Overlapping Inflows: Catalysts for AGN and Not Only that.

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Gas inflow at different scales (e.g. Shlosman et al. 1989, Jogee 2006, Hopkins and Quataert 2010, 2011).

\[ r_{\text{inf}} \ll GM_{\text{BH}} \ll 11.2 \times \sigma \]

~ 10 kpc – Galactic scales: Non-axisymmetric potential.

~ 1 kpc - 100 pc – Galactic Bulge: “Bars within bars”.

\[ r_{\text{inf}} \sim \frac{GM_{\text{BH}}}{\sigma^2} \]

Keplerian Potential \( \rightarrow \) Centrifugal barrier!

~ 0.01 pc down – Accretion Disc: Shakura Sunyaev alpha disc.
Disc Formation.

1st Inflow event, gaseous shell: \( \nu_{\text{rot}} = 0.3 \)

[Hobbs et al. 2011]

\[
\begin{align*}
  r_{\text{shell}} &= 100\text{pc} \\
  \vec{v}_{\text{shell}} &= \nu_{\text{rot}} \hat{e}_\varphi \\
  r_{\text{disc}} &= r_{\text{circ}} \sim 15 - 20\text{pc} \\
  \nu_{\text{disc}} &\sim r^{-1/2}
\end{align*}
\]
\( v_{\text{rot}} = 0.2 \)

\( \theta_{\text{tilt}} = 60 \)

\( v_{\text{rot}} = 0.3 \)

\( \theta_{\text{tilt}} = 60 \)

\( v_{\text{rot}} = 0.7 \)

\( \theta_{\text{tilt}} = 60 \)

\( \theta_{\text{tilt}} = 150 \)
Accretion rates:
Strongly dependent on angular momentum difference.
(+ G. Murante, P. Monaco, P. Barai)

Disc Morphologies:
Nested discs? WARPS?
(+M. Colpi, M. Dotti, R. Valdarnini)
Conclusions:

- Overlapping inflows are good candidates for explaining: i) Black Hole Feeding, ii) Reservoir Growing, iii) Warp Formation.
- The degree of misalignment between overlapping inflows has a strong impact on the inflow rate.
- Massive warped discs and misaligned gas streams are a general outcome of overlapping inflows.

[Carmona-Loaiza et al. (2014) & Carmona Loaiza et al. (in preparation)]

Future and Ongoing work:

(+ M. Colpi, M. Dotti, G. Murante, P. Monaco, P. Barai, R. Valdarnini)

- How is the inflow rate linked to the angular momentum of the gas? – Sub-grid recipe for AGN feedback in large scale simulations.
- Star Formation: Are this kind of interactions responsible for the warped disc observed around Sgr A*?
- More realistic environments: How likely is it to have these kind of events?
- Would overlapping inflows impact the evolution of a binary BH?