.
- You only need a very skeletal knowledge to start:
  - tasks
  - epar task

CONclusions

- Clearly a very very powerful system
- Think more on user interface

Astro-WISE

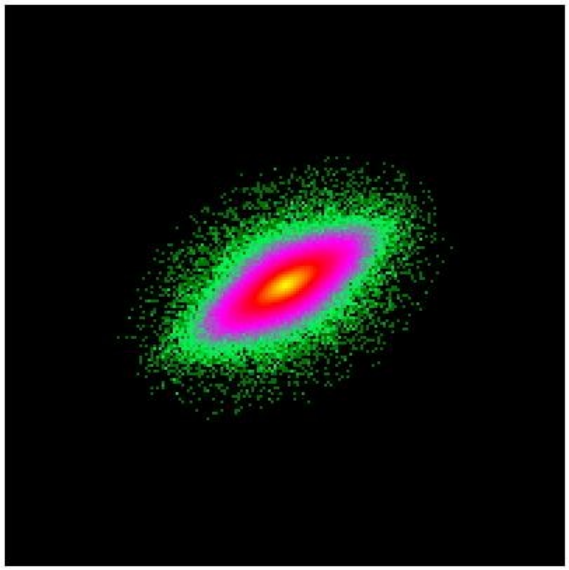
- Astro-WISE might benefit from taking care of this level: the skeletal level of knowledge that allows the novice user to get something done
  - Once we know how to get something done, we will progressively learn the inner workings.

- Another example: look at my laptop
  - Underneath the smooth performance, lots of C++, classes, dictionaries
  - The user needs not know ANY of that.

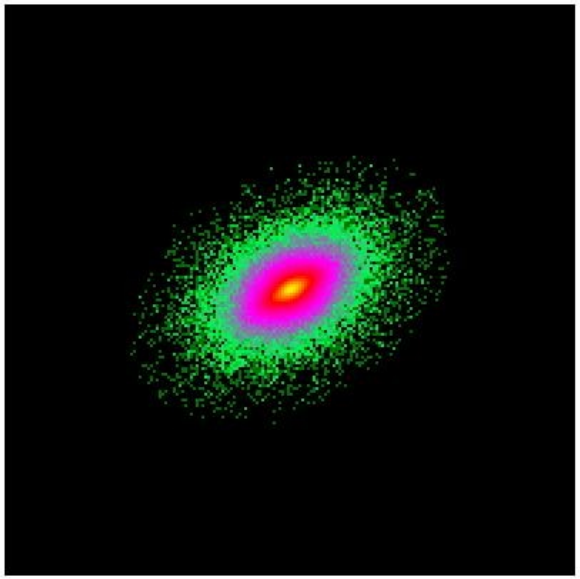
- Mac OSX, a model of user interface
  - The user only thinks his own language
  - Apple, a long tradition of intuitive User Interface

Examples

- I=22
- B/T = 0.2
- i = 70



- I=22
- B/T=0.5
- i = 70



Injection in ACS images