What TMT will (hopefully) tell us about AGNs and SMBHs: beyond first light

Yoshiki Matsuoka (Ehime Univ.)

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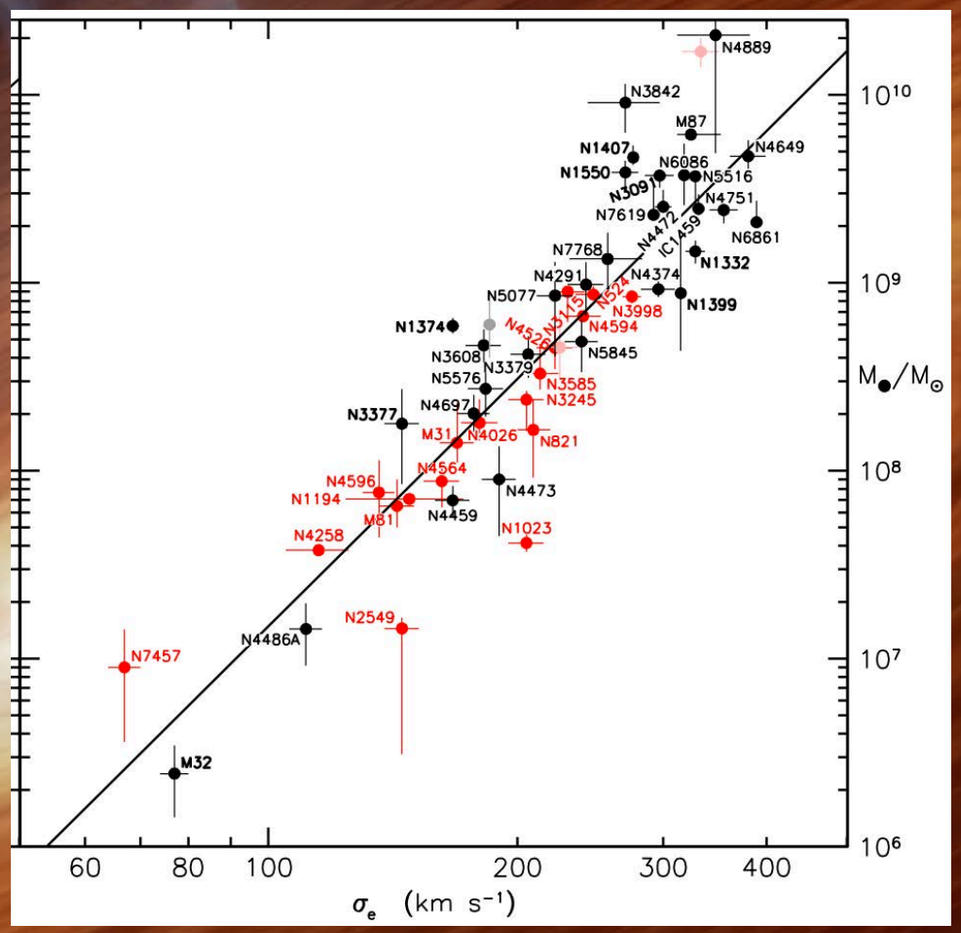
What we know/believe about AGNs and SMBHs

✶ There are objects called AGNs (or quasars) in the sky.
✶ They are powered by mass accretion onto supermassive black holes (SMBHs), which are (almost) always found in the center of galaxies.
✶ SMBHs prevail in the Universe. They are already in place at z = 7, i.e., less than a billion years after the Big Bang.
✶ SMBHs may have “co-evolved” with the host galaxies.

Simpson+04



Normandy & Ho 13

What we will know about AGNs and SMBHs, with the TMT first-light instruments

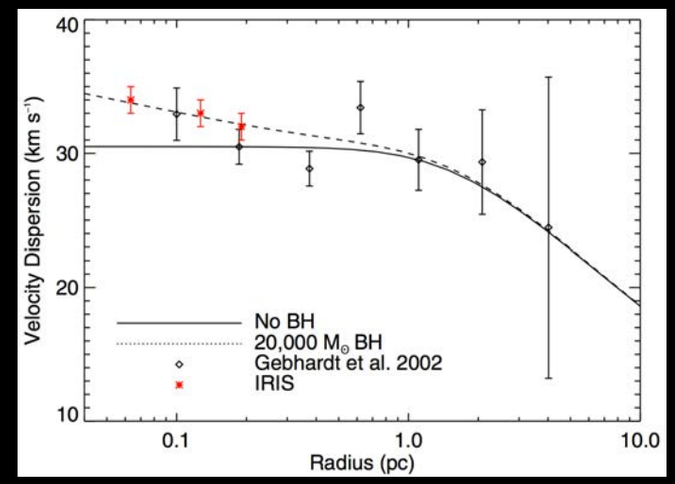
✶ IRIS + NFIRAOS will:

➔ observe SMBHs being formed; SMBHs with 10^7 M_{sun} at z = 10 will be detected in a few hours (if they are shining at the Eddington limit, and not obscured).

➔ find intermediate-mass black holes (IMBHs) in globular clusters and/or dwarf galaxies, if present (e.g., G1 in M31).

➔ map the kinematics of ionized/neutral/molecular gas in AGN host galaxies, to look for the signature of the putative "AGN feedback", with ~100 pc resolution even at z = 1-2.

ⓒ NASA/JPL-Caltech

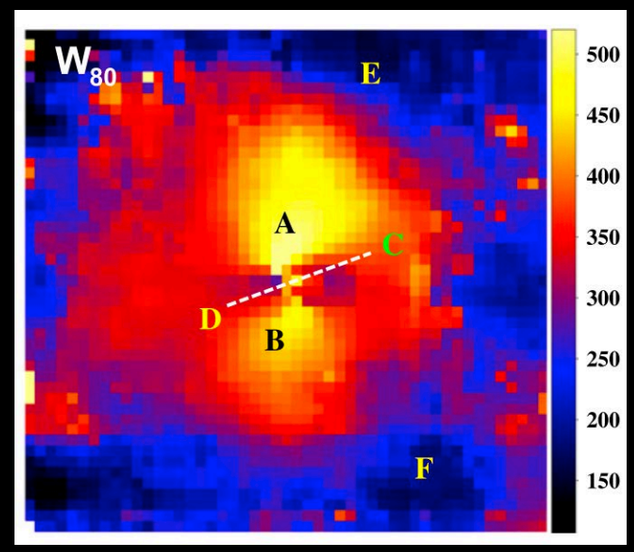


Do+14

✶ WFOS will:

➔ identify a large number of AGNs in optically-faint X-ray sources, as well as in galaxies without significant X-ray emission.

➔ trace the chemical evolution of galaxy centers close to SMBHs, through measurements of multiple metal emission lines.



Liu+15

What we further want to know about AGNs and SMBHs, with TMT next-generation instruments

✶ IMBHs in GCs and dwarf galaxies

→ *Optical/NIR high-resolution spectrograph*

✶ AGN torus

✶ Energetics of IR galaxies

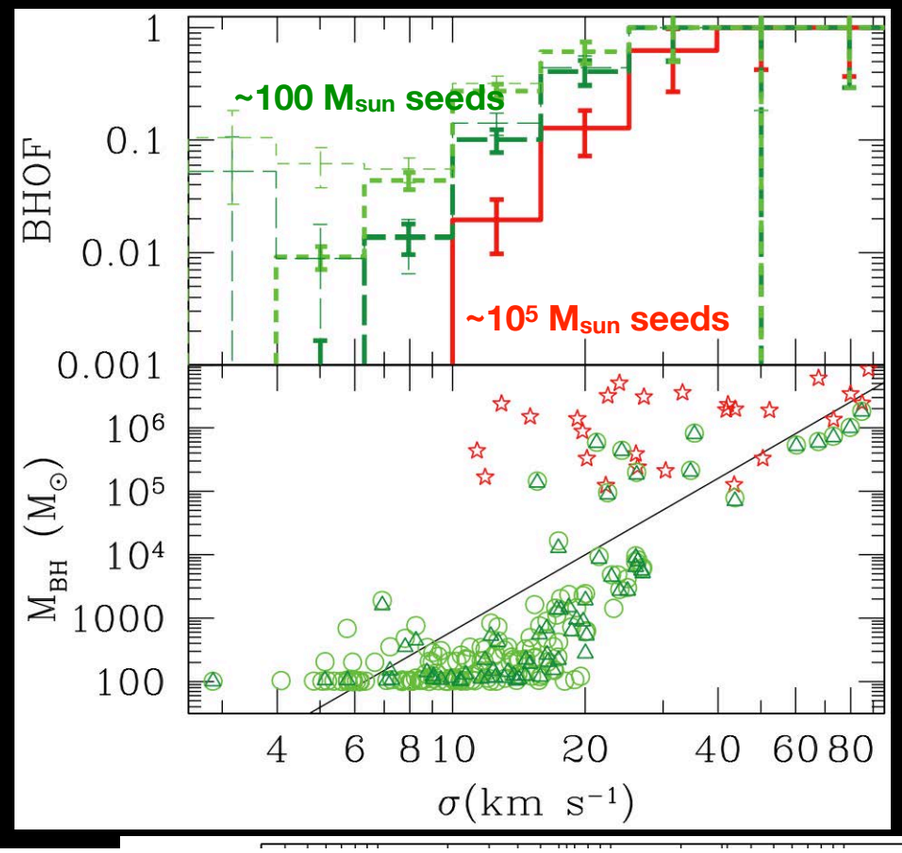
→ *MIR imager + AO*

✶ AGN demographics at the "cosmic noon"

→ *NIR multi-object spectrograph*

IMBHs in GCs and dwarf galaxies

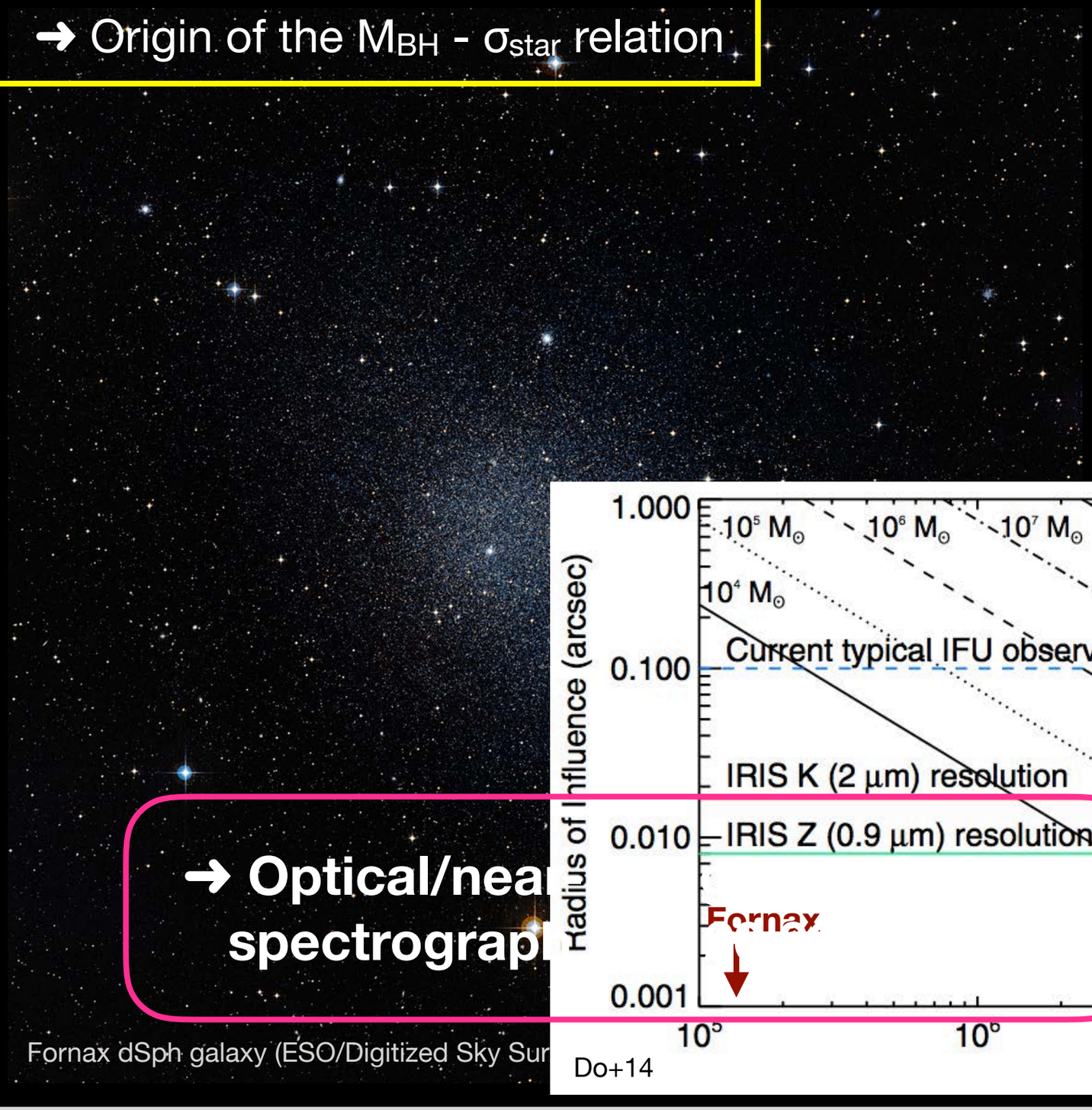
Van Wassenhove+10

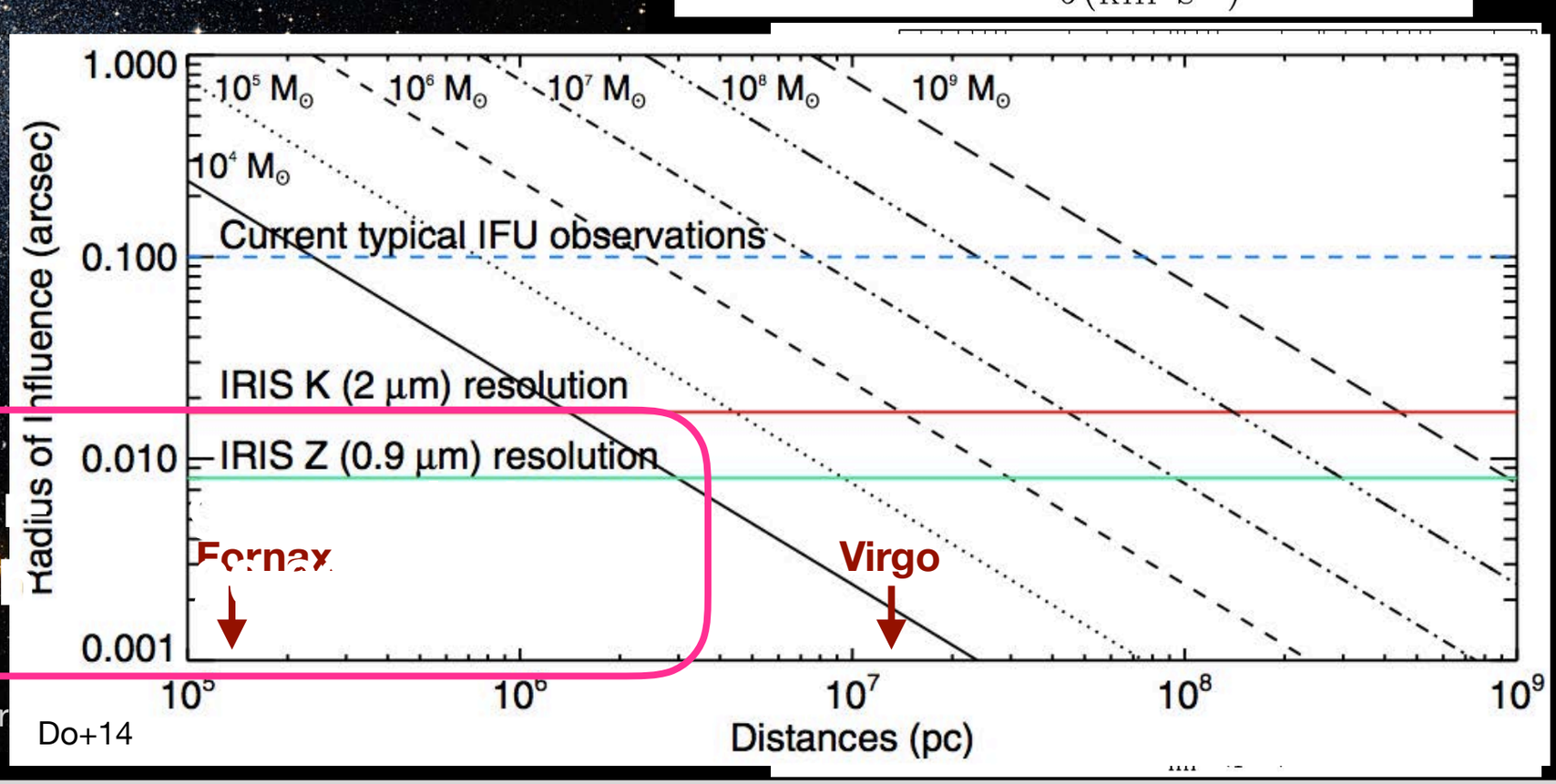


Why do we care?

➜ SMBH formation

➜ Origin of the M_{BH} - σ_{star} relation



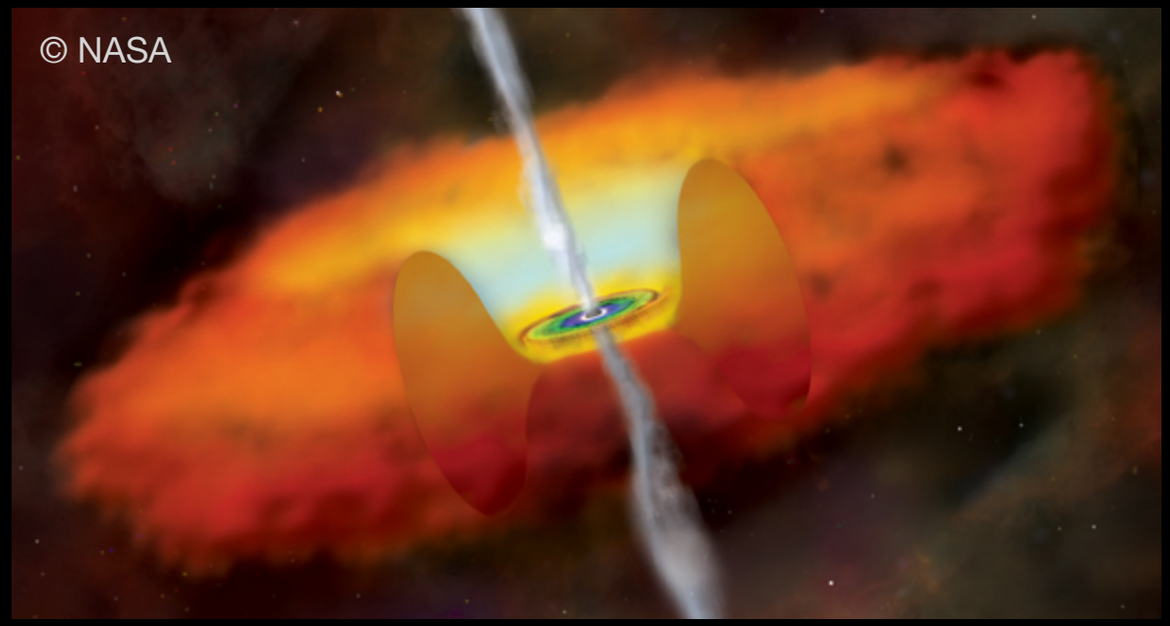


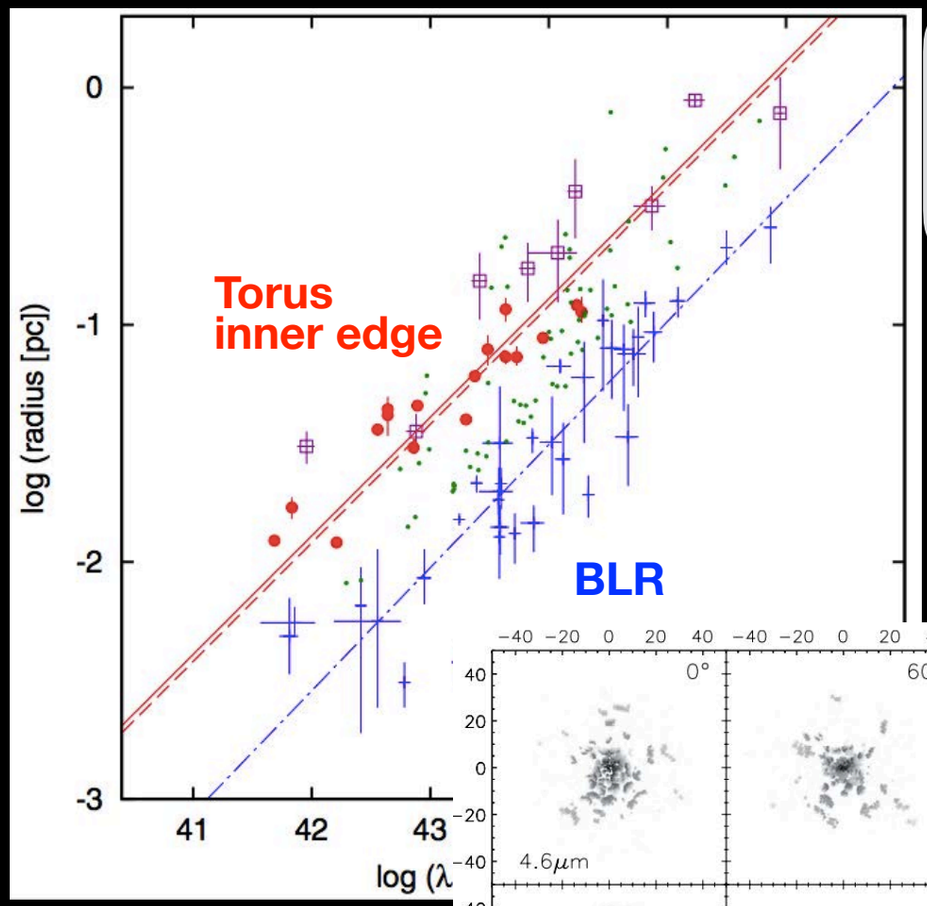
➜ Optical/near-IR AO spectrographs

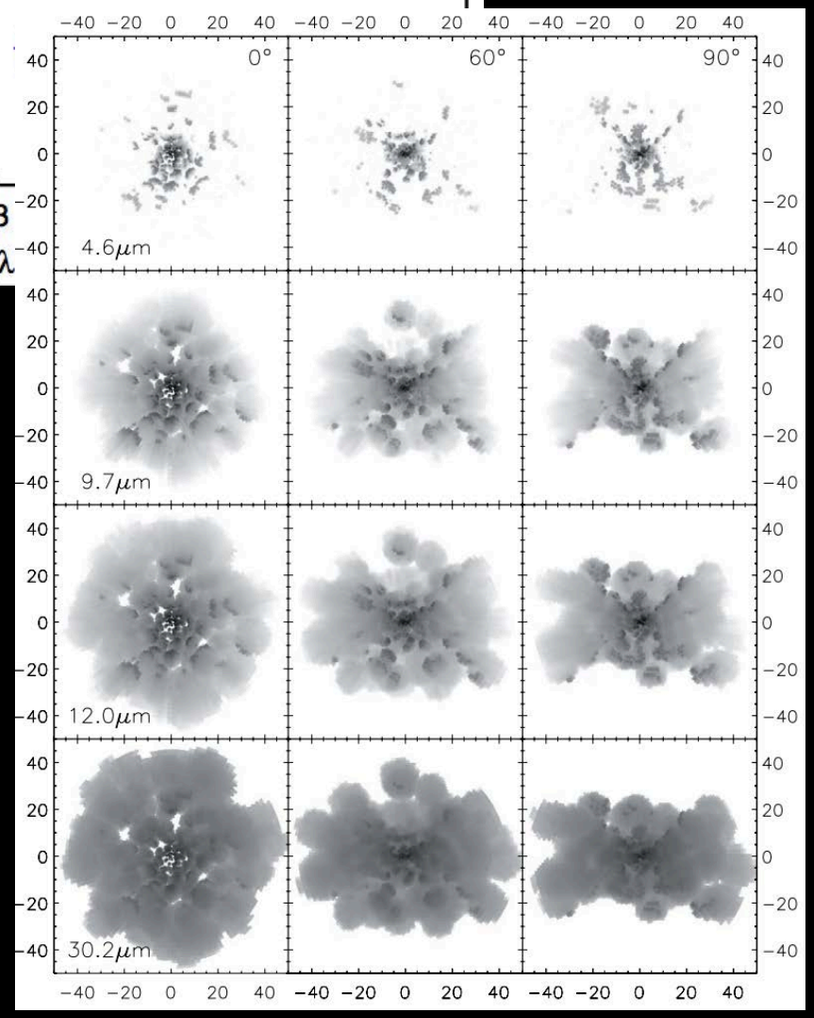
Fornax dSph galaxy (ESO/Digitized Sky Sur

Do+14

AGN torus







Why do we care?

➜ AGN unification model

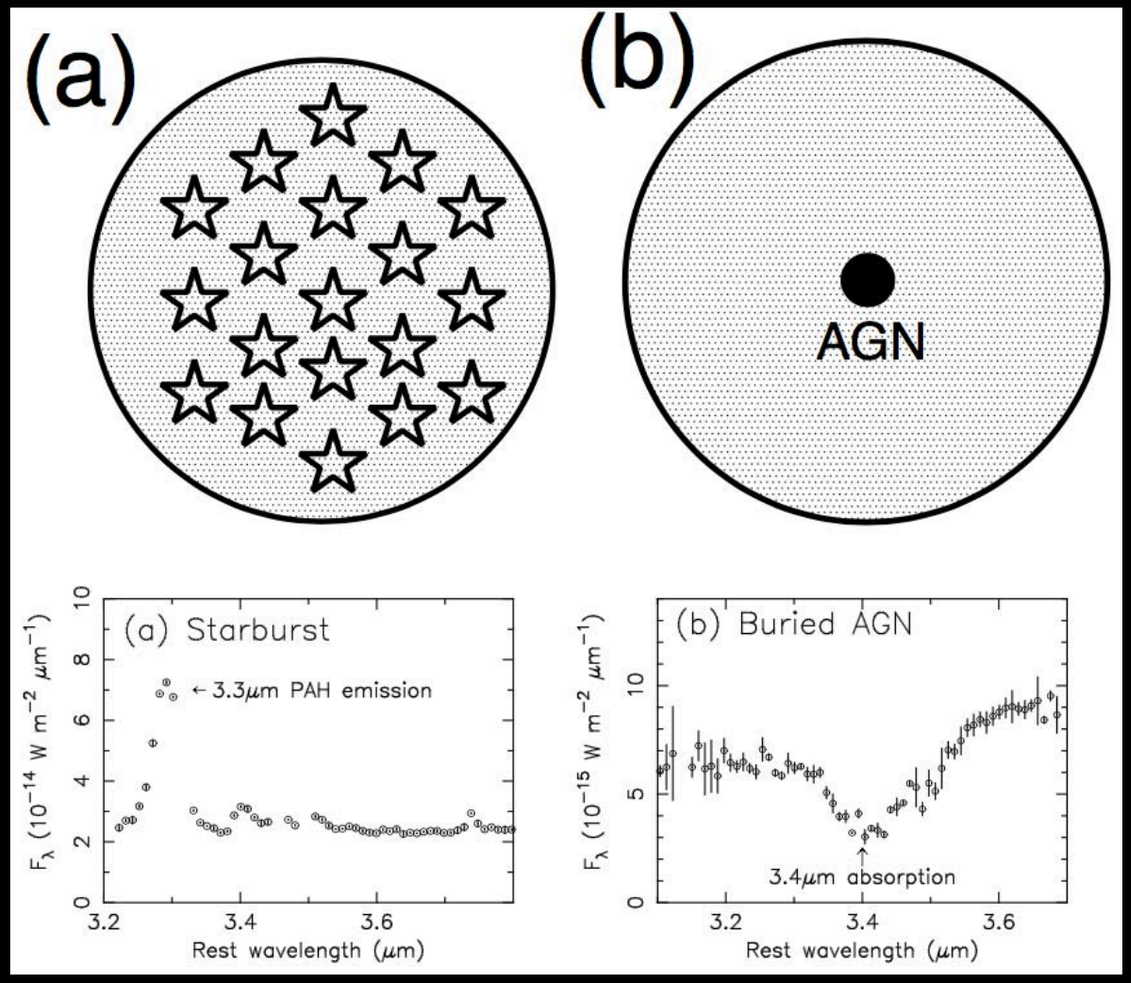
➜ SMBH feeding and feedback

➜ Mid-IR imager + AO

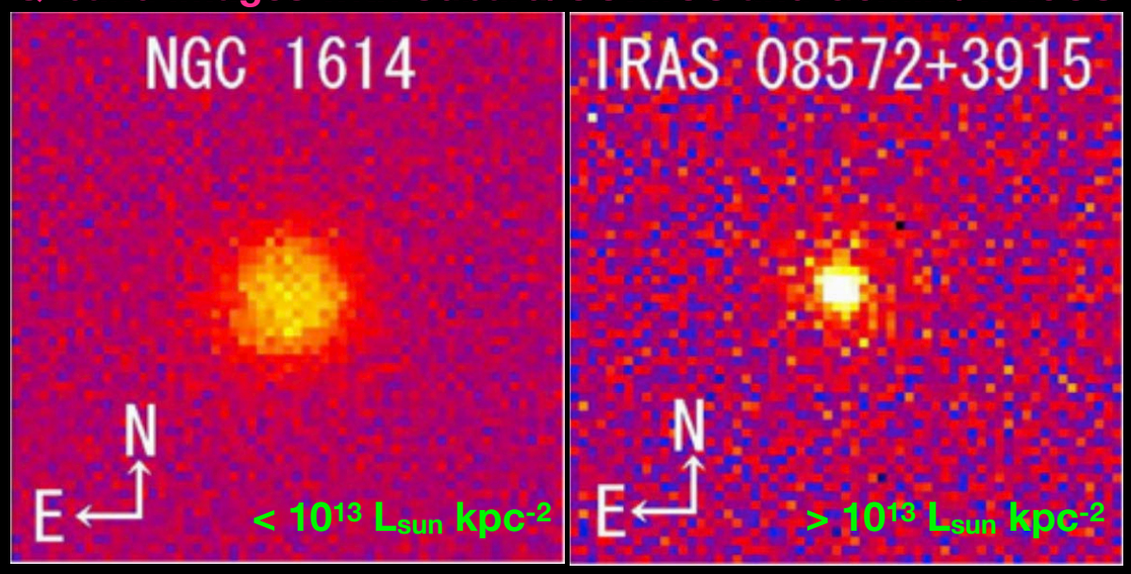
- ✶ Q-band (20 μm) imaging with ~0”.1 resolution (~20 pc at z = 0.01) - Unique to TMT!
- ✶ Gas kinematics from H_2 IFS, with IRIS + NFIRAOS
- ✶ Synergy with ALMA, which will probe cold molecules with the CO lines, with similar spatial resolution.

Energetics of IR galaxies

Imanishi+06,07,11



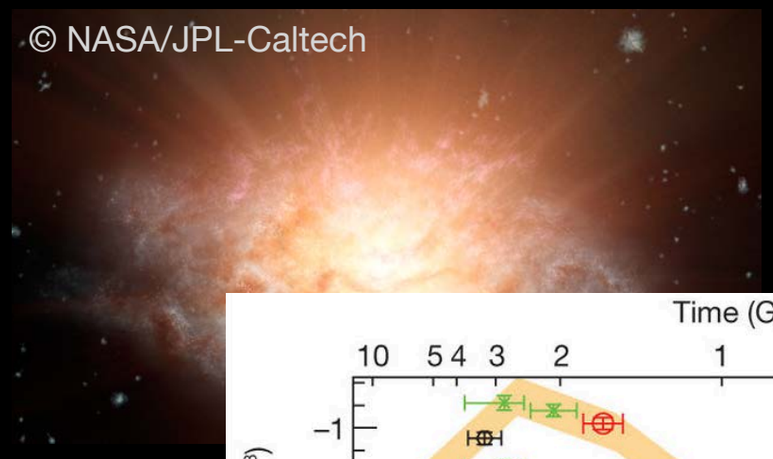
Q-band images with Subaru/COMICS and Gemini/T-ReCS



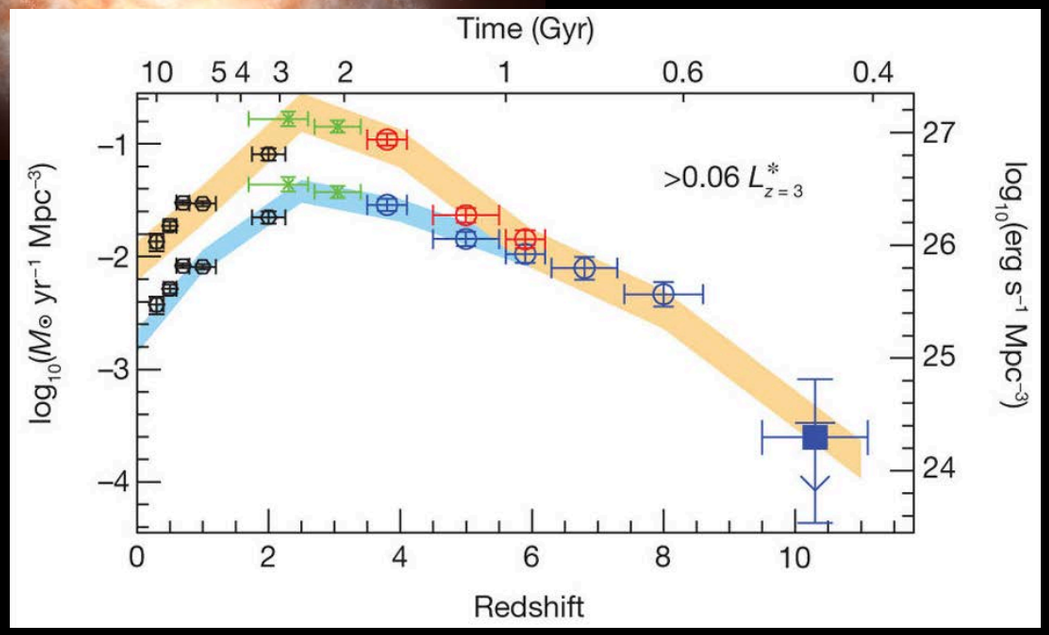
Why do we care?

➜ Cosmic SF largely obscured by dust

➜ Optically-elusive AGNs



Bouwens+11



➜ Mid-IR imager
+ low-resolution spectrograph

AGN demographics at (and beyond) the “cosmic noon”

Why do we care?

➜ AGN demographics

➜ SMBH growth throughout the Universe

Spec-z sample

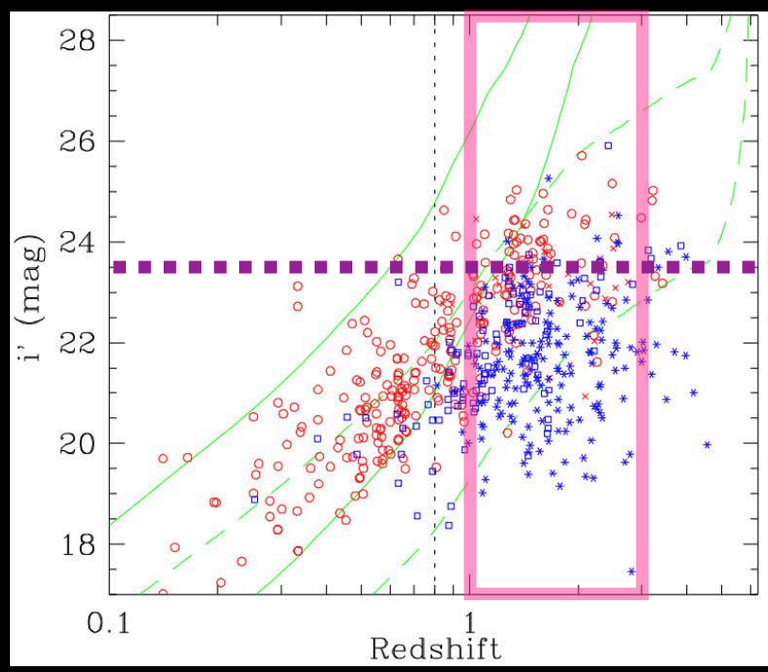
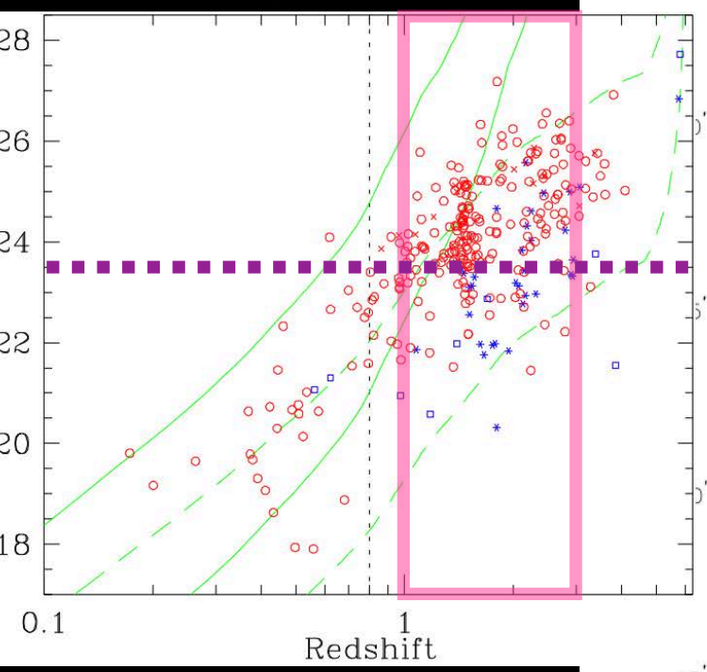
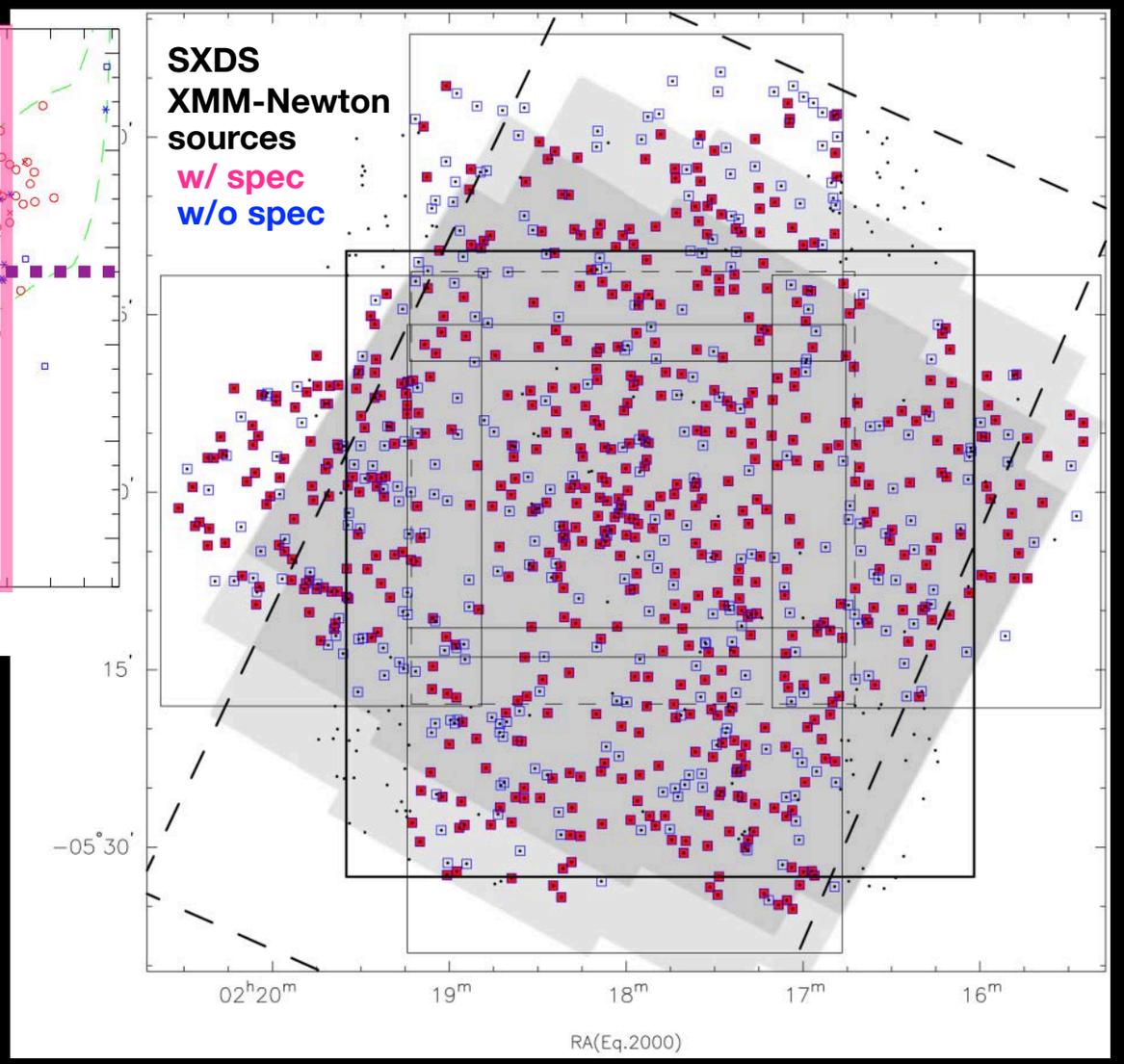


Photo-z sample





Akiyama+15

➜ Near-IR multi-object spectrograph

✶ Coordinated follow-up of X-ray sources, along with normal (non X-ray) galaxies.

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