

X-ray Surveyor Feedback Science Working Group

Co-chairs:

Chris Reynolds & Megan Donahue

Outline

- Membership
- Driving Science Questions
- First thoughts on X-ray Surveyor's Impact
- Experience from Hitomi
- Next steps...

SWG membership

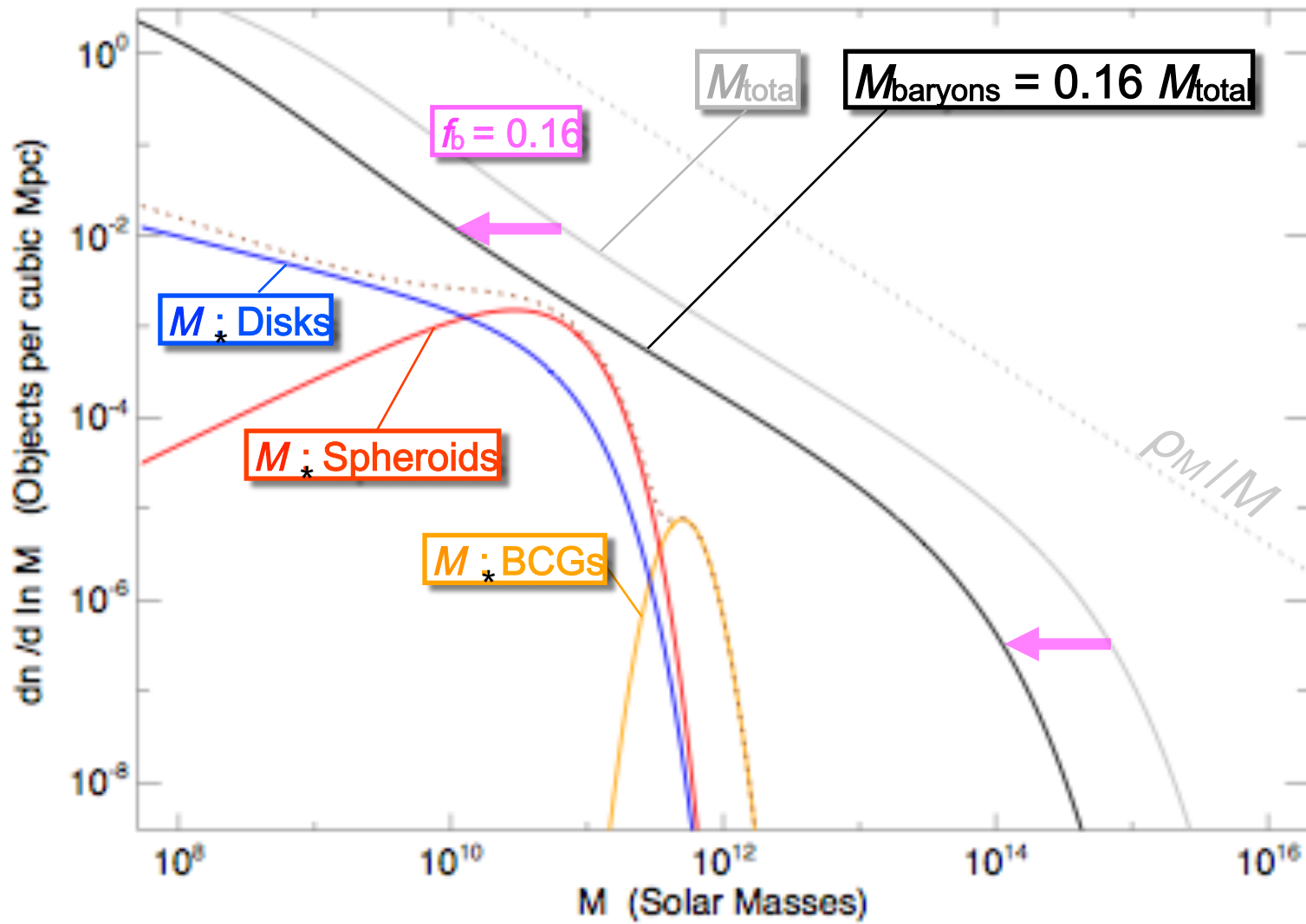
- | | |
|--------------------------------------|---|
| • Megan Donahue (MSU) | Cluster-scale feedback |
| • Chris Reynolds (UMd) | ICM-Jet interaction / AGN winds |
| • Nahum Arav (VT) | AGN winds / BALQSOs |
| • Laura Brenneman (CfA) | Accretion and BH spin |
| • Larry David (CfA) | Cluster feedback |
| • Oleg Gnedin (U.Mich) | Cosmological Simulations / Feedback |
| • Julie Hlavacek-Larrondo (Montreal) | Cluster scale feedback over cosmic time |
| • Edmund Hodges-Kluck (U.Mich) | CGM, ICM and radio-galaxies |
| • Brian McNamara (Waterloo) | Cluster feedback |
| • Jon Miller (U.Mich) | Disk winds across BH mass scale |
| • Paul Nulsen (CfA) | Cluster feedback |
| • Scott Randall (CfA) | AGN-ICM feedback |
| • Eric Schlegel (UT) | Feedback across scales |
| • Dan Schwarz (CfA) | AGN Jets |
| • Aneta Siemiginowska (CfA) | Jet-ISM interactions |
| • Gregory Sivakoff (Alberta) | Accretion-jet connection in XRBs |
| • Francesco Tombesi (UMd) | AGN winds |
| • Grant Tremblay (Yale) | Galactic-scale feedback/multiwaveband |
| • Shuo Zhang (MKI) | BH jets and Sgr A* |

I : Driving Science Issues

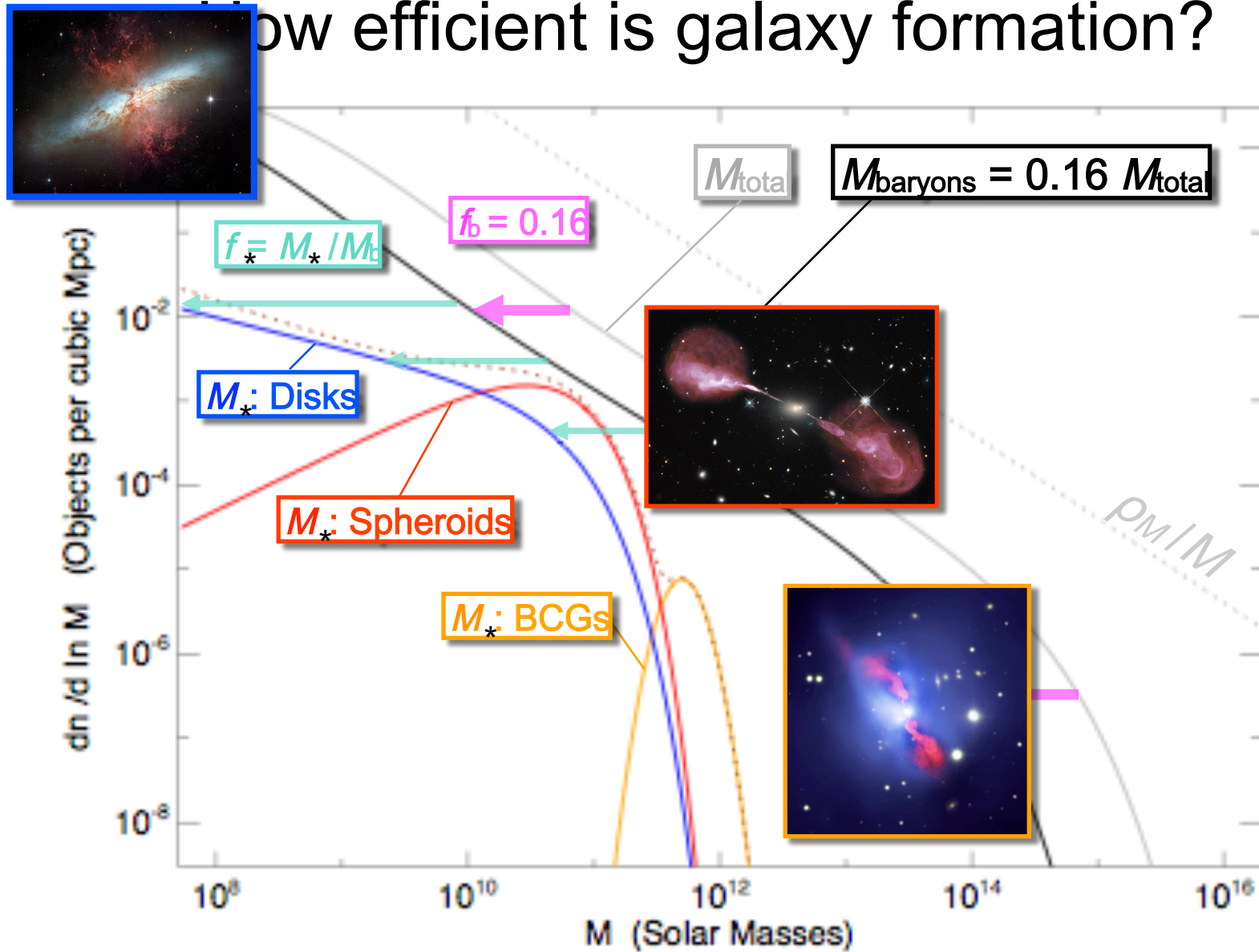
- Manifestations of feedback
 - Galactic SF rate \ll cold gas mass / dynamical time
 - Too few low-mass galaxies
 - Too few high-mass galaxies
 - M_{BH} -sigma relation
 - Lack of cooling catastrophe in relaxed clusters
- Injection/cycling of mass, energy, and metals into hot ISM/CGM/IGM
- The baryons ain't missing – there're just hot!

Compared to number of parent dark matter halos

How efficient is galaxy formation?

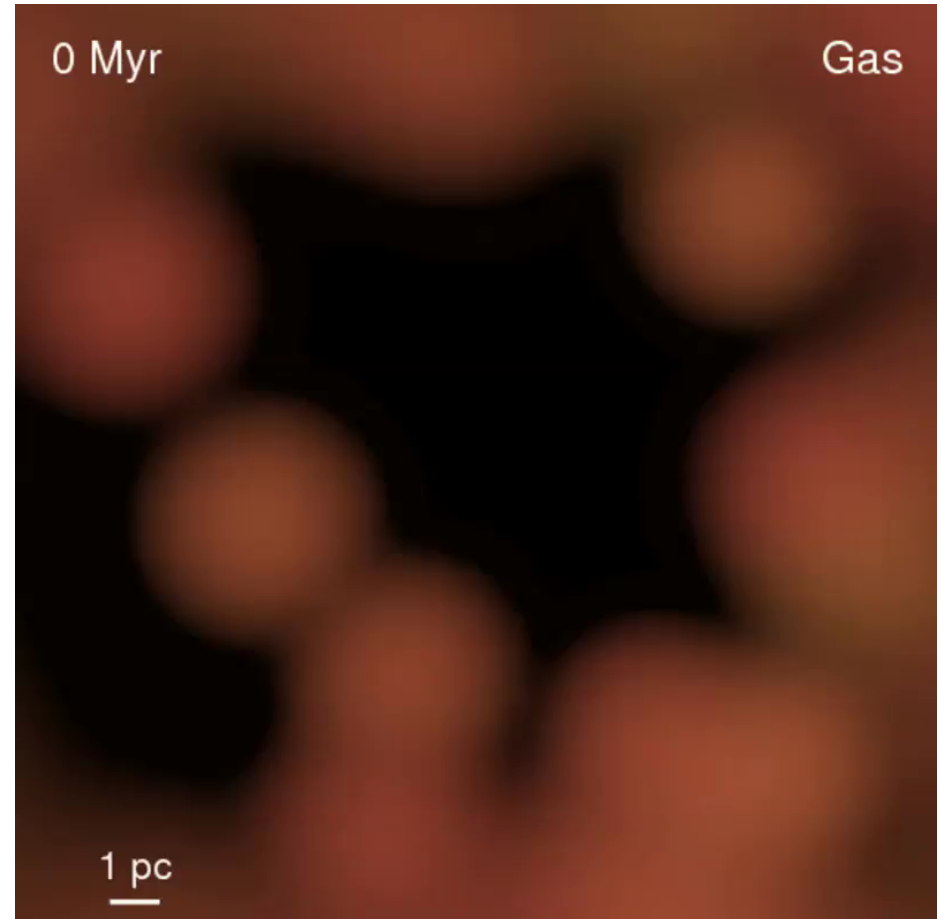


How efficient is galaxy formation?



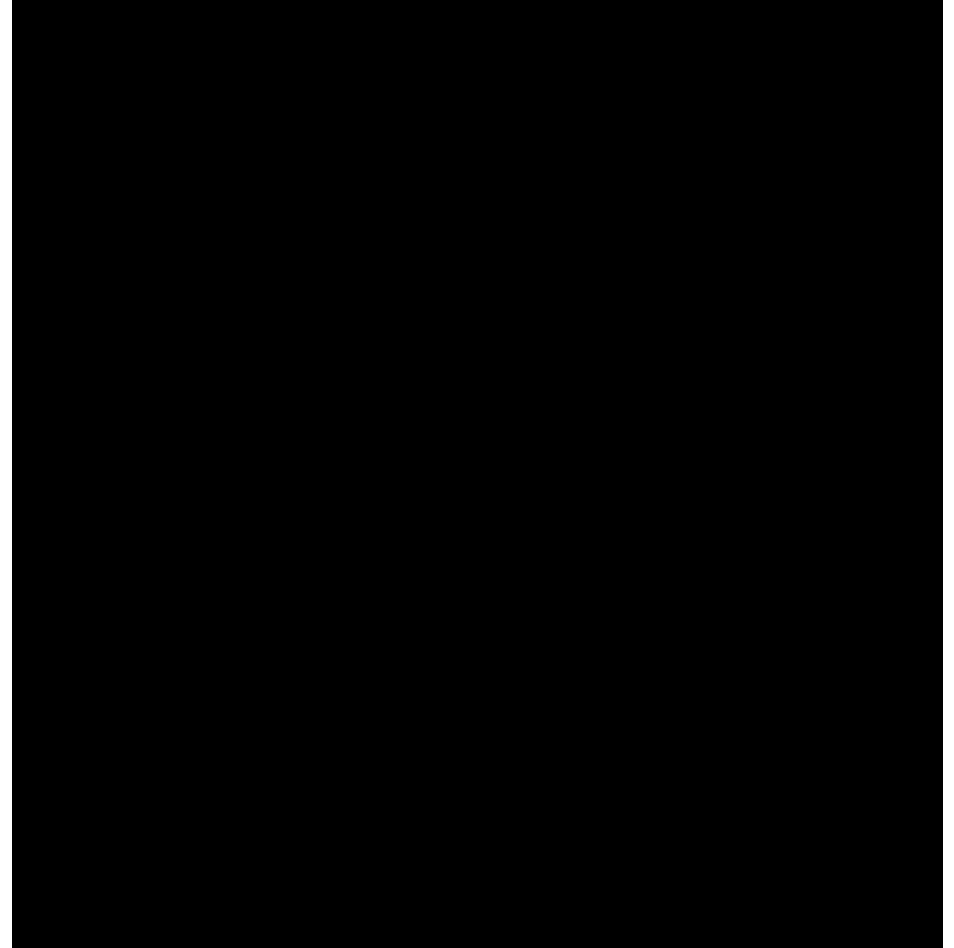
Galactic Scale Stellar Feedback

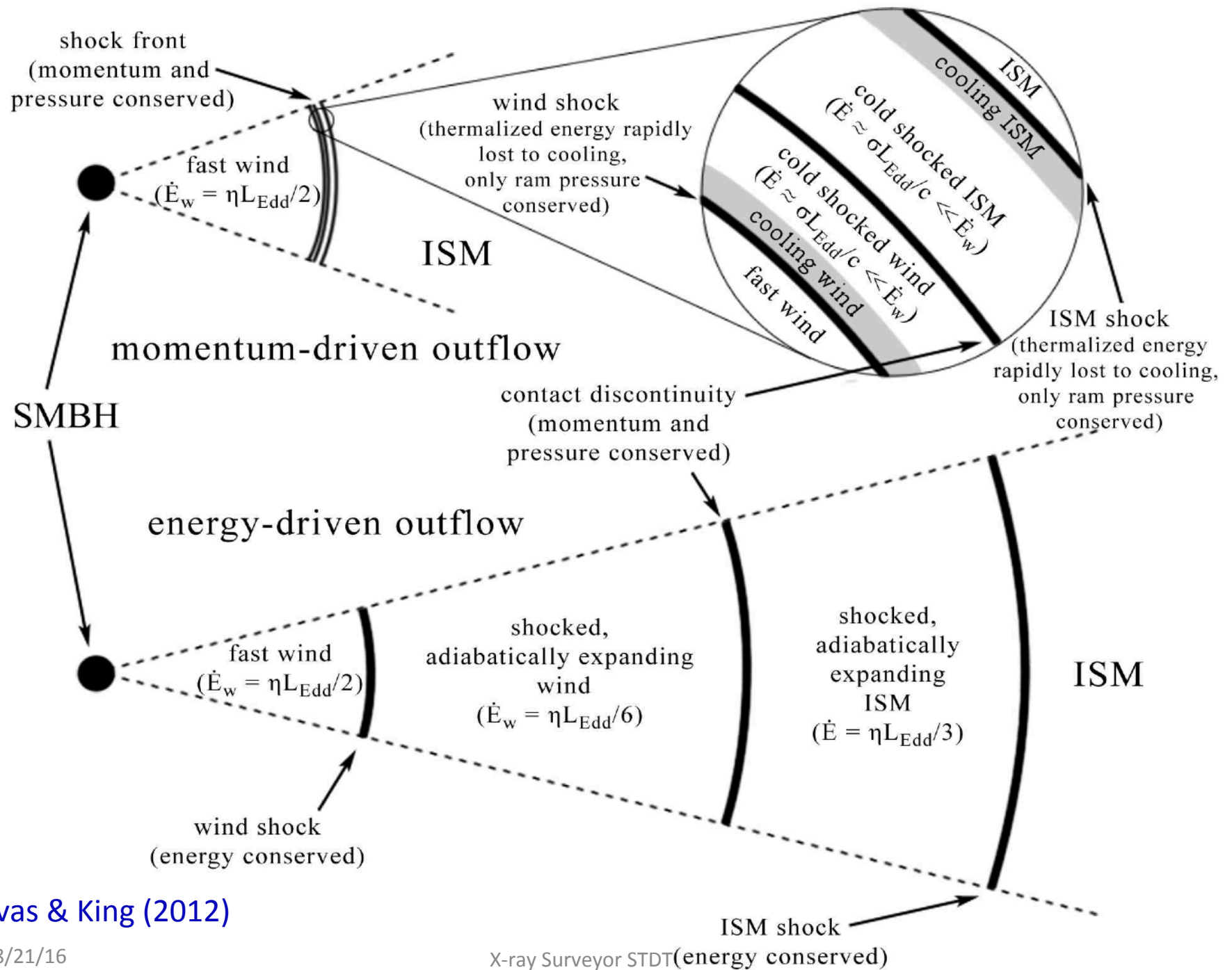
- Key issue is cycling of mass, energy and metals from galaxy into circumgalactic medium (CGM).
- To make progress...
 - Imaging spectroscopy of hot baryonic halos
 - Absorption spectroscopy of hot IGM
 - Next generation models that predict state of CGM/IGM given physical feedback prescriptions
 - Connection to Baryon Cycling SWG



Galactic Scale AGN Feedback

- Key issue is coupling of the AGN to the ISM/CGM
 - Relative roles & physics of
 - Radiation
 - Winds
 - Jets
- } “Quasar mode”
- What is the cosmic history of these processes?
 - Obvious connection to AGN Populations SWG



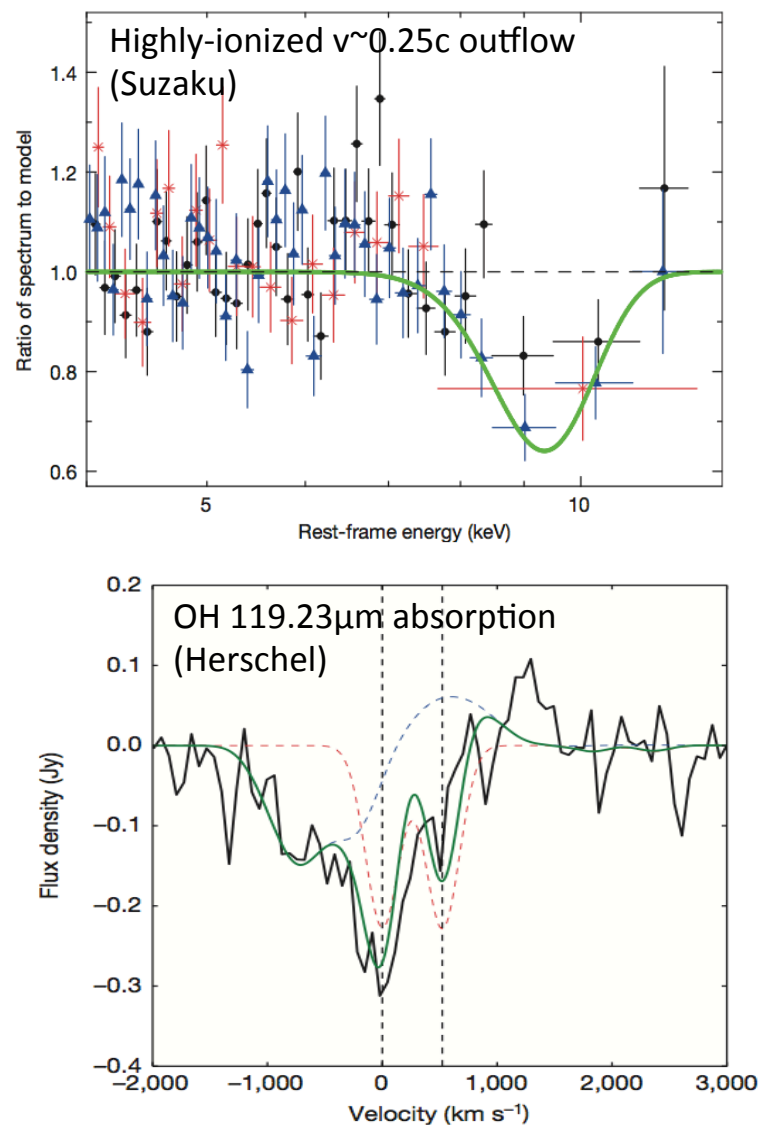


Zubovas & King (2012)

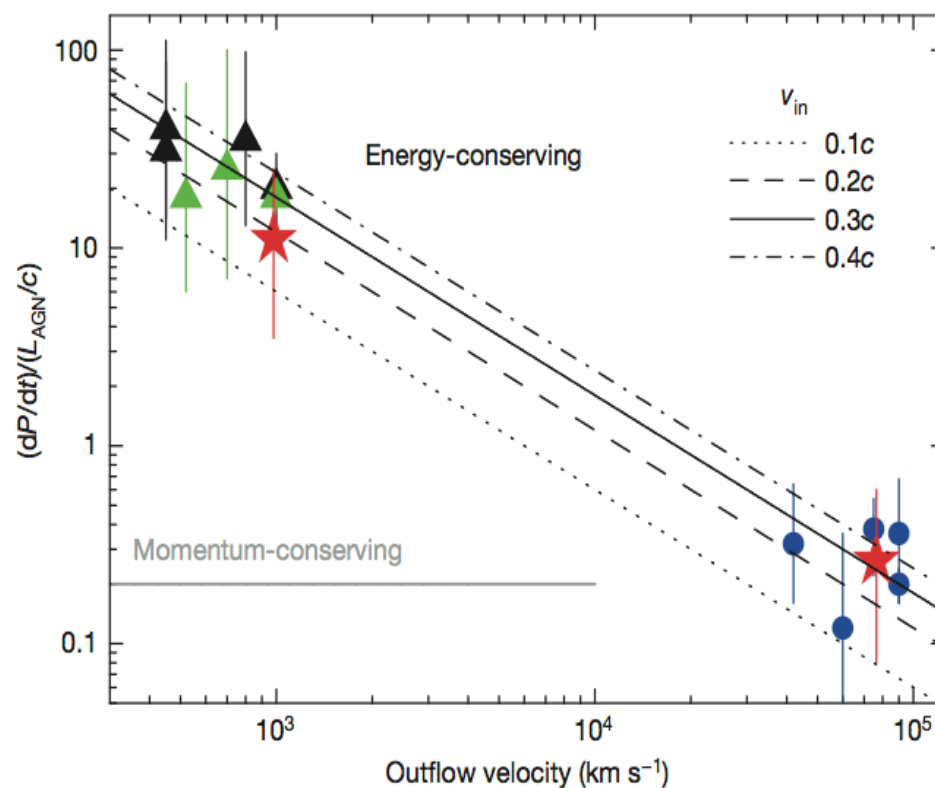
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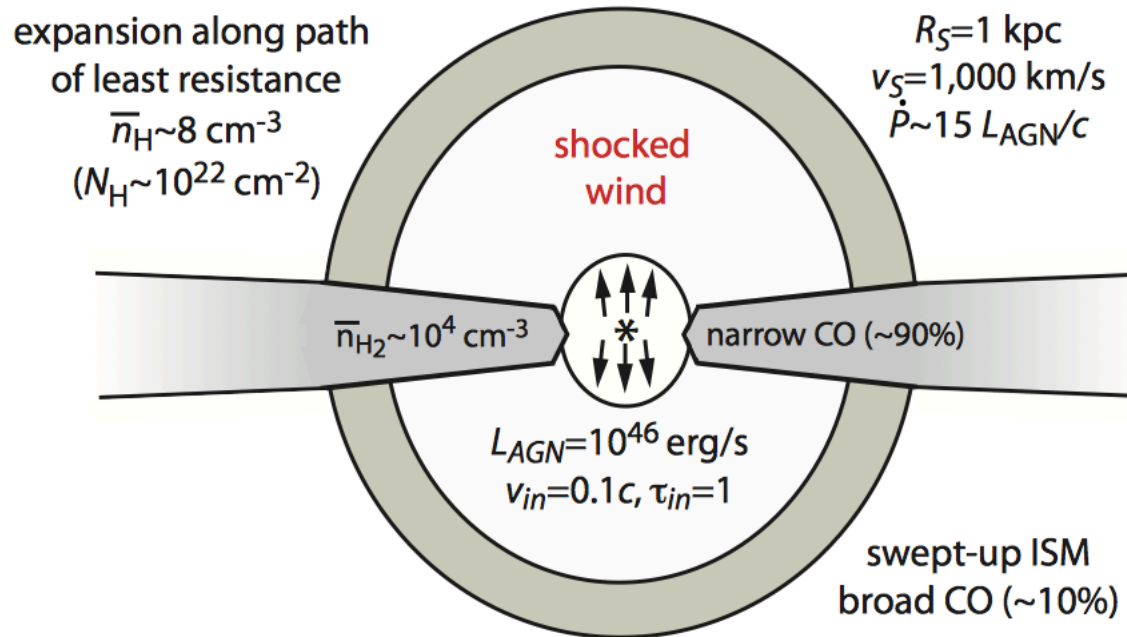
X-ray Surveyor STDT (energy conserved)

The $z=0.18$ ULIRG IRASF11119+3257 (Tombesi et al. 2015)



X-ray Surveyor + ALMA will obtain similar data on $z=2$ quasar





Faucher-Giguere &
Quataert (2012)

Shocked wind bubble emits in X-rays...

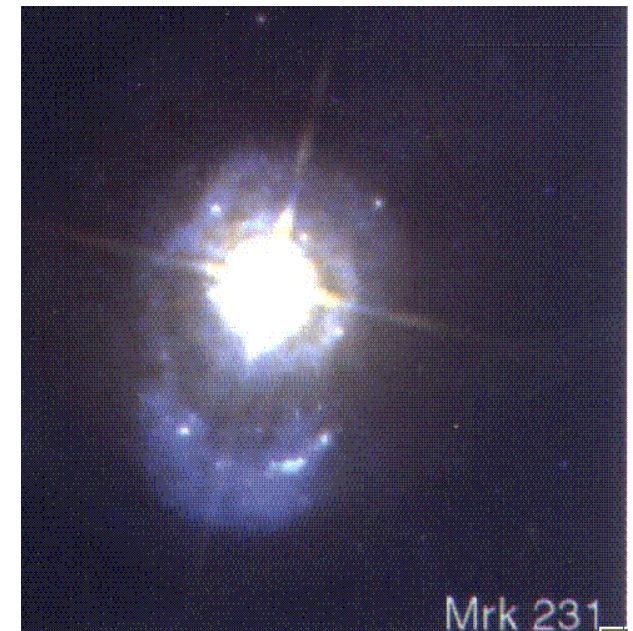
$L_{\text{brems}} \sim 10^{39} \text{ erg/s}$ (peaking at 200keV)

$L_{\text{IC}} \sim 10^{41} \text{ erg/s}$ (peaking at few keV)

Characteristic size of bubble is $\sim \text{kpc}$

Resolvable by X-ray Surveyor out to $z=0.1$

(good candidate; Mrk231 at $z=0.042$)

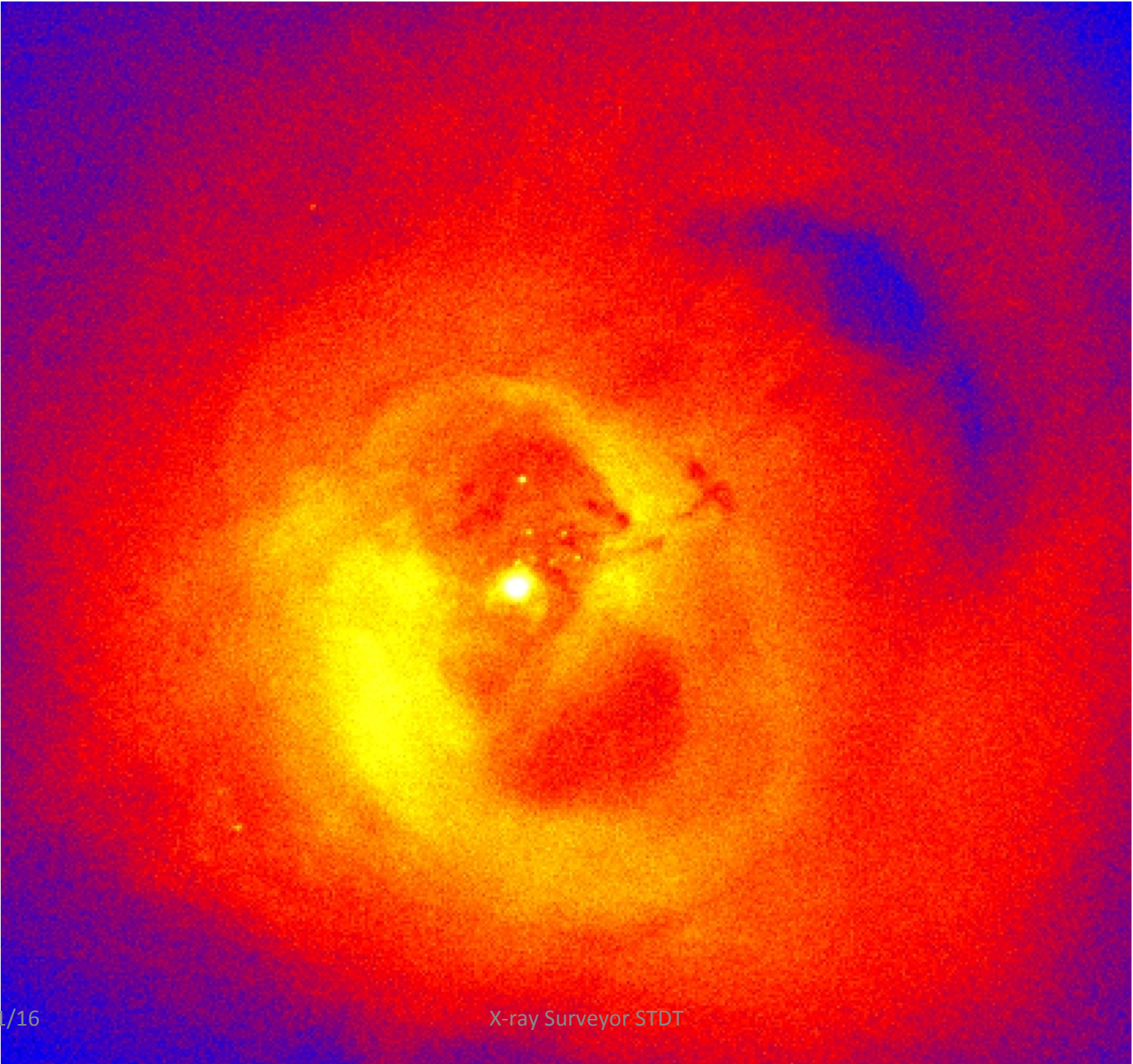


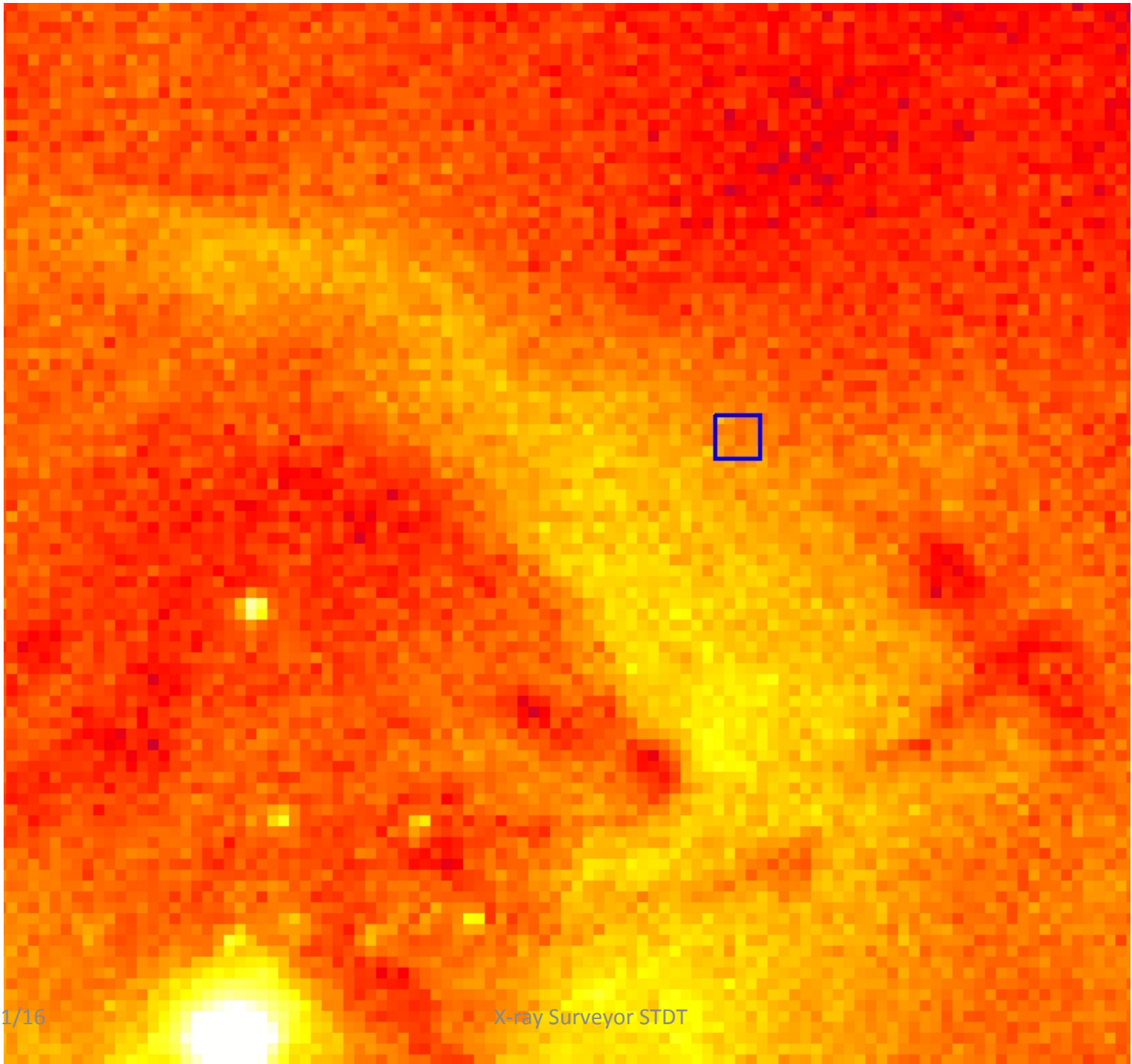
Cluster-scale feedback

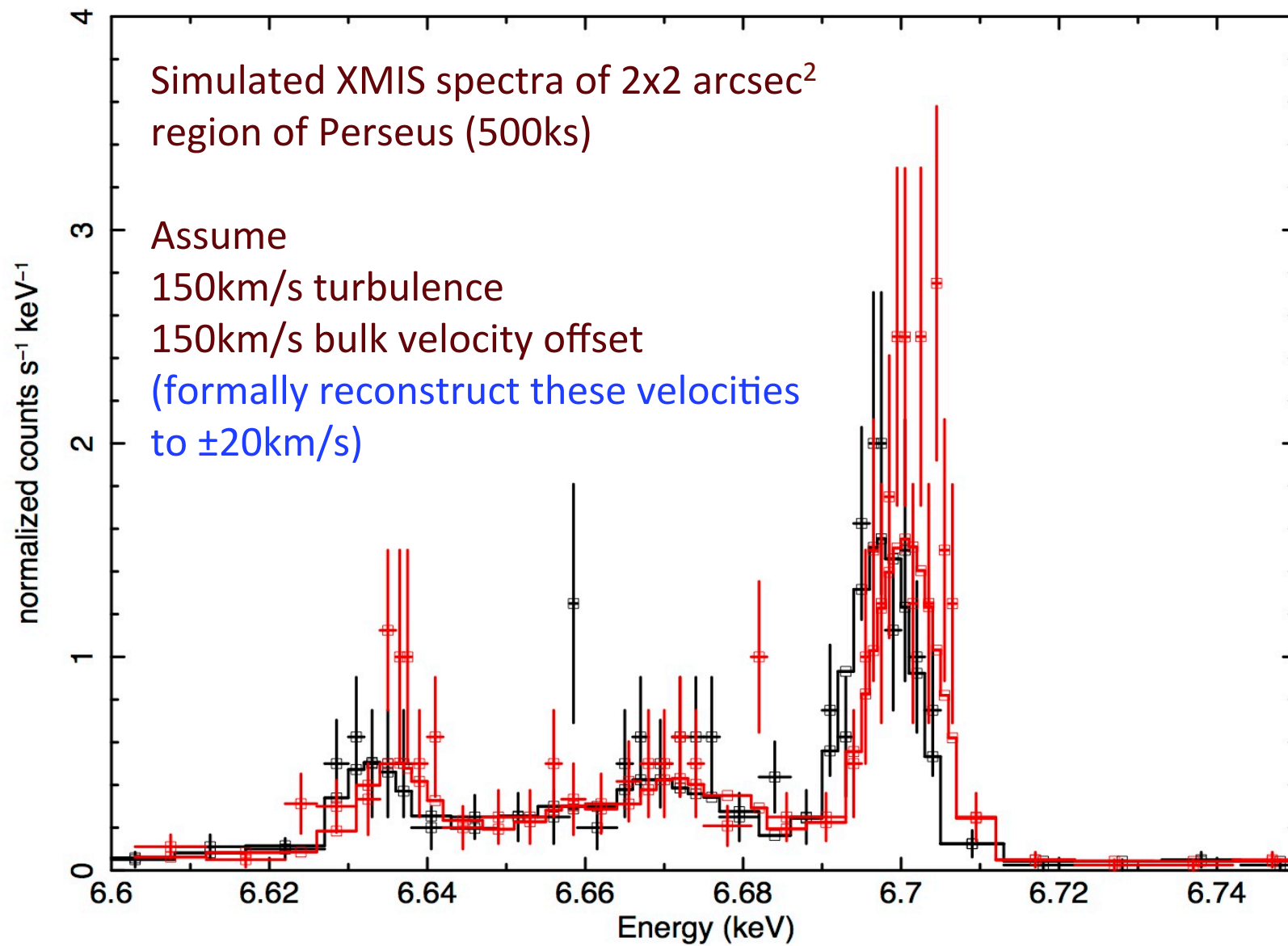
- Key issue is the nature of AGN-ICM coupling and the physics behind the self-regulation
- Role of
 - Turbulence
 - Shocks / sound waves
 - Sloshing
 - Bubble/ICM mixing
- Need to consider the ICM as a plasma (i.e. worry about plasma instabilities, thermal conduction, viscosity)
 - Obvious connection to Plasma Physics SWG



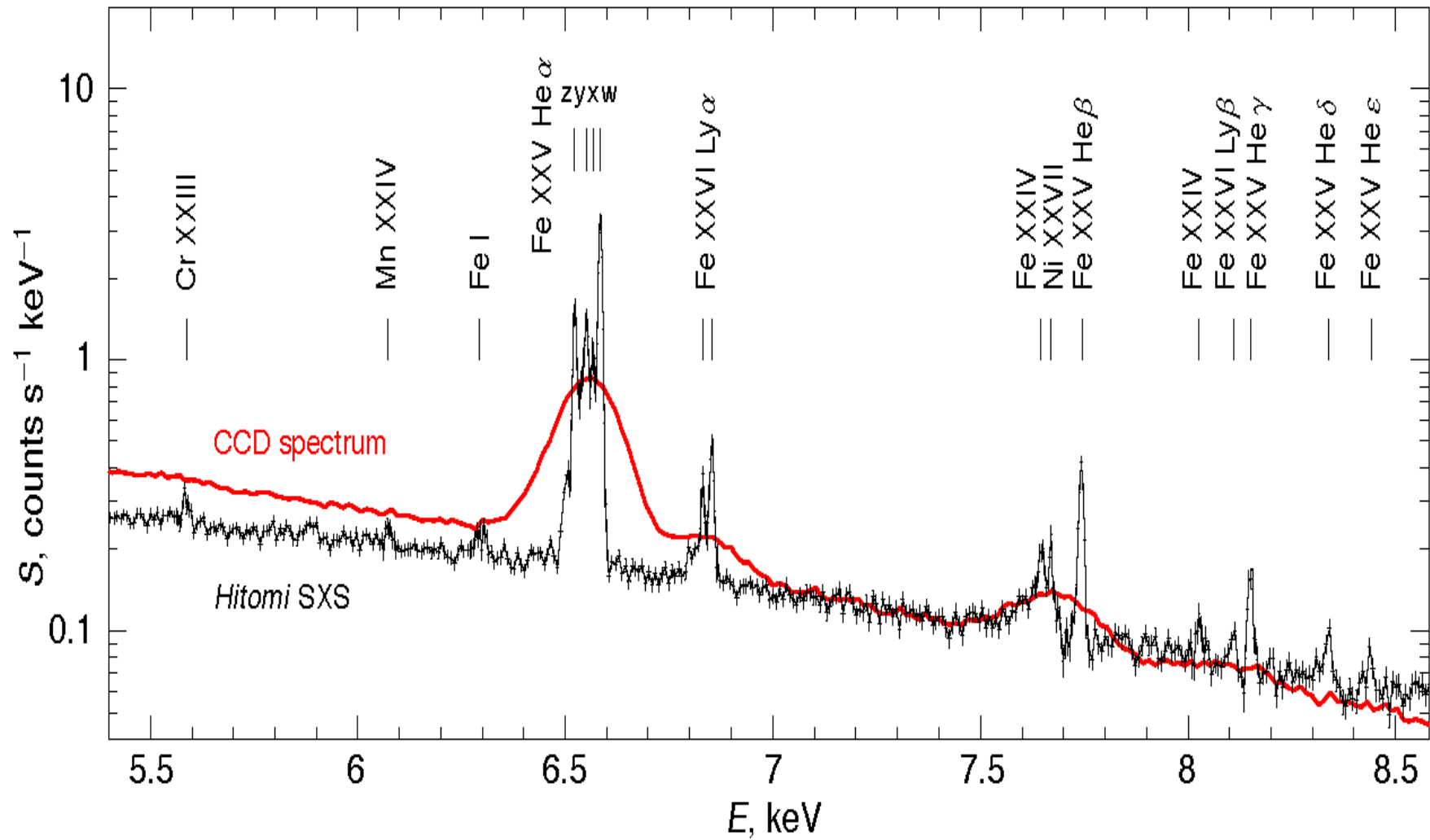
Edge-detection Chandra image of Perseus
(Sanders, Fabian... 2016)



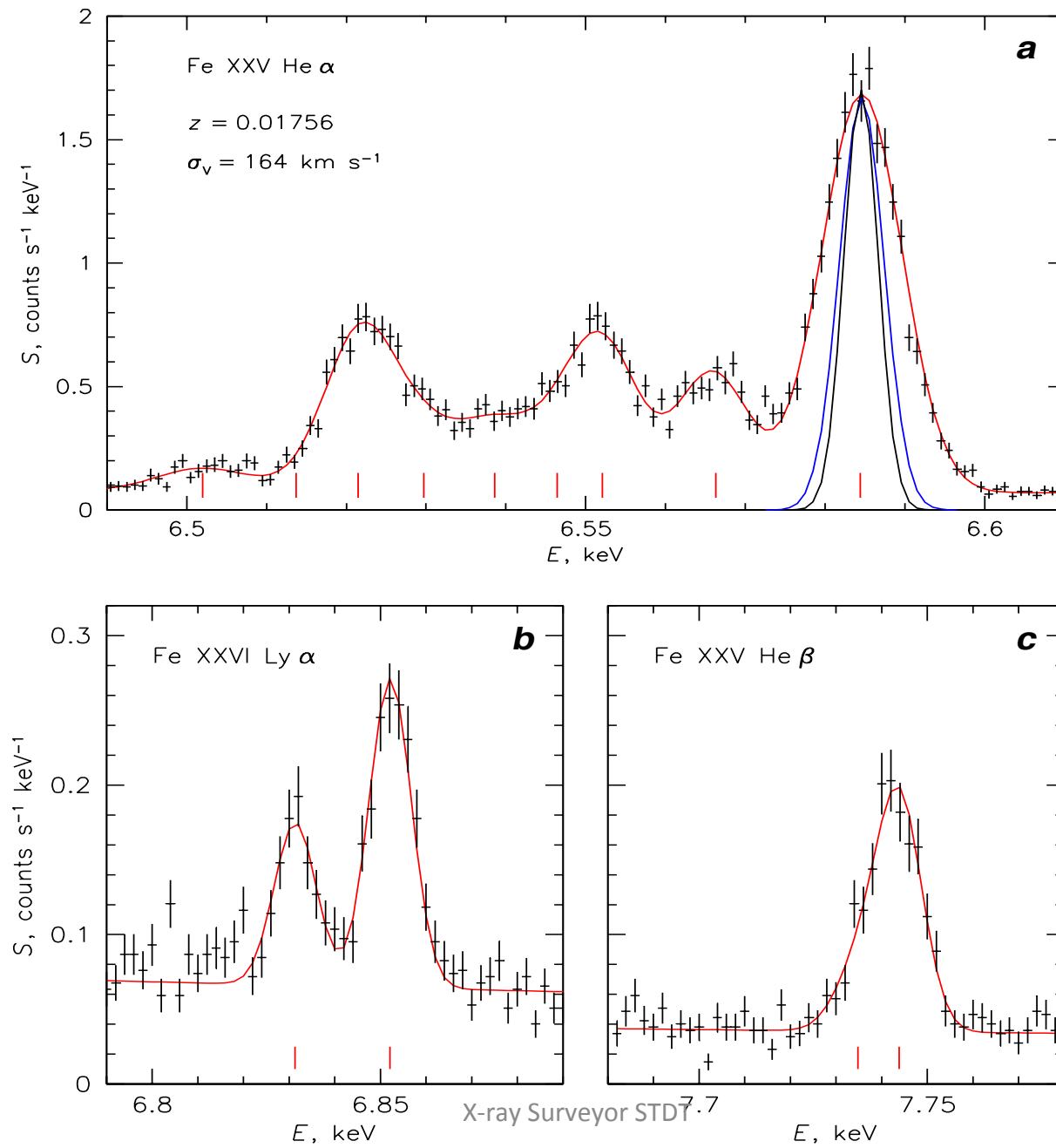


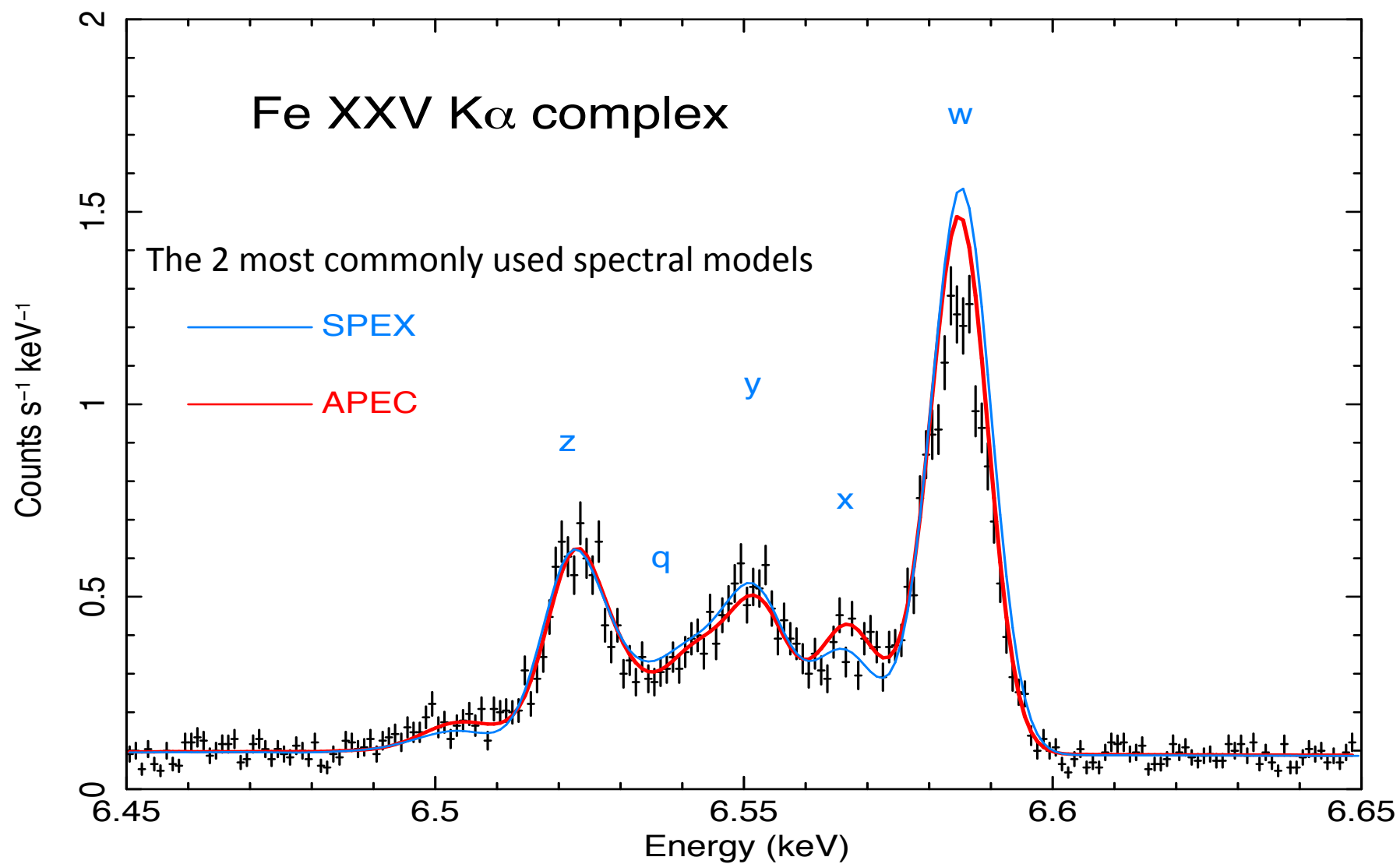


Hitomi Collaboration (2016)

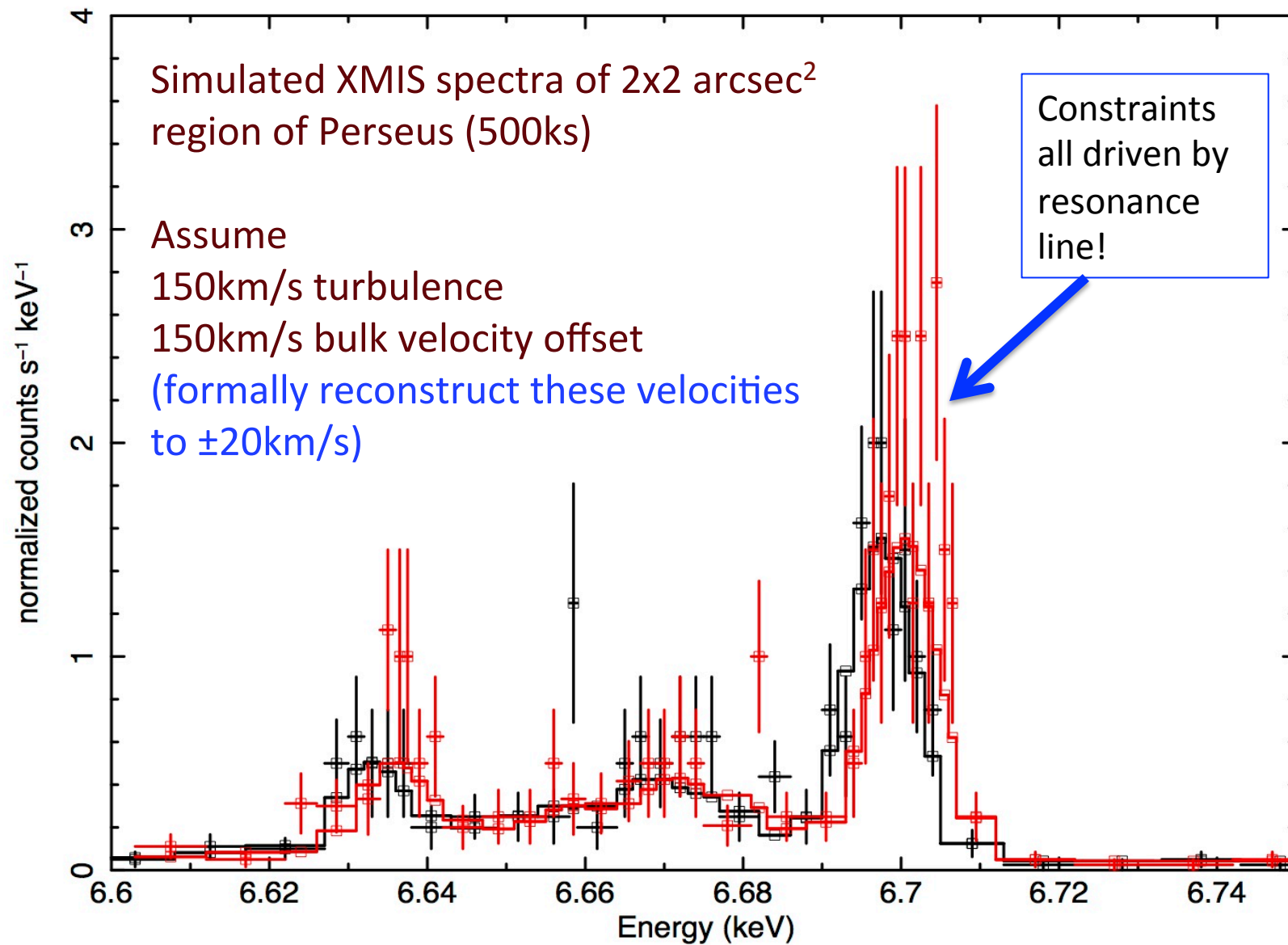


Hitomi Collaboration (2016)





Hitomi Collaboration (2016)



- Perseus is has highest surface brightness of any diffuse source on the Sky.
- Even then, it is challenging to collect enough photons to simultaneously use \sim arcsec spatial resolution AND calorimeter spectral resolution!
- But spatial resolution crucial for...
 - Separation of AGN & ICM for high-z clusters
 - ...

The Path Forward...

- Will pull team together and start regular telecons after the XRS f2f
- Initial list of tasks...
 - ICM imaging spectroscopy (rigorous assessment of XRSs capabilities in light of Hitomi data)
 - CGM emission & absorption studies (end-to-end simulations)
 - Hot ISM in other galaxies / connections to CGM
- Interface with other SWGs
 - Baryon cycling
 - First Accretion Light
 - Evolution of structure
 - Plasma physics SWG

Questions?

Hitomi Collaboration (2016)

