

Discovery of QSO-Mode Feedback in Galaxy Mergers



Rhodes College
— 1818 —

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Sanders

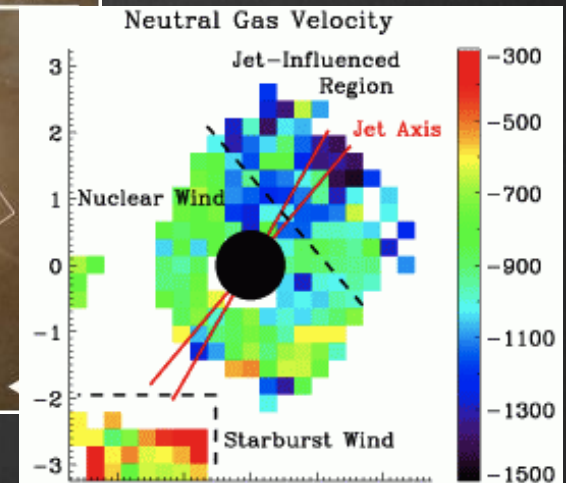
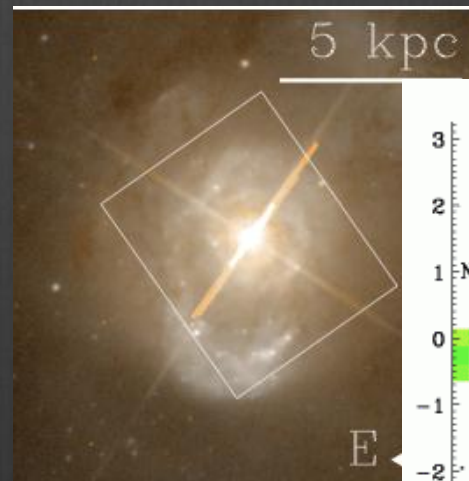
Credit: Gemini / AURA / Lynette Cook

Key Points

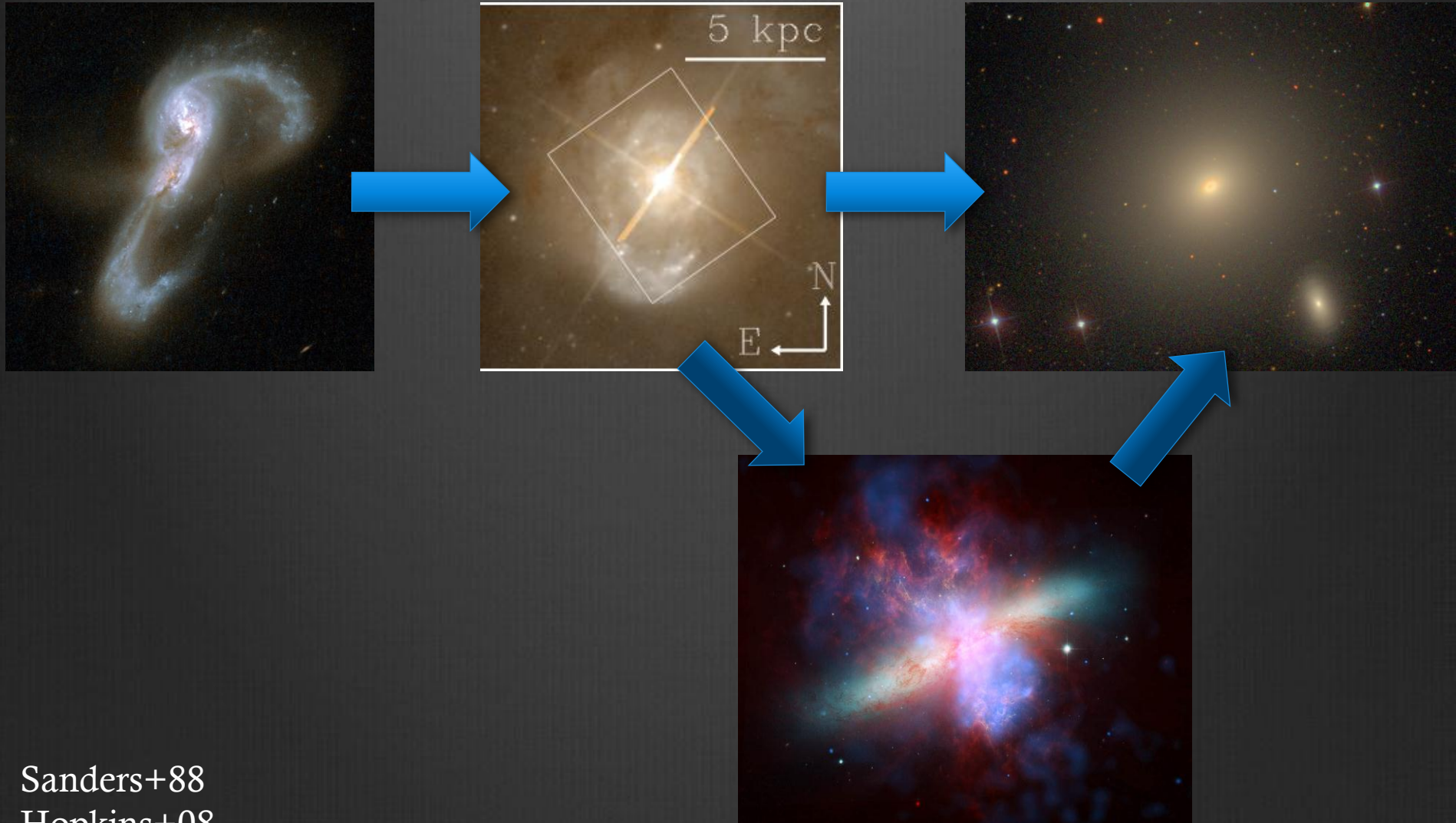
1. Feedback in mergers is pivotal to galaxy evolution.



2. QSO-mode feedback exists in mergers.

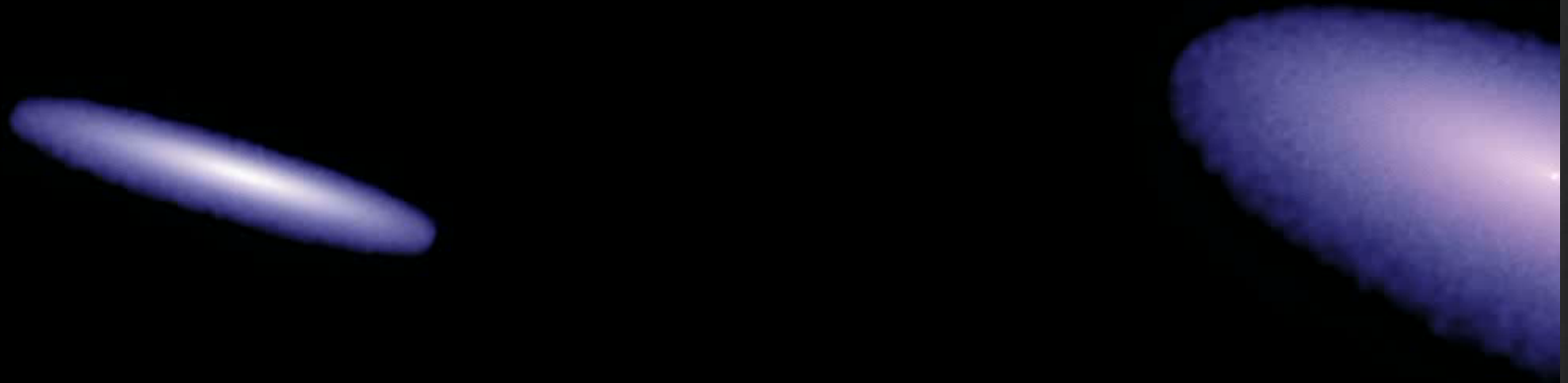


Feedback in Mergers is Pivotal to Galaxy Evolution: Basic Model



Sanders+88
Hopkins+08

Feedback in Mergers is Pivotal to Galaxy Evolution: Numerical Simulations

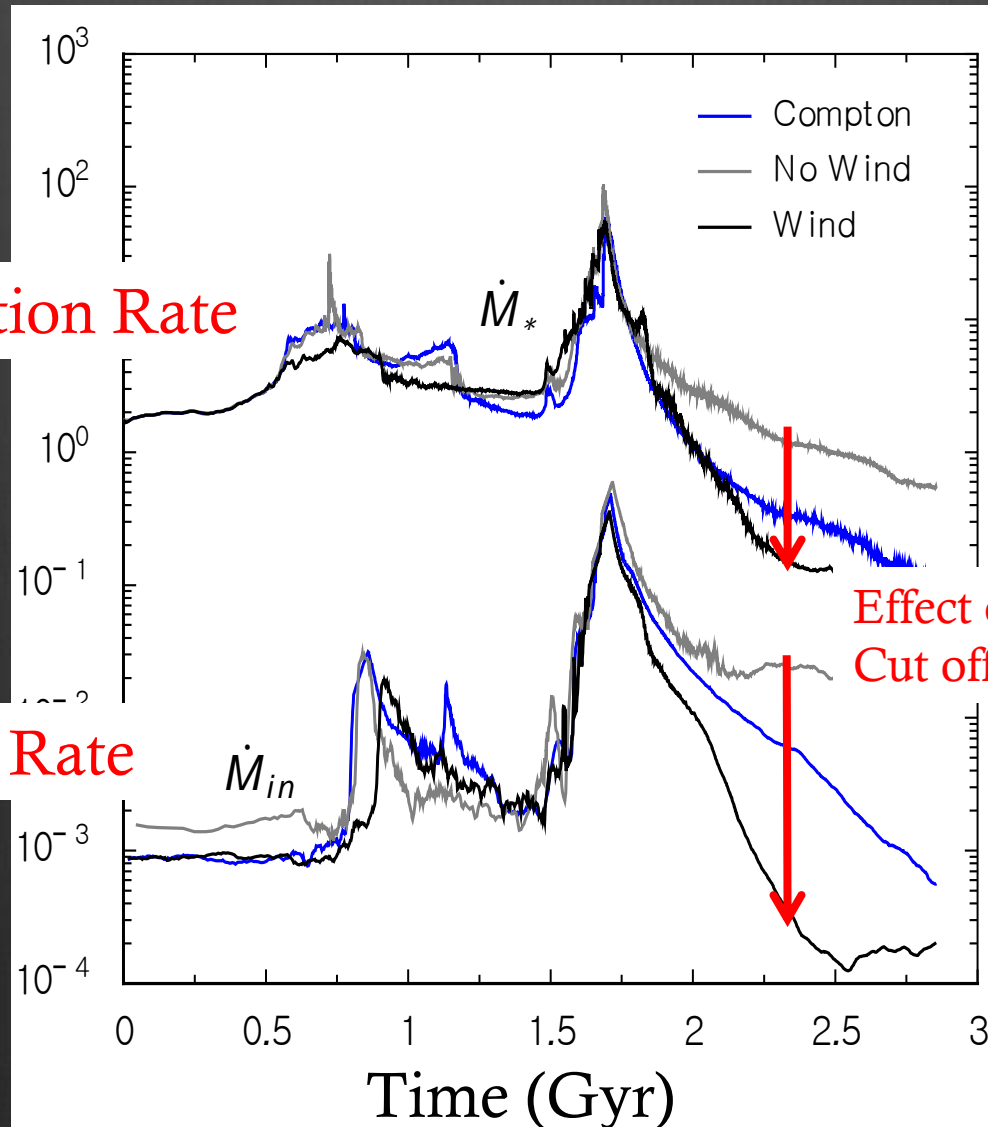


Simulation from Phil Hopkins.

Feedback in Mergers is Pivotal to Galaxy Evolution: Numerical Simulations

Star Formation Rate

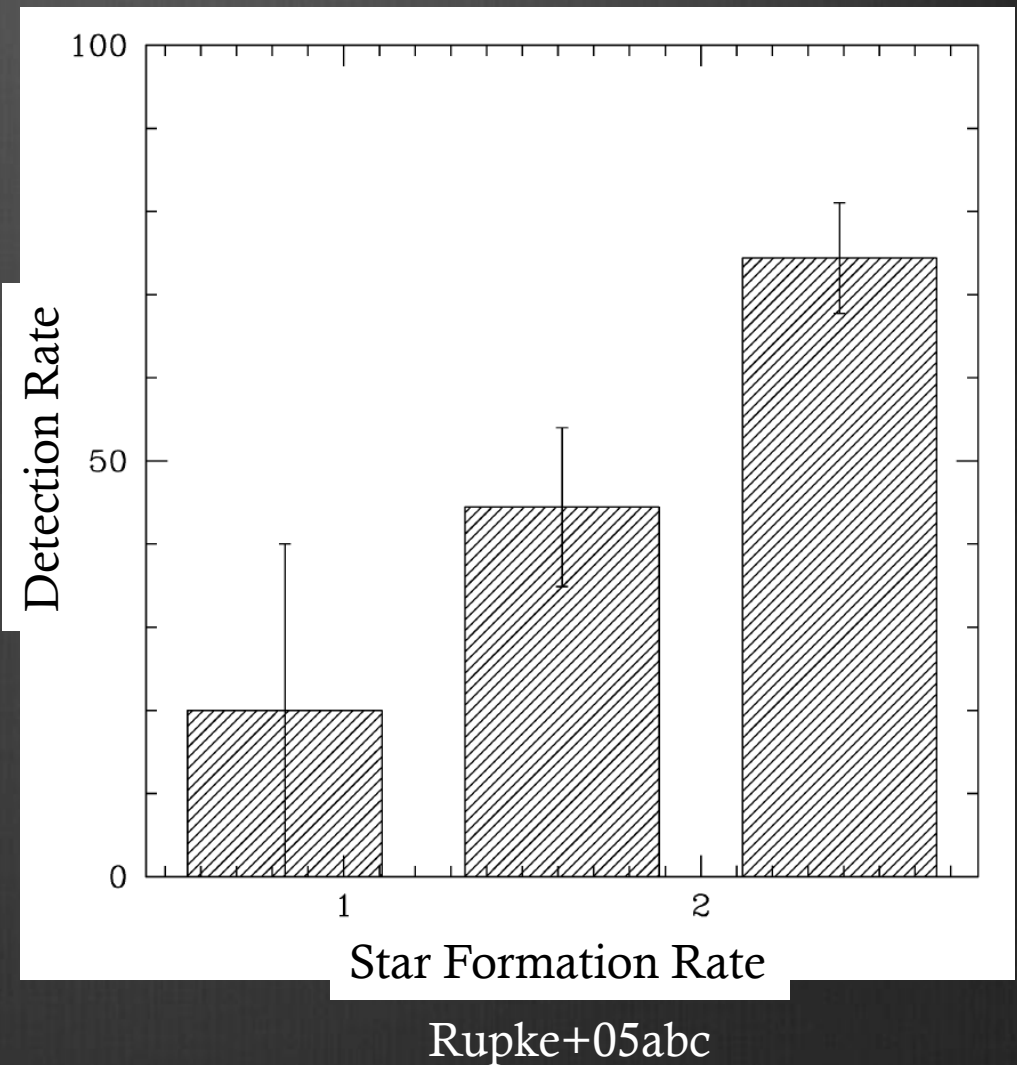
Accretion Rate



Feedback in Mergers is Pivotal to Galaxy Evolution: Observations

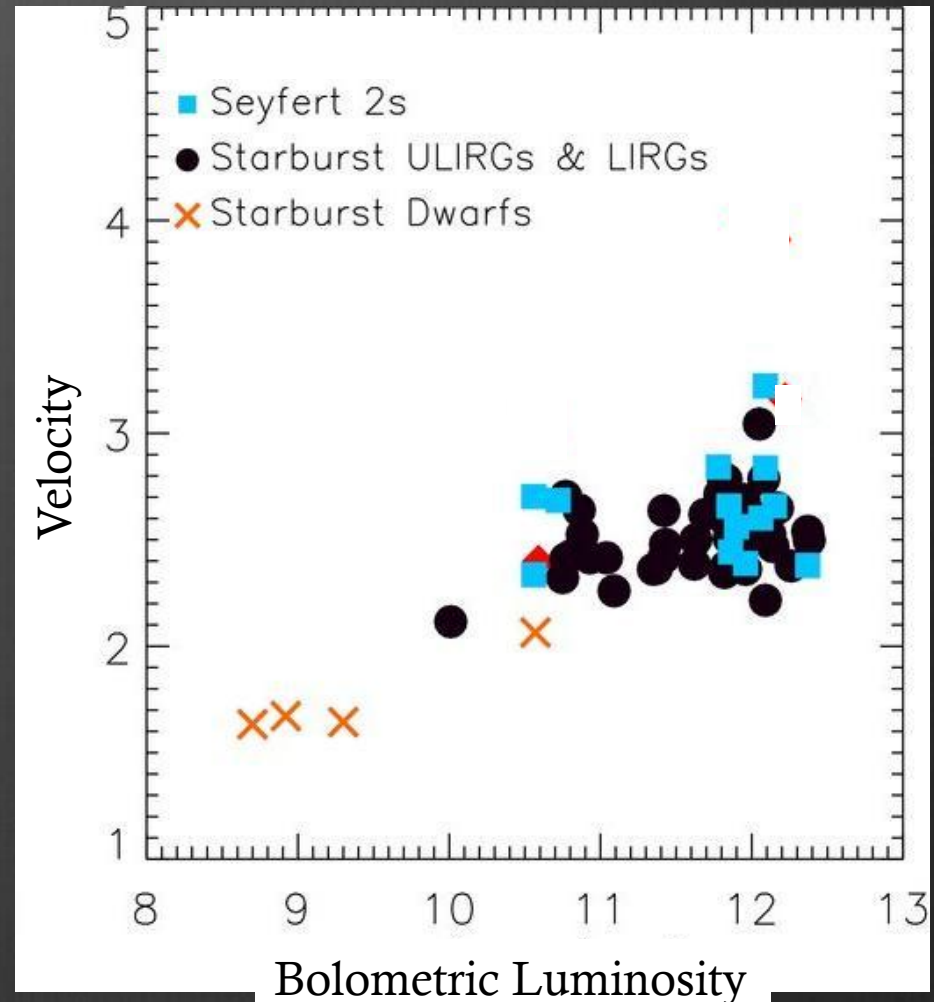
Winds in mergers are

1. Ubiquitous: 100%
2. Large Scale: $>1\text{kpc}$
3. High-vel: 400km/s
4. Massive: $10^9 M_{\text{sun}}$
5. Energetic: 10^{57}erg/s



QSO-Mode Feedback Does NOT Exist in Mergers: 2005

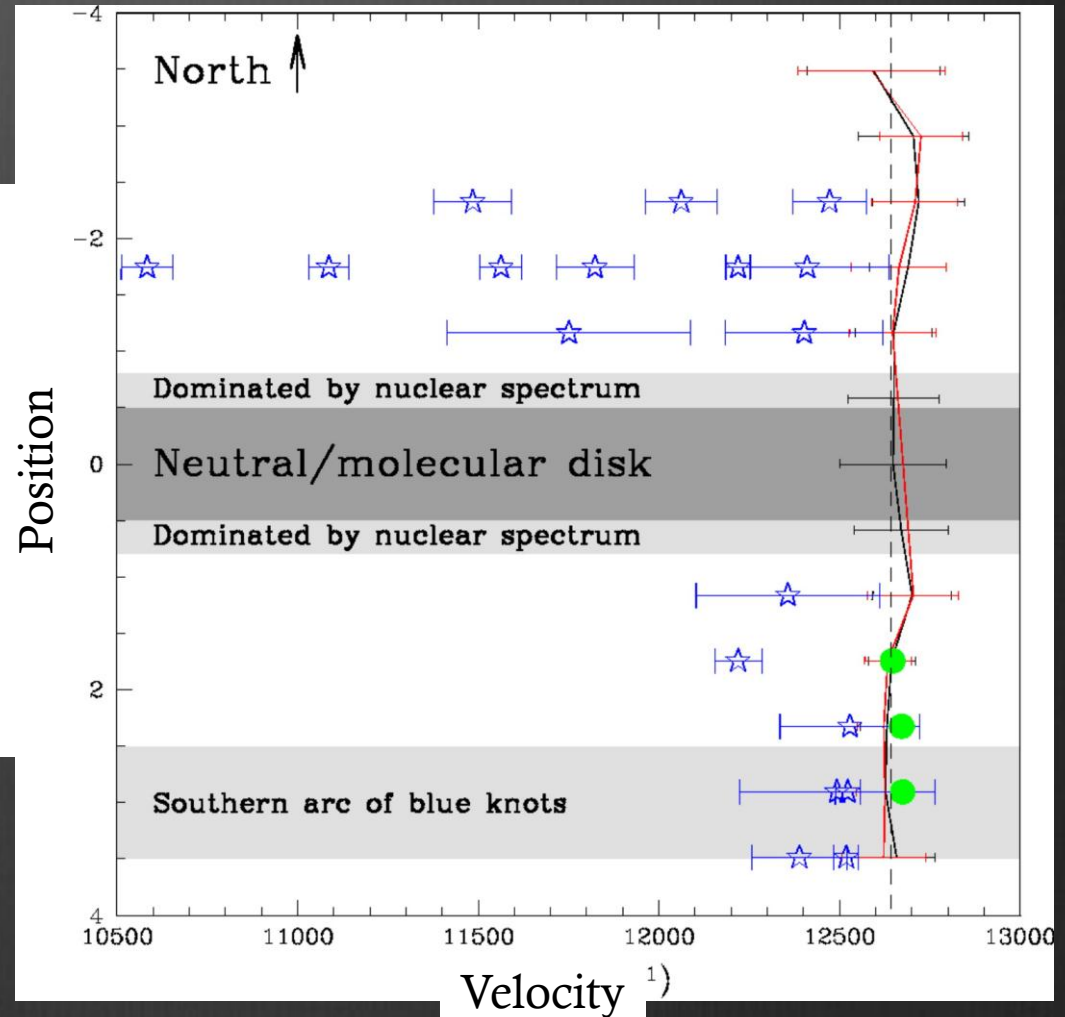
- No significant difference between:
 - Large-scale winds in galaxies dominated by star formation
 - Large-scale winds in galaxies dominated by AGN activity



Rupke+05abc, Krug+10

QSO-Mode Feedback Does NOT Exist in Mergers: 2005. But ...

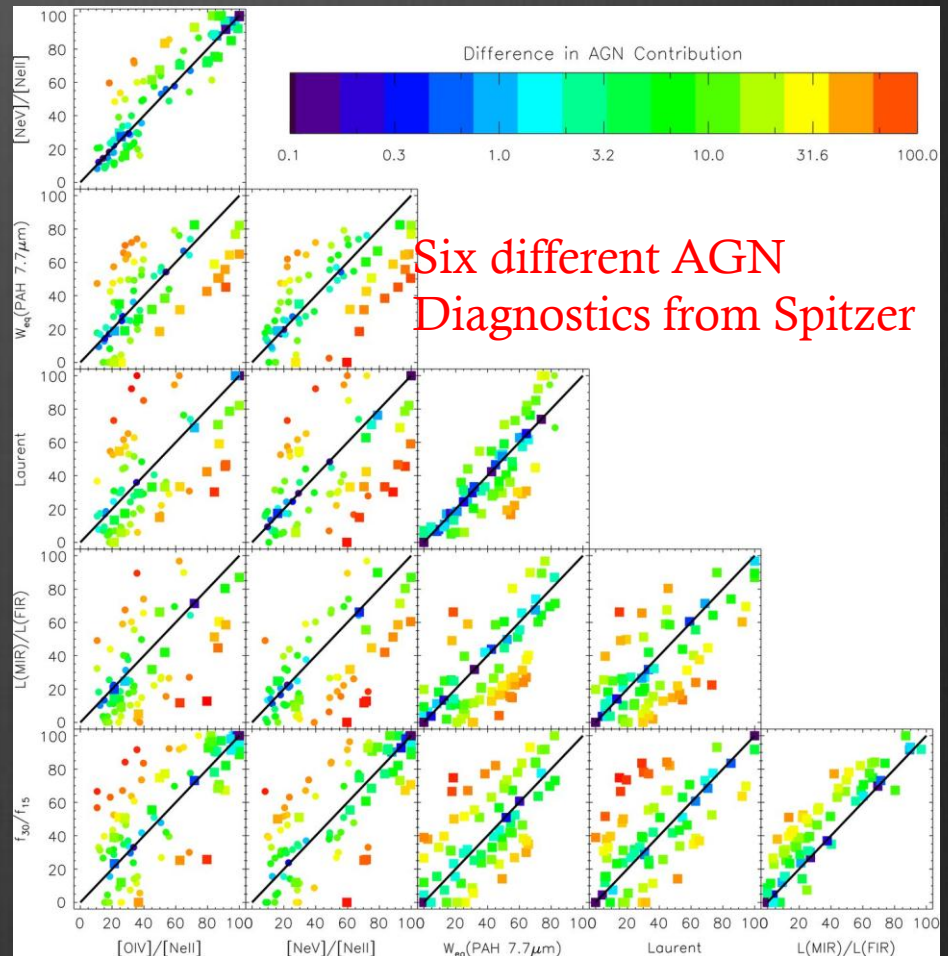
- Mrk 231 shows extended, high-velocity flow
- (NOT the classic BAL)
- Caveat: slit along the jet axis!



QSO-Mode Feedback Exists in Mergers: 2011

Three developments
lead to a new answer.

1. AGN Luminosities

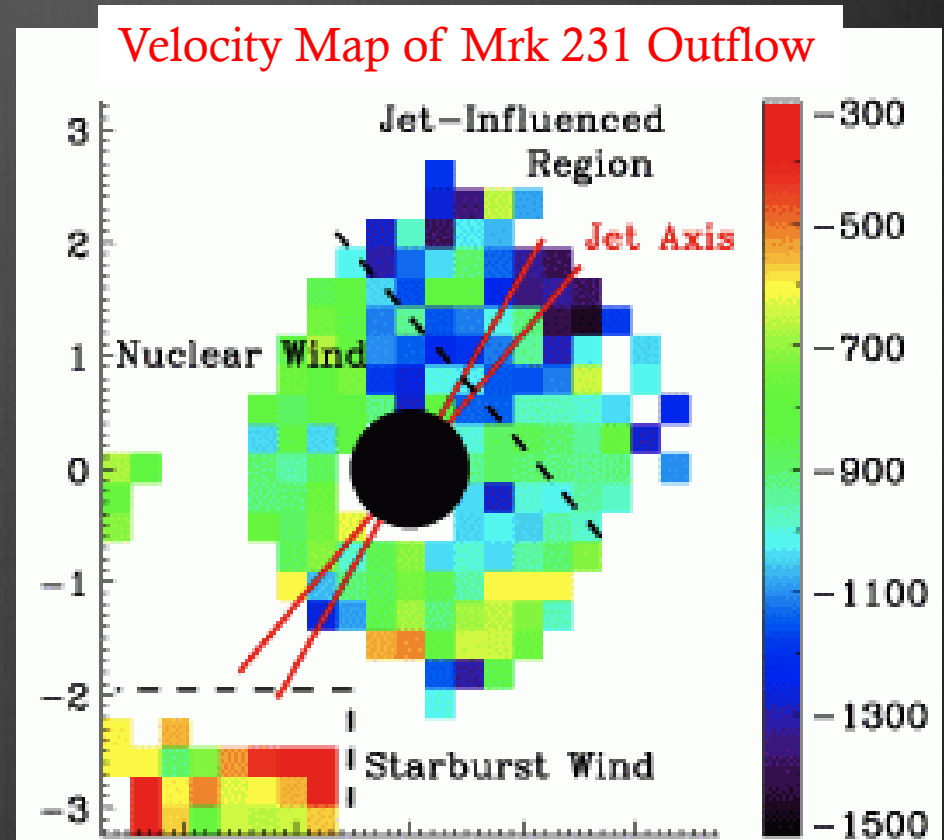


Veilleux+09

QSO-Mode Feedback Exists in Mergers: 2011

Three developments lead to a new answer.

1. AGN Luminosities
2. Integral Field Spectroscopy

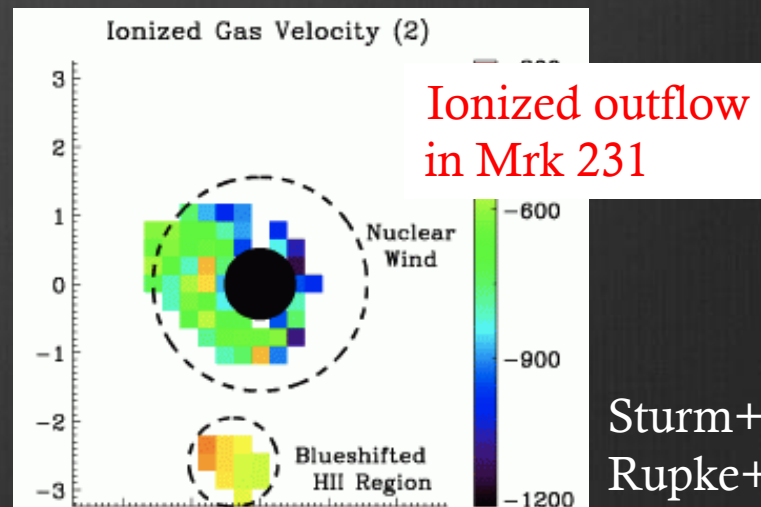
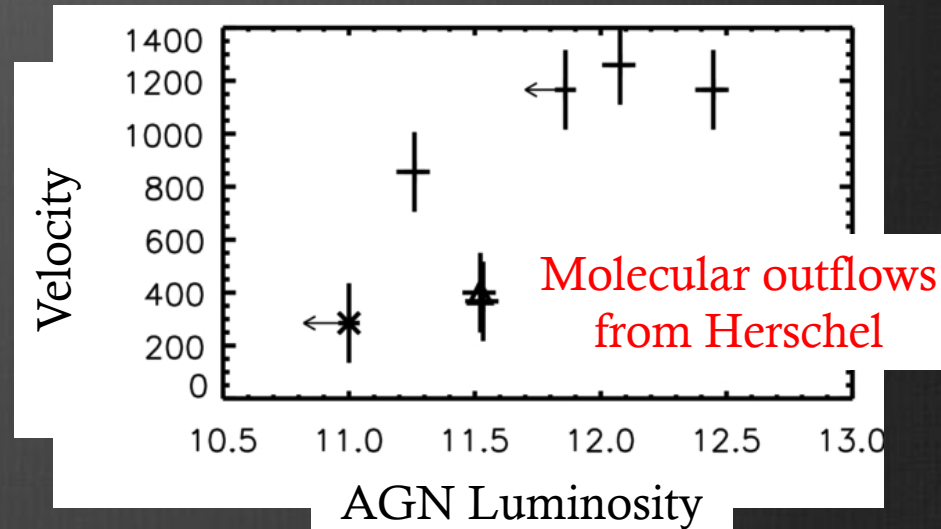


Rupke+Veilleux 11

QSO-Mode Feedback Exists in Mergers: 2011

Three developments lead to a new answer.

1. AGN Luminosities
2. Integral Field Spectroscopy
3. Multiphase Data



Sturm+11,
Rupke+Veilleux 11

QSO-Mode Feedback Exists in Mergers: 2012

What to expect: more data!

1. 6-galaxy IFU sample: Rupke+12, in prep.
2. More molecular gas data (see Veilleux talk)
3. More wavelengths ...

IFU Sample

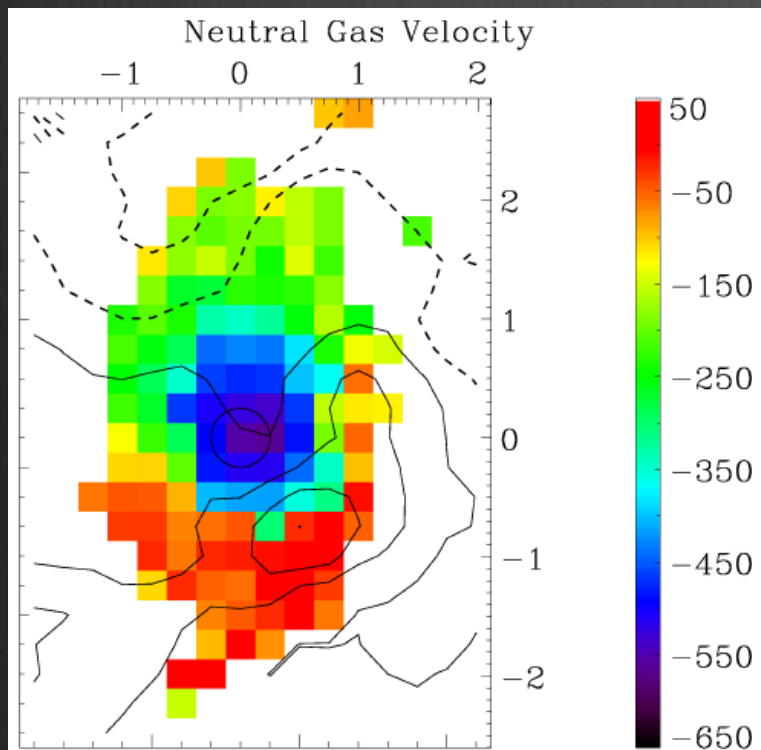
Starbursts



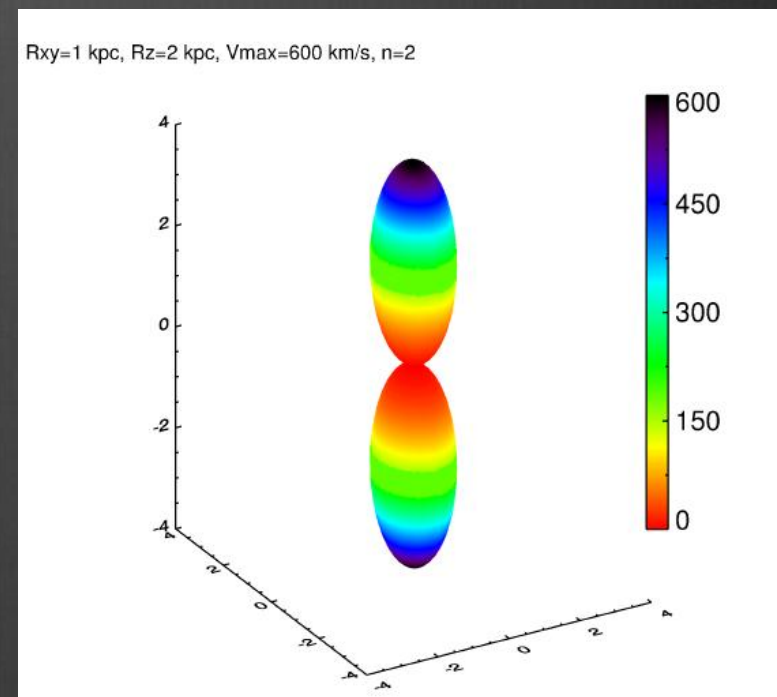
AGN



QSO-Mode Feedback Exists in Mergers: 2012

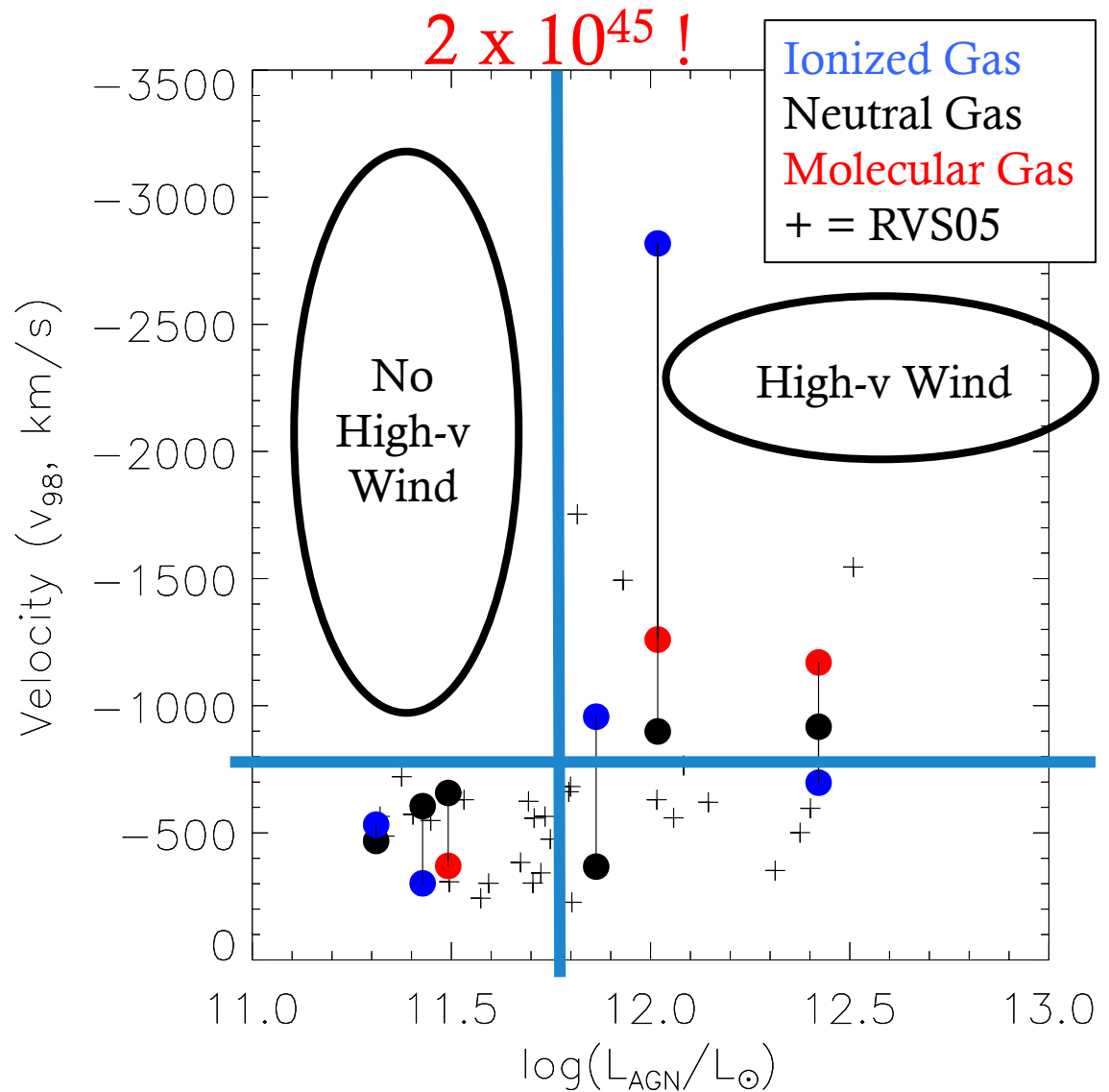


Data



(Preliminary) Model

QSO- Mode Feedback Exists in Mergers: 2012



Key Points

1. Feedback in mergers is pivotal to galaxy evolution.



2. QSO-mode feedback exists in mergers.

