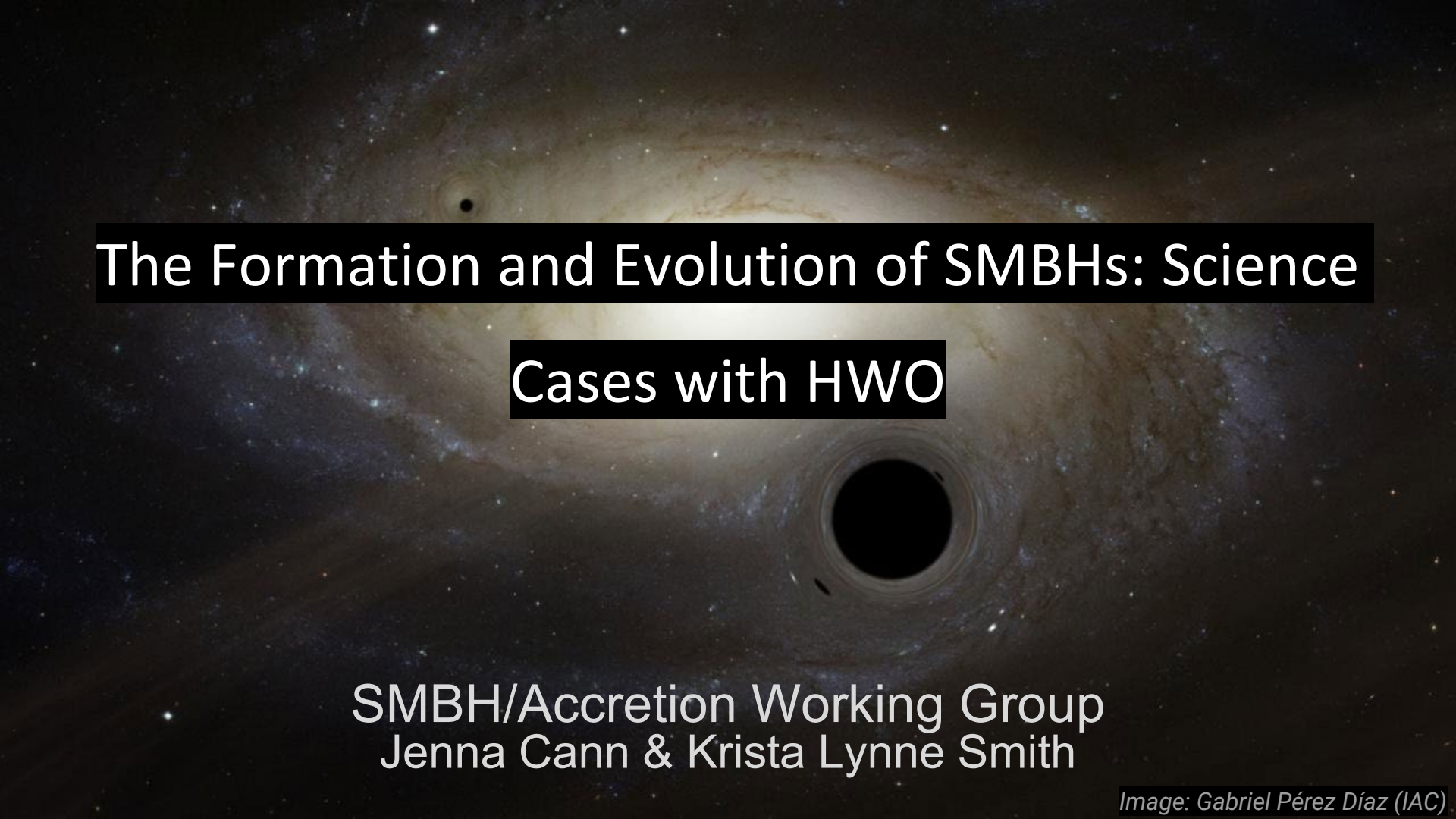




The Formation and Evolution of SMBHs: Science

Cases with HWO

SMBH/Accretion Working Group
Jenna Cann & Krista Lynne Smith

Image: Gabriel Pérez Díaz (IAC)

Supermassive Black Hole/Accretion Working Group

Krista Lynne Smith

Jenna Cann

Francesca Civano

Satyapriya Das

Erin Hicks

Gagandeep Kaur

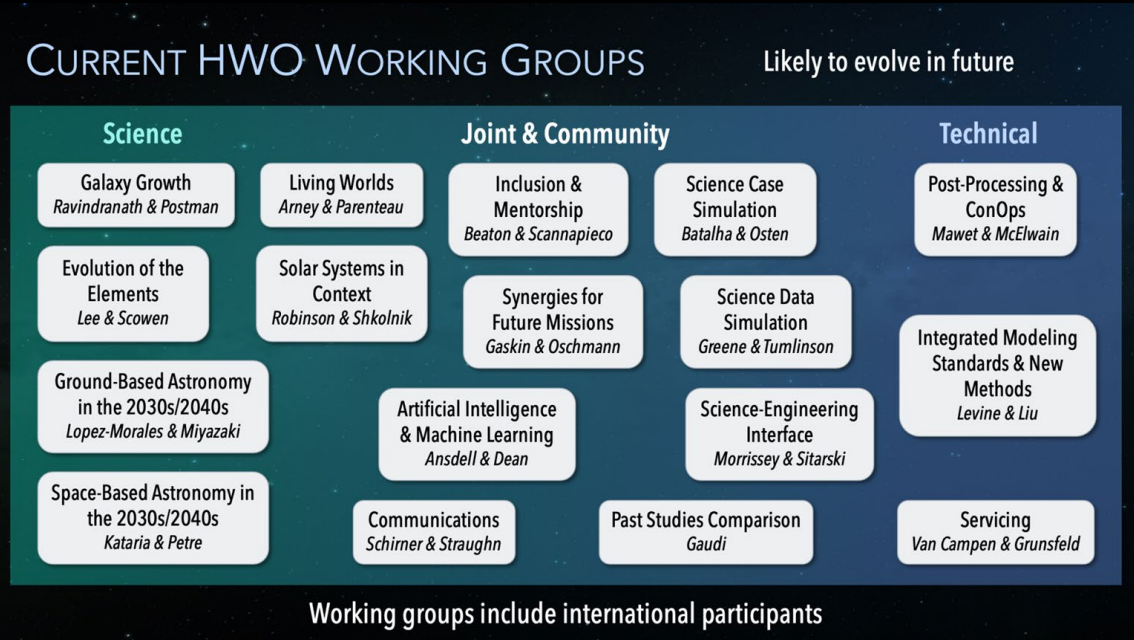
Steph LaMassa

Erini Lambrides

Jeffrey McKaig

Missagh Mehdipour

Gopka SM



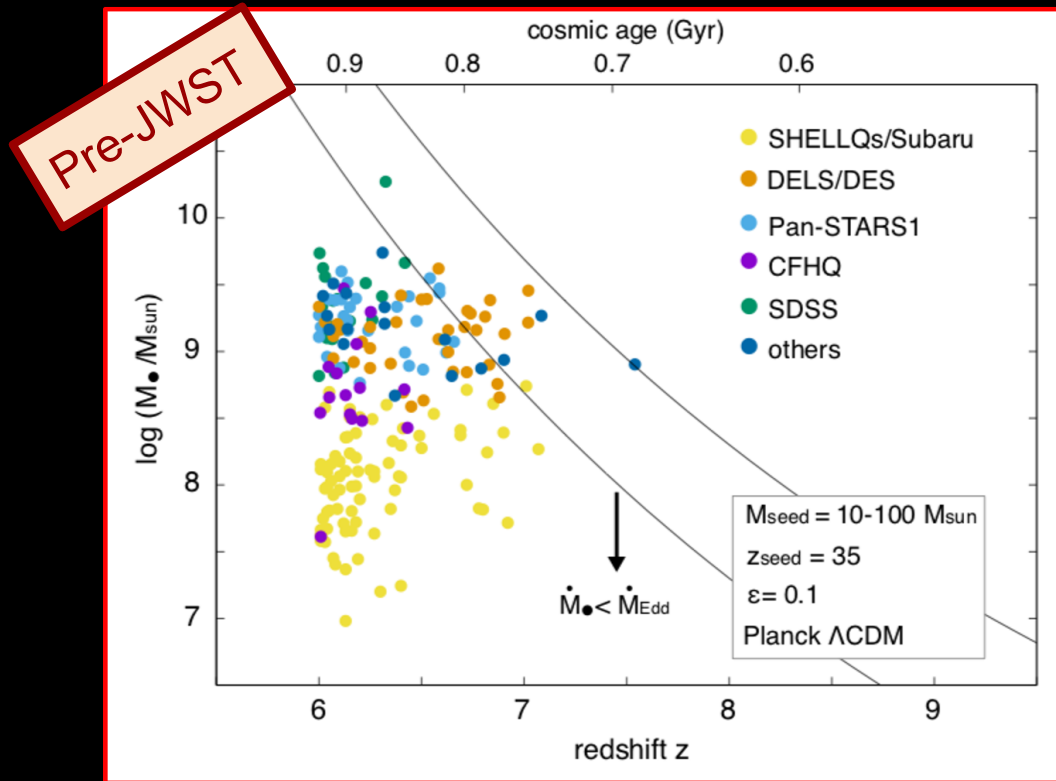
Want to get involved in the SMBH/Accretion WG?

Feel free to reach out to co-chairs Krista (kristalynnesmith@tamu.edu) or myself (jenna.cann@nasa.gov)!

Image: NASA GSFC/Roberge

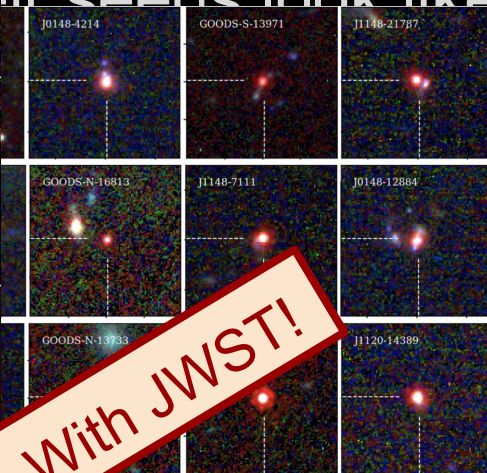
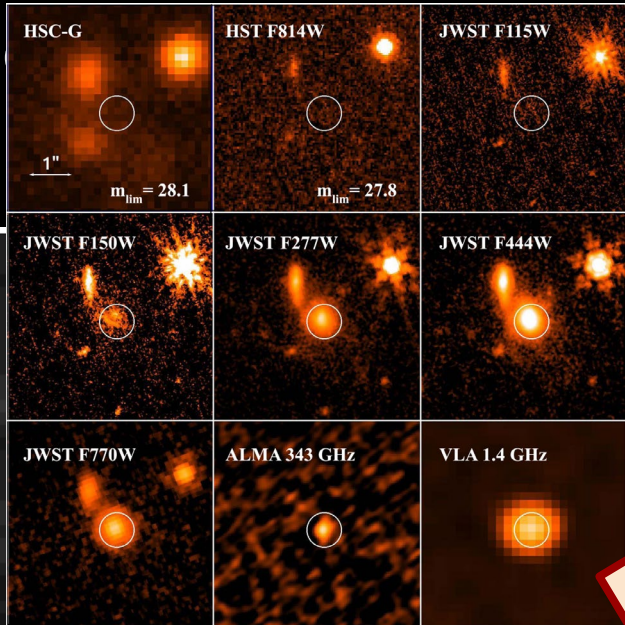
How were supermassive black holes formed in the early Universe?

How were supermassive black holes formed in the early Universe? What do their seeds look like?

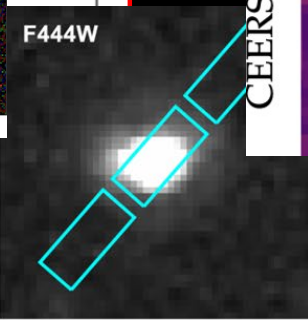
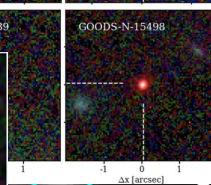
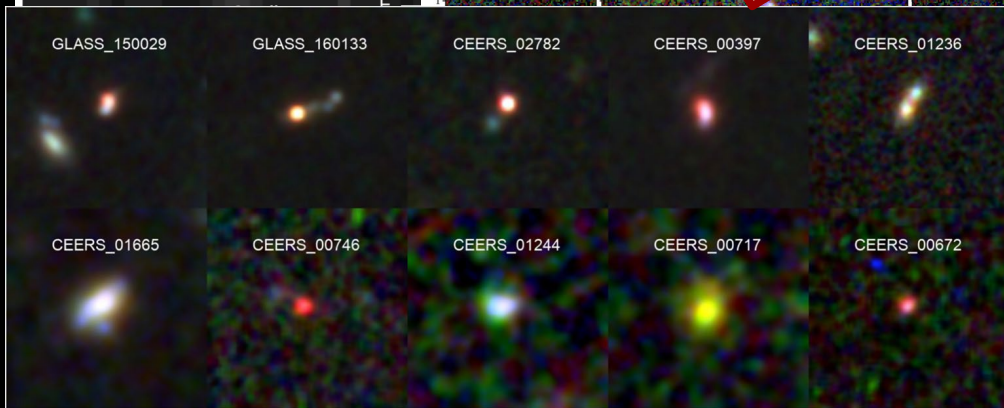
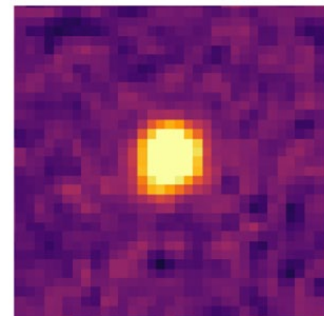
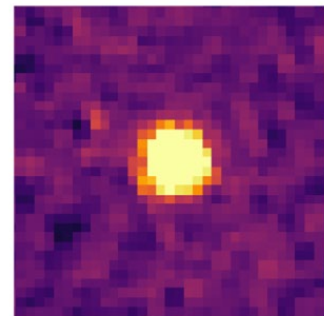
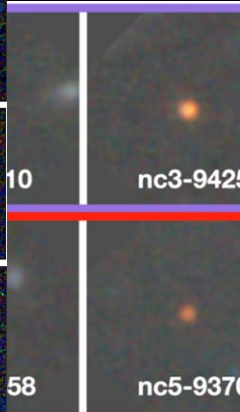


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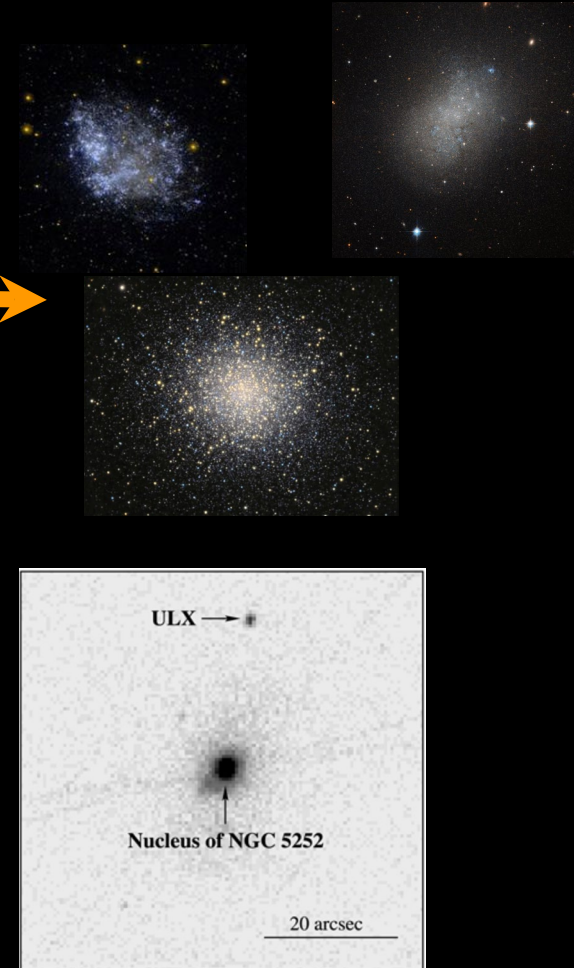
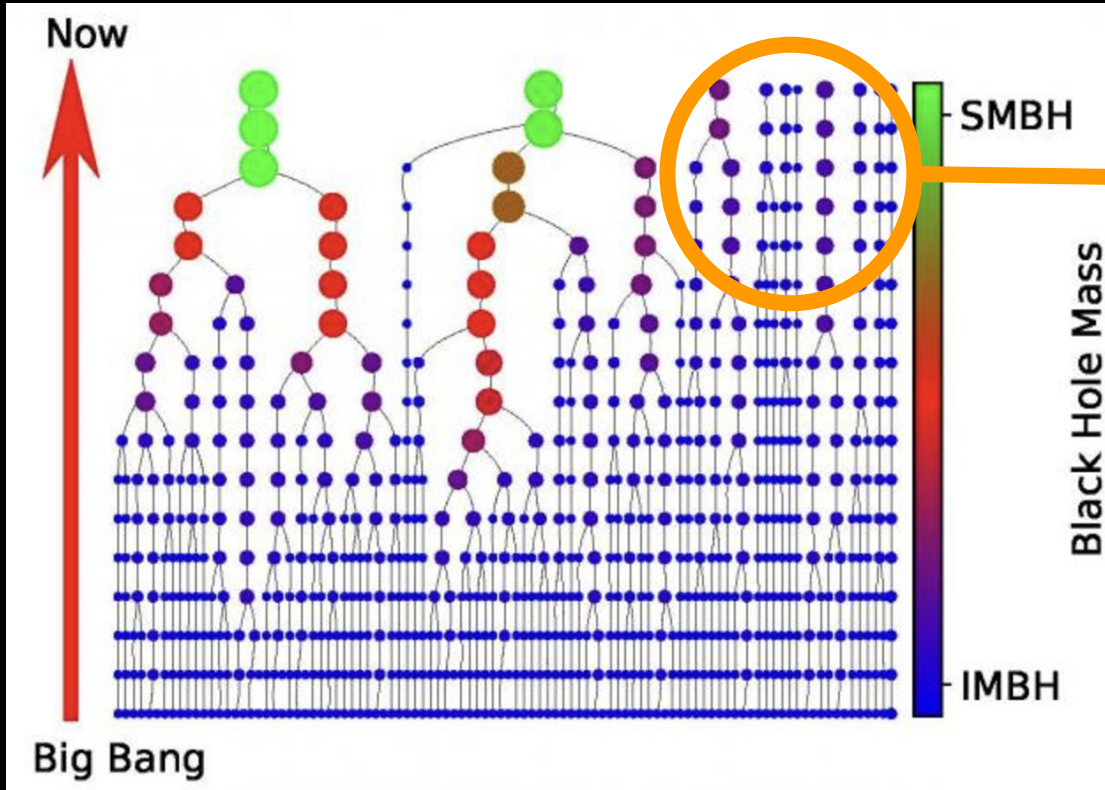
Have black holes formed in the early universe?
What do their seeds look like?



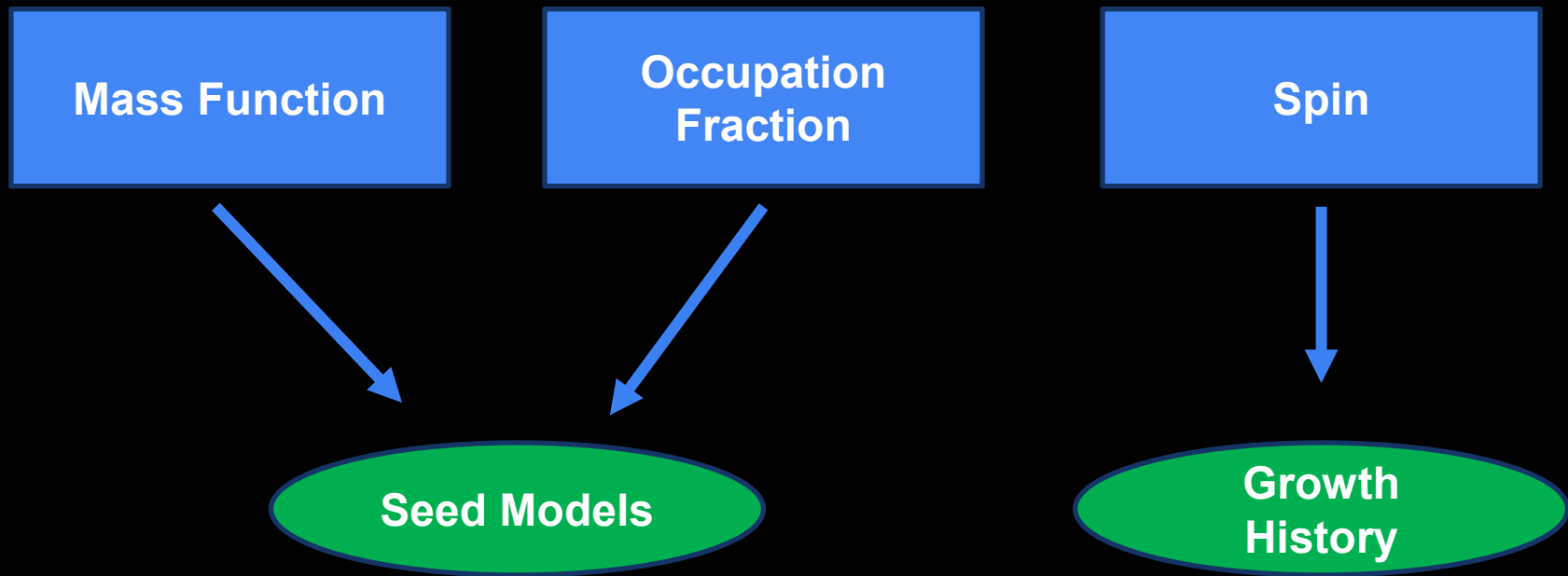
With JWST!



Detailed properties of local IMBHs tell us about the black hole seeds in the early universe.

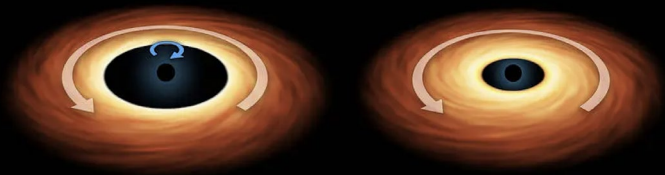
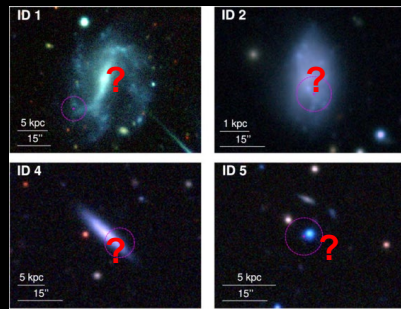


What info do we need?



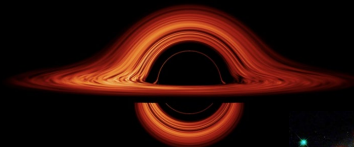
How were supermassive black holes formed in the early Universe? What do their seeds look like?

- Do a similar **fraction** of dwarf galaxies host massive black holes as Milky Way-sized galaxies?



- Do the **mass** and **spin** distributions of IMBHs differ between nuclear and off-nuclear (e.g., globular clusters, ULXs) environments?

- Is the **spin** distribution of AGN, particularly IMBH-driven AGN, more consistent with a merger-driven or accretion-driven growth history?

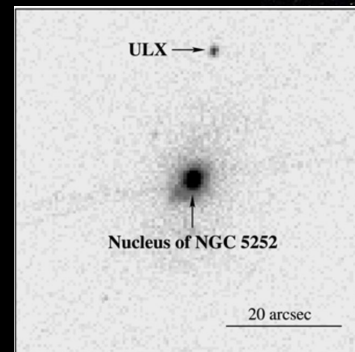


vs



Target IMBH candidates in:

- (1) low metallicity dwarf galaxies analogous to high-z galaxies,
- (2) globular clusters,
- (3) off-nuclear sources (e.g., ULXs)



Large wavelength coverage IFU/imaging study enabling:

- **Census** building through coronal line detections, UV, etc.
- Virial and dynamical **mass** measurements
- Black hole **spin** measurements from simultaneous UV→NIR continuum fitting

Science Goal:

Detection of IMBHs

Instrumental Need:

Large 1' FOV or mosaicking with IFU

Method: direct search for off-nuclear sources

High sensitivity: 1×10^{-20} erg/cm²/s

High spatial resolution: comparable to/better than JWST

Method: Coronal line detection, UV selection

Black hole spin measurements

UV → NIR simultaneous spectral coverage

Method: Continuum fitting

Black hole mass measurements

High spatial resolution: comparable to/better than JWST

Method: kinematic (and/or virial) mass

Other Science Cases being Explored

(1) Fundamental Properties of Accretion: Does the shape/geometry of the BLR depend on accretion rate? Do “little red dot” AGN represent a “new” geometry or physics of accretion compared to what is seen in most AGN in the local universe? Are changing-look AGN associated with different accretion states?

(2) Fundamental Properties of SMBHs: As a population, do AGNs tend to have spins indicative of merger-driven or accretion-driven growth? Is there a redshift or mass dependence to spin? Do galaxies with an actively growing SMBH follow the expected scaling relations, and do those relations change with redshift? Is the currently assumed geometry that enables reverberation mapping correct?

Other Science Cases being Explored

(1) Fundamental Properties of Accretion: Does the shape/geometry of the BLR depend on accretion rate? Do “little red dot” AGN represent a “new” geometry or physics of accretion compared to what is seen in the most AGN in the local universe? Are changing-look AGN really changing with different accretion states?

(2) Fundamental

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...population, do AGNs ...
...jet-driven or accretion-driven ...
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