What I will and won’t present

- Will present performance (accuracy, precision, robustness, runtime) on simulations & real data
  - How well (or not) single-band CModel does now
  - How well in-progress alternatives (MultiProFit, ngmix) do

- Won’t present:
  - How good/useful are errors/uncertainties
  - Multi-object fitting (possible but not tested by us)
  - Background model fitting
  - Stars: they’re basically fine
Terminology
- CModel: implemented now in meas_modelfit (stack)
- MultiProFit (MPF): Sersic profile fitting & more
- ngmix (bd): Constrained bulge-disk model
  - Used in DES and tested on HSC
- All are Gaussian mixtures under the hood
  - too slow without analytic convolution
How well does CModel perform?
- fast; fine for stars* but not so much for galaxies
- robustness poor: deblending & backgrounds?
- accuracy and precision both worse than for stars
  - precision measured via repeatability in validate_drp:

* Slightly worse than PSF phot.
Robustness: HSC/COSMOS CModel
- many outliers are low surface brightness but huge
  - possibly garbage in/out; see examples later

*probably?*
DESC DC2 Simulation

HSCMap with DC2 gri data via Johann Cohen-Tanugi (DESC) & NAOJ

CosmoDC2 Simulation Details: https://arxiv.org/abs/1907.06530
Large biases; scatter grows at bright end
Significant outlier fraction; mostly model too faint

Accuracy: DC2 CModel Fluxes

Accuracy: DC2 CModel Colours

Colours not much better than individual mags
Scatter scales better; r-i better than g-r; g-r bright bias

![DC2 3828Resolved g-r, stack CModel, N=129133](image)

![DC2 3828Resolved r-band, stack CModel, N=129490](image)

![DC2 3828Resolved r-i, stack CModel, N=129297](image)

Outliers bluer & redder
Forced CModel (struct. params fixed to one band) ...improves colours but not fluxes
Accuracy: DC2 MultiProFit colours

Colours improve with:
Single-band to multiband; CModel to Sersic*

Outliers improve significantly; bright g-r bias remains

*Single-band Sersic is no better than CModel
Accuracy: DC2 ngmix colours

Colours improve with:
Single-band to multiband; CModel to bd (bulge-disk)*

ngmix bd colour diffs nearly same as MPF Sersic

*Single-band bd somewhat better than CModel
Robustness: DC2 model colours

ngmix bulge-disk & MultiProFit Sersic g-r colours agree shocking well...

... except for when they don’t:
~5% >0.2 mag diff. either direction
Multiband fitting slightly improves fluxes

‘Better’ algorithms aren’t universally better
- HSC i+z fits should be comparable to HST F814W
- mags so awful I refuse to show them

Accuracy/Robustness: COSMOS MultiProFit

Most galaxy sizes ok-ish

Most outliers unresolved

Too faint in HST?

Needs better calib.
Robustness: What are outliers?

Detection failures: (some solvable, others hard blends)

Garbage in/out:
(can flag as bad, some already)
Conclusions

- CModel is fast but performs poorly

- Multiband fitting helps colours but not fluxes

- ‘Better’ models help colours further in multiband

- ngmix bd & MultiProFit Sersic agree on colours

- ngmix & MultiProFit much slower (≈10x, ≈35x resp.)
  - solvable but not trivial
Extra Slides Begin
Runtime: DC2 new vs old

ngmix & MPF have larger fixed overhead
Accuracy: DC2 Unresolved Fluxes

Mostly model- and centroiding-independent, but:

... fewest outliers* in CModel, smallest bias in MPF

*but smallest N so probably just more failures!
Accuracy: DC2 Unresolved Colours

$g-r$ worse than $r$; $r-i$ comparable

![Graphs showing $g-r$ and $r-i$ comparisons](image)
Robustness: DC2 Model Sizes

Size priors are critical and must be mag dependent

How many of these outliers are not matched?
DC2 Completeness and Purity

Completeness has room for improvement
Some bright CModel objects false positives