



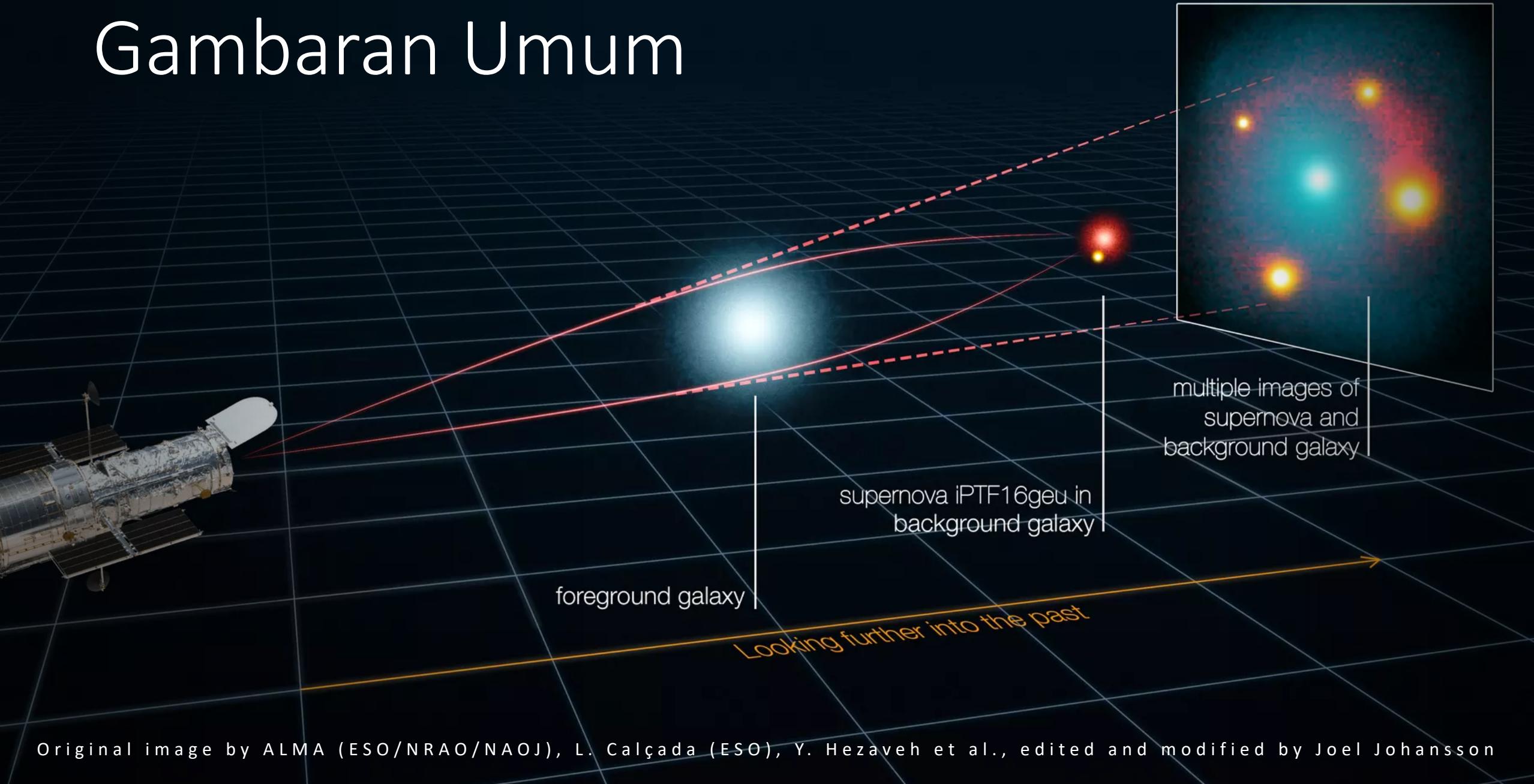
**Program Penelitian KK Astronomi & Observatorium Bosscha 2021**

# **Penelitian Ekstragalaksi Menggunakan Lensa Gravitasi**

Oleh:

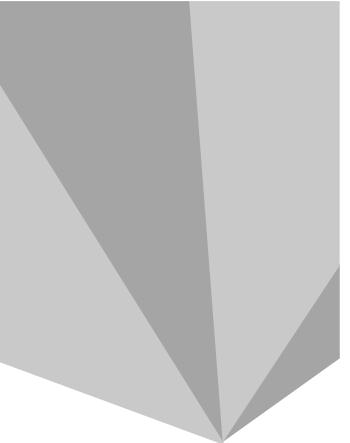
Anton T. Jaelani & Premana W. Premadi

# Gambaran Umum



# Ide Penelitian: Programming – (Pengamatan)





# Penelitian 2021 1

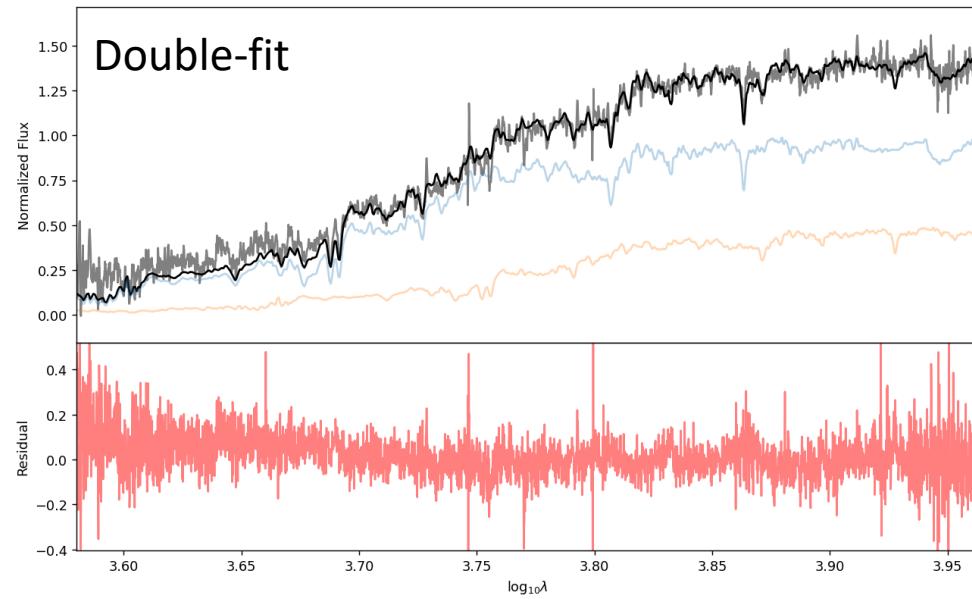
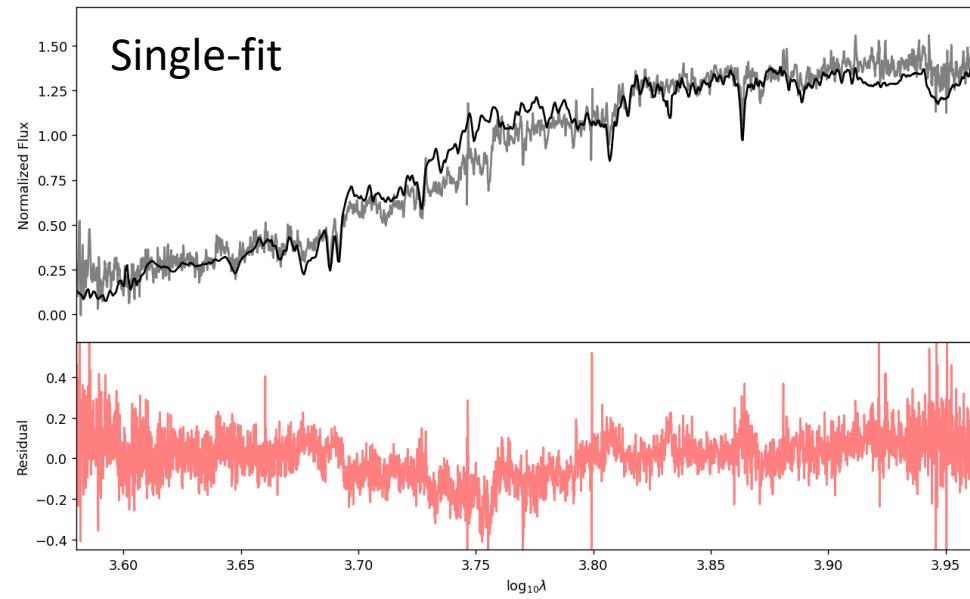
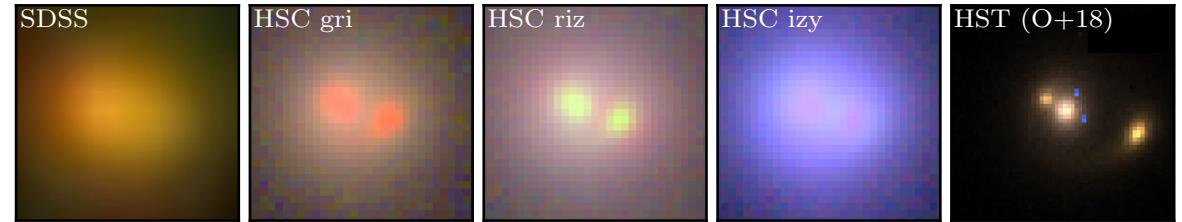
Anton T. Jaelani, Sulistiyowati, Premana  
W. Premadi, Evan I. Akbar, Murtadho, ...

**P2MI**

*Telaah Galaksi ‘Red Nuggets’ Menggunakan Lensa Gravitasi*

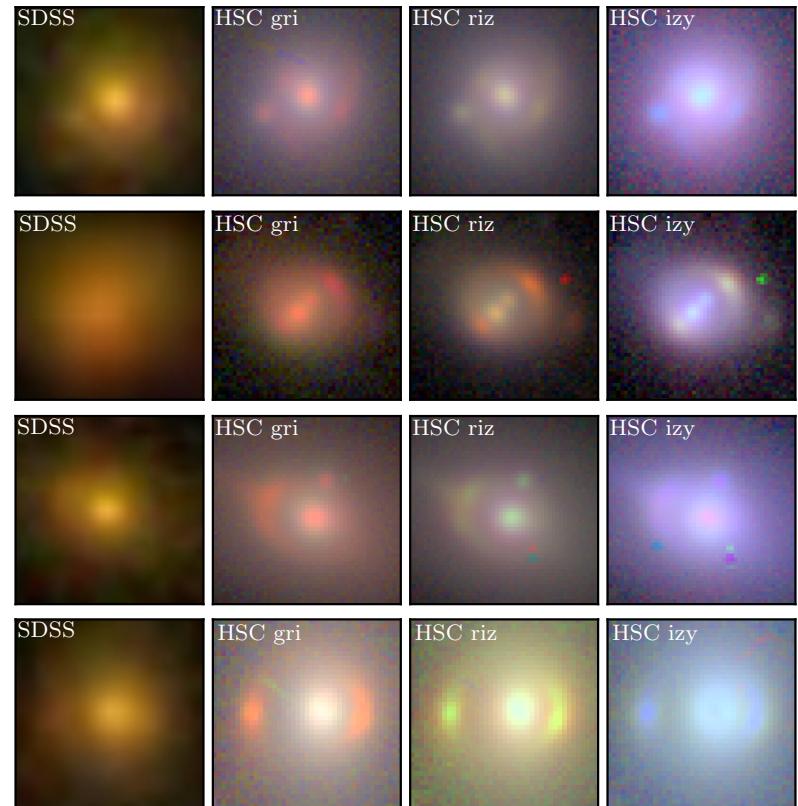
# Early type-Early type Lensing (EELs)

- Potensi daya pisah survey landas bumi terbaru (mis. HSC)
- Publik data spektroskopi SDSS
- Kompak galaksi pada redshift  $z < 1.0$
- Oldham+17 mengonfirmasi 12 EELs (mis. J2228) menggunakan Teleskop Keck

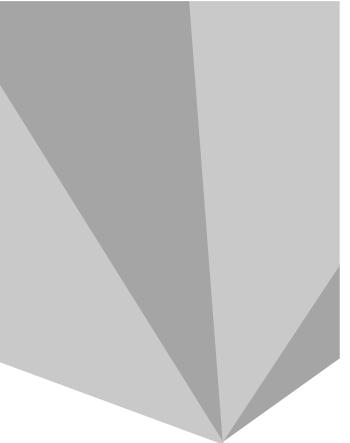


# Early type-Early type Lensing (EELs)

- Membangun program fitting multi-galaksi untuk spektrum SDSS (preliminary)
- Validasi dengan menggunakan 12 EELs (Oldham+17)
- Konfirmasi lensa galaksi merah dari database sistem lensa
- Pemodelan lensa untuk mengetahui radius efektif
- Melakukan fitting ulang spektrum SDSS galaksi elips masif



Kandidat EELs (Jaelani+20)



# Penelitian 2021 2

Anton T. Jaelani, Premana W. Premadi,  
Muhammad A. Dobson, Muhammad G.  
Prawiradilaga, ...

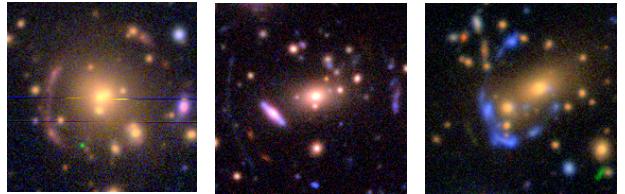
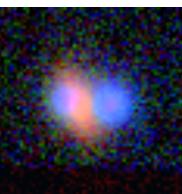
**Riset Peningkatan Kapasitas Dosen Muda ITB**

*Telaah Lensa Gravitasi Kuat: I. Pencarian Sistem Lensa Baru Menggunakan Deep Learning*

# Pencarian Lensa Gravitasi Baru

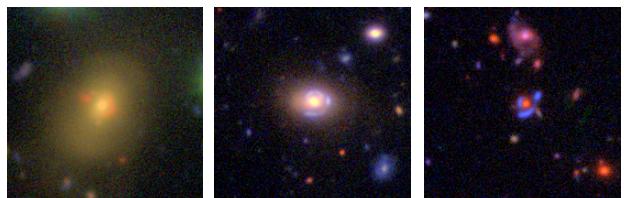
## Visual

- Efektif untuk skala Grup/Gugus Galaksi  
(SuGOHI V, Jaelani+20)
- Citizen-Science  
(SuGOHI VI, Sonnenfeld+20)



## Semi-otomatis

- Arcfinder/ringfinder untuk skala galaksi dan lensa quasar  
(SuGOHI I & IV, Sonnenfeld+18, Chan+20)
- Variabilitas untuk lensa quasar  
(Chao+20a,20b, Jaelani+21)



## Deep Learning

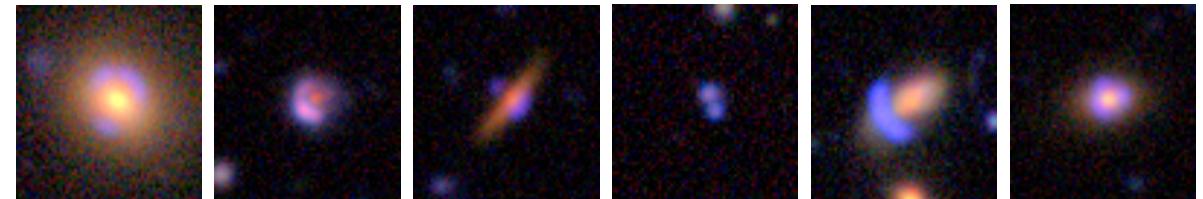
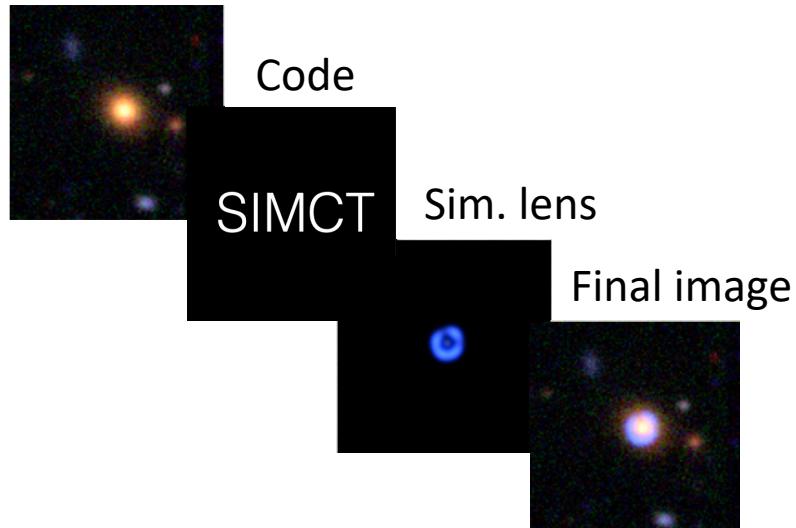
- Sudah mulai dilakukan pada data DES, KiDS, PanSTARRS
- Inisiasi sudah dimulai untuk data HSC

# Pencarian dengan Deep Learning

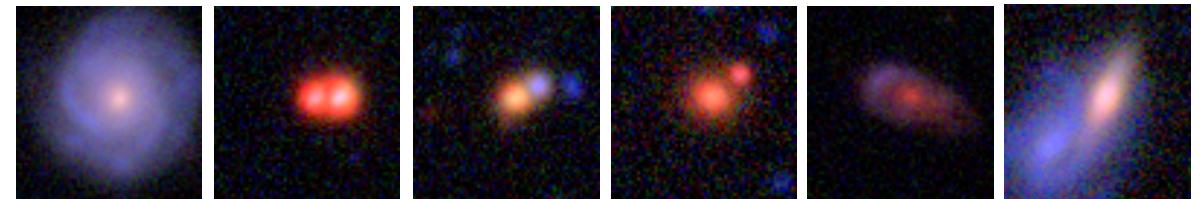
Pembuatan sampel data untuk training:

- ~ 21000 lensa galaksi-galaksi (perlu peningkatan jumlah)
- Lensa quasar dan skala grup
- Membangun Network

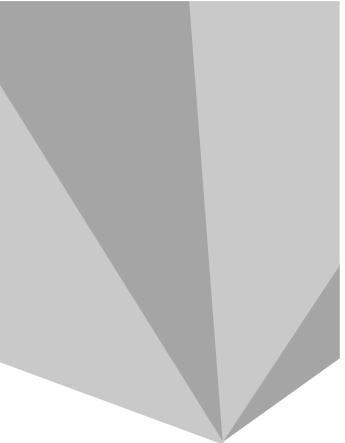
Real image+catalogs



Mock lenses



Nonlens



# Penelitian 2021 3

Anton T. Jaelani, Anupreeta More,  
Premania W. Premadi, ...

*Joint Analysis SL & WL: Lensed Lyman Break Galaxy HSC J2211-0008*

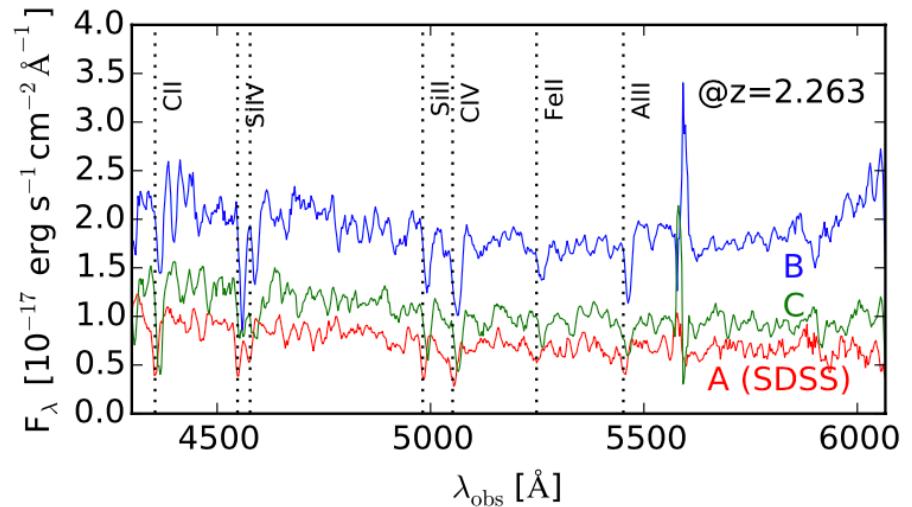
# Distribusi massa galaksi grup

Data:

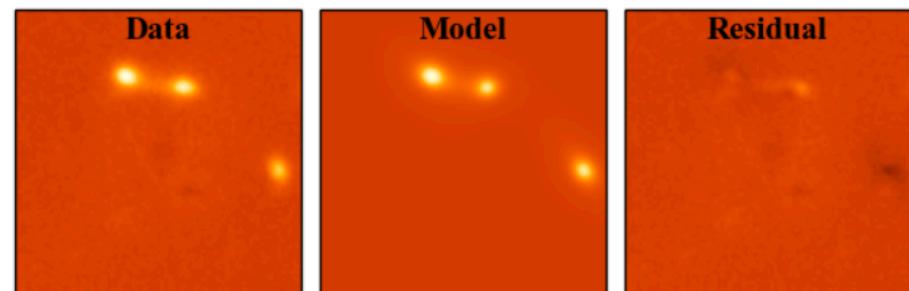
- Imaging: HSC (*grizy*)
- Spektroskopi: SDSS & Subaru

Analisis:

- Analisis spektrum (sudah)
- Model lensa (preliminary) – pemodelan ulang
- Stellar vel. disp. (VD) dari galaksi lensa
- Distribusi massa, VD + SL + WL



**Figure 2.** Spectra of the images B and C obtained with Subaru. The SDSS spectrum of the image A is also shown for comparison. All three spectra are almost identical confirming that these are lensed images of the same galaxy.



**Figure 3.** Lens mass model. We show the HSC *g* band data (left), the best fit NFW mass model (middle) and the corresponding residual image (right).



# Terima kasih!

Ada pertanyaan? Join?

Kami ada pertemuan Riset Lensa Gravitasi  
pada Rabu, 27 Januari 2021 pukul 15.30 wib

[antontj@as.itb.ac.id](mailto:antontj@as.itb.ac.id) or <https://antontj1.github.io/index.html>