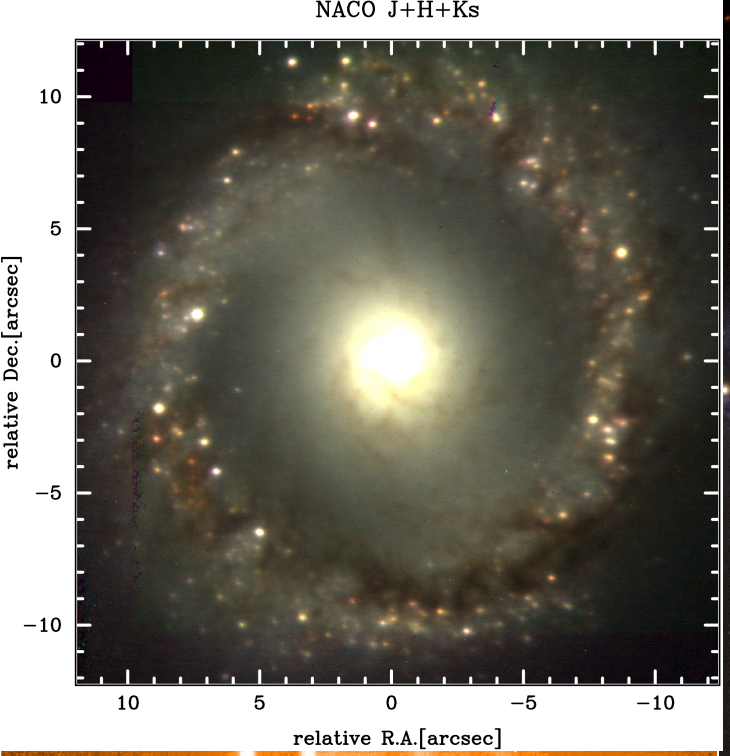
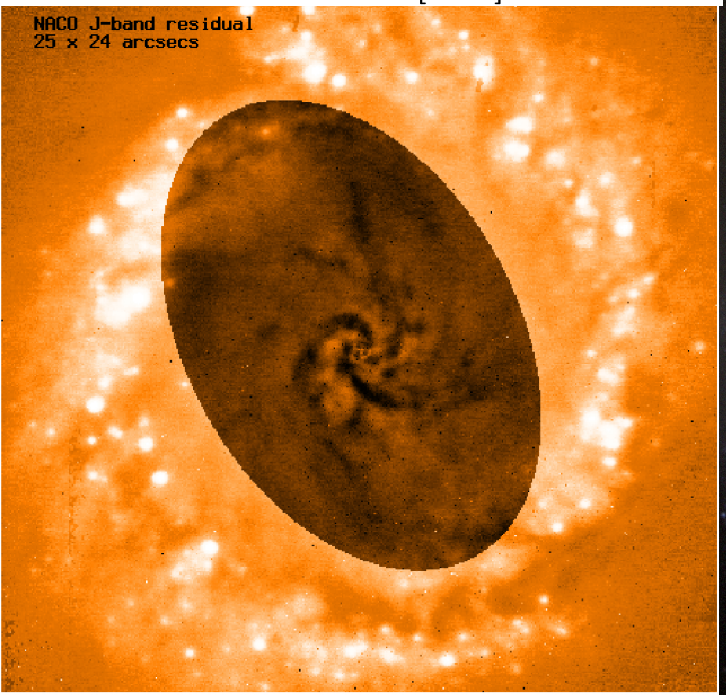




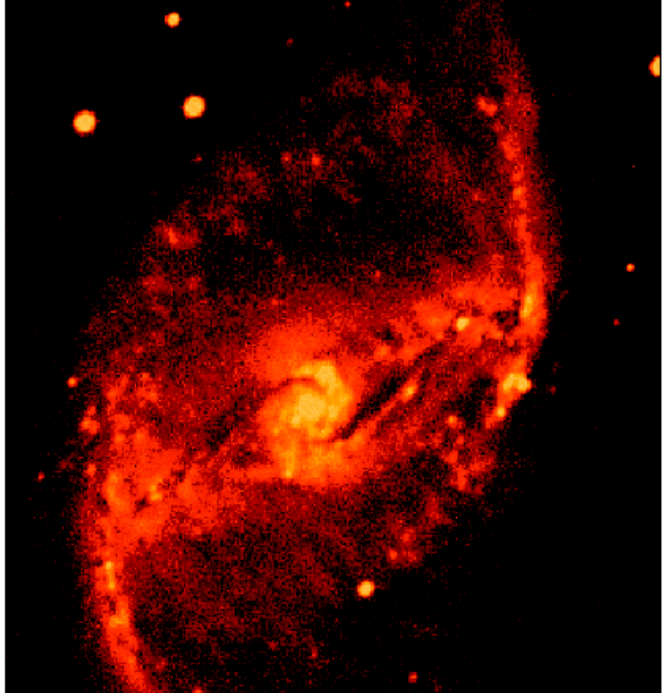
3D kinematics of nuclear spirals in galaxies

NGC 1097
(VLT)

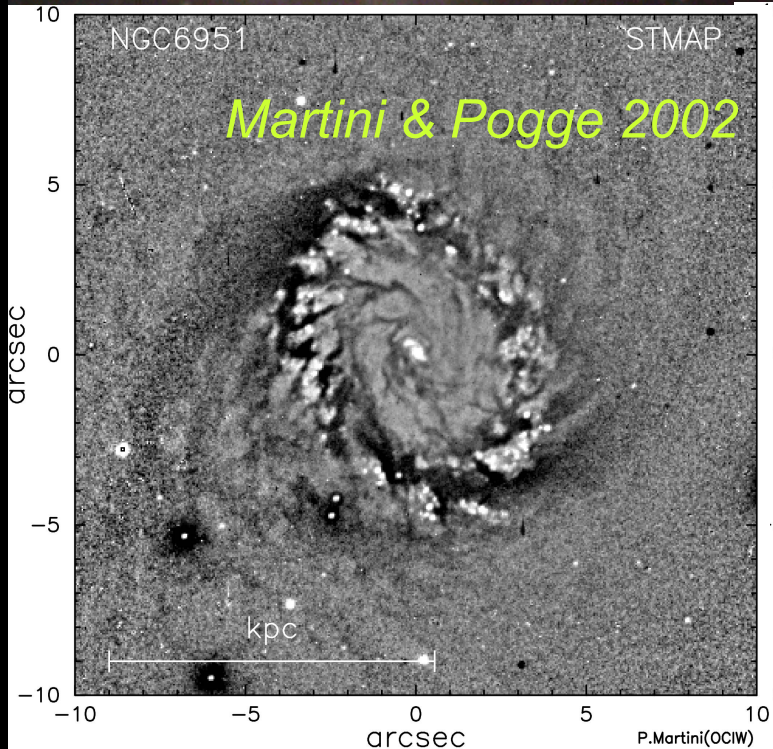
Witold Maciejewski

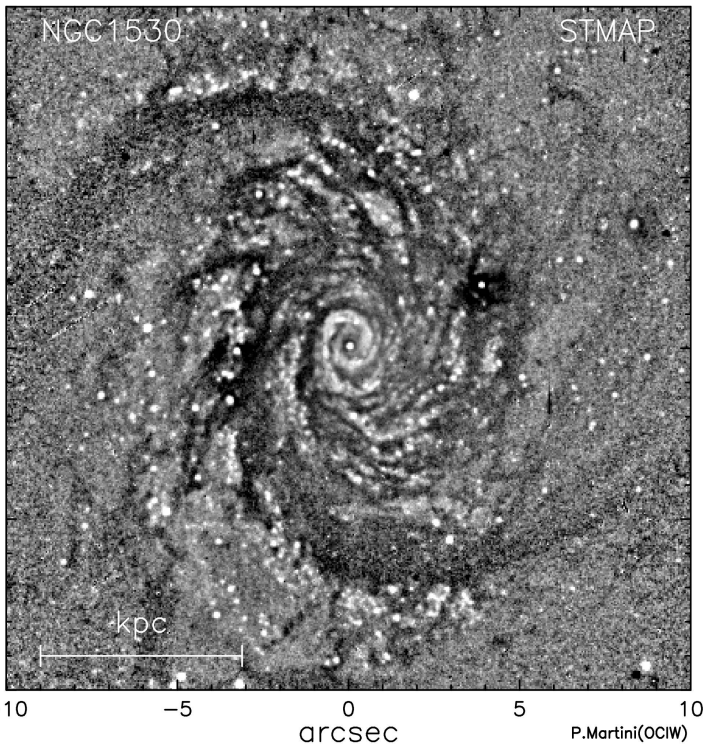
Astrophysics Research Institute
Liverpool John Moores University

Grand design nuclear spirals (GDNS)



- NS common; dusty, often flocculent
- but GDNS show coherent spiral arms

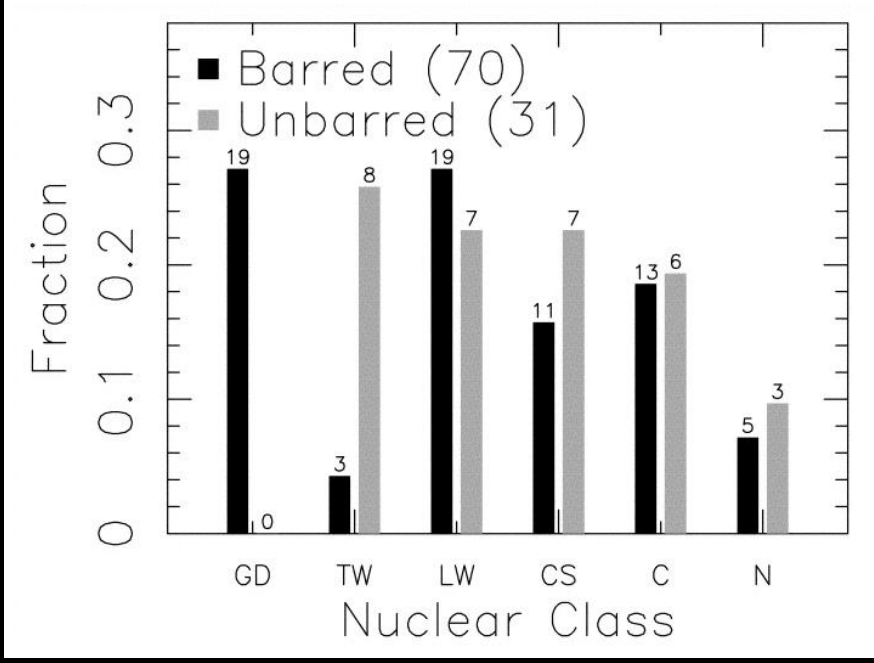




GDNS found only in barred galaxies

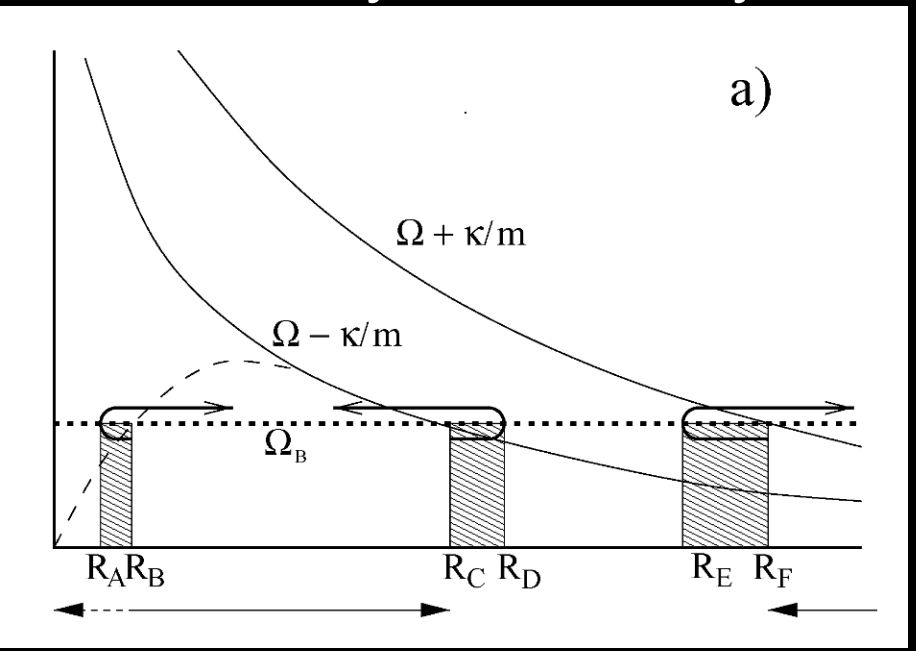
→ nuclear spiral driven by a bar?

Martini et al. 2003

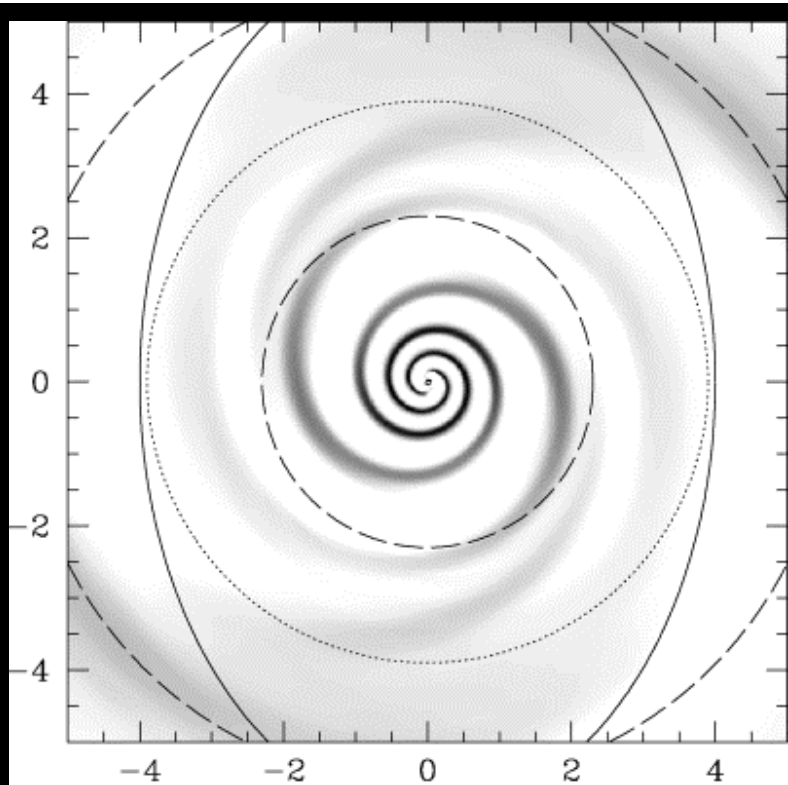


Bars/ovals naturally generate spiral structure in gas

linear density-wave theory

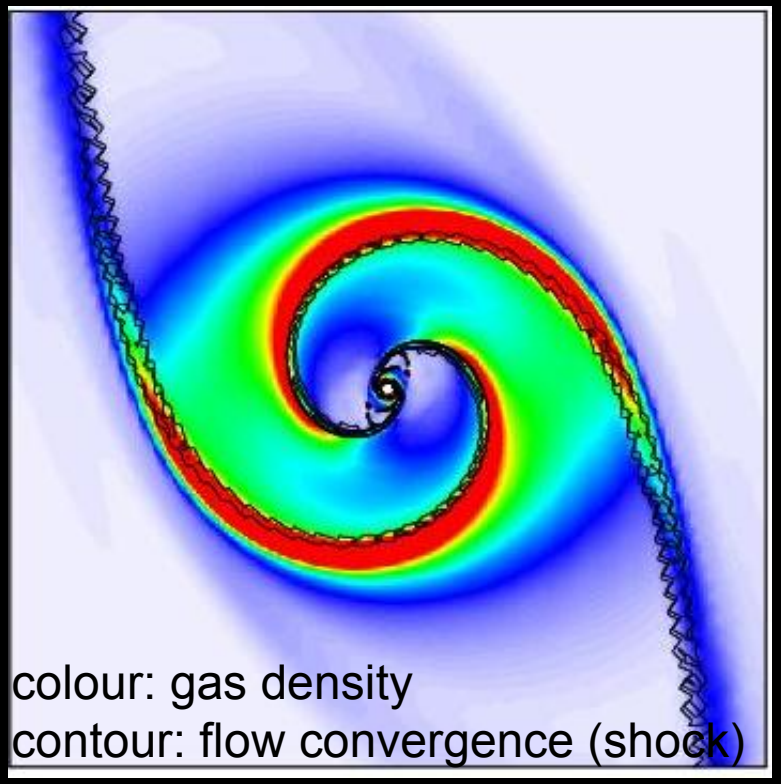


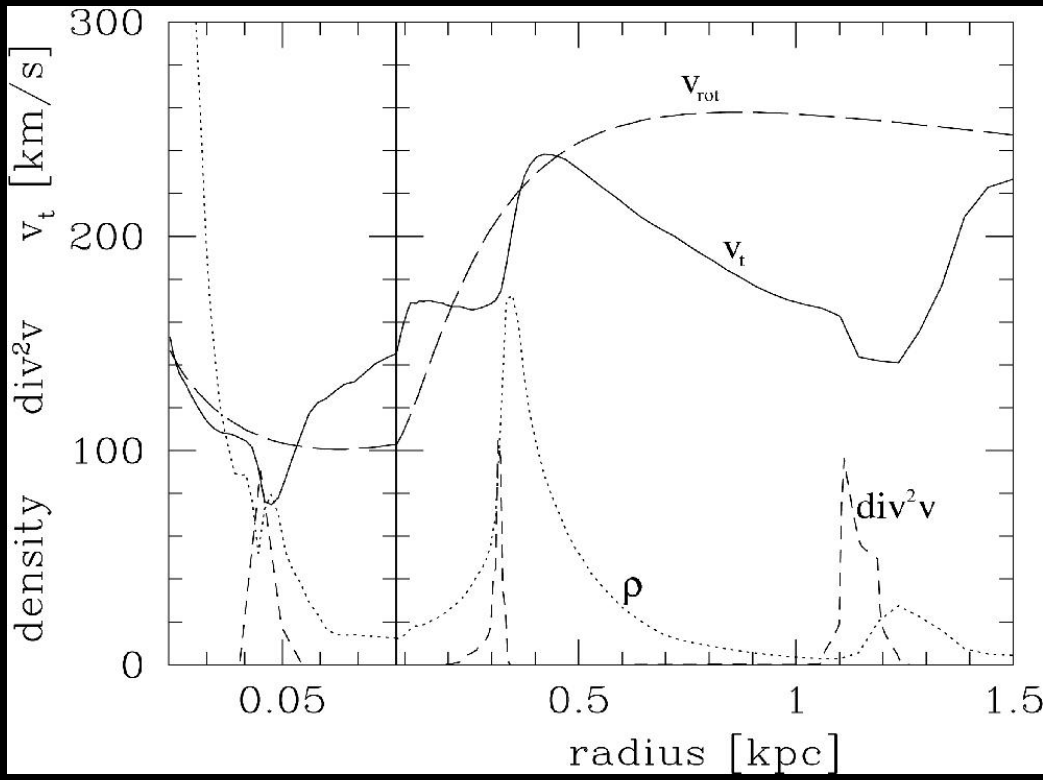
WM
←2004a
2004b→



hydrodynamical representation

GDNS in strong bar: spiral shock in gas





WM2004b

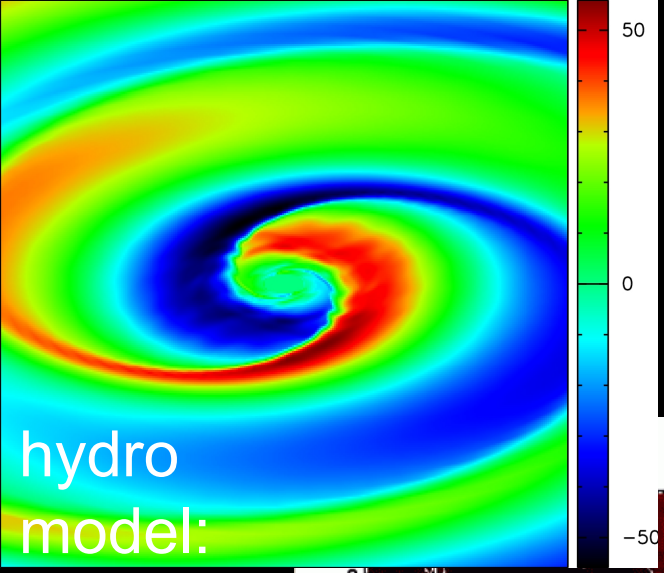
- NS propagates inwards past the nuclear ring
- departures from circular motion by ~50 km/s

→ should show up in gas kinematics

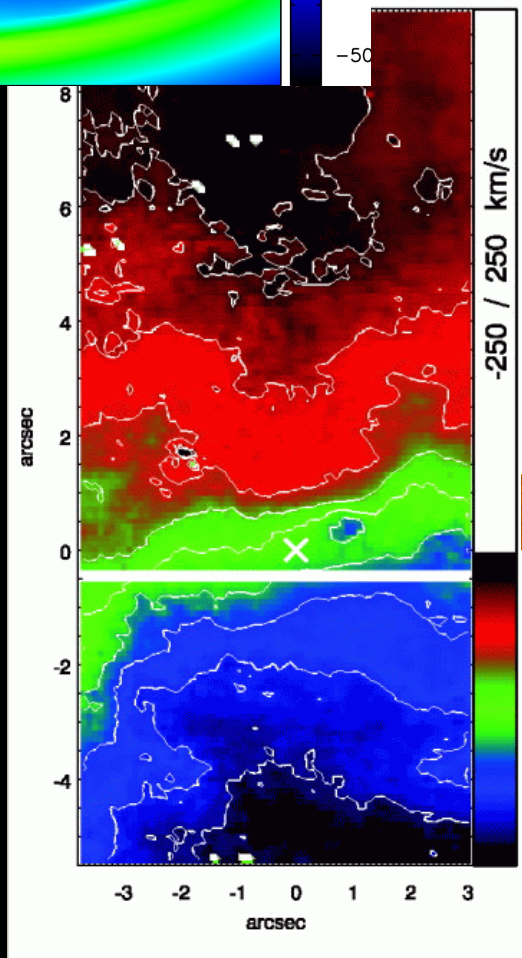
- inflow in to 40-pc radius ~0.2 Msun/yr (brightest local AGN)

3D kinematics of GDNS

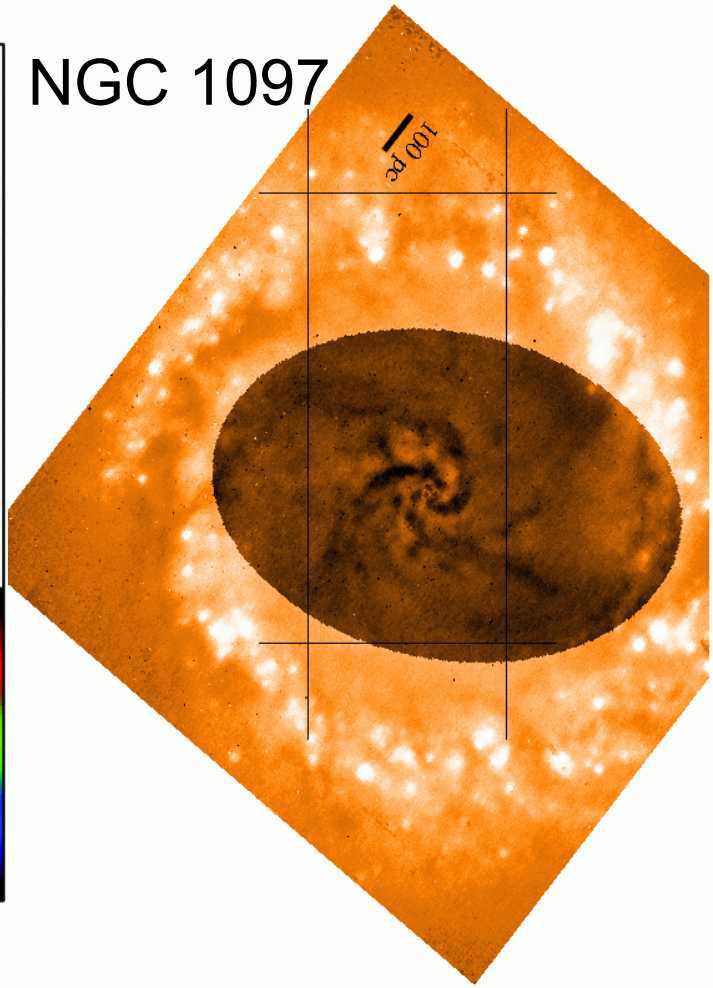
- from LOS velocity subtract model of circular motion
- kinematic spiral arms appear

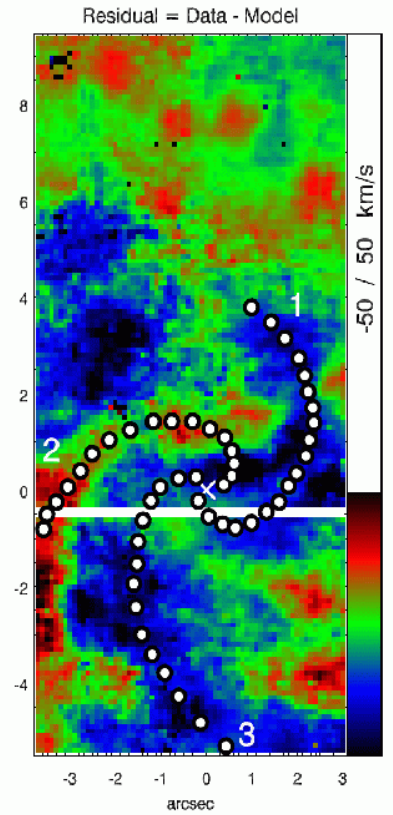


hydro model:
WM2004b



NGC 1097



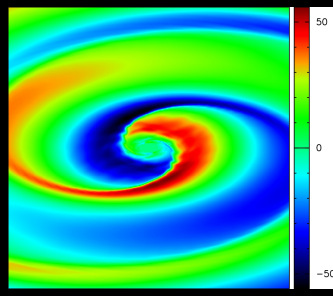


GMOS

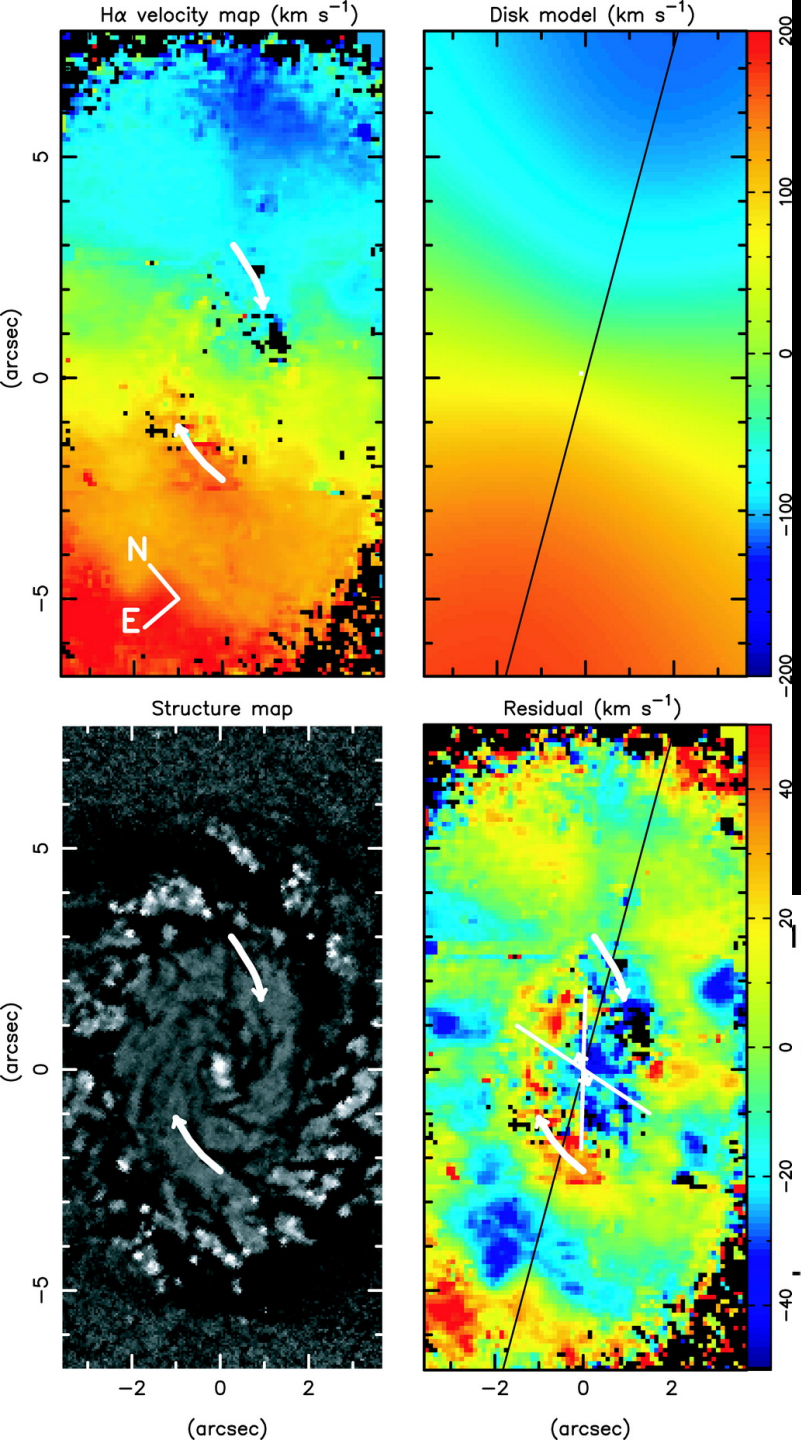
Fathi et al. 2006

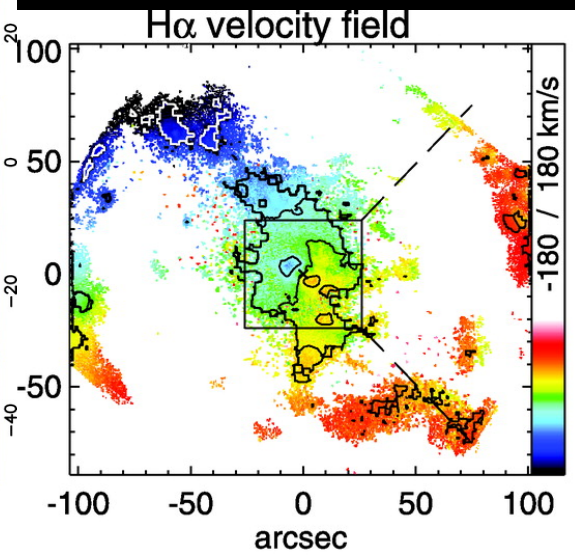
~50 km/s amplitude of velocity residuals in kinematic spiral arms **cannot be explained without shock in gas**

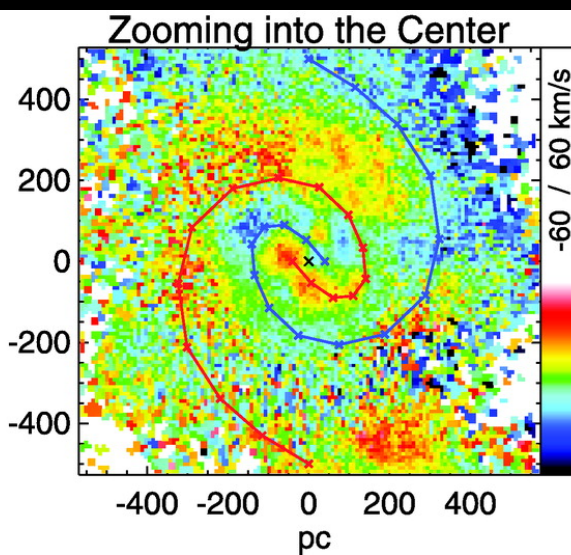
NGC 6951 (GMOS *Storchi-Bergmann et al. 2007*)



M 83 (Fabry-Perot GHalphaFaS *Fathi et al. 2008*)







Summary

- after subtracting circular motion, velocity maps show coherent gas flows
- in Grand Design Nuclear Spirals (GDNS): large amplitude of residual velocities

  → shocks

  → dissipation

  → inflow

  → (SF/AGN feeding?)