# The CFIS Pipeline

Samuel Farrens

# Outline

1. Pipeline Motivation
2. Pipeline Team
3. Pipeline Architecture
4. Pipeline Development

CosmoStat + EPFL

GREAT3
The third GRavitational lEnsing Accuracy Testing challenge

### Overall Leaderboard

| Name | Notes | Score | Number of entries |
|---|---|---|---|
| sFIT | Modified DLS stackfit algorithm | 80001 | 162 |
| Amalgam@IAP | Some fellows developing software based around SExtractor and PSFex for real-life shape measurements. | 80000 | 215 |
| CEA-EPFL | The team wants to investigate if we could improve shear estimation by combining gfit with sparse representation methods. | 72000 | 340 |
| MegaLUT | Evolutions of the MegaLUT technique : how far can we go with SExtractor + Machine Learning ? | 52000 | 234 |
| Fourier_Quad | Our team uses the quadrupole moments of the spectral density of galaxy images in Fourier space to measure shear. | 32000 | 36 |
| EPFL_gfit | Using the gfit shear measurement method, testing how far one can go by using forward model fitting + new approaches for bias calibration | 24000 | 124 |
| MaltaOx | Malta-Oxford GREAT3 team. We aim to test shear measurement by likelihood fits to individual galaxies, using lensfit, and without using simulations to calibrate bias. | 3001 | 15 |
| E-HOLICs | E-HOLICs method is developed for aim of precise and fast shear analysis. E-HOLICs method is moment method like KSB method , but use elliptical weight function for avoiding one of systematic errors. | 3000 | 58 |
| MBI | Team members:Lang CMU, Hogg NYU, Schneider LLNL, Dawson LLNL, Bard SLAC, Marshall SLAC, Meyers Stanford, Boutigny SLAC | 1000 | 51 |
| COGS | Capitalizing On Gravitational Shear Team based primarily at University of Manchester and University College London, and lead by Sarah Bridle. Most entries will use the im3shape code described in http://arxiv.org/abs/1302.0183. | * | 38 |
| GREAT3_EC | GREAT3 executive committee - submissions using example scripts. | * | 10 |
| EPFL_lensfit | Testing a multi-processor version of lensfit 7.2 (Miller et al., 2007, Kitching et al., 2008) | 0 | 0 |
| FDNT | Fourier Domain Null Test method (Bernstein 2010) with additional m+c bias calibration | * | 36 |
| ess | Various pipelines by Erin S. Sheldon | 0 | 13 |
| DeepZot | Team members: Daniel Margala and David Kirkby at UC Irvine | 0 | 0 |
| CMU experimenters | This is a team for Rachel Mandelbaum's group at CMU to experiment with some crazy ideas that probably won't work, but are kind of fun to think about. | * | 4 |
| miyatake-test | Test for GREAT3 data by the HSC pipeline. | * | 4 |
| CEA_denoise | Moment correction on denoised images. | 0 | 25 |
| MetaCalibration | This team is testing how well we can extract the shear response by shearing the images themselves, and modifying the psf accordingly. | * | 3 |
| BAMPenn | Bernstein, Armstrong & March, University of Pennsylvania. | 0 | 8 |
| HSC/LSST-HSM | A sanity check of the bookkeeping in the obs_great3 package written to allow HSC/LSST pipeline algorithms to be run on the GREAT3 simulations, using an old implementation of the HSM code. | * | 4 |
| EPFL_MLP_FIT | multilayer perceptron, fitted data as input | 0 | 1 |
| EPFL_KSB | From quadrupole moments to shear, based on the KSBf90 (Heyamans et al. 2005). | 0 | 39 |
| EPFL_HNN | Hopfield Neural Network | 0 | 32 |
| EPFL_MLP | MLP | 0 | 51 |
| Wentao Luo | A modified method based on both BJ02(Bernstein & Jarvis 2002) and HS03(Hirata & Seljak 2003). | 0 | 25 |

# Pipeline Motivation

**Modular implementation** →

- Ability to add new features with minimal impact on the global architecture

**Python Job-Handler** →

- Fast development
- Good portability (e.g. no PBS system requirements, etc.)

**End-to-End Processing** →

- In-house analysis
- Minimise dependence on outside processing

# Pipeline Team

**Development & analysis**

| | |
|---|---|
| **Samuel Farrens** | pipeline management, development |
| **Axel Guinot** | pipeline development, processing |
| **Martin Kilbinger** | pipeline development, processing |
| **Arnau Pujol** | bias estimation, validation tests |
| **Morgan Schmitz** | PSF estimation |

**Methodology & analysis**

| | |
|---|---|
| **Jerome Bobin** | machine learning, shear calibration |
| **Alexandre Bruckert** | blend identification |
| **Austin Peel** | mass mapping |
| **Sandrine Pires** | mass mapping |
| **Jean-Luc Starck** | weak lensing science |
| **Florent Sureau** | shape measurement |

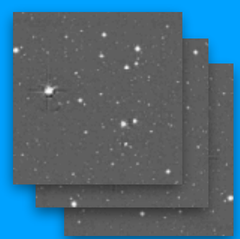
# Pipeline Architecture

## Core Pipeline

- Series of Python packages
- Job handler for parallel processing of images
- Centralised IO system
- Versioning control
- Configuration file management
- Logging system for error handling

# Pipeline Architecture

## Input Images



## Mask Generation

- Bright stars
- Spikes
- Haloes
- (Cosmic Rays)

## Source Extraction

- SExtractor

## Star-Galaxy Separation

- FWHM vs Magnitude cut

## PSF Modelling

- PSFEx
- Vignettes from PSF model

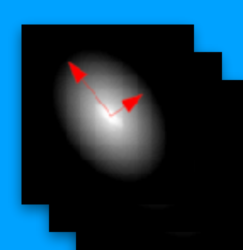
## Shape Measurement

- KSB
- GFit

## Calibration

- Meta-calibration

## WL Catalogue



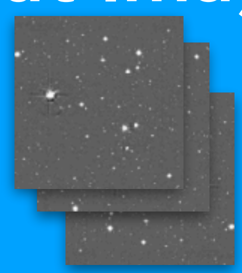
## Cosmological Analysis

- Mass mapping
- Shear bias

# Pipeline Architecture

## Relevant Talks

**Input Images**

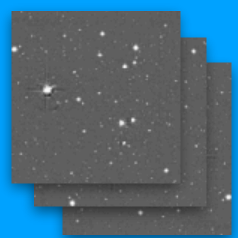


**Overview of CFIS Weak Lensing**

Martin Kilbinger

# Pipeline Architecture

## Input Images



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## Mask Generation

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## Source Extraction

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## Star-Galaxy Separation

- FWHM vs Magnitude cut

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## Calibration

- Meta-calibration

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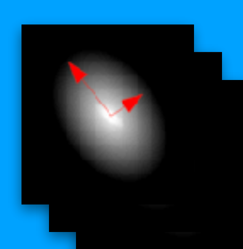
## WL Catalogue



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## Cosmological Analysis

- Mass mapping
- Shear bias

# Pipeline Architecture

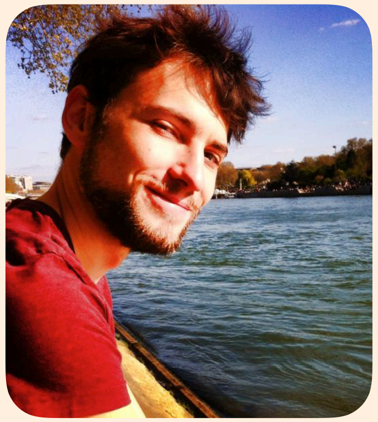
## Relevant Talks

**PSF Modelling**

- PSFEx
- Vignettes from PSF model

**PSF Modeling using a Graph Manifold**

Morgan Schmitz



**PSF Modelling**

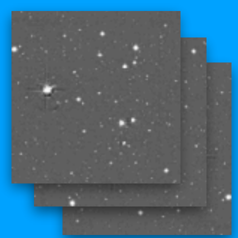
- PSFEx
- Vignettes from PSF model

**Optimal Transport and PSF Modeling**

Rebeca Araripe Furtado Cunha

# Pipeline Architecture

**Input Images**



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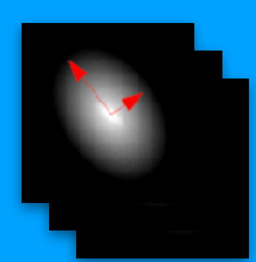
**PSF Modelling**
- PSFEx
- Vignettes from PSF model

**Shape Measurement**
- KSB
- GFit

**Calibration**
- Meta-calibration

**WL Catalogue**



**Cosmological Analysis**
- Mass mapping
- Shear bias

# Pipeline Architecture

## Relevant Talks

### Mask Generation

- Bright stars
- Spikes
- Haloes
- (Cosmic Rays)

### Source Extraction

- SExtractor

### Star-Galaxy Separation

- FWHM vs Magnitude cut

**Preliminary CFIS Results**

Axel Guinot

### Shape Measurement

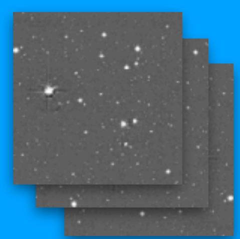
- KSB
- GFit

### Calibration

- Meta-calibration

# Pipeline Architecture

## Input Images



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## Mask Generation

- Bright stars
- Spikes
- Haloes
- (Cosmic Rays)

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## Source Extraction

- SExtractor

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## Star-Galaxy Separation

- FWHM vs Magnitude cut

←

## PSF Modelling

- PSFEx
- Vignettes from PSF model

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## Shape Measurement

- KSB
- GFit

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## Calibration

- Meta-calibration

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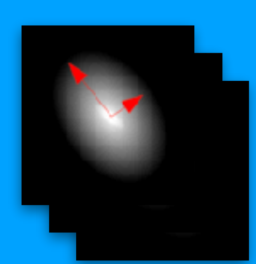
## WL Catalogue



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## Cosmological Analysis

- Mass mapping
- Shear bias

# Pipeline Architecture

## Relevant Talks

**Cosmological Analysis**

- Mass mapping
- Shear bias

**WL Mass Mapping**

Jean-Luc Starck

**Cosmological Analysis**

- Mass mapping
- Shear bias

**Cosmology with Mass Maps**

Austin Peel

# Pipeline Architecture

## List of Modules

- **PSFExInterpolation_package**
- **PSFExRun_package**
- **SETools_package**
- **SExtractor_package**
- gfit_common_package
- gfit_package
- isap_package
- **mask_package**
- mkpsf_package
- mksim_package
- mpfcfhtlens_package
- mpfcs82_package
- mpfg3_package
- **mpfg_package**
- **mpfx_package**
- multifit_package
- **ngmix_wrapper_package**
- *ppe_package* --> replaced by **PSFExRun_package**
- *pse_package* --> replaced by **SExtractor_package**
- **scatalog_package**
- scdm_package
- **sconfig_package**
- sf_deconvolve_package
- **shapelens_package**
- **slogger_package**
- spredict-0.5.0
- template_package

# Pipeline Development

- Private GitLab repository hosted on CEA server
  - Integrated wiki
- Well-defined development plan
  - Issue definition (with tracking)
  - Milestone for set of issues
  - User branches for specific issue
  - Merge request review
  - Documentation
- Validation test framework

# Pipeline Development

## Core Pipeline

- Improved IO
- Improved logging
- Simplified installation

## Deblending

- DNN blend identification
- Multi-class labelling
- Segmentation

## PSF Modelling

- RCA
- Optimal transport
- Graphs

## Mask Generation

- Extended artefact handling
- Machine learning

## Deconvolution

- Sparsity
- Low-rank approximation
- Tikhonov + DNN

# Pipeline Development

## Deblending

- DNN blend identification
- Multi-class labelling
- Segmentation

**Machine learning for blended objects separation**

Alexandre Bruckert

# 谢谢