## Power of UV+X-ray high-resolution spectroscopy for probing AGN outflows

#### → <u>Need for Arcus Probe</u>

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#### Science goal: Reveal how black holes impact their surroundings



Understanding different types and regions of AGN outflows with simultaneous UV+X-ray spectroscopy: Arcus Probe

#### **Arcus** A proposed NASA Probe mission concept



### **Open questions on AGN outflows**

- Kinematical & dynamical structure of outflows? How the multiple ionization & velocity components are formed?
- What is the connection between various outflows in the Broad and Narrow Line Regions?
- Do they have common or different origin & driving mechanism?
- Which wind parameters vary over time and produce the observed spectral variability?
- How wind parameters scale with redshift and the AGN properties such as accretion rate and luminosity?
- How the energy & momentum of outflows propagate into the host galaxy and what are their impact on their environment?

#### Deciphering UV and X-ray spectral variability to probe key properties of AGN outflows



#### Simultaneous UV+X-ray high-resolution spectroscopy with Arcus



UV

X-ray

#### Simultaneous UV+X-ray high-resolution spectroscopy with Arcus



UV

X-ray

#### **Constraints on parameters of Broad Line Region winds using simultaneous UV+X-ray spectroscopy**



#### Arcus enables constraining the density, location, and energetics of the AGN outflow components



# Pushing the frontiers of high-resolution UV+X-ray spectroscopy to higher redshift AGN



## Conclusions

- AGN outflows are multi-component with complex ionization and velocity structure
- Simultaneous UV+X-ray spectroscopy and timing are key for probing the poorly-understood properties of AGN outflows
- Arcus high-resolution spectroscopy is needed to overcome current limitations in measuring parameters of AGN outflows
- Arcus would enable us to establish the ionization structure, kinematics, and energetics of the various outflows in AGN
- Arcus diagnosis of the origin and driving mechanism of the outflows would provide useful benchmarks for testing different theoretical models