MODELLING OF ACCRETION ON TO THE MILKY WAY'S SUPERMASSIVE BLACK HOLE

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Currently, the black hole at the center of the Milky Way is inactive, but a few million years ago there was a period of increased activity leaving traces in the surrounding environment [1]. It is suggested that an active galactic nucleus (AGN) phase could follow a collision of the molecular gas ring that surrounds the black hole (the circumnuclear ring or CNR) and an infalling molecular cloud. The observed ~ 6 Myr stellar population in the central parsec as well as the *Fermi* bubbles could be linked to this AGN phase [1, 2].

We aim to reproduce the activity period with a hydrodynamical Gadget-3 model of the several-parsec-wide region of the Galactic centre. The model consists of three main components: the central black hole ($M_{\rm bh} = 4 \times 10^6\,{\rm M}_\odot$), the CNR-like toroidal gas ring ($M_{\rm r} = 10^5\,{\rm M}_\odot$, $R_{\rm in} = 1.5\,{\rm pc}$, $R_2 = 4\,{\rm pc}$) and the infalling molecular cloud ($M_{\rm mc} = 10^5\,{\rm M}_\odot$, $R_{\rm mc} = 3\,{\rm pc}$). The central black hole is fed by the gas that crosses a sink boundary ($r_{\rm sink} = 0.01\,{\rm pc}$) in the hydrodynamical model. We also allow for star formation.

By varying the initial inclination angle (γ) of the orbit of the molecular cloud we change the outcome of the encounter, including the feeding rate of the central accretion disc and the morphology of resulting structures.

We find that larger angles result in more compact systems with more mass concentrated in the centre. Large angle collisions also result in significant star formation in the central parsec. We also find that in the case of the most extreme collisions ($\gamma = 175^\circ$ and 180°) about one quarter to a half of the initial gas mass is accreted by the central black hole, although the accretion rate is well above Eddington limit. We account for this by using a simple model of the accretion disc and find that the energy released during the activity period is reduced by at least a half.

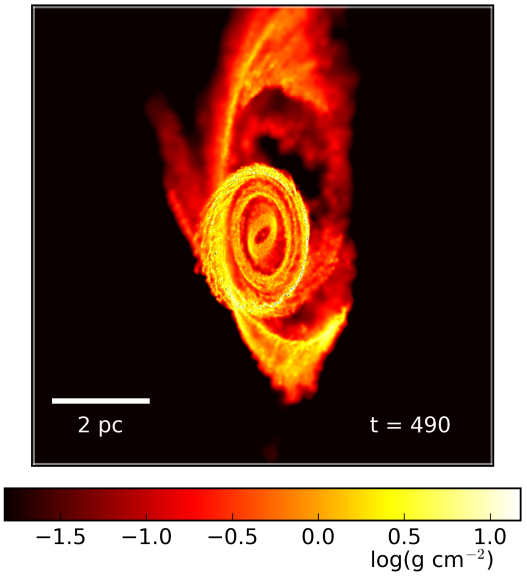

Fig. 1. Density map of the resultant system with $\gamma = 120^\circ$ at the time $t = 490$ kyr

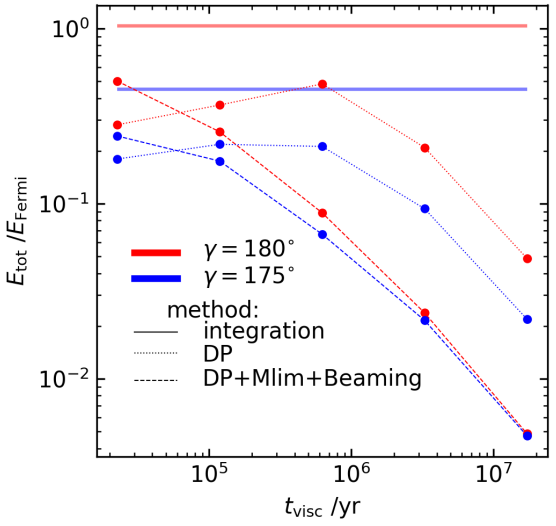

Fig. 2. The total energy released during the activity period depending on the viscous timescale $t_{\rm visc}$ of the accretion disc in the units of $E_{\rm Fermi}$

[1] Ponti G., Morris M. R., Terrier R., Goldwurm A., 2013, in Cosmic Rays in Star-forming Environments, edited by D. F. Torres, O. Reimer, vol. 34 of Astrophysics and Space Science Proceedings, 331.
[2] Zubovas K., Nayakshin S., 2012, MNRAS, 424, 666.