Exploring the universe with AI

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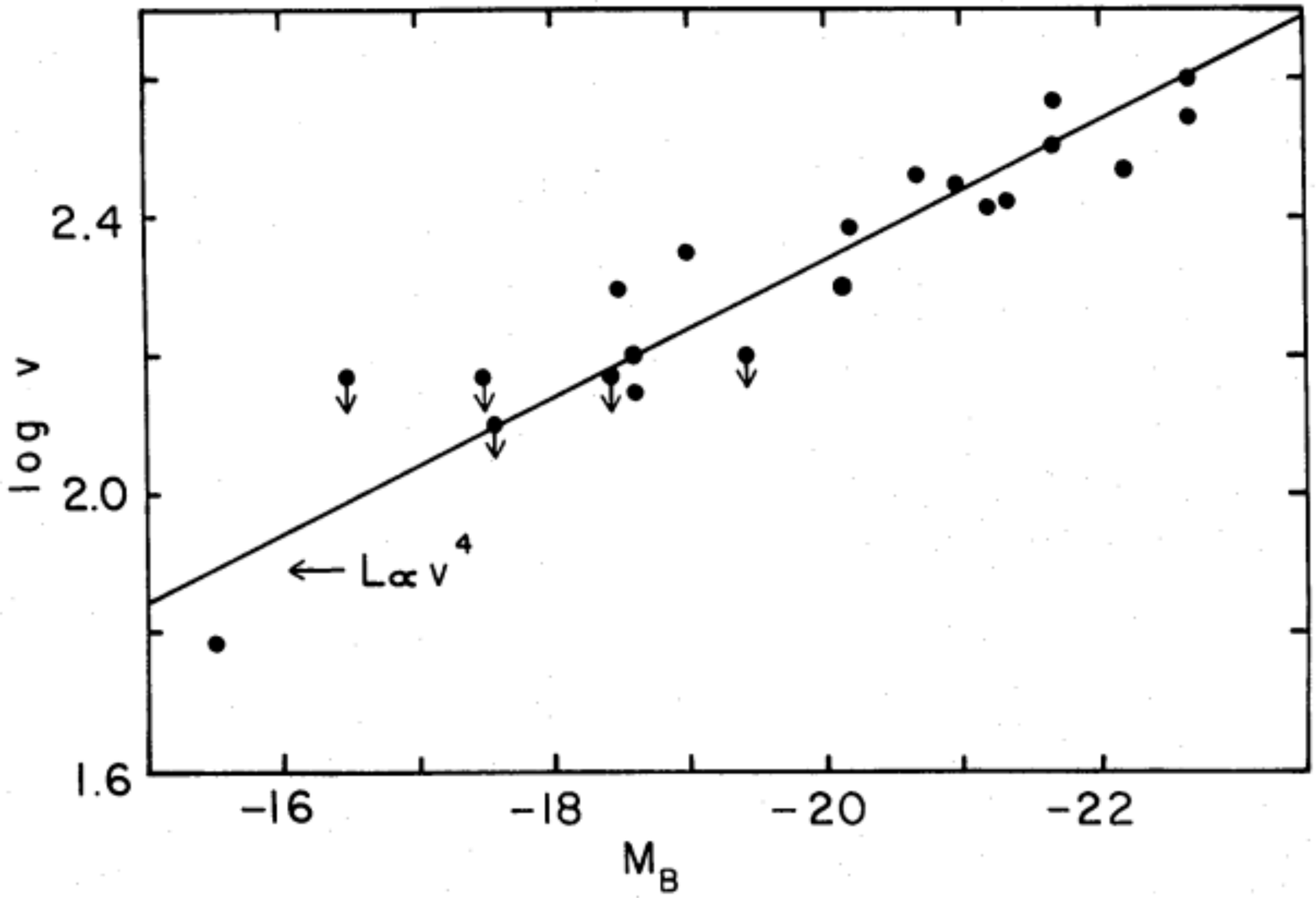
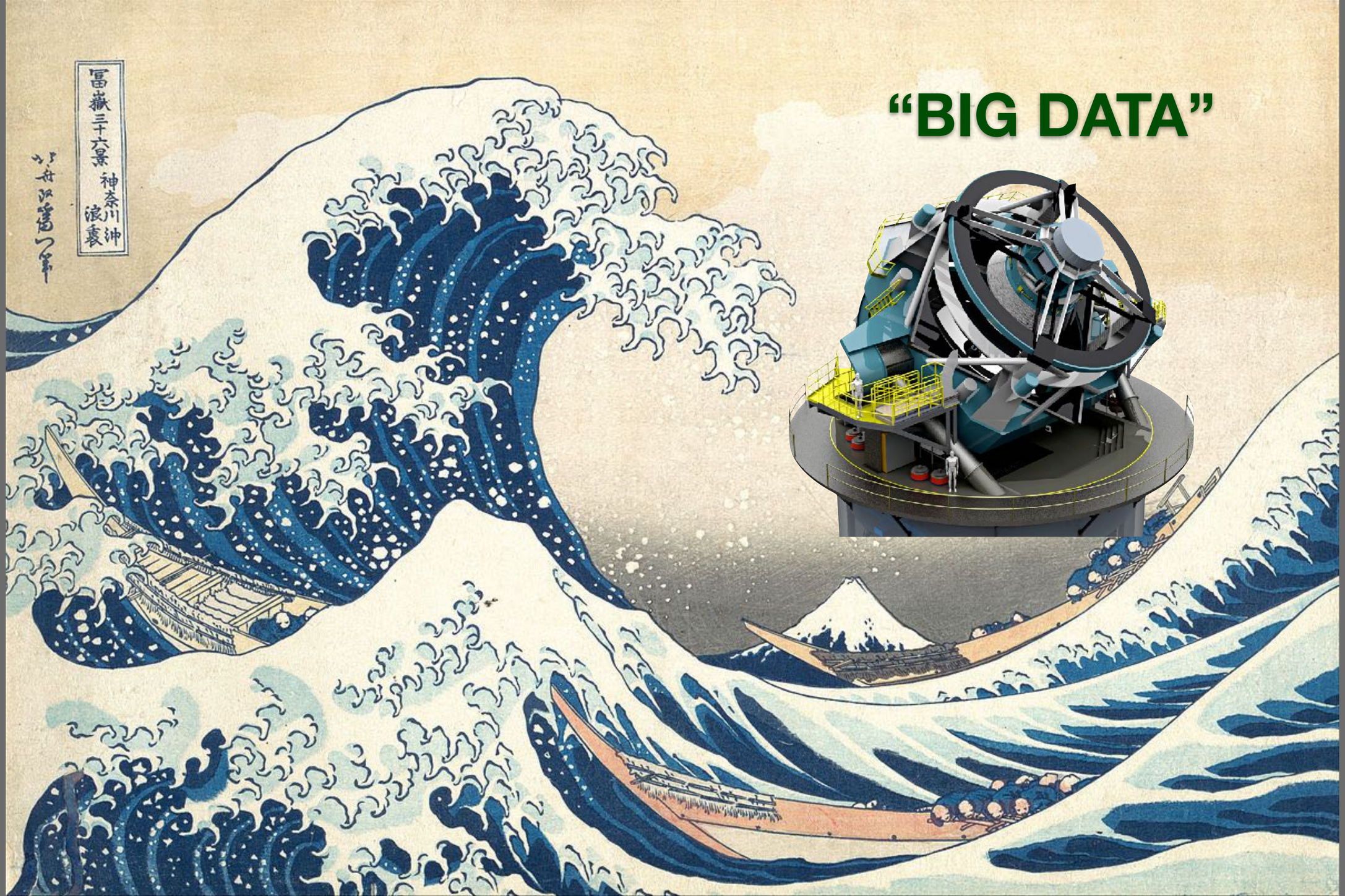
ETH black hole group
Grüp Bægg Negar Politecnic da Zürig


2.4
2.0
1.6
log v
← L∝ v⁴
-16
-18
-20
-22
M_B

how can
machine learning/ artificial intelligence
help us understand the universe?

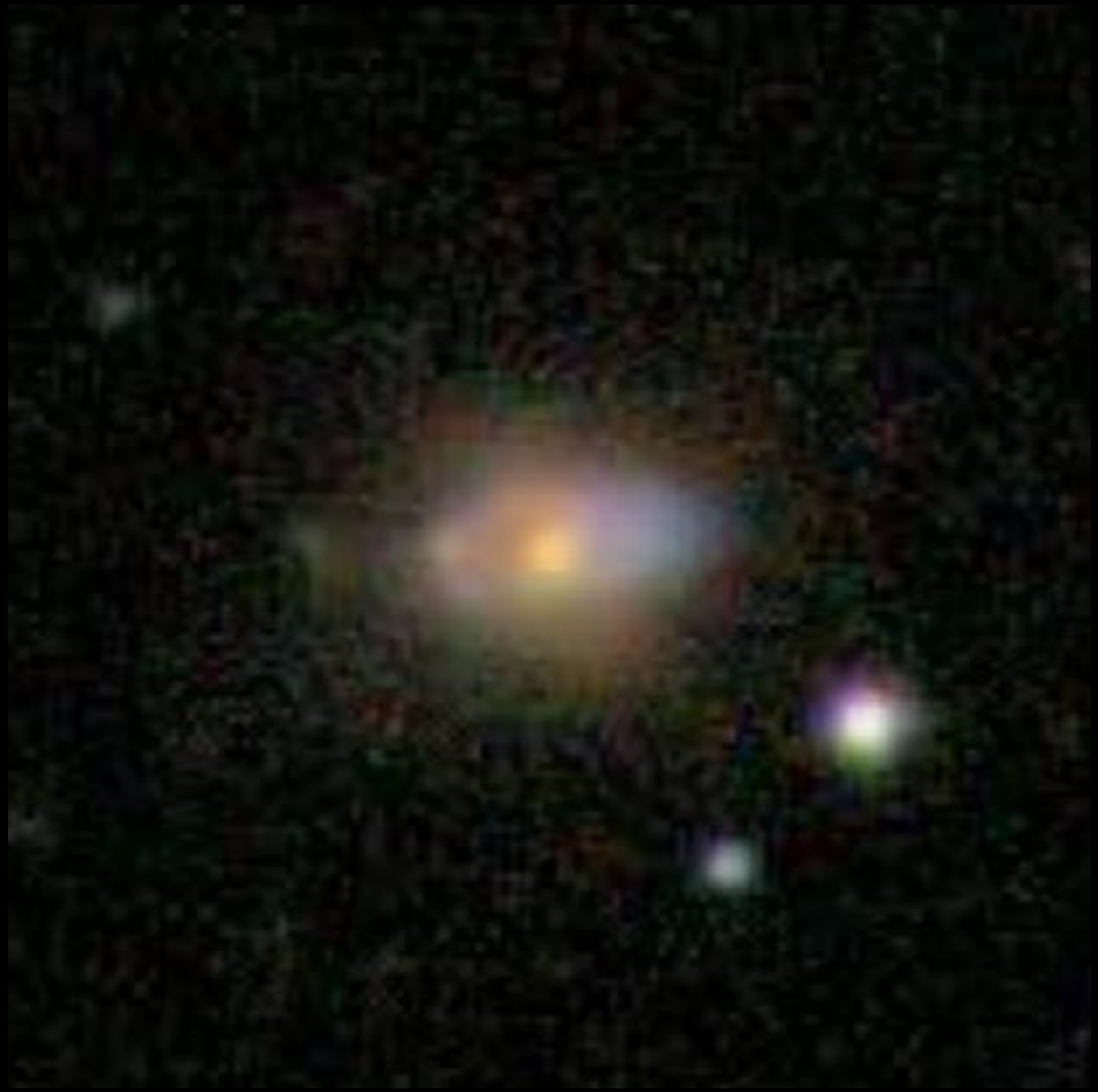

“BIG DATA”


space.ml
from model-driven astrophysics to data-driven astrophysics
GalaxyGAN
More projects coming, stay tuned!
Selected Press Coverage
The Verge: AI could be the perfect tool for exploring the Universe
Science Magazine: AI is changing how we do science. Get a glimpse
The Atlantic: Machine Learning Is Bringing the Cosmos Into Focus
WIRED Science: Astronomers Deploy AI to Unravel the Mysteries of the Universe
The Register: From drugs to galaxy hunting, AI is elbowing its way into boffins' labs
Phys.org: Neural networks promise sharpest ever images
ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

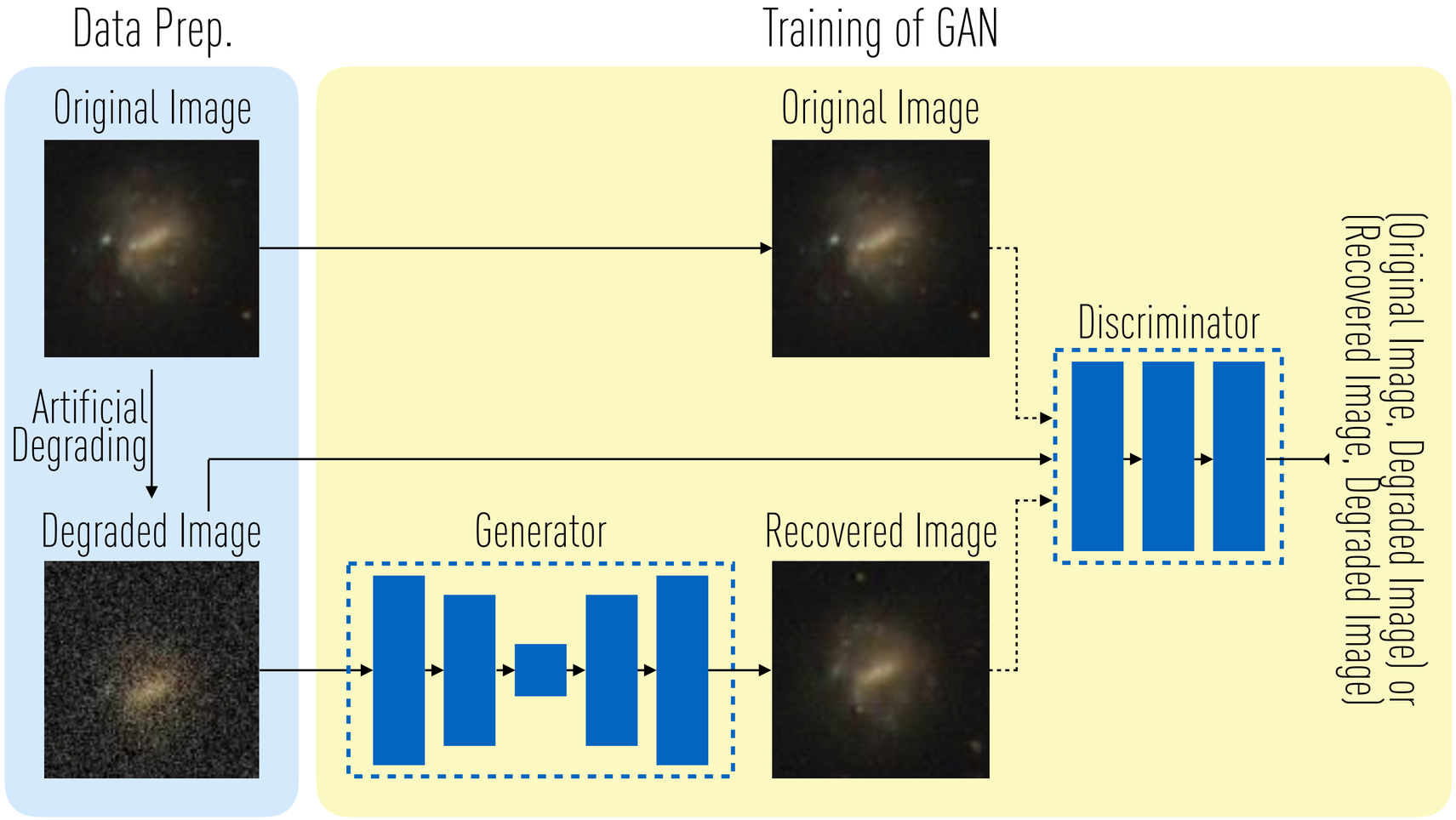
GalaxyGAN: de-noising and feature reconstruction

PSFGAN: point source subtraction

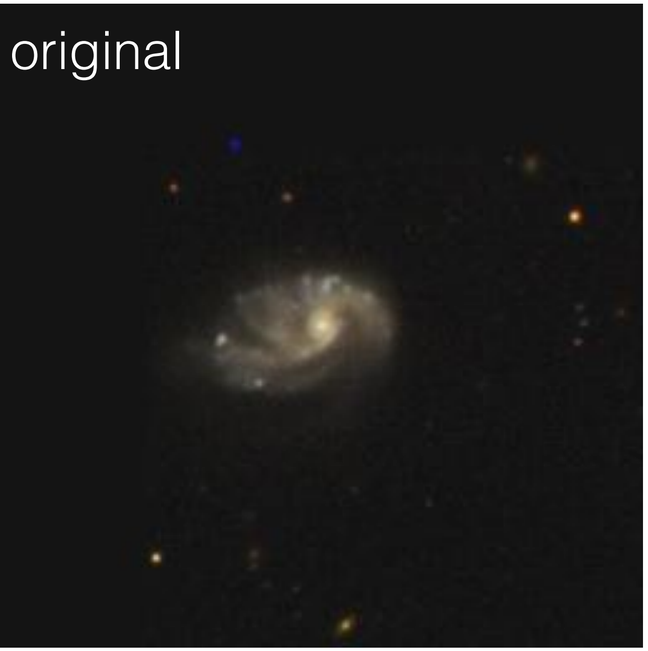
Generative models: data-driven exploration

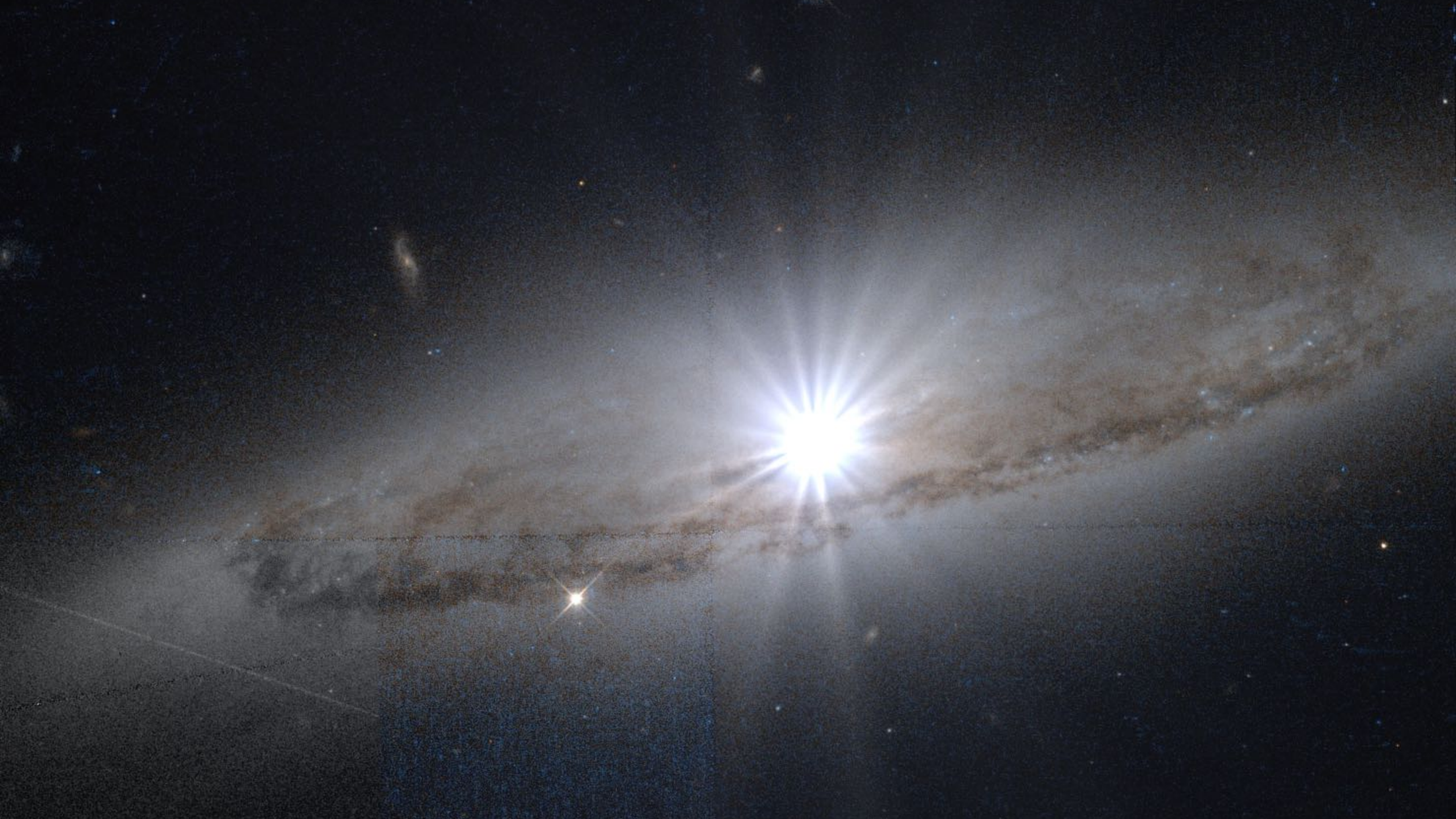


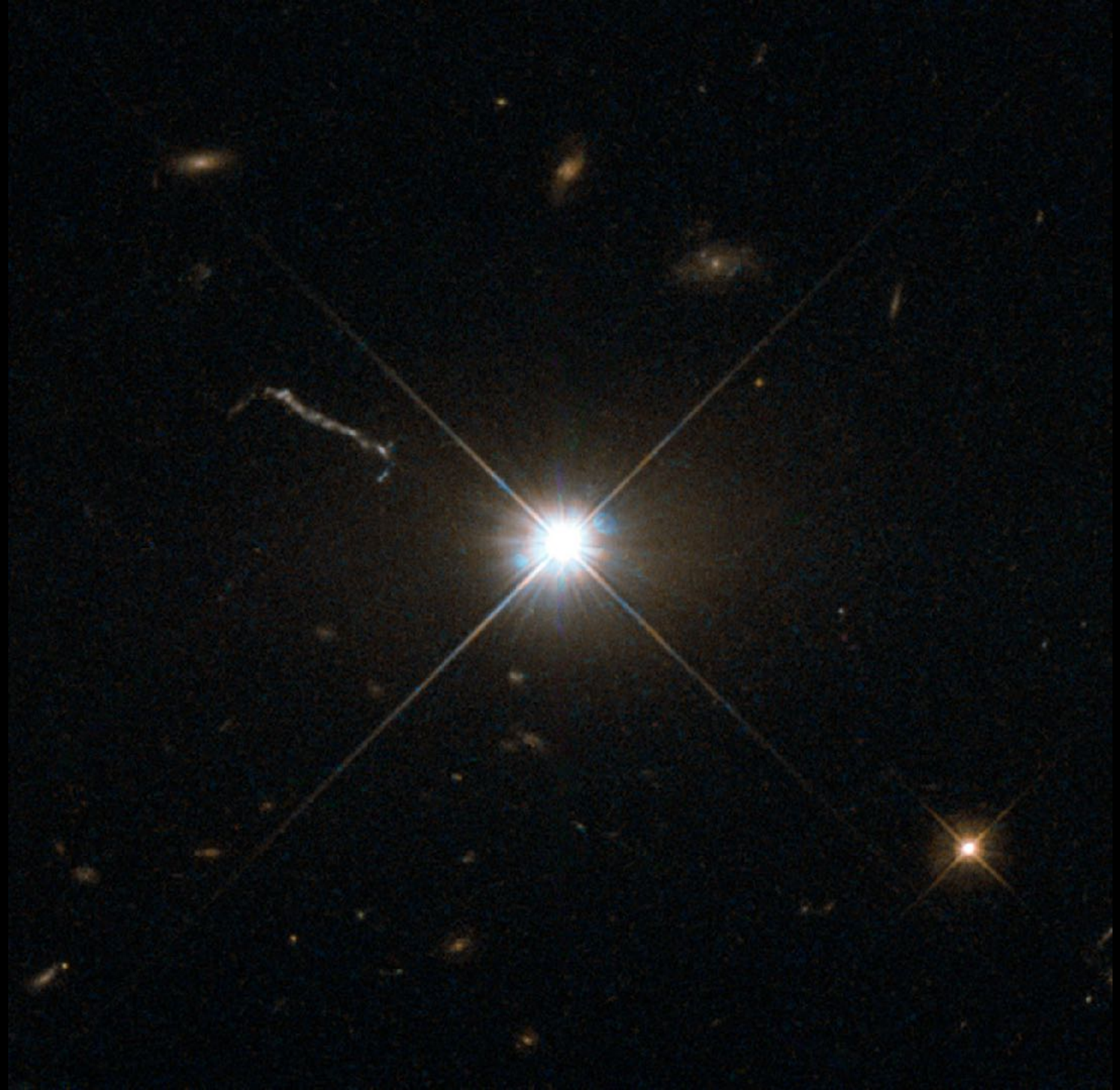
generative adversarial network for overcoming limitations in astrophysical images

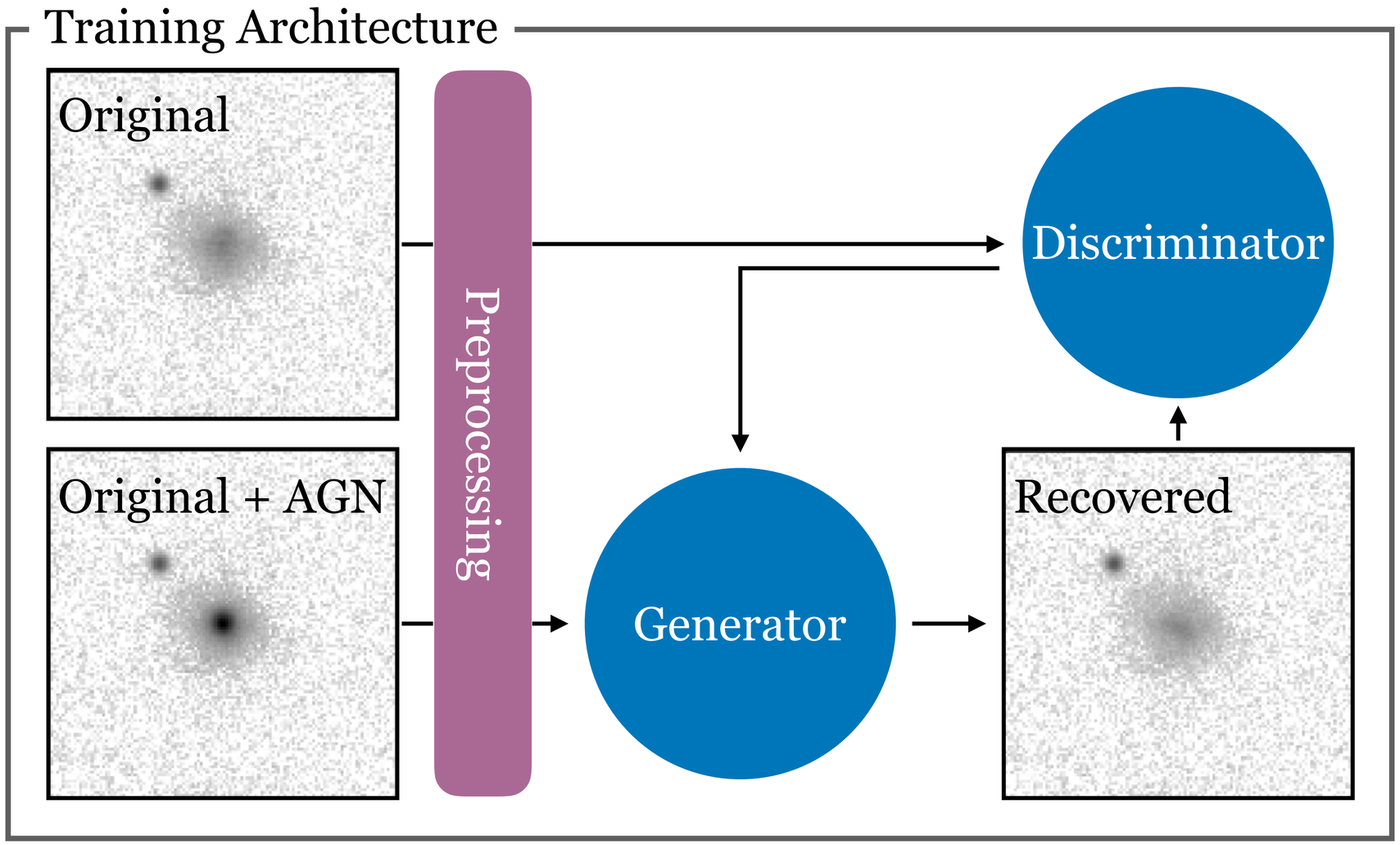


Schawinski+17


original

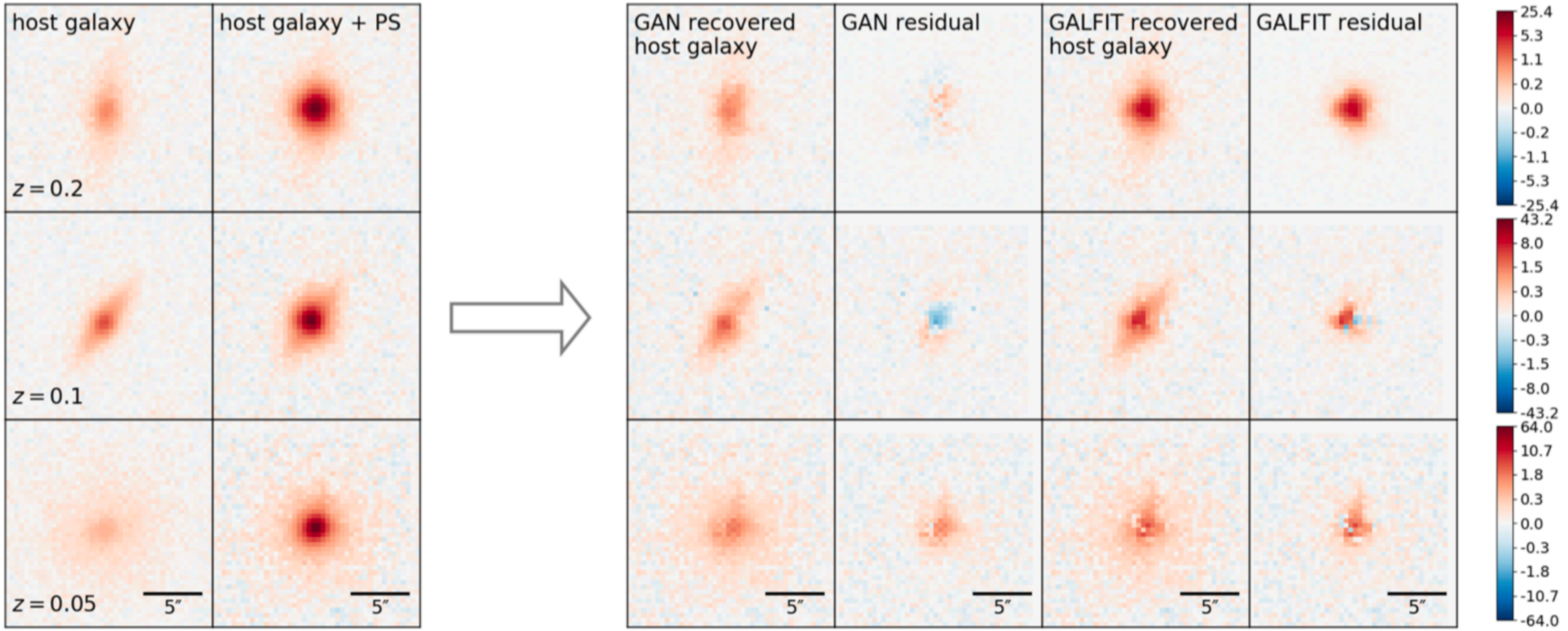




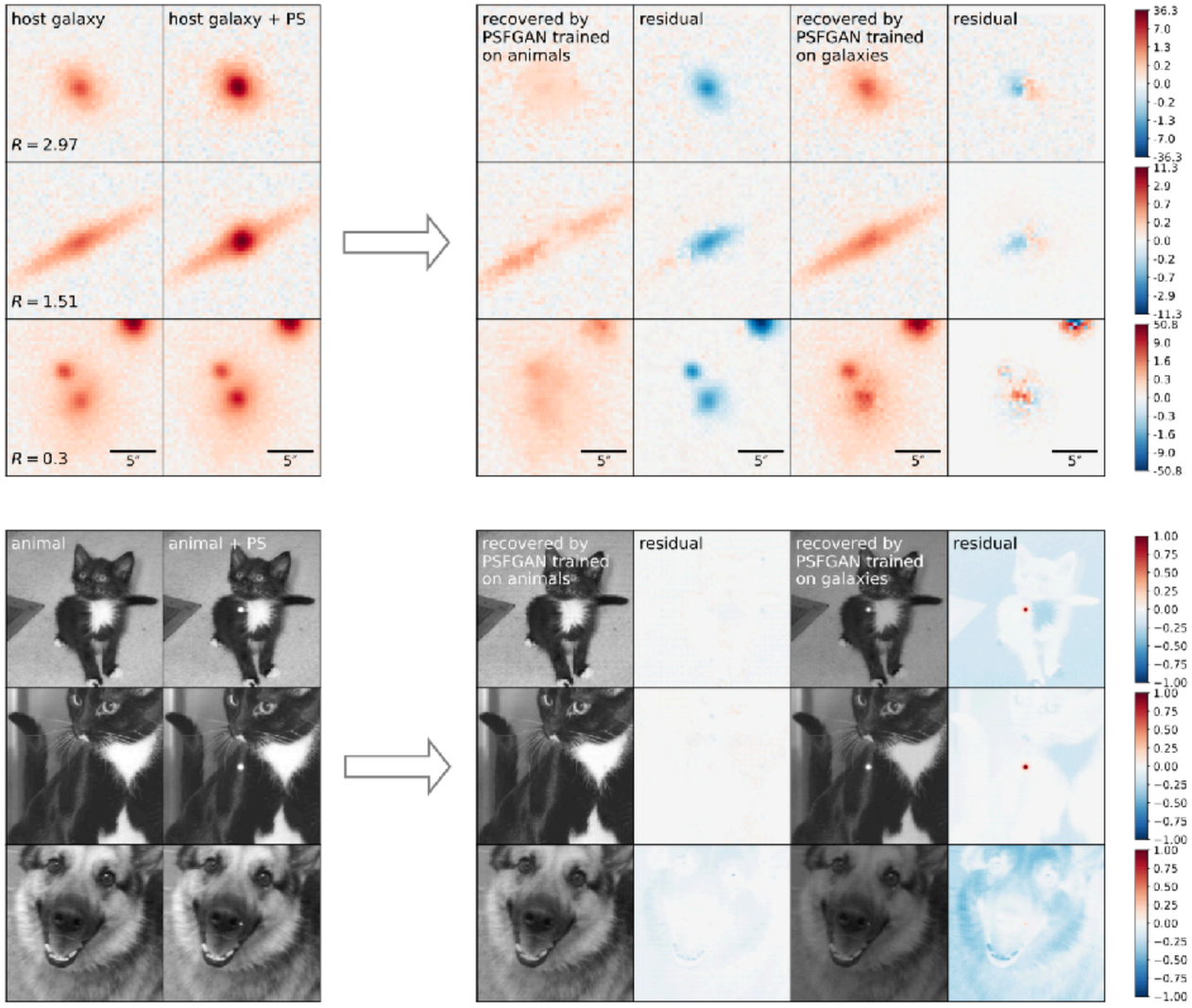


PSFGAN, Stark+ submitted

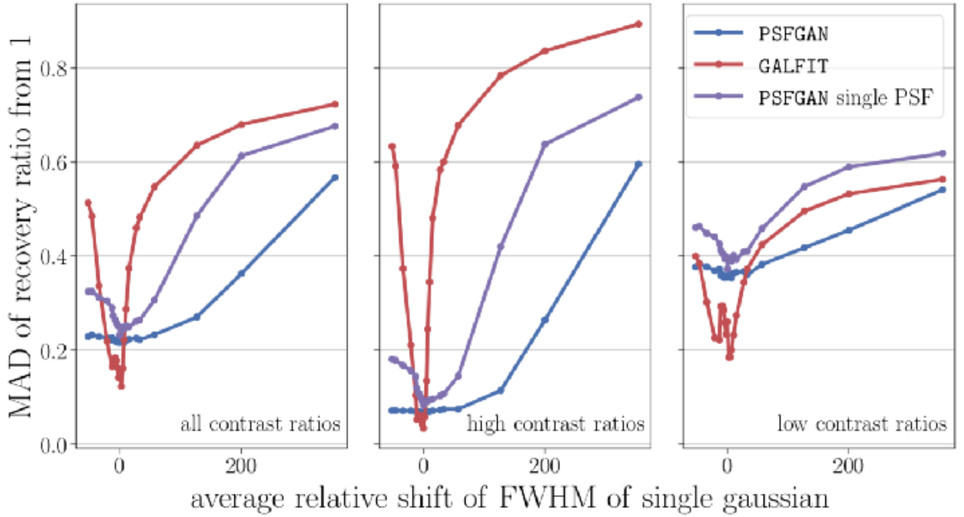
Dominik Stark



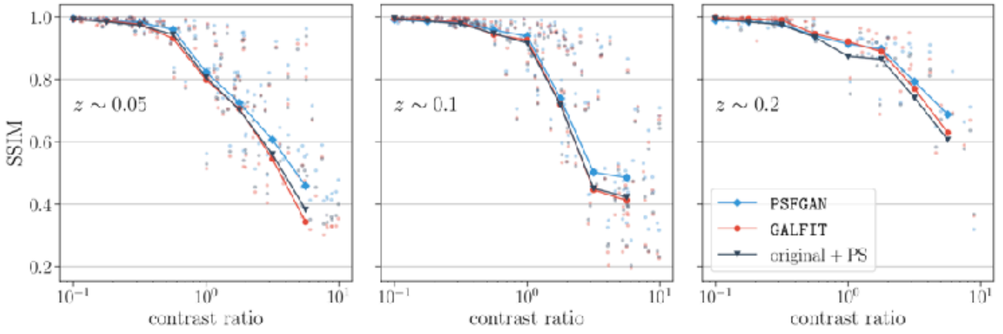
PSFGAN, Stark+ submitted



Less sensitive to PSF changes



Better at recovering features



PSFGAN, Stark+ submitted

original data

encoder

latent space

z

decoder

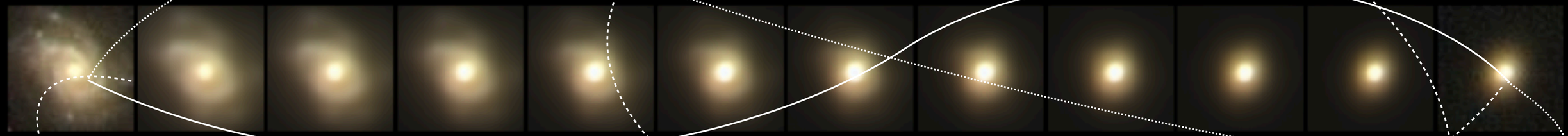
reconstructed data

Dennis Turp

z_1

z_2

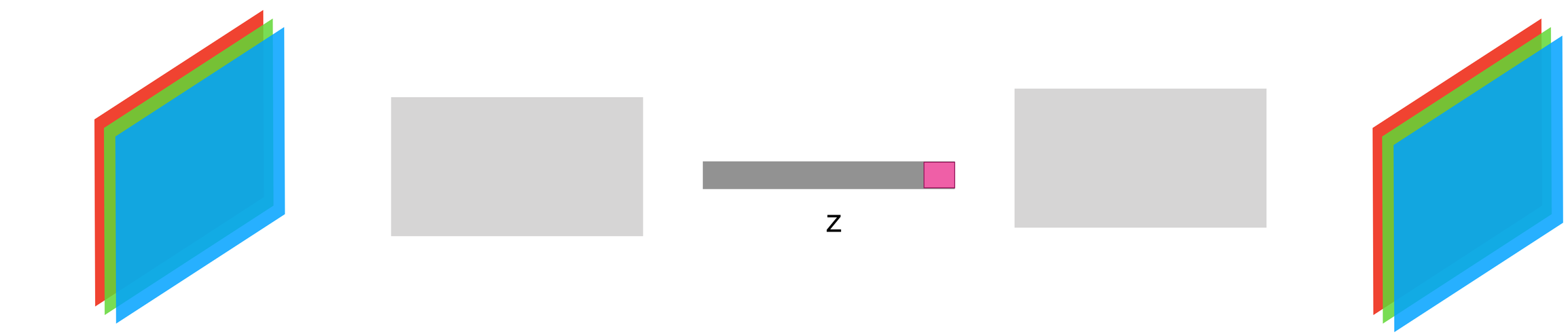
$$z' = a \times z_1 + b \times z_2$$

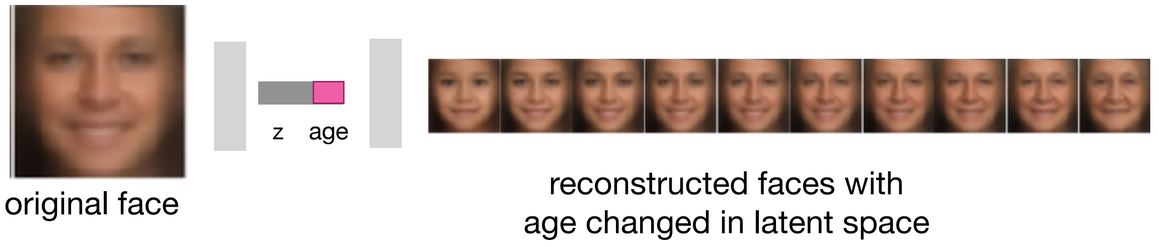


z_1

z_2

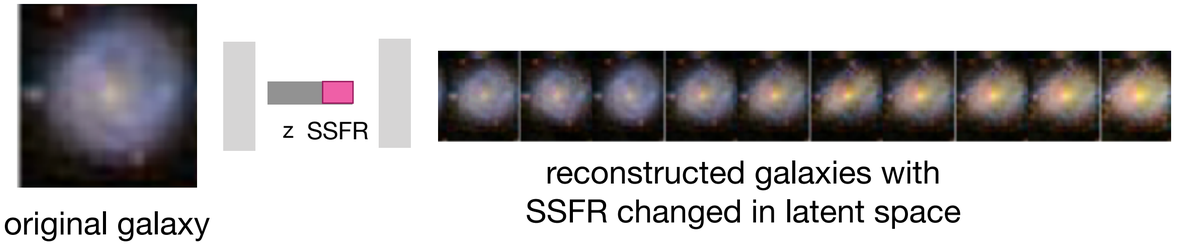
$$z' = a \times z_1 + b \times z_2$$





original face

reconstructed faces with
age changed in latent space

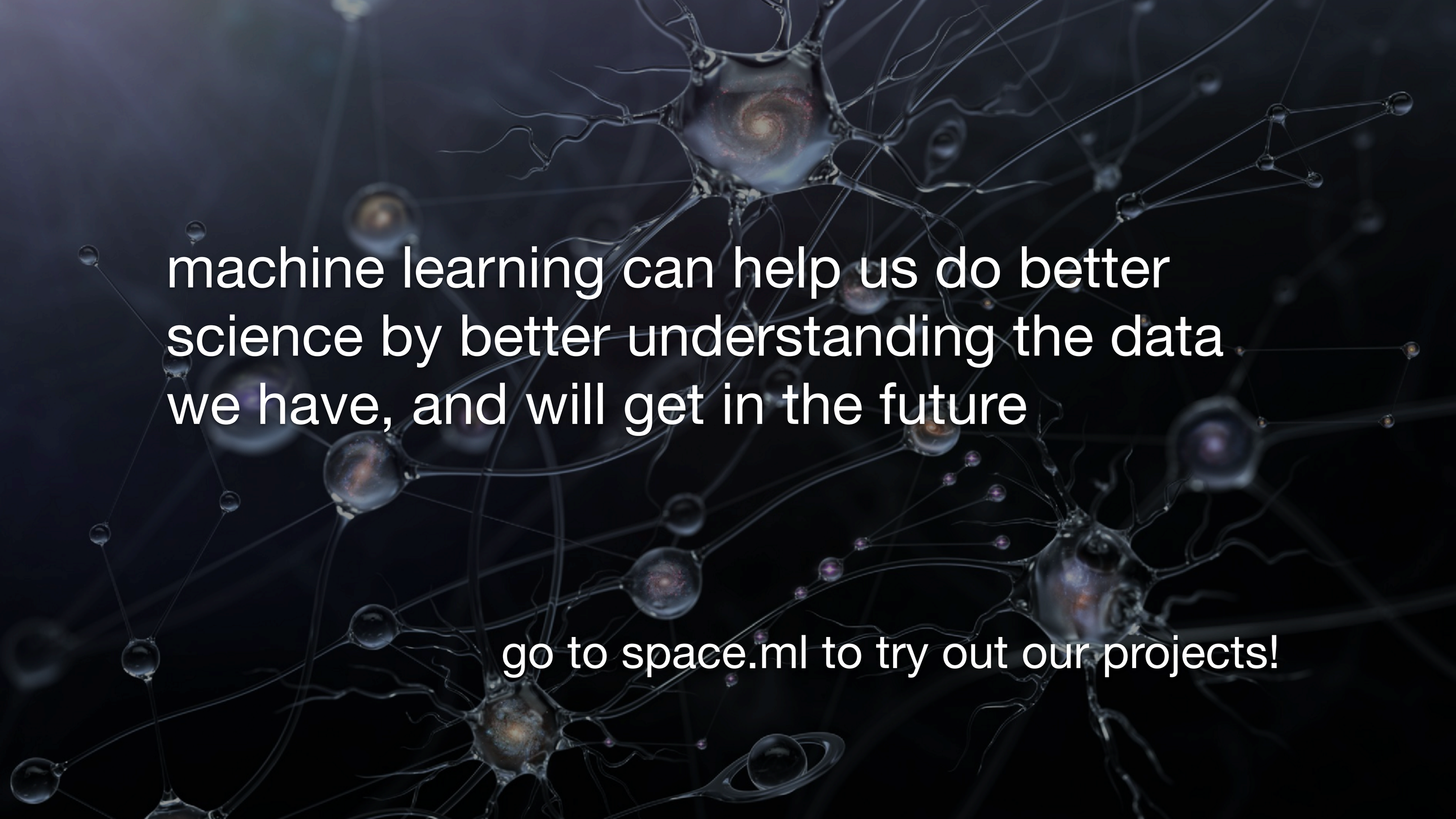


original galaxy

reconstructed galaxies with
SSFR changed in latent space

changing SSFR
in latent space

changing bulge-to-disk
in latent space


machine learning can help us do better science by better understanding the data we have, and will get in the future
go to space.ml to try out our projects!