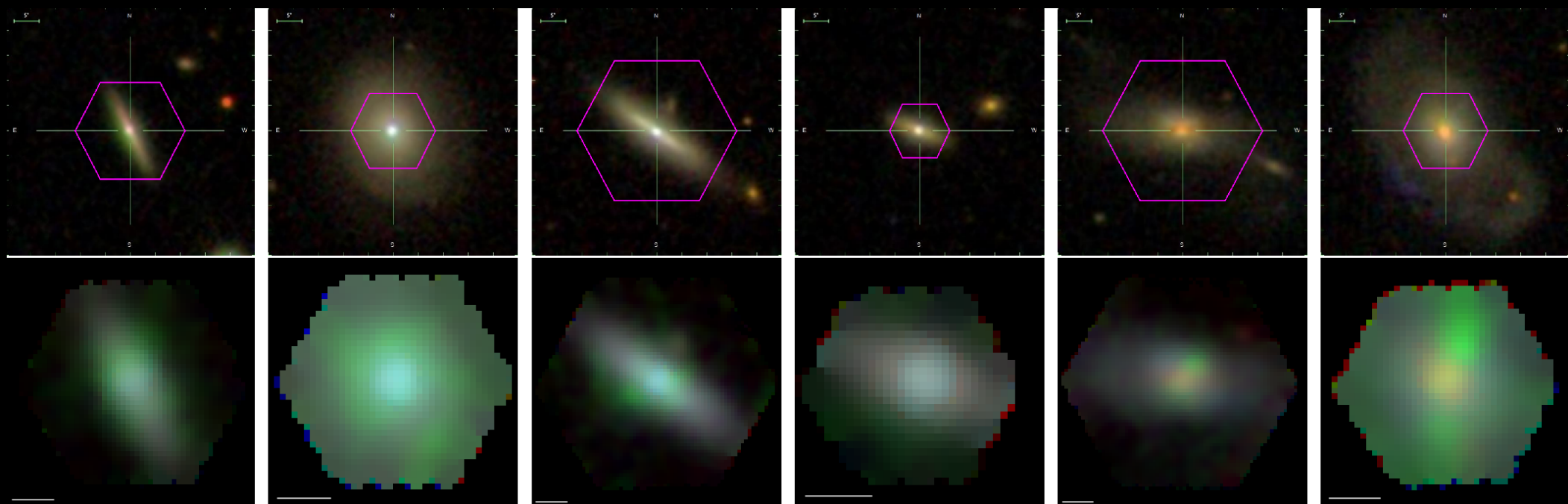


Past AGN Activity in TDE Host Galaxies



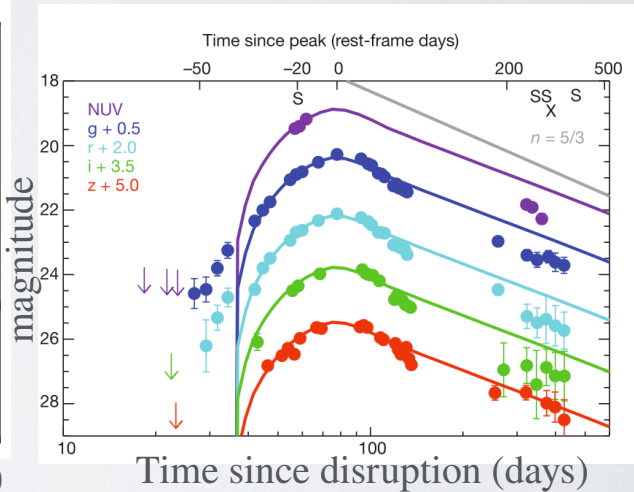
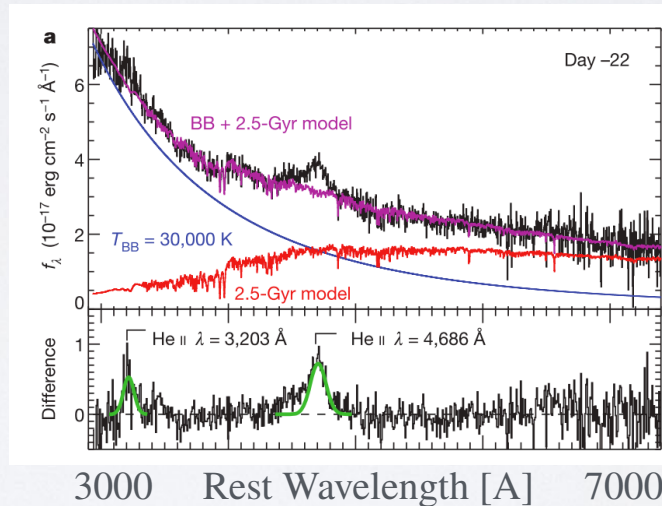
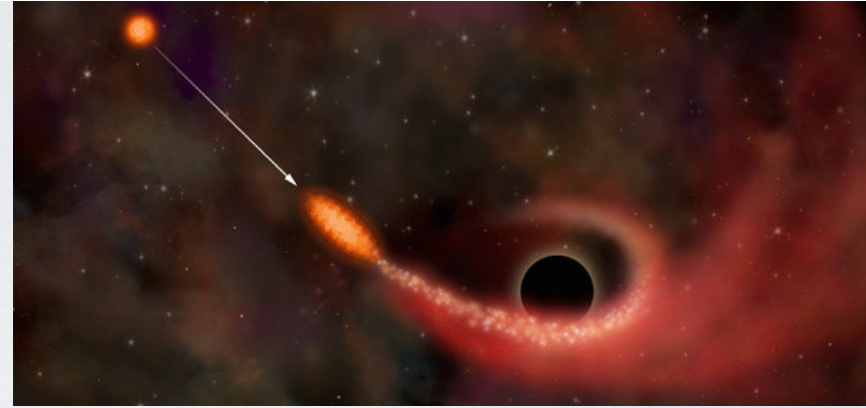
K. Decker French

University of Illinois Urbana-Champaign

In collaboration with: Nick Earl, Annemarie Novack, Bhavya Pardasani, Vismaya Pillai, Akshat Tripathi, Maggie Verrico

Tidal Disruption Events

- Stars which travel closer than the tidal radius of a black hole are disrupted
- If this occurs outside the event horizon (if $M_{\text{BH}} < 10^8 M_{\odot}$), observable flare
- Bright in the UV/optical
- Characteristic light curve shape, broad H/He emission

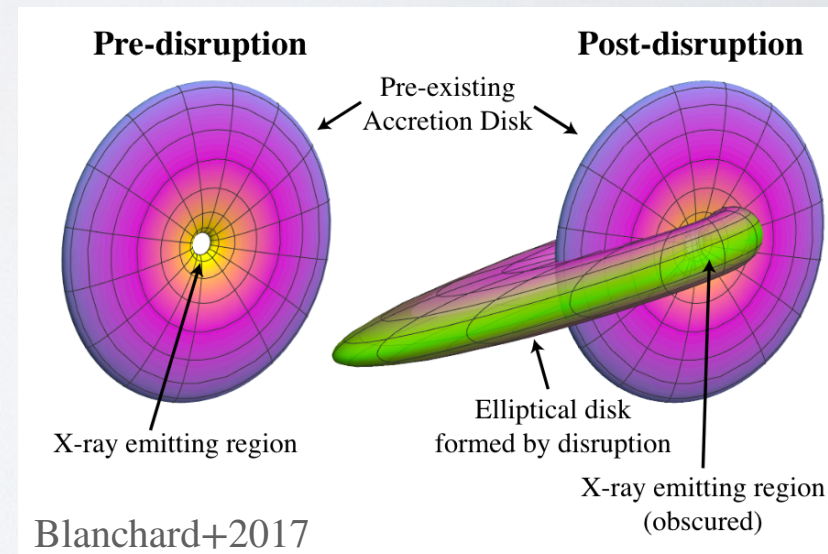
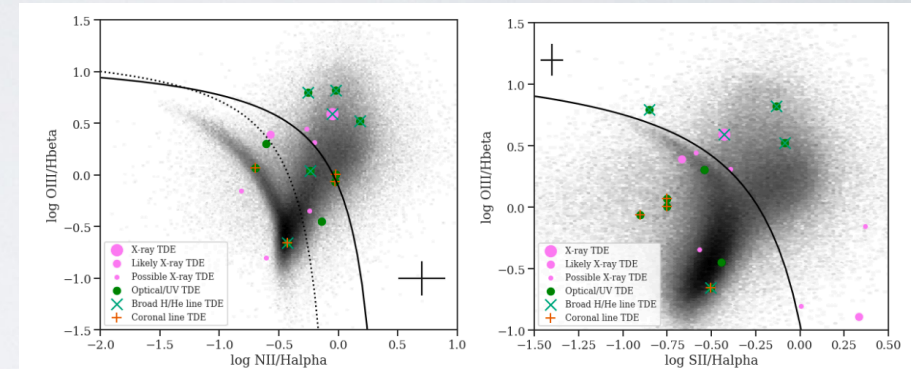


PS1-10jh, Gezari+ 2012

Distinguishing TDEs from AGN

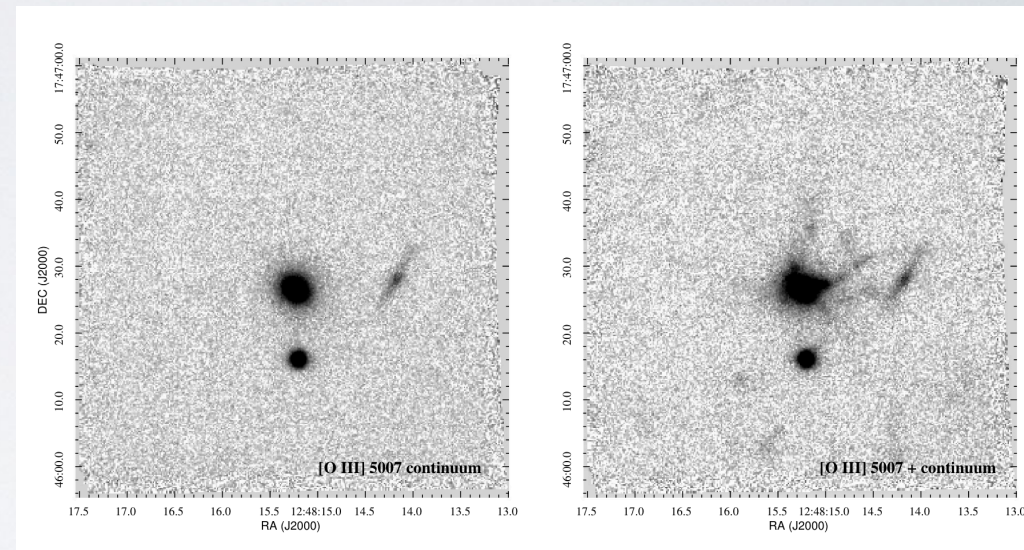
French+2020

- Select against quasars, luminous AGN, anything in milliquas...
- But:
 - TDEs have still been found in AGN hosts
 - The presence of an AGN may even increase the TDE rate (e.g. Kennedy+2015)
 - Selecting against TDEs in persistent AGN systems may bias the resulting population
 - Need to understand ambiguous events (e.g. AT2017bgt like events, Trakhtenbrot+2019)



A puzzling example: ASASSN-14li

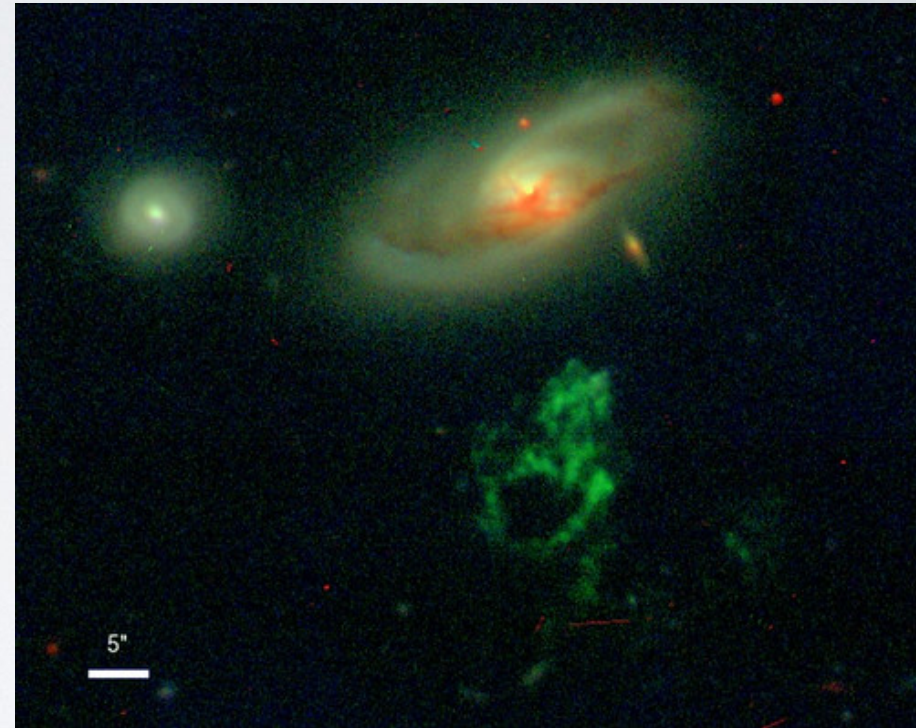
- ASASSN-14li (Holoien+2016) is a nearby ($D \sim 90$ Mpc) TDE among the best studied, prototypical events
- MUSE observations of the host galaxy show OIII-bright filaments on >10 kpc scales (Prieto+2016)
- Filaments likely gas from a recent merger (consistent with the post-starburst spectra of the host), photoionized by AGN
- Host spectra from pre-TDE show only weak LINER-like emission, not enough to have ionized these filaments



Prieto+2016

Extended Emission Line Regions (EELRs) as tracers of past AGN activity

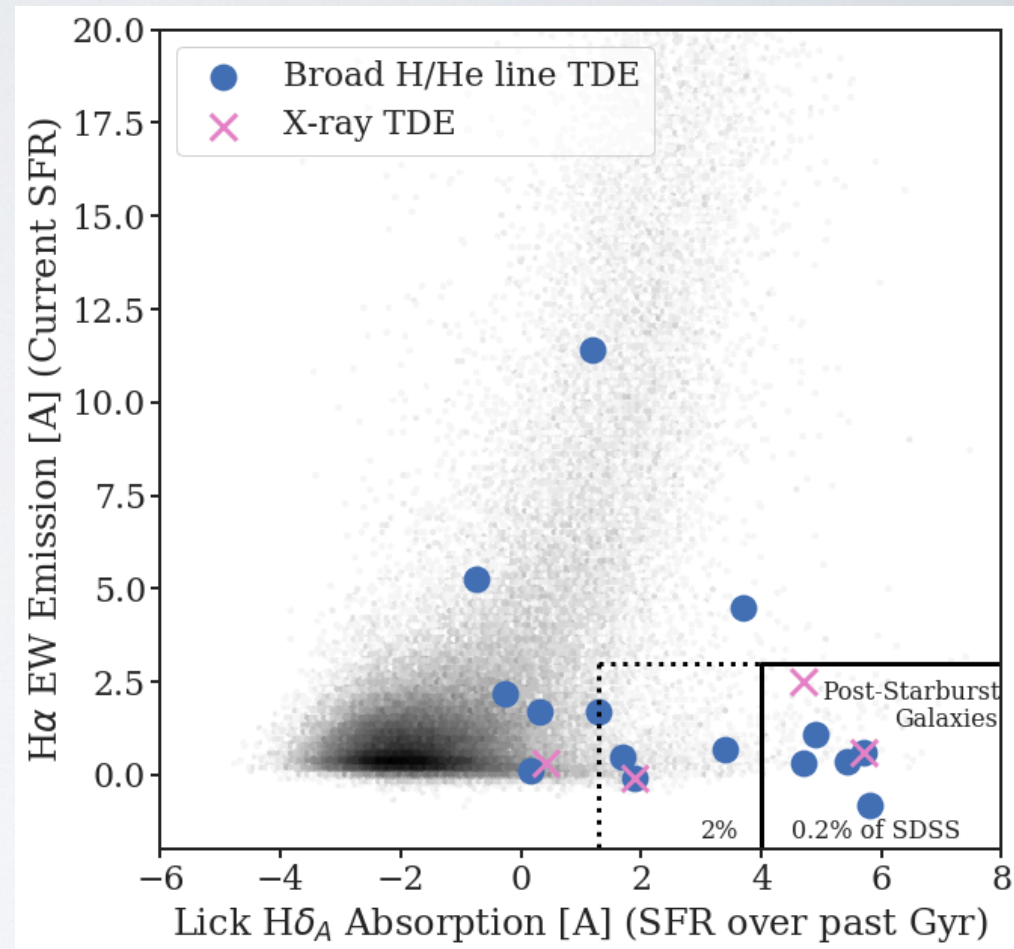
- Extended gas around galaxies can be ionized by the AGN
— traces ionization with lag time = light travel time
- Example: Hanny's voorwerp, OIII-bright nebula implying quasar-like activity ~10,000 years ago that has since faded
- Need very luminous AGN + large amounts of extended gas to be visible in optical broadband imaging
- To see fainter EELRs, need wide field IFU spectroscopy



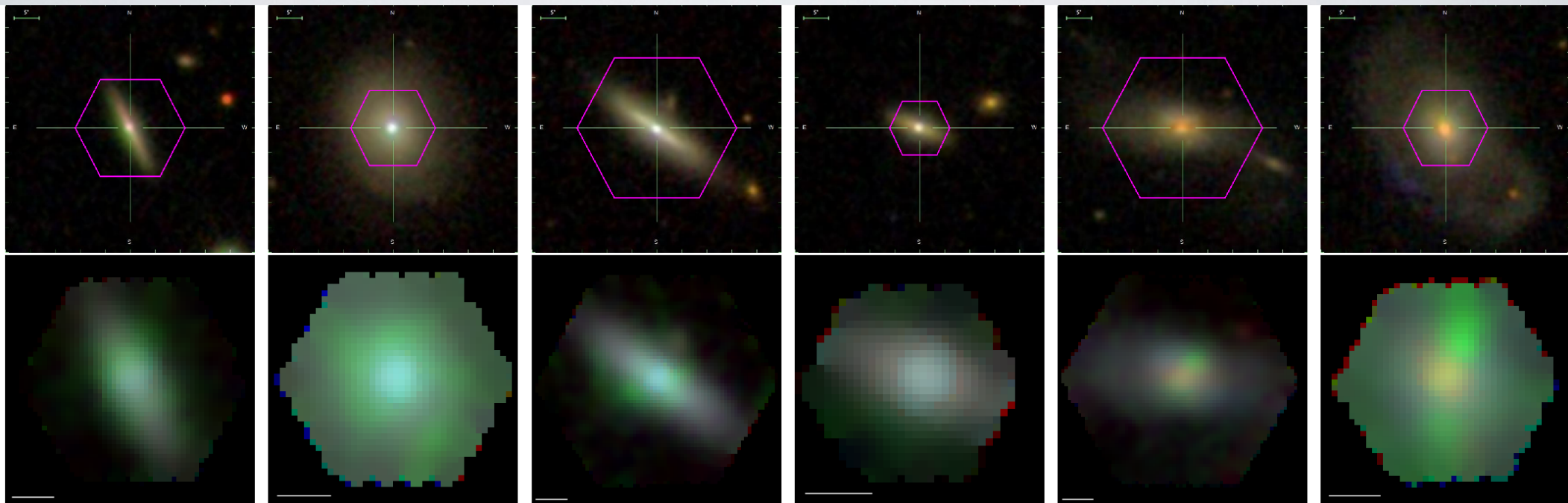
WIYN/William Keel/Anna Manning

Are TDE Host Galaxies likely to have EELRs?

- Roughly half of all TDEs are found in quiescent Balmer-strong galaxies
- TDE rate enhanced by $\sim 20\text{-}50\times$ in quiescent Balmer-strong and post-starburst galaxies
- Post-starburst galaxies thought to be post-merger, may be more likely to have extended gas required to see an EELR

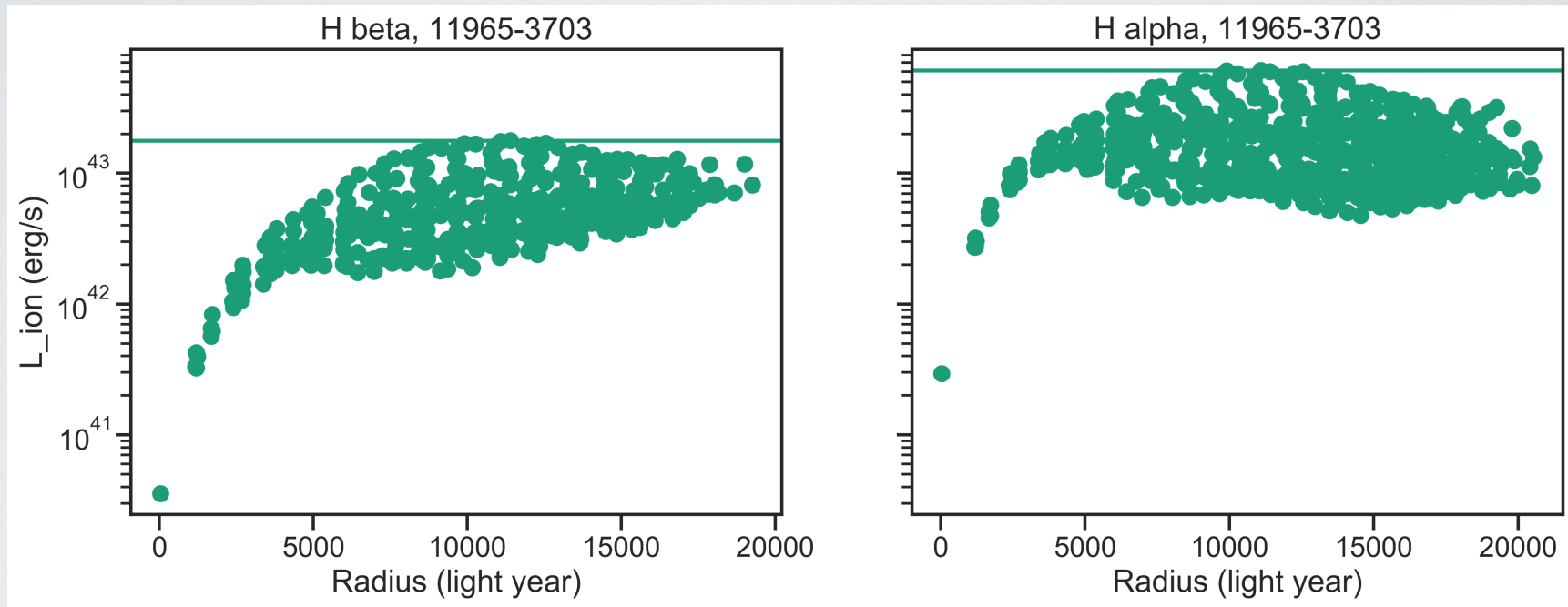


Searching for EELRs in post-starburst galaxies in MaNGA



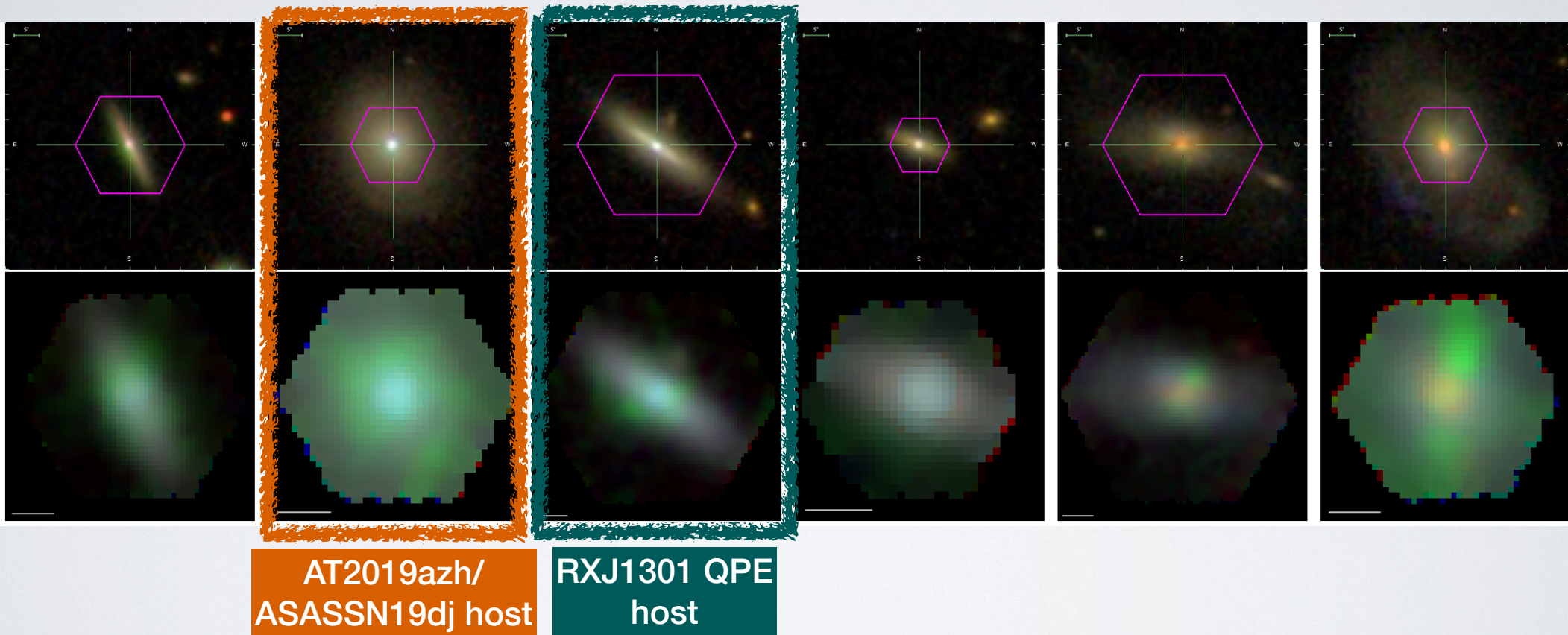
- Of the 93 post-starburst galaxies in MaNGA, we identified 6 galaxies with extended OIII-bright regions consistent with AGN (and not star formation) ionization

Using EELRs to measure past AGN activity



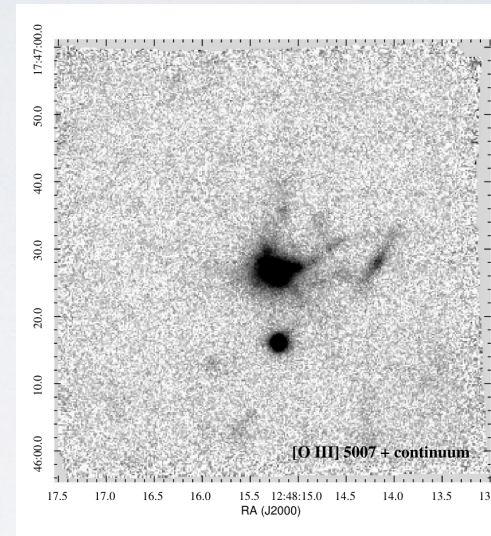
- Following Lintott+09, Keel+12, we assume a recombination balance to determine the minimum past luminosity; use density/ionization potential constraints to determine the maximum past luminosity

EELRs in TDE host galaxies

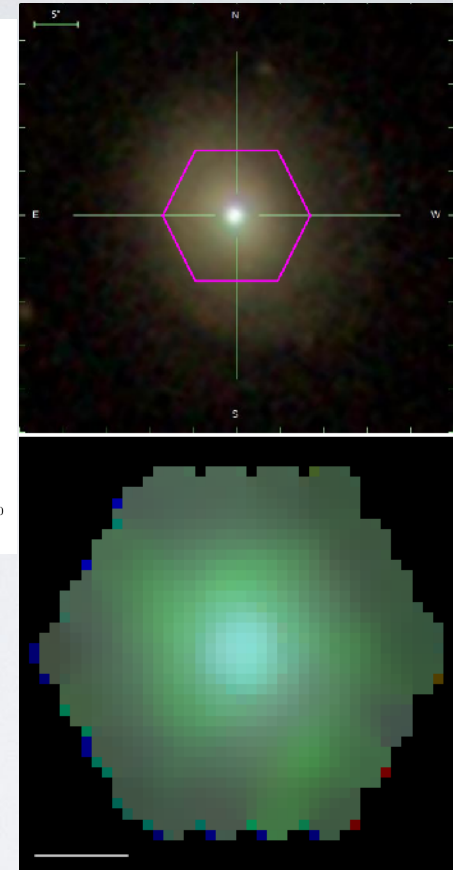


Past AGN activity in TDE host galaxies

- 6 TDEs have been identified in strictly-selected post-starbursts
- 2 so far have IFU spectroscopy, both display EELRs
- Even if the other 4 do not display EELRs, these results imply an even higher TDE rate in post-starburst galaxies with past AGN activity (from MaNGA, only ~6-12% of the total post-starburst sample)
- Similar effects may be present for QPEs, which also show a rate enhancement in post-starburst galaxies (Wevers et al. 2022).
- Selection effects: rate enhancement from circumnuclear material w/o ongoing AGN activity to obscure TDE detection?



Prieto+2016

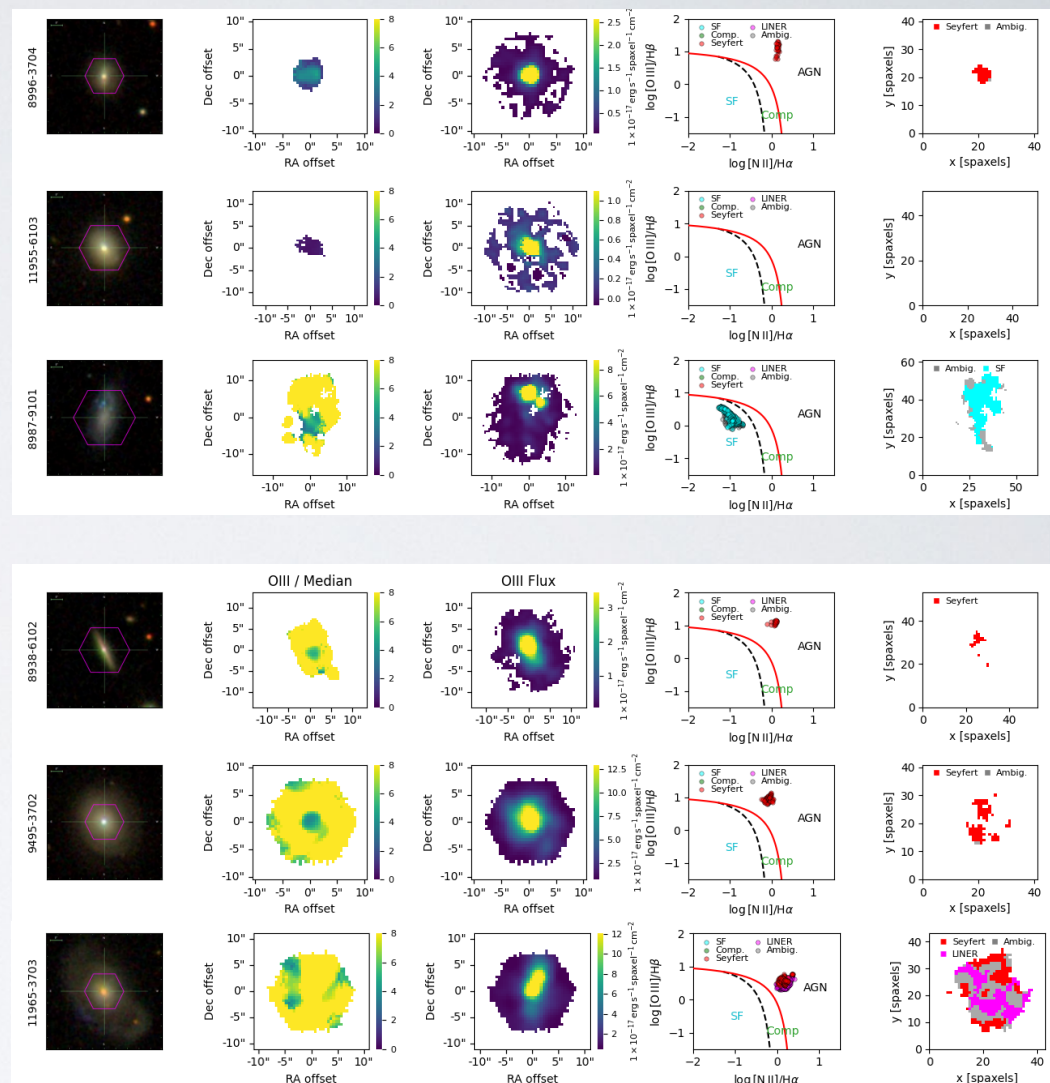


French+2023b

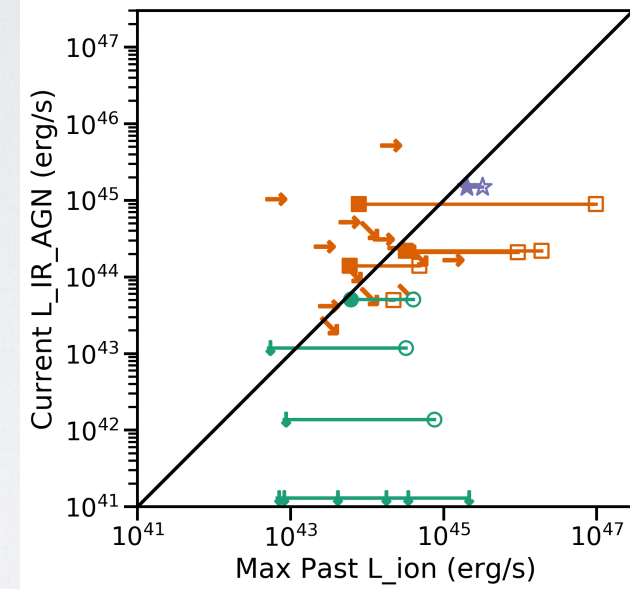
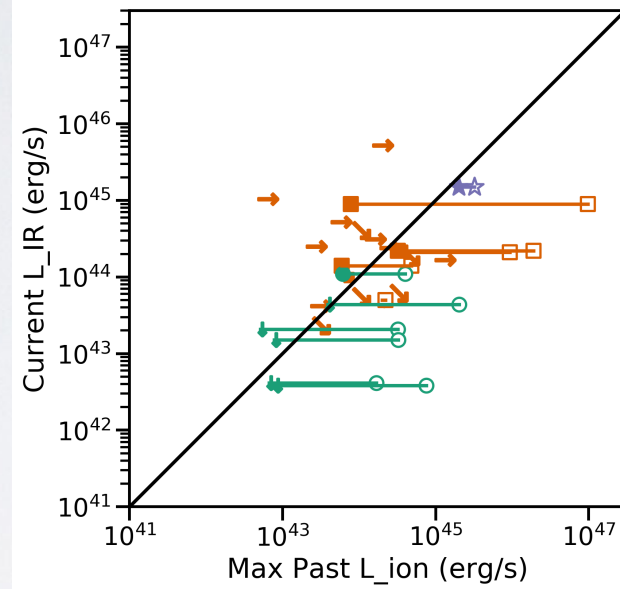
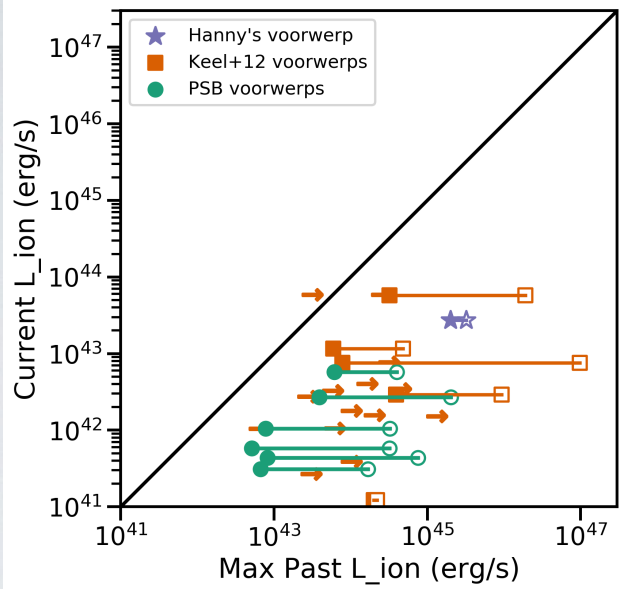


Searching for EELRs in post-starburst galaxies in MaNGA

- 93 post-starburst galaxies from French+18, Alatalo+16, Wild+07,09 samples are in MaNGA (mostly primary/secondary sample, ~20 in PSB special program)
- For EELRs, want large extended areas of high OIII/median flux, with ionization from Seyfert/LINER
- 6 post-starburst galaxies with EELRs identified



Using EELRs to measure past AGN activity



- The six post-starburst galaxies show evidence of Seyfert-like AGN luminosities in their recent pasts
- 5/6 are clearly fading, using IR constraints from IRAS to account for obscured current AGN luminosity
- Can be used to constrain the duty cycle of AGN activity during this phase, in combination with current AGN constraints