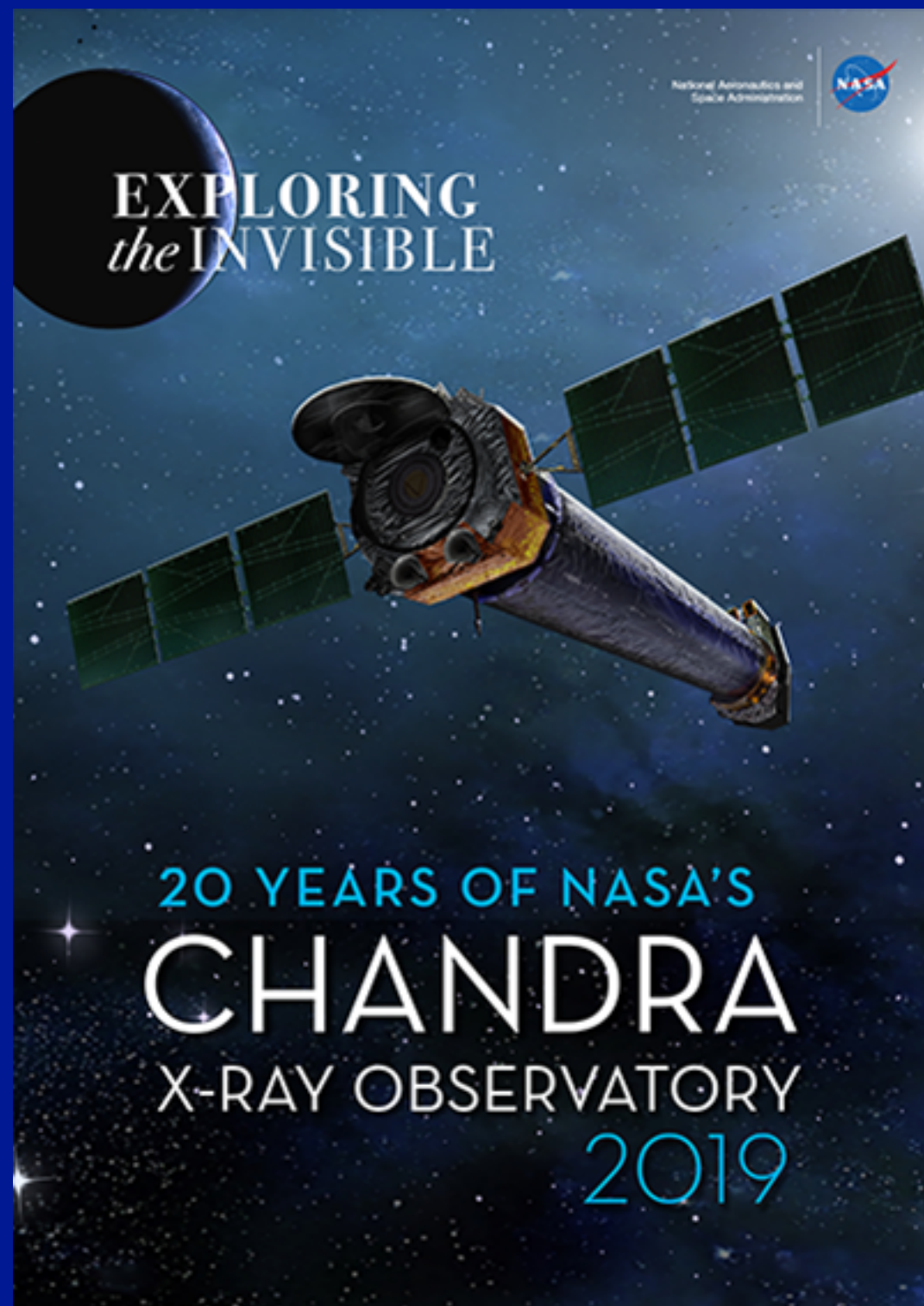


CHANDRA ALMA & MUSE REVEAL FEEDING & FEEDBACK IN OBSCURED AGN

C. FERUGLIO - INAF ITALY

THANKS TO:

P. FABBIANO, M. ELVIS
F. FIORE, M. BISCHETTI, A. TRAVASCIO



Celebrating 20 Years of
Chandra

MULTIPHASE WINDS IN AGN

AGN OUTFLOWS

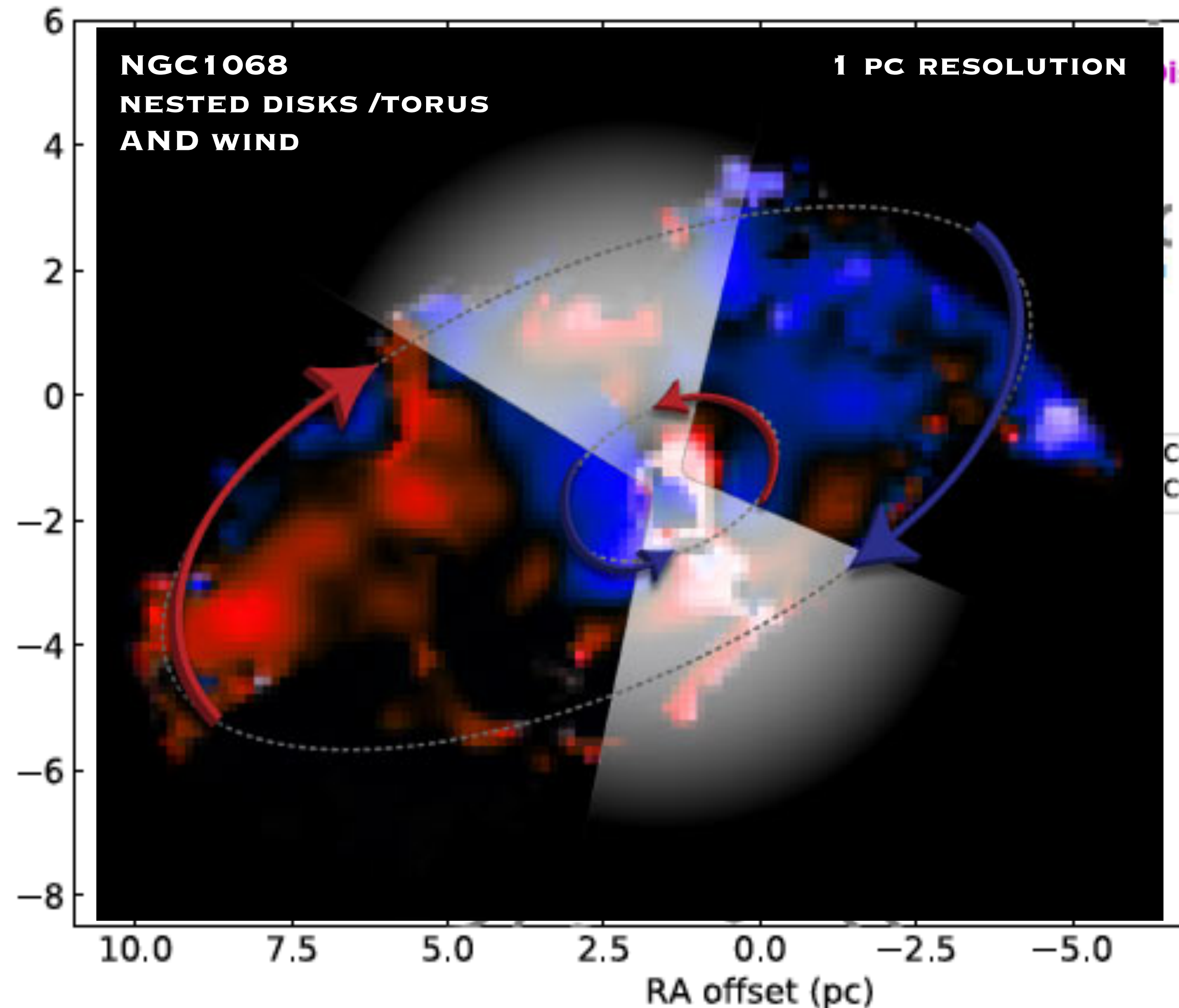
AND ALL DYNAMICAL COMPONENTS

ARE MULTIPHASE

HOT, WARM AND COLD PHASES

**CHARACTERISATION REQUIRES
MULTIWAVELENGTH
OBSERVATIONS**

**SYNERGY OF CHANDRA
WITH MAJOR OBSERVATORIES**



AGN MULTIPHASE WINDS MODELS

AGN OUTFLOWS MODELS PREDICT
COOLING SEQUENCE DURING WIND EXPANSION

MENCI+2019, RICHINGS+2017, FAUCHER-GIGUERE+2012

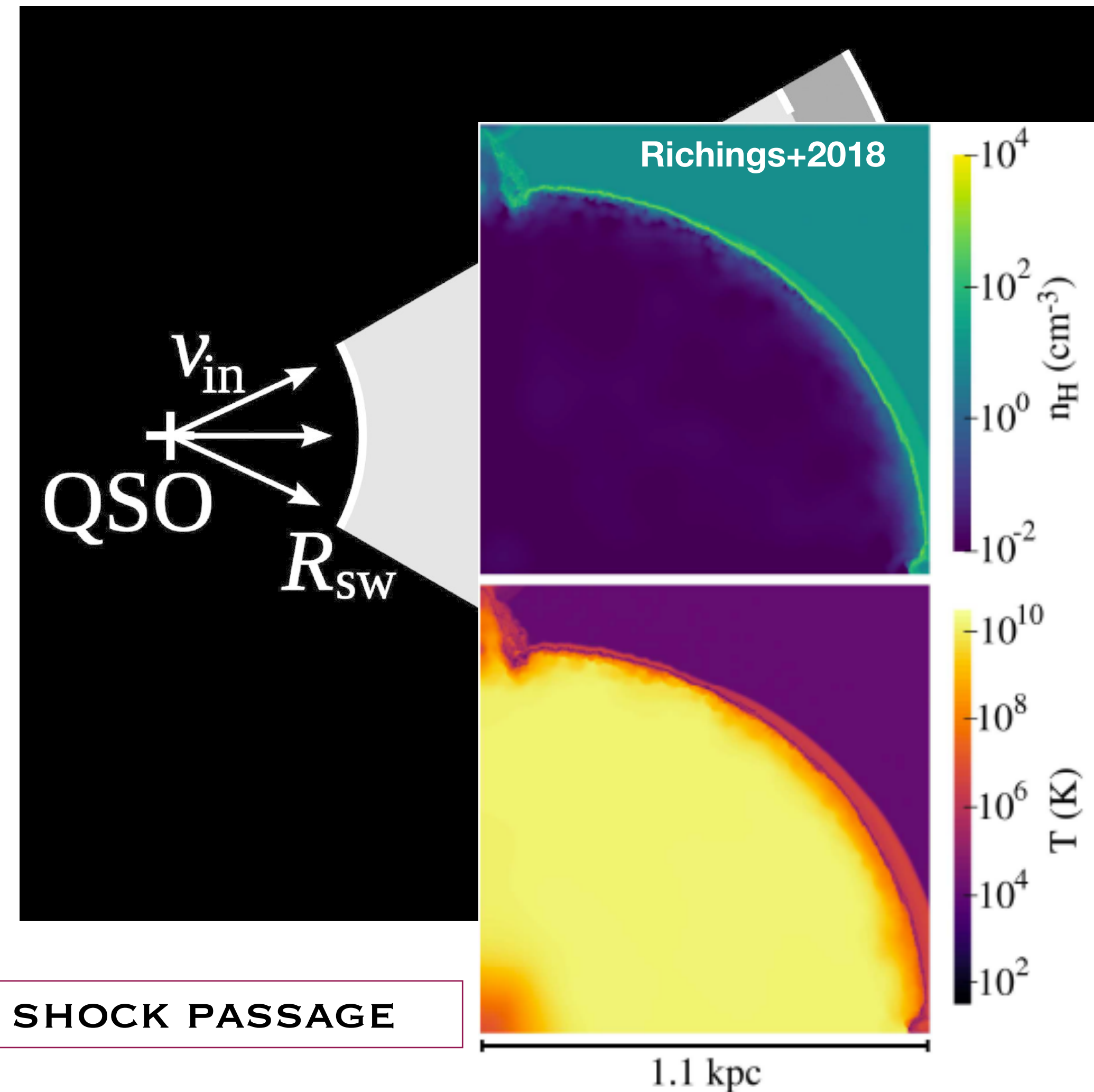
NUCLEAR SEMI-RELATIVISTIC WIND

→ SHOCK EXPANDING INTO THE ISM

COOLING

→ WARM IONISED & COLD MOLECULAR
WINDS ON KPC SCALE

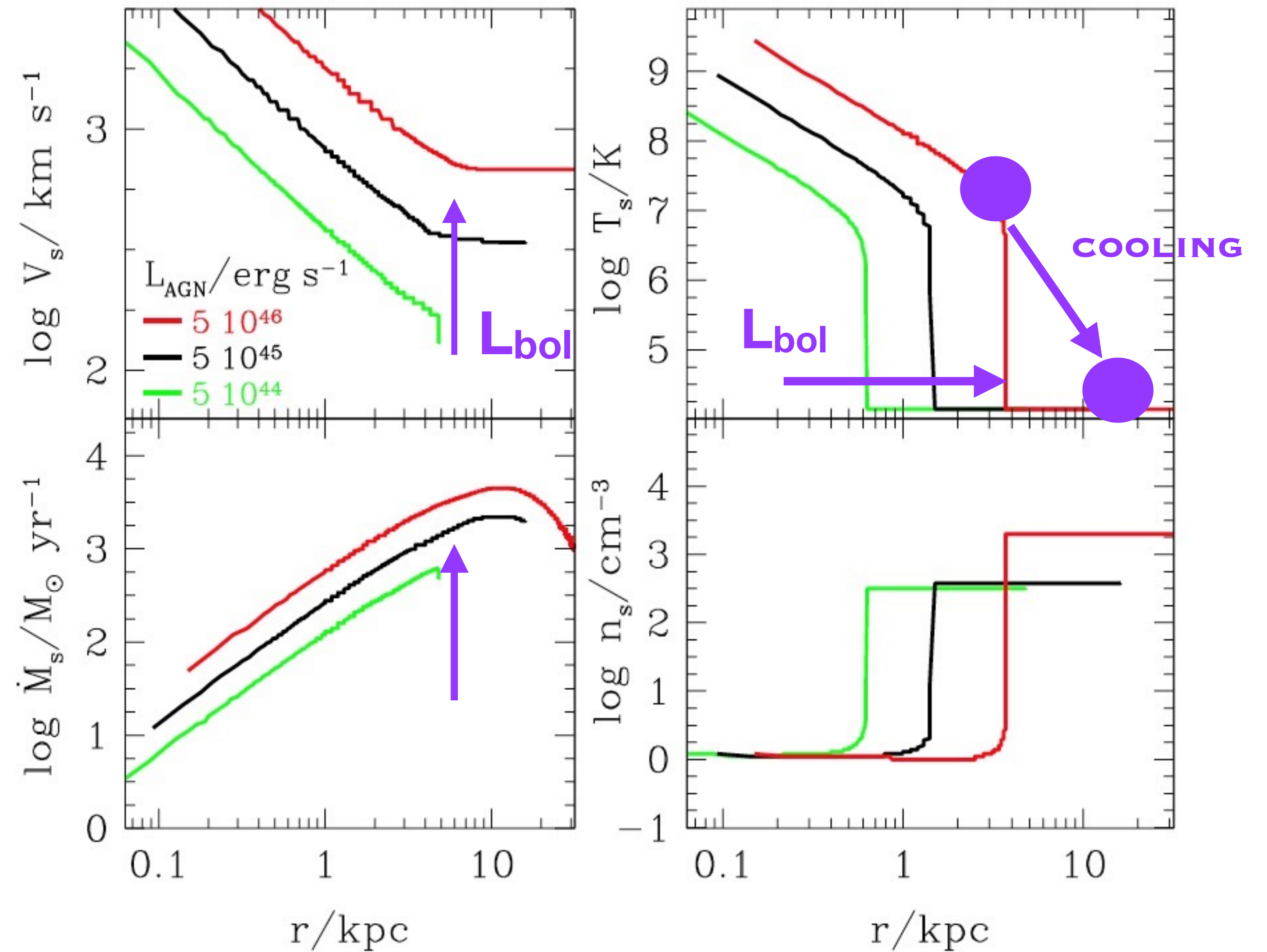
MOLECULAR OUTFLOWS → MOLECULAR REFORMATION AFTER SHOCK PASSAGE



AGN MULTIPHASE WINDS MODELS

MENCI, FIORE, CF 2019, APJ,877,74M

UPDATE RICHINGS & FAUCHER-GIGUERE
MODEL WITH EXPONENTIAL DENSITY
PROFILE FOR GAS DISTRIBUTION IN DISK

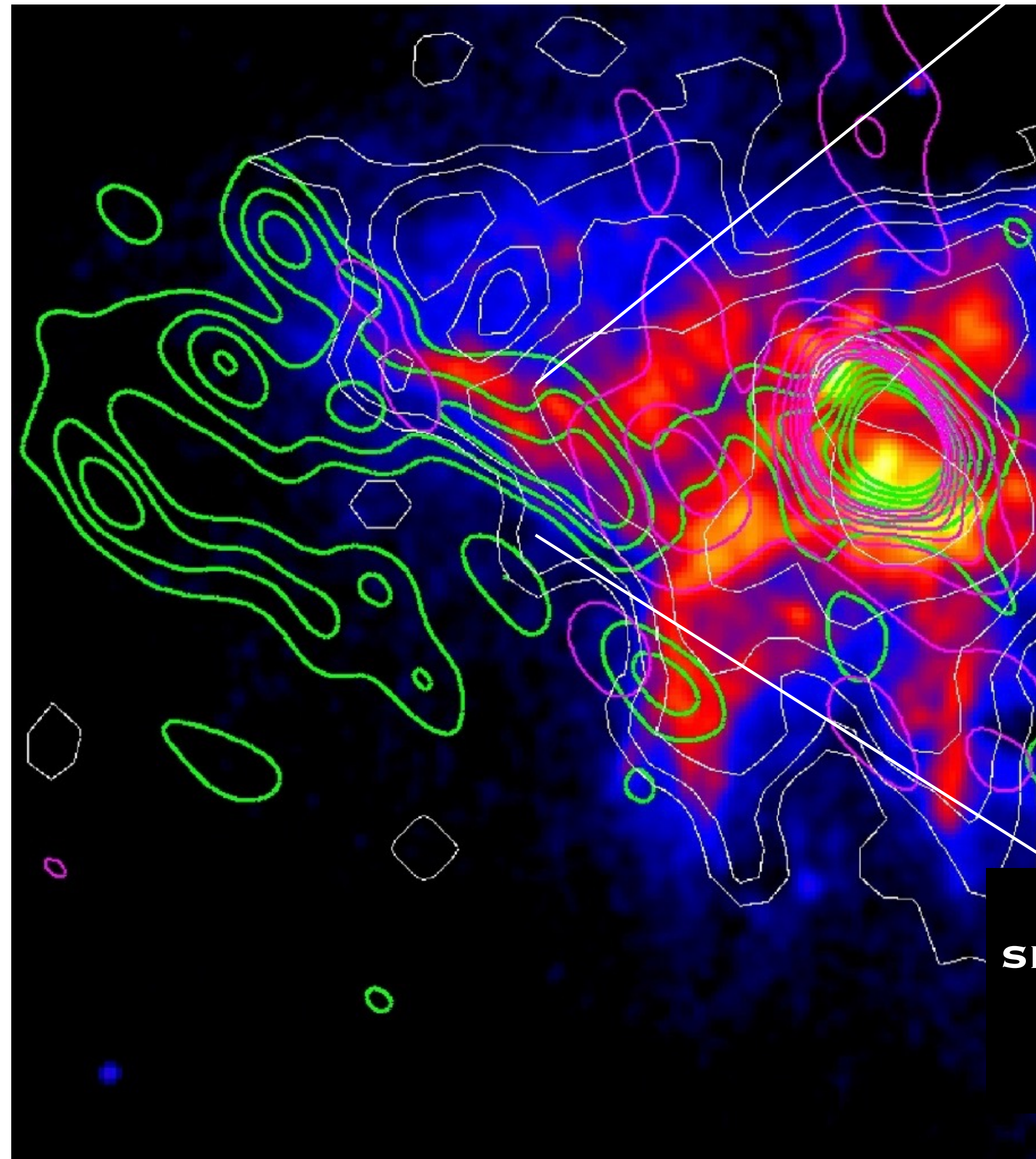


NGC6240 CHANDRA

HA IMAGE

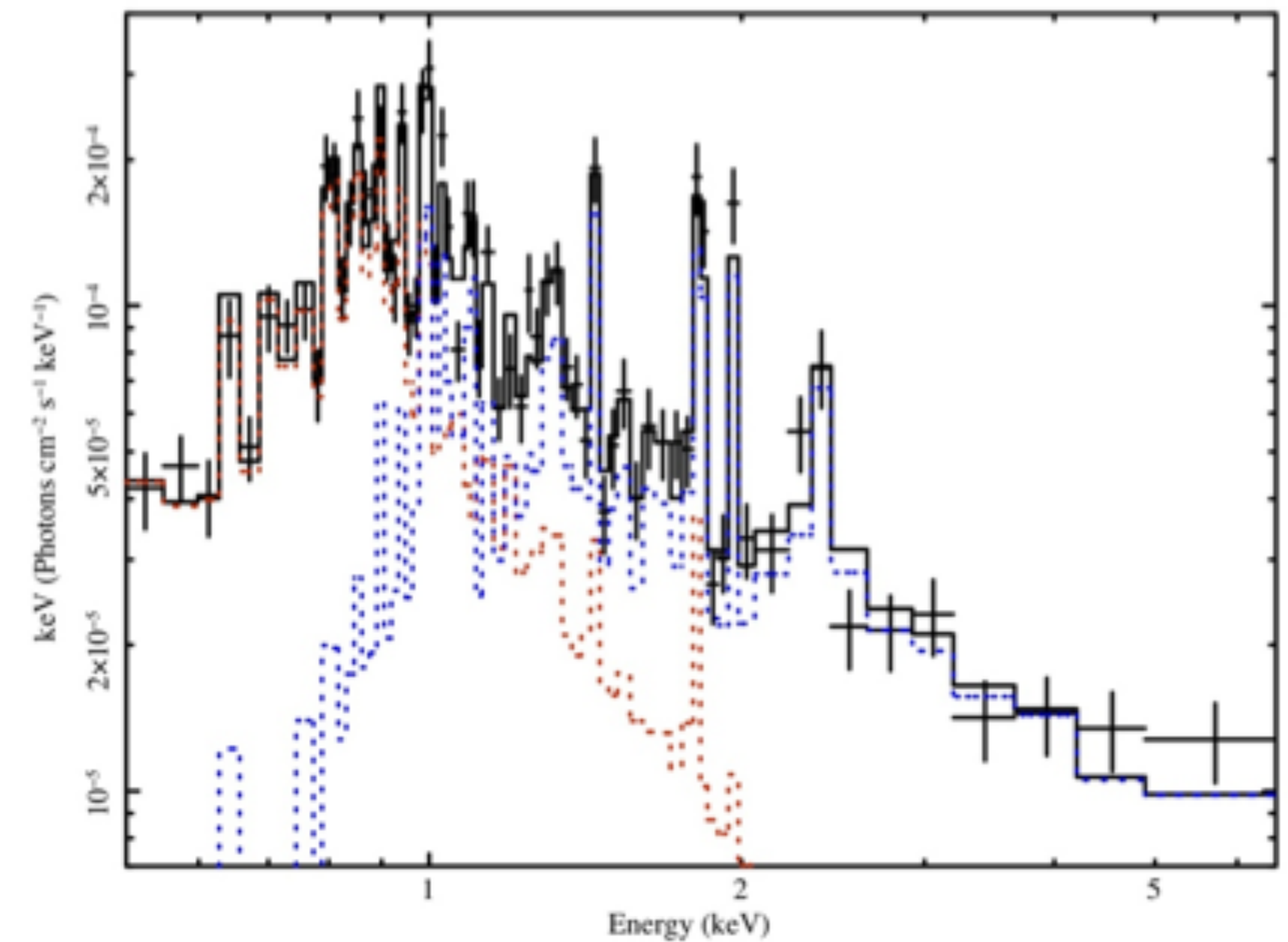
FAST CO

CHANDRA X-RAYS



FERUGLIO+2013

NGC6240 extended X-ray emission
Thermal equilibrium plus shock model



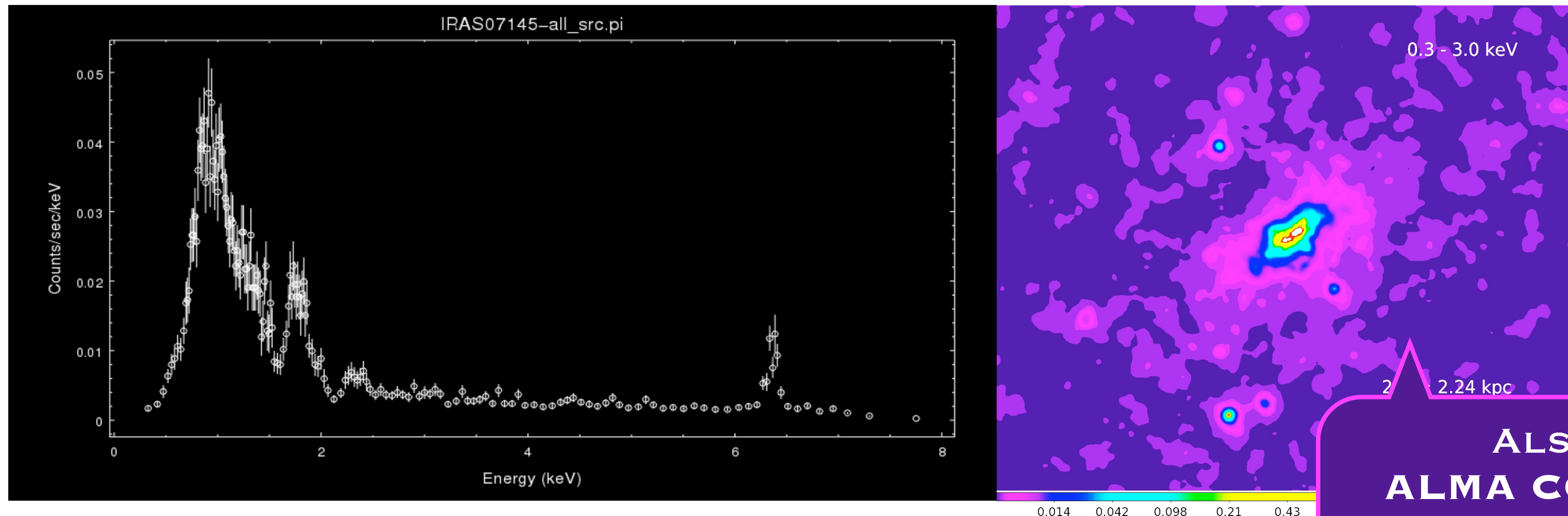
CHANDRA SPECTRA
SHOCKED GAS AT THE POSITION OF THE HA EMISSION.
SHOCK PROPAGATING EASTWARD
COMPRESSING MOLECULAR GAS

THE CT SEYFERT ESO428-G14 CASE

MULTI-PHASE PLASMA SHOCK-HEATED RELATED TO AGN FEEDBACK

150 KS CHANDRA, SOFT LINE DOMINATED EMISSION

Fabbiano et al 2017, 2018a, 2018b, ApJ



SOFT LINE
EMISSION
OVII, OVIII, NEIX,
MGXI, SIXIII, ETC.

HARD
CONTINUUM

FE K LINES
NEUTRAL AND FE
XXV

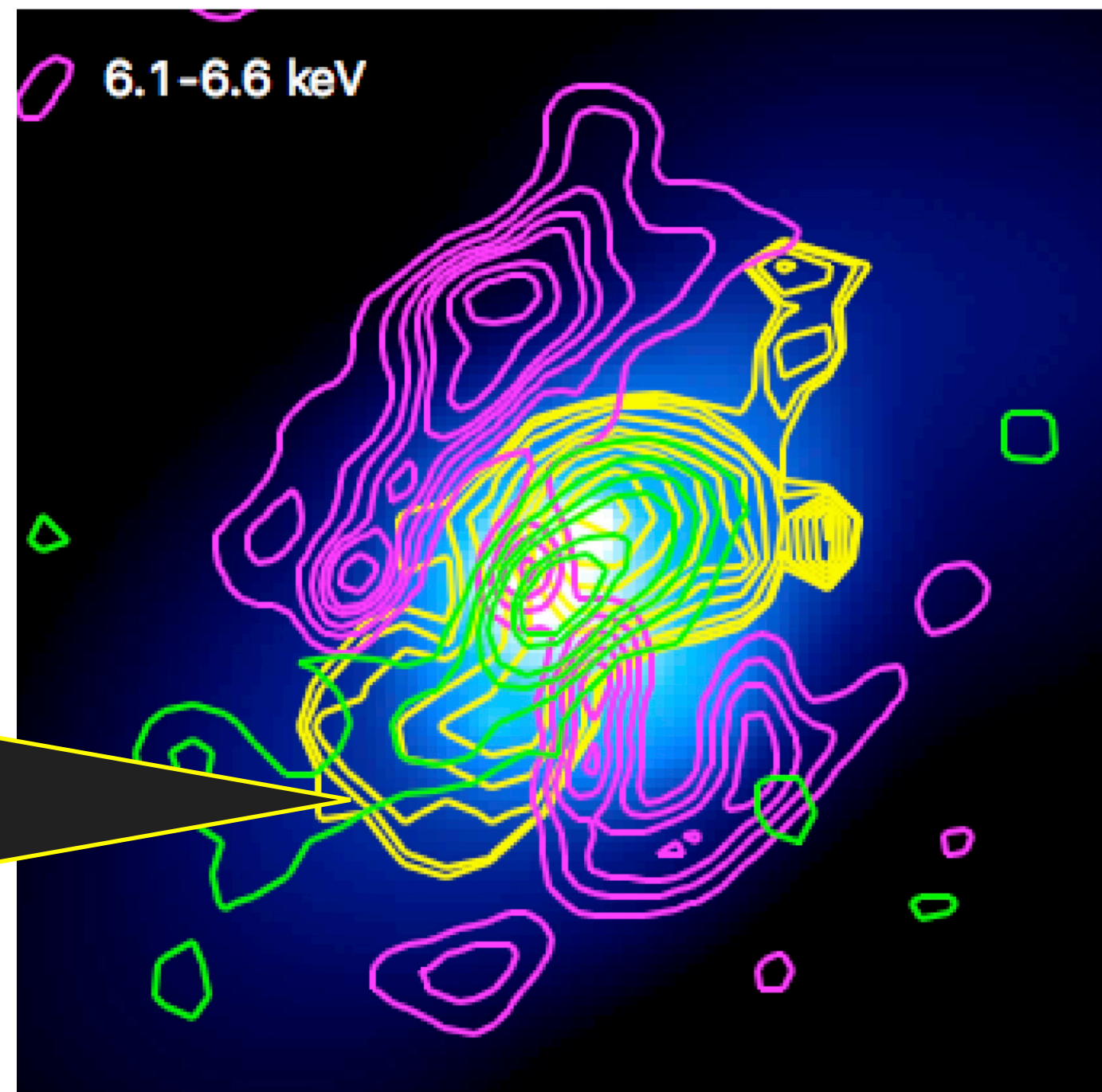
ALSO
ALMA CO(2-1)
SINFONI/VLT NIR
MUSE/VLT
HIGH RESOLUTION
DATA

GABRIELE PONTI'S
TALK YESTERDAY

HARD X-RAY EMISSION

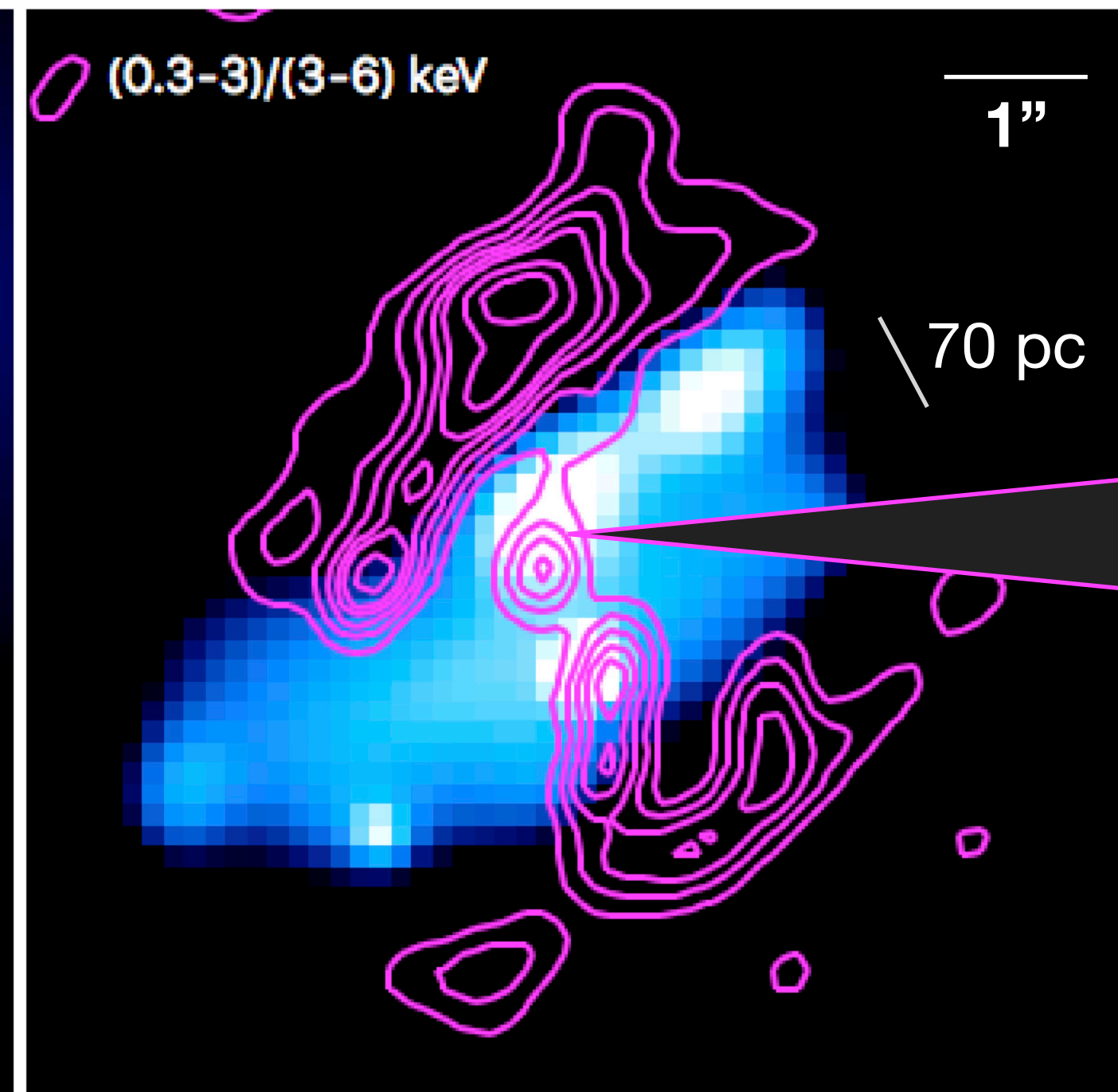
CHANDRA HIGH RESOLUTION SPECTRO-IMAGING
+ ALMA CO(2-1) AND SINFONI H₂ MAP UNVEIL EFFECT OF AGN IN THE INNER ~100 PC REGION

CHANDRA FE K α MAP



FE K α PRODUCED BY SCATTERING
FROM COLD AND WARM
MOLECULAR MATERIAL

HARDNESS RATIO MAP



COMPTON-THICK OBSCURATION
DUE TO MOLECULAR MATERIAL
IN THE INNER ~50 PC
CLOSE TO TORUS

Feruglio, Fabbiano+2019

Fabbiano et al 2017,
2018a, 2018b, ApJ

SINFONI/VLT:

**H₂ 1.2MM EMISSION
AT NUCLEUS AND IN
FE K α EMISSION
REGION**

ALMA:

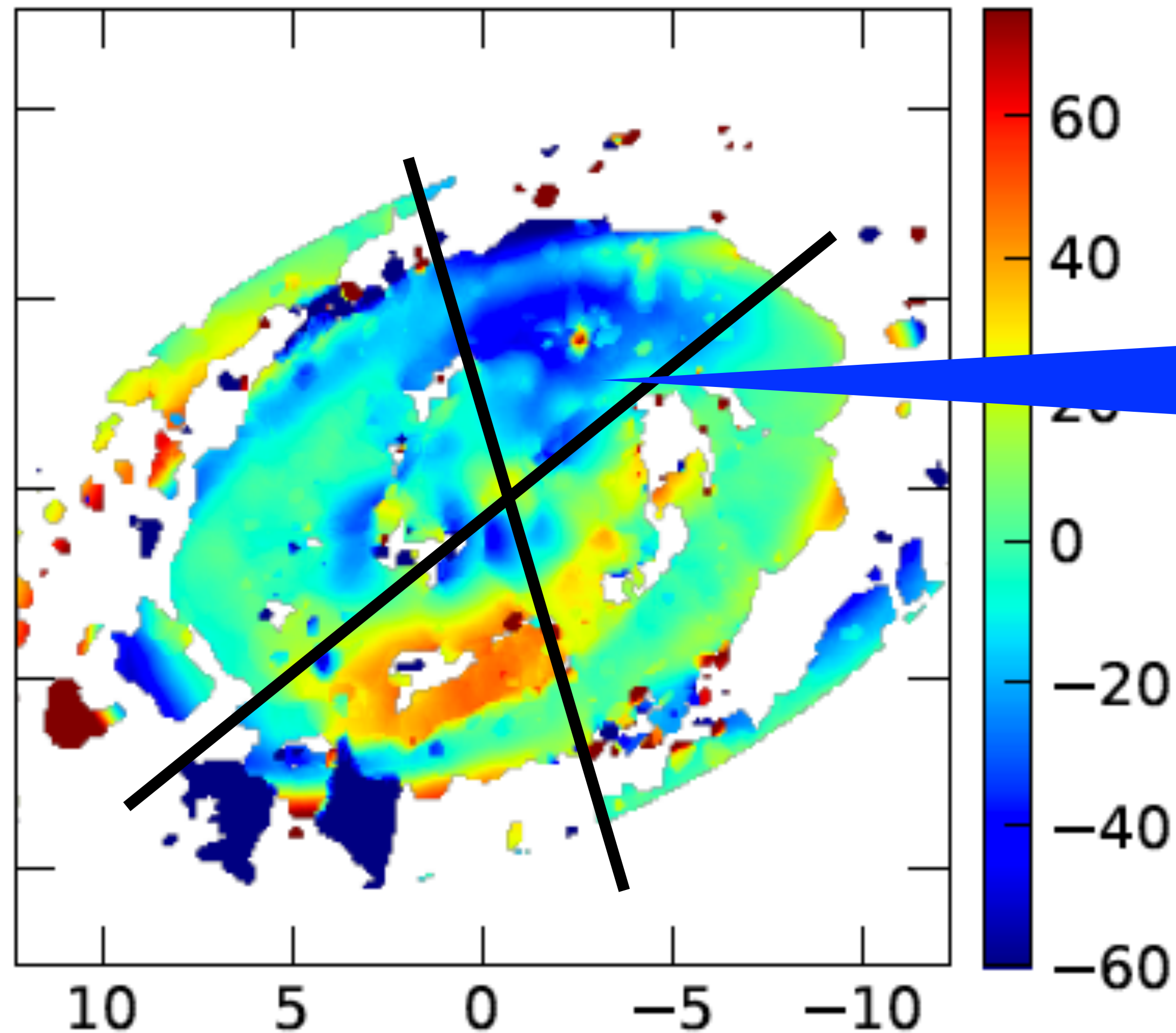
**CO(2-1) EMISSION
COLD MOLECULAR GAS
IN THE CT NUCLEUS**

RESOLUTION
ALMA 70 PC
SINFONI/VTL 20 PC

SOFT X-RAY EMISSION

SINFONI
SOFT-X COINCIDES
WITH WARM H₂ OUTFLOW
ON 150 PC SCALES

ALSO [Si VI] 1.9 μm
OUTFLOW
(MAY+2018)



CO(2-1) VELOCITY MAP
DATA - DISK MODEL

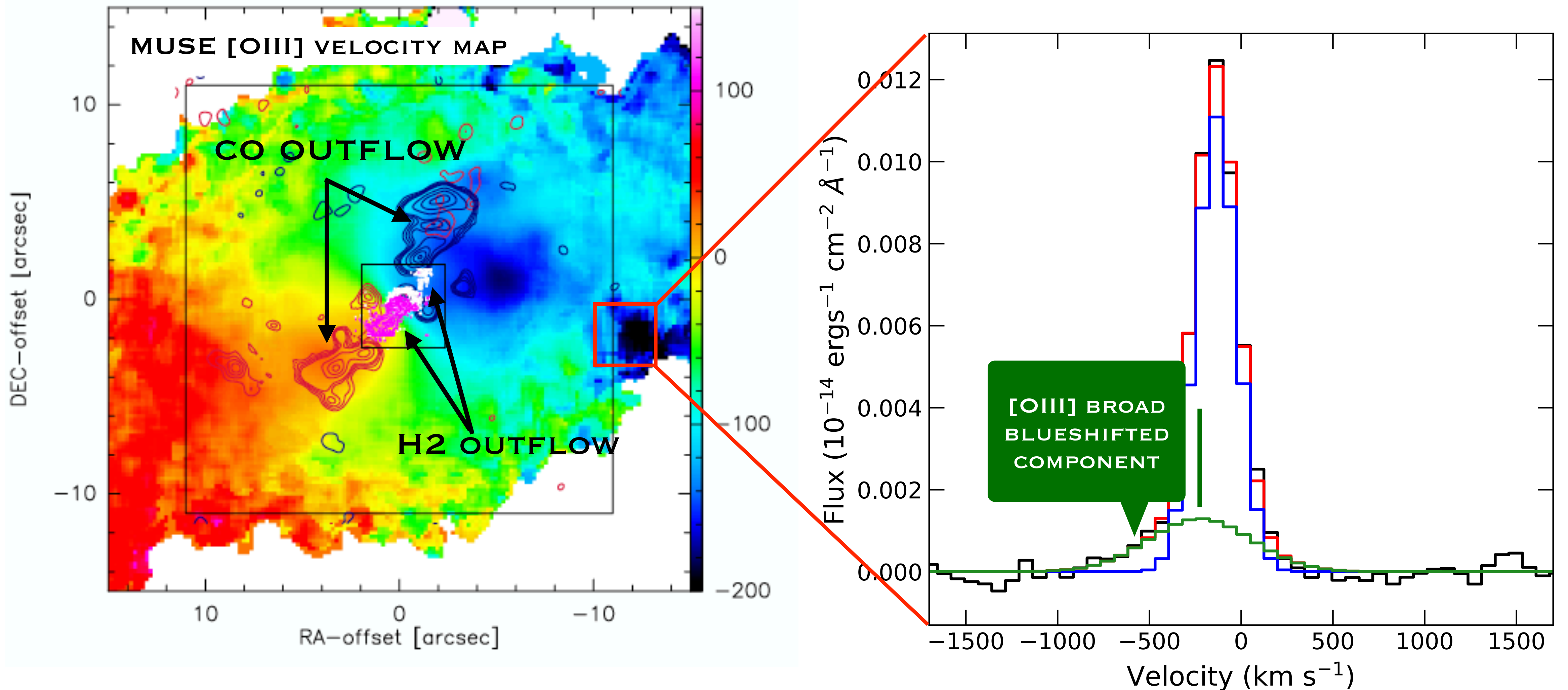
ALMA
CO COLD OUTFLOW
ON LARGER SCALES
OUT TO 700 PC

$$\dot{M}_{out} = 0.1 - 0.3 M_{\odot}/yr$$

OUTFLOW
COOLING SEQUENCE
FROM SOFT X-RAYS
TO WARM H₂
TO COLD CO

FAST [OIII] WIND FROM MUSE

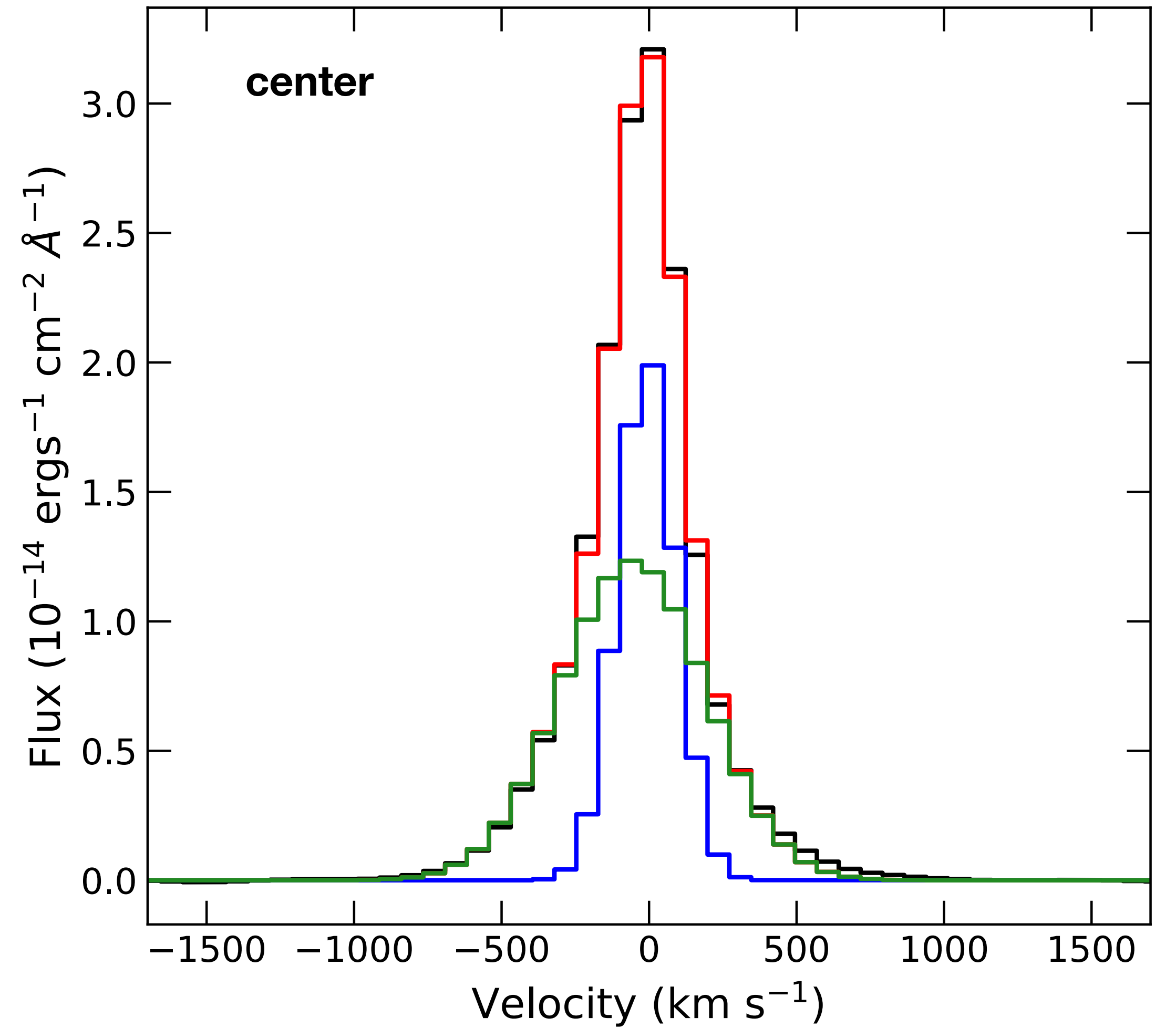
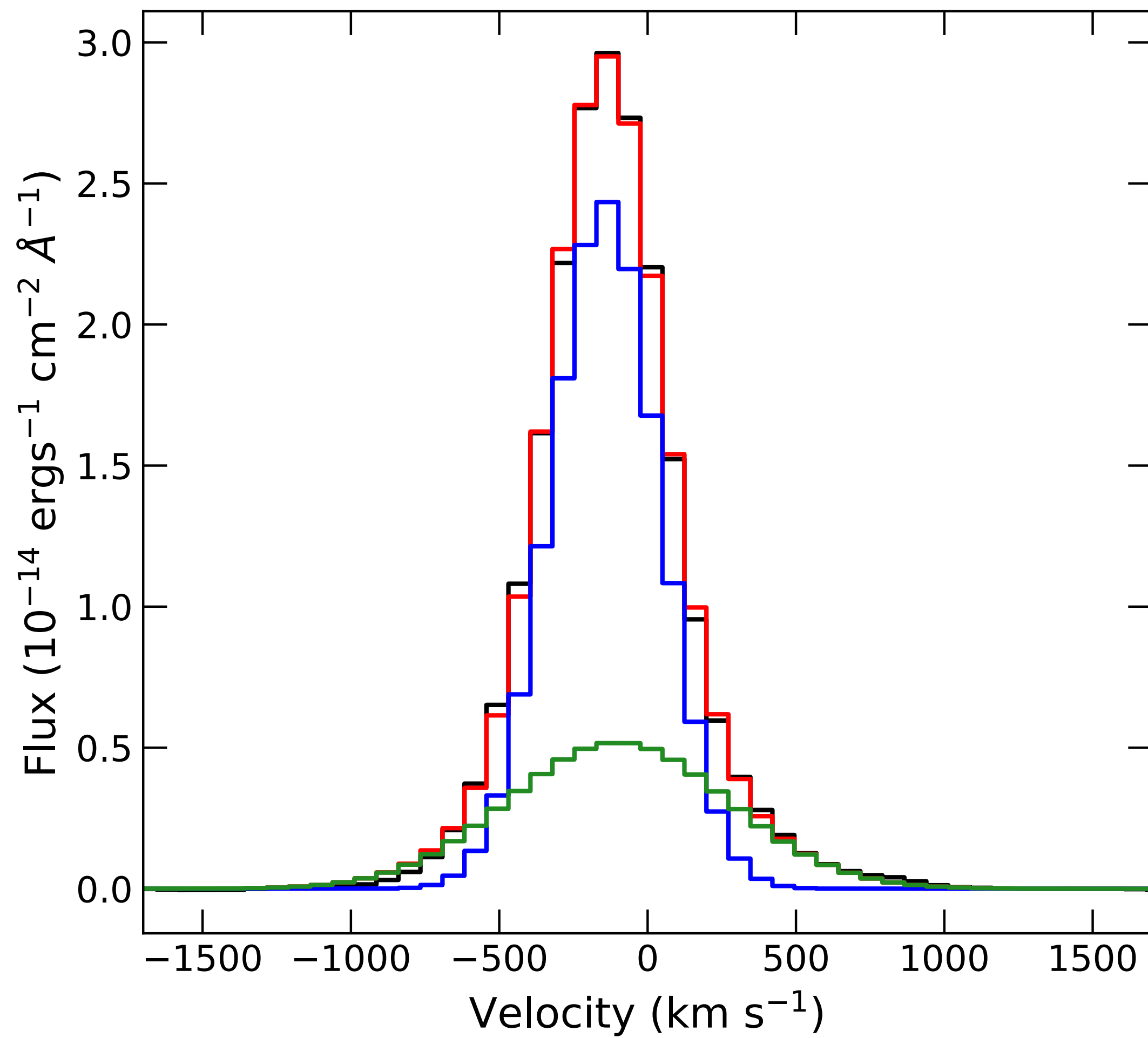
[OIII] WITH VELOCITY > 1000 KM/S



CONCLUSIONS

- ✦ **CHANDRA PROVIDED UNIQUE OBSERVATIONS FOR FEEDING & FEEDBACK IN NEARBY AGN**
- ✦ **ANGULAR RESOLUTION IS KEY —> CHANDRA, LYNX**
- ✦ **<0.1 ARCSEC RESOLUTION ROUTINELY ACHIEVED WITH ALMA (100 PC AT 200 MPC DISTANCE, RESOLVE HII REGIONS AND GIANT MOLECULAR CLOUDS)**
- ✦ **FUTURE: HIGH-RESOLUTION MULTIWAVELENGTH DIAGNOSTICS**

[OIII] spectra



Anche questo
e' outflow
ed e' quello che si
vede nella mappa dei
residui
di Barolo

