



# HIDRODINÁMICA EN EL NÚCLEO DE GALAXIAS AGN

**FILIBERTO HUEYOTL ZAHUANTITLA**

Seminario FCFM-UNACH, 29 de Septiembre de 2016



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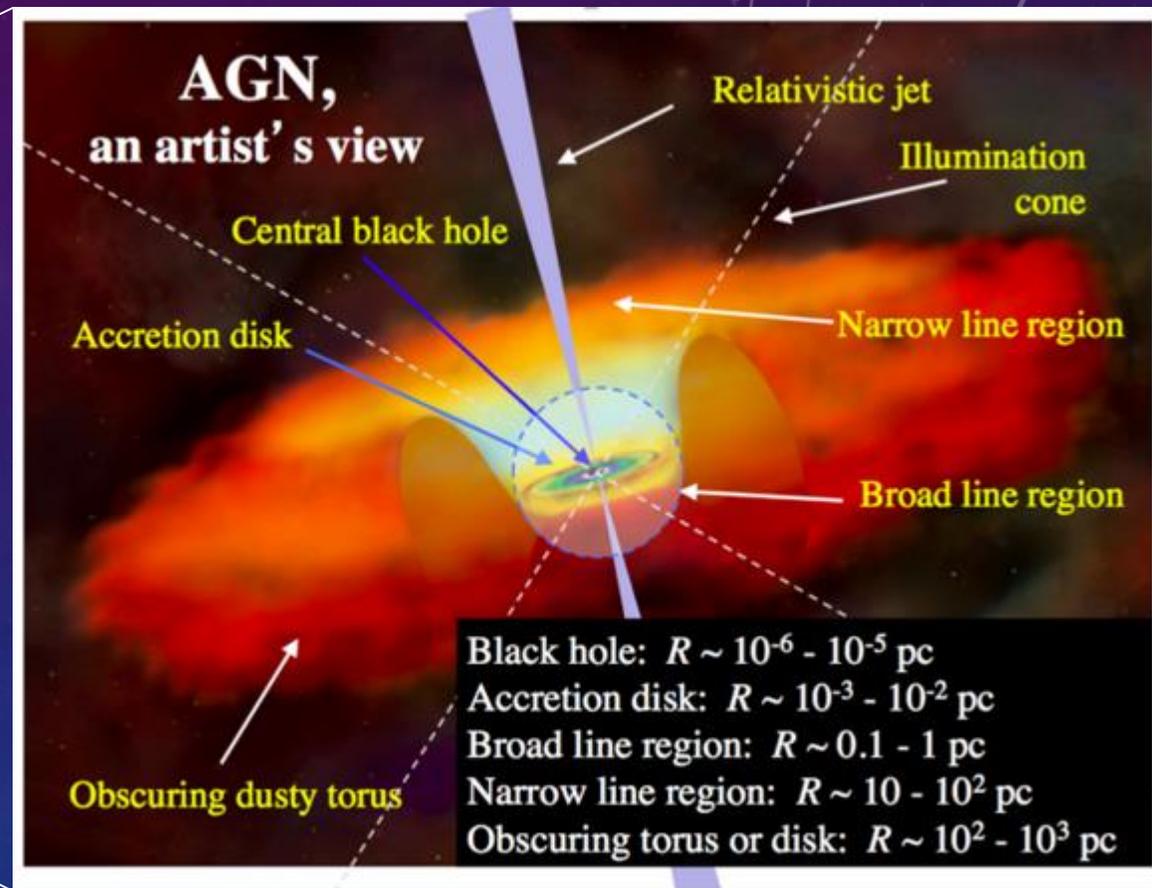
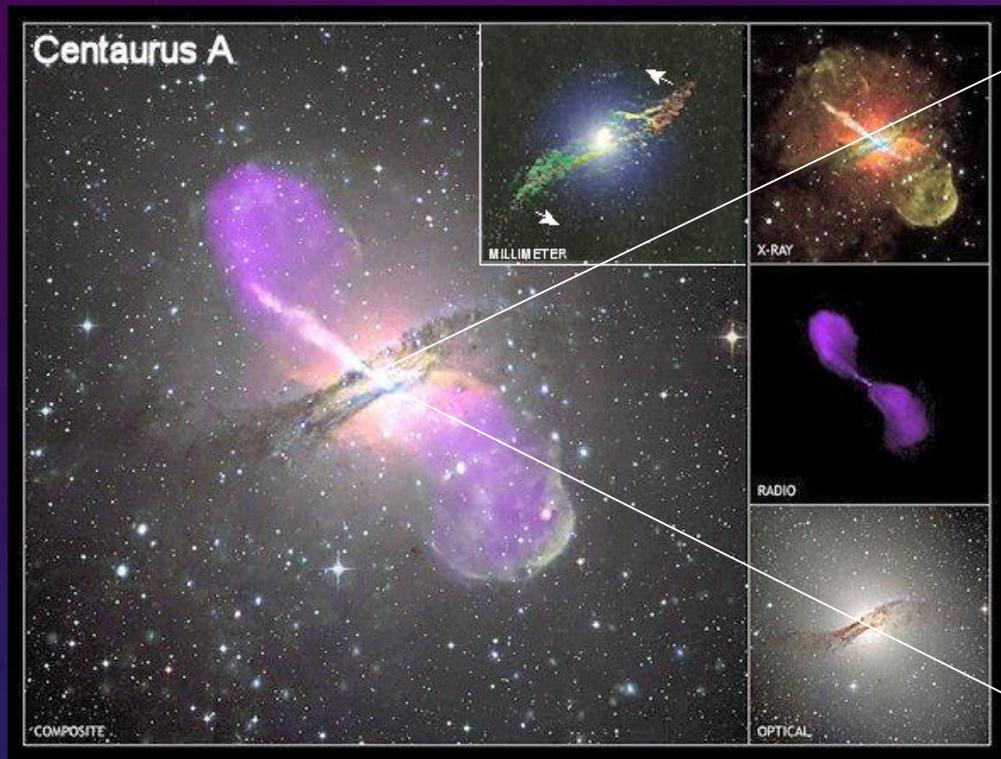


GUILLERMO-TENORIO-TAGLE & SERGIY SILICH

# CONTENIDO

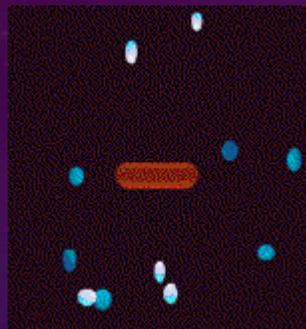
- Galaxias AGN
- Cúmulos estelares nucleares (NSC)
- Modelo hidrodinámico NSC+SMBH
- Conclusiones

# GALAXIAS AGN

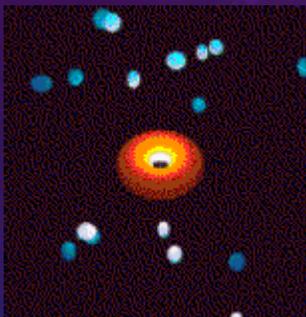


# Clasificación de AGNs en el óptico/UV (Modelo Unificado)

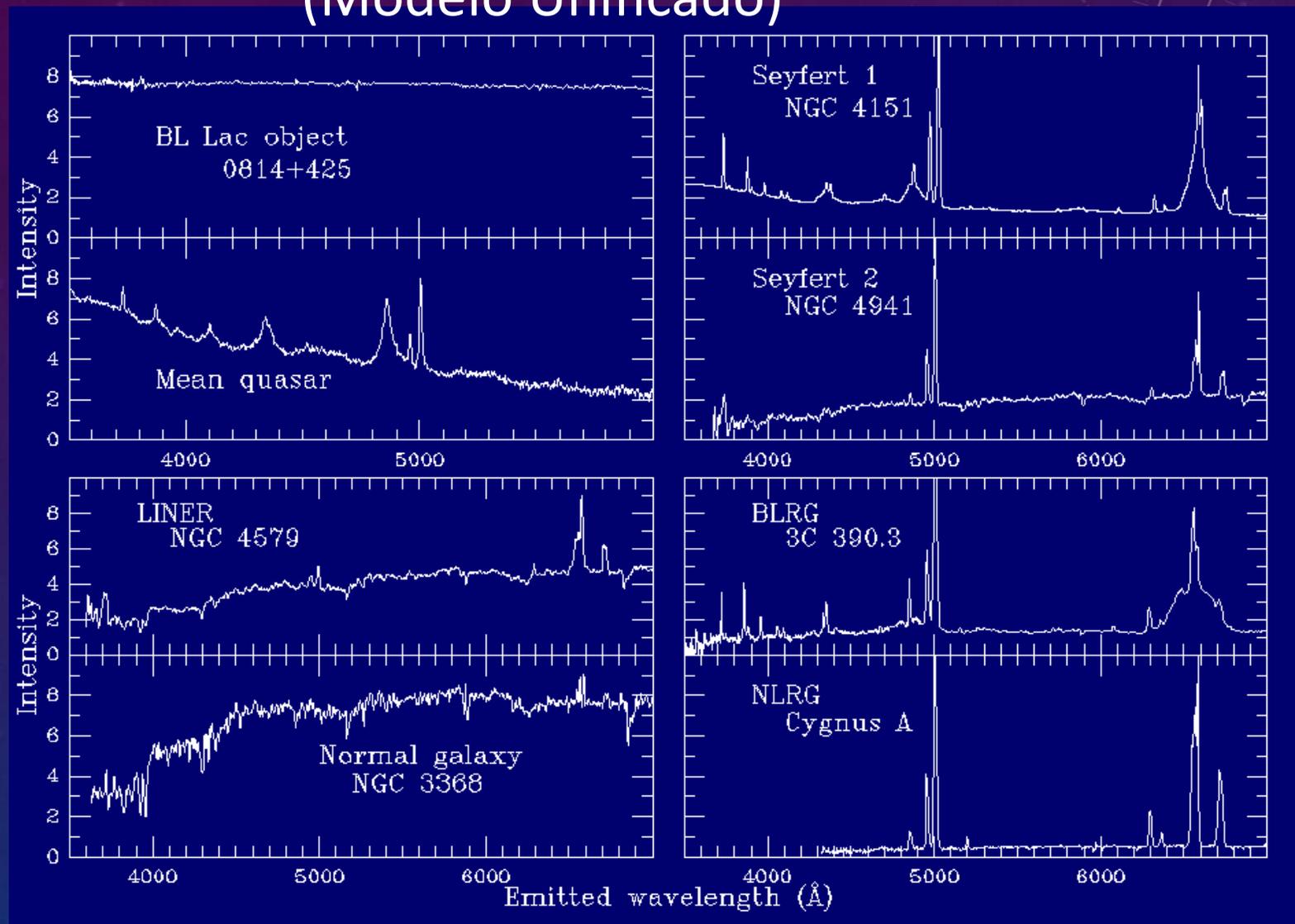
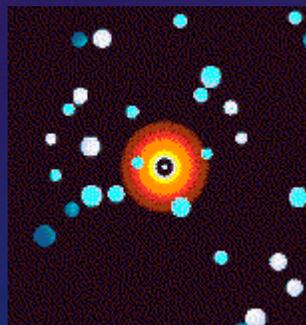
Seyfert 2



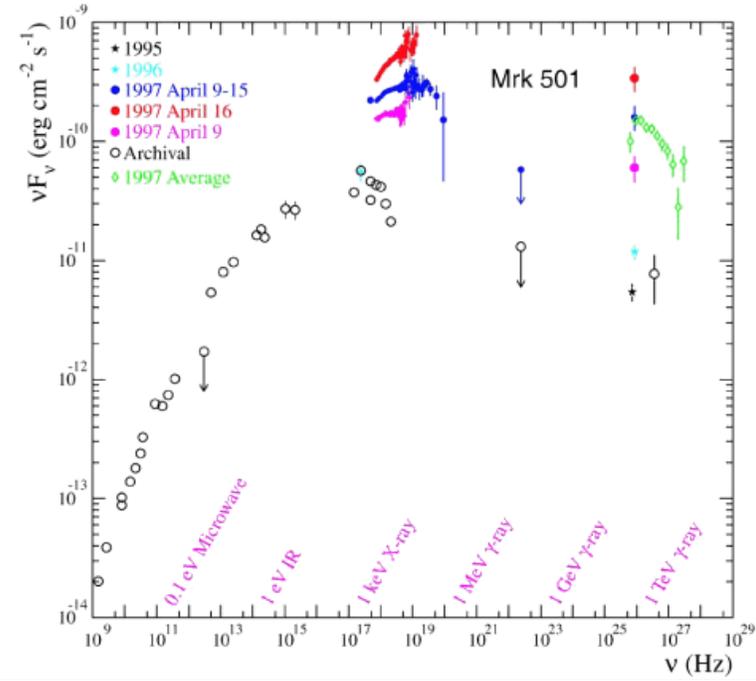
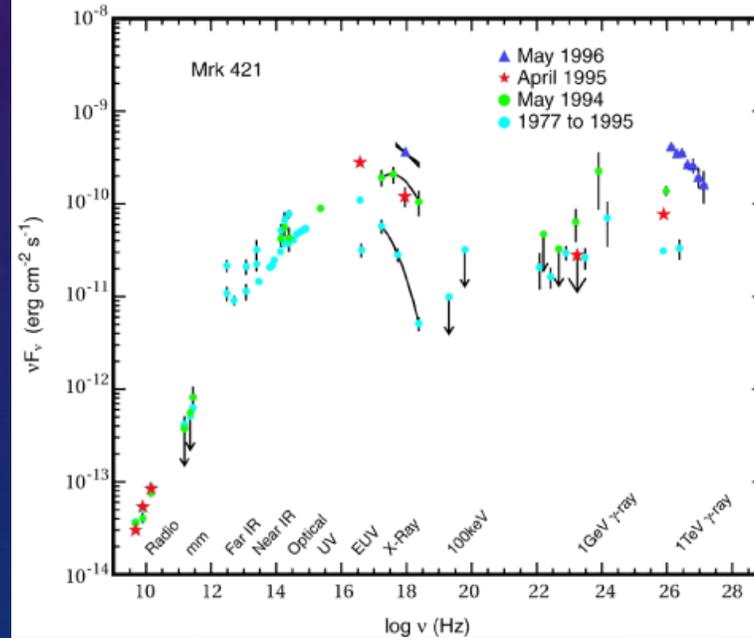
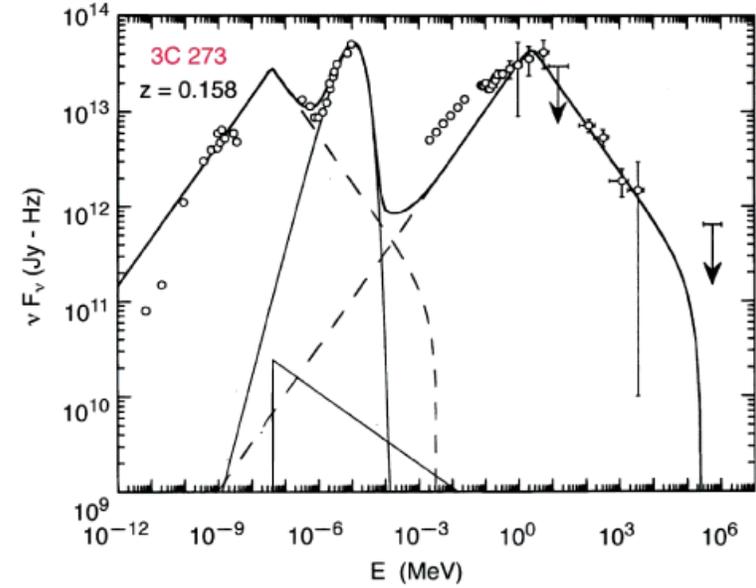
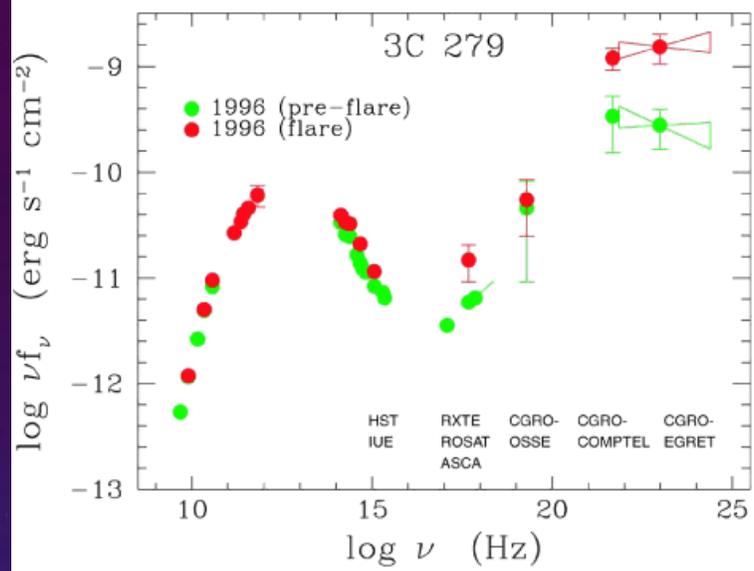
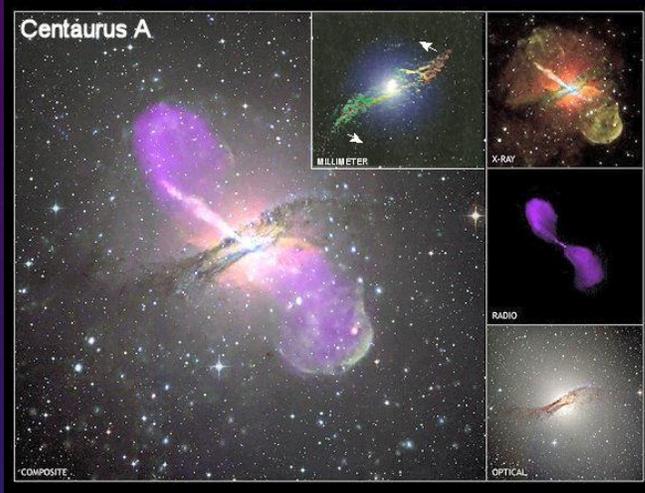
Seyfert 1



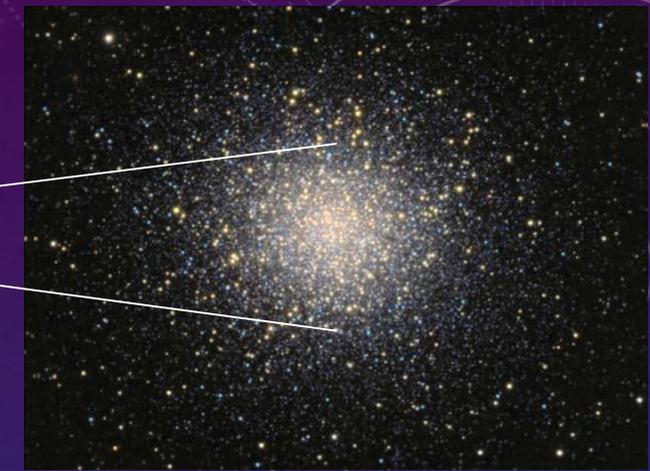
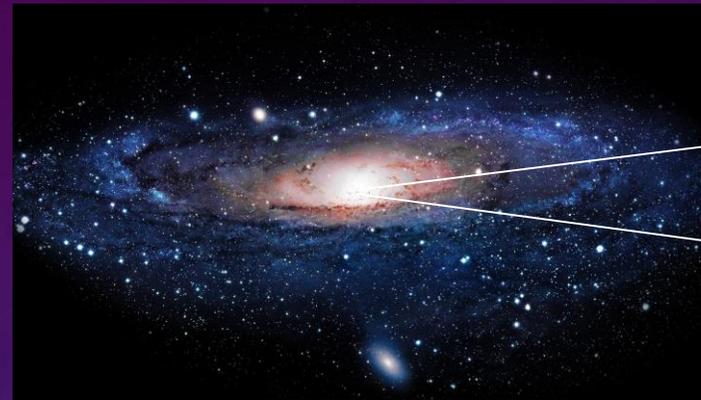
Blazar



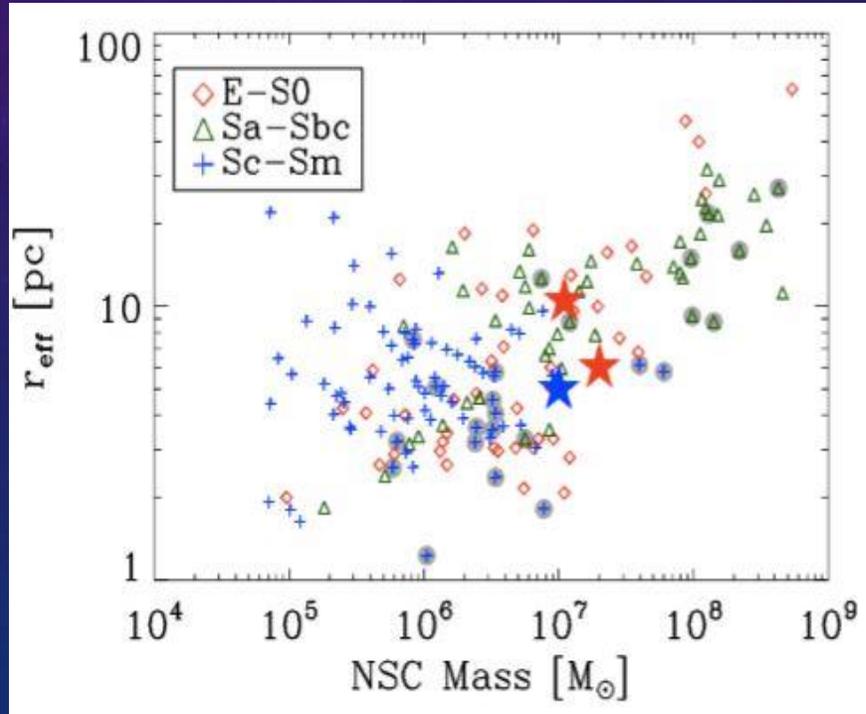
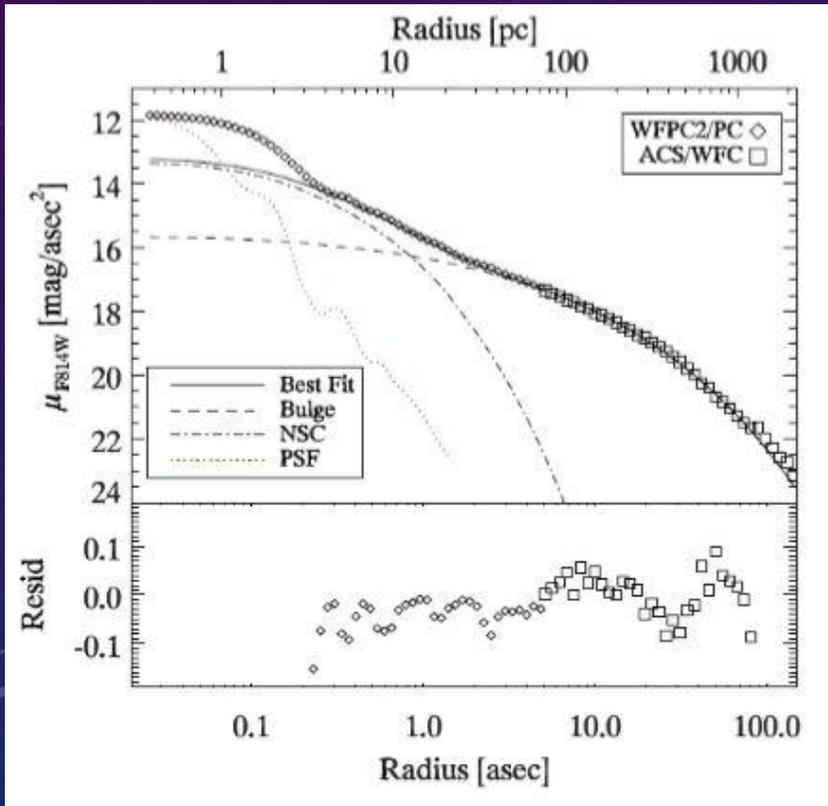
# Distribución espectral de energía de AGNs



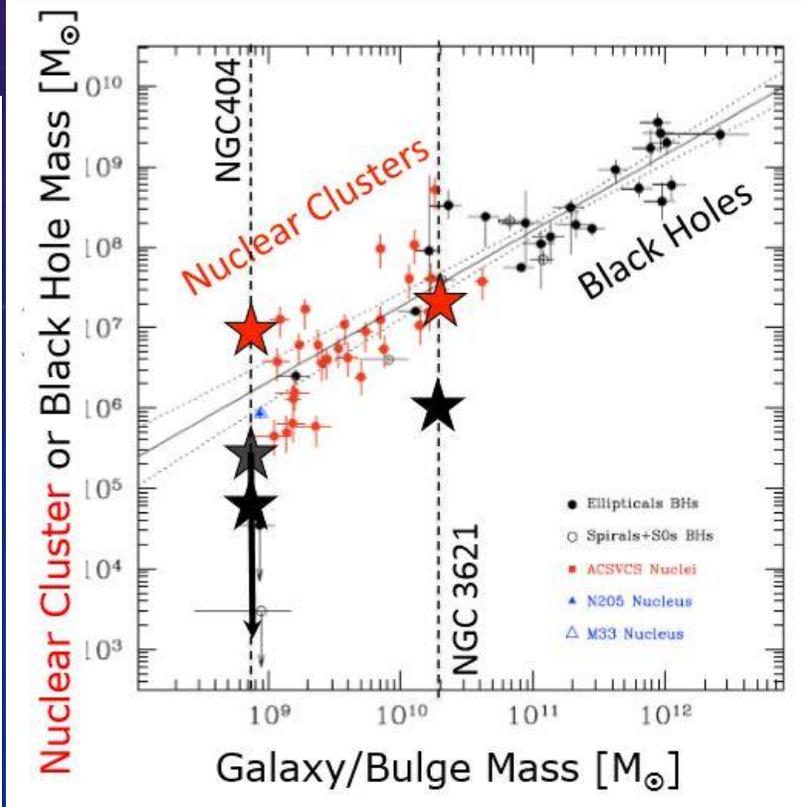
# CÚMULOS ESTELARES NUCLEARES



1	<a href="#">2016MNRAS.457.2122G</a>	1.000	04/2016	<a href="#">A</a> <a href="#">E</a> <a href="#">F</a> <a href="#">X</a> <a href="#">D</a> <a href="#">R</a> <a href="#">C</a> <a href="#">S</a> <a href="#">N</a> <a href="#">O</a> <a href="#">U</a>
Georgiev, Iskren Y.; Böker, Torsten; Leigh, Nathan; Lützgendorf, Nora; Neumayer, Nadine		Masses and scaling relations for nuclear star clusters, and their co-existence with central black holes		
2	<a href="#">2016ApJ...821...44F</a>	1.000	04/2016	<a href="#">A</a> <a href="#">E</a> <a href="#">F</a> <a href="#">D</a> <a href="#">R</a> <a href="#">C</a> <a href="#">S</a> <a href="#">O</a> <a href="#">U</a>
Fritz, T. K.; Chatzopoulos, S.; Gerhard, O.; Gillessen, S.; Genzel, R.; Pfuhl, O.; Tacchella, S.; Eisenhauer, F.; Ott, T.		The Nuclear Cluster of the Milky Way: Total Mass and Luminosity		
3	<a href="#">2016ASL...418..107C</a>	1.000	00/2016	<a href="#">A</a> <a href="#">E</a> <a href="#">X</a> <a href="#">I</a> <a href="#">R</a> <a href="#">C</a> <a href="#">U</a>
Cole, David R.; Debattista, Victor P.		Nuclear Star Clusters and Bulges		

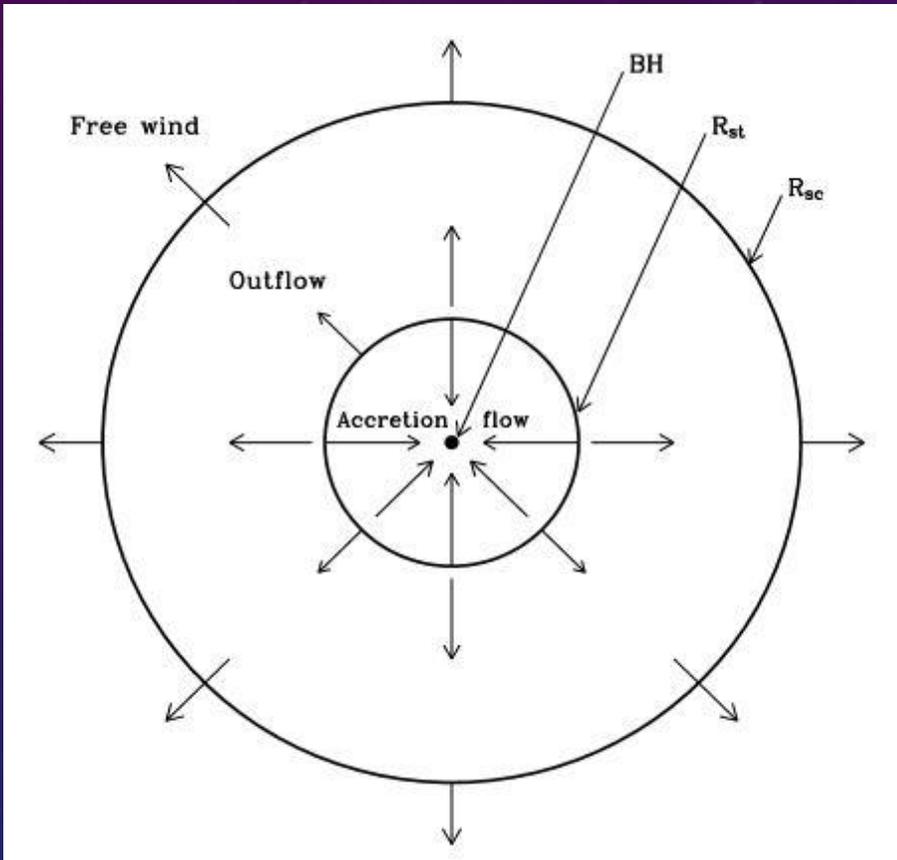


Seth et al. 2010



Ferrarese et al. 2006

# MODELO HIDRODINÁMICO NSC+SMBH

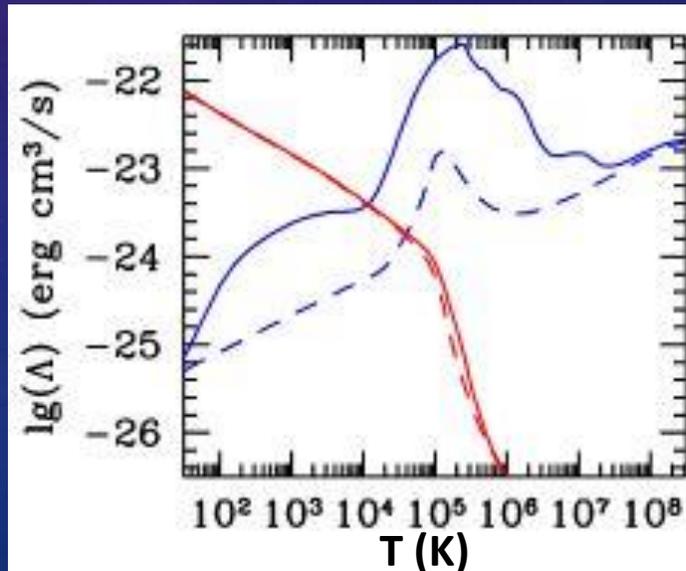


$$\frac{\partial \rho}{\partial t} + \nabla \cdot (\rho \mathbf{u}) = q_m, \quad (1)$$

$$\frac{\partial \mathbf{u}}{\partial t} + (\mathbf{u} \cdot \nabla) \mathbf{u} = -\frac{1}{\rho} \nabla P - \nabla \Phi + \mathbf{g}_{\text{grad}}, \quad (2)$$

$$\frac{\partial \epsilon}{\partial t} + \nabla \cdot [\mathbf{u}(\epsilon + P + \rho \Phi)] = q_e - Q + H_{\text{AGN}}, \quad (3)$$

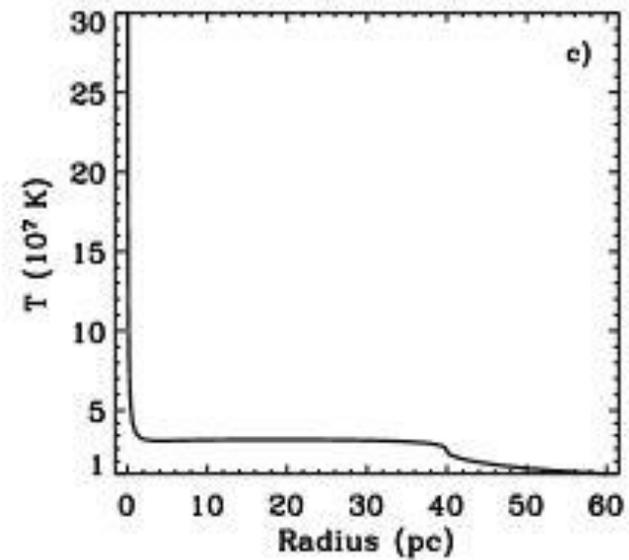
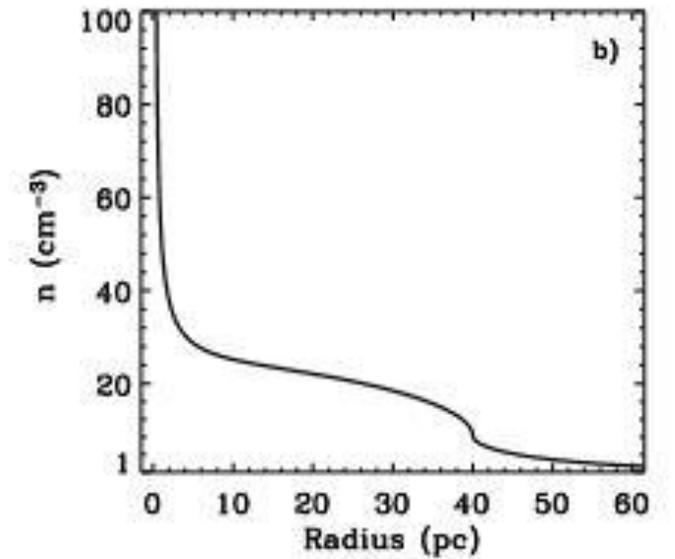
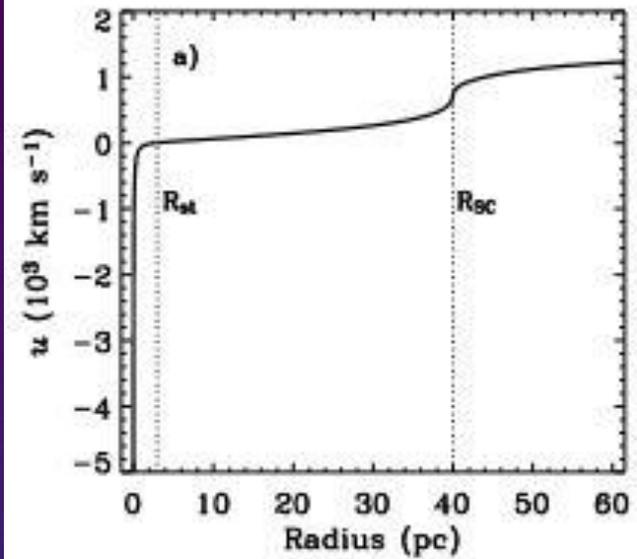
$$+ P = (\gamma - 1)e,$$



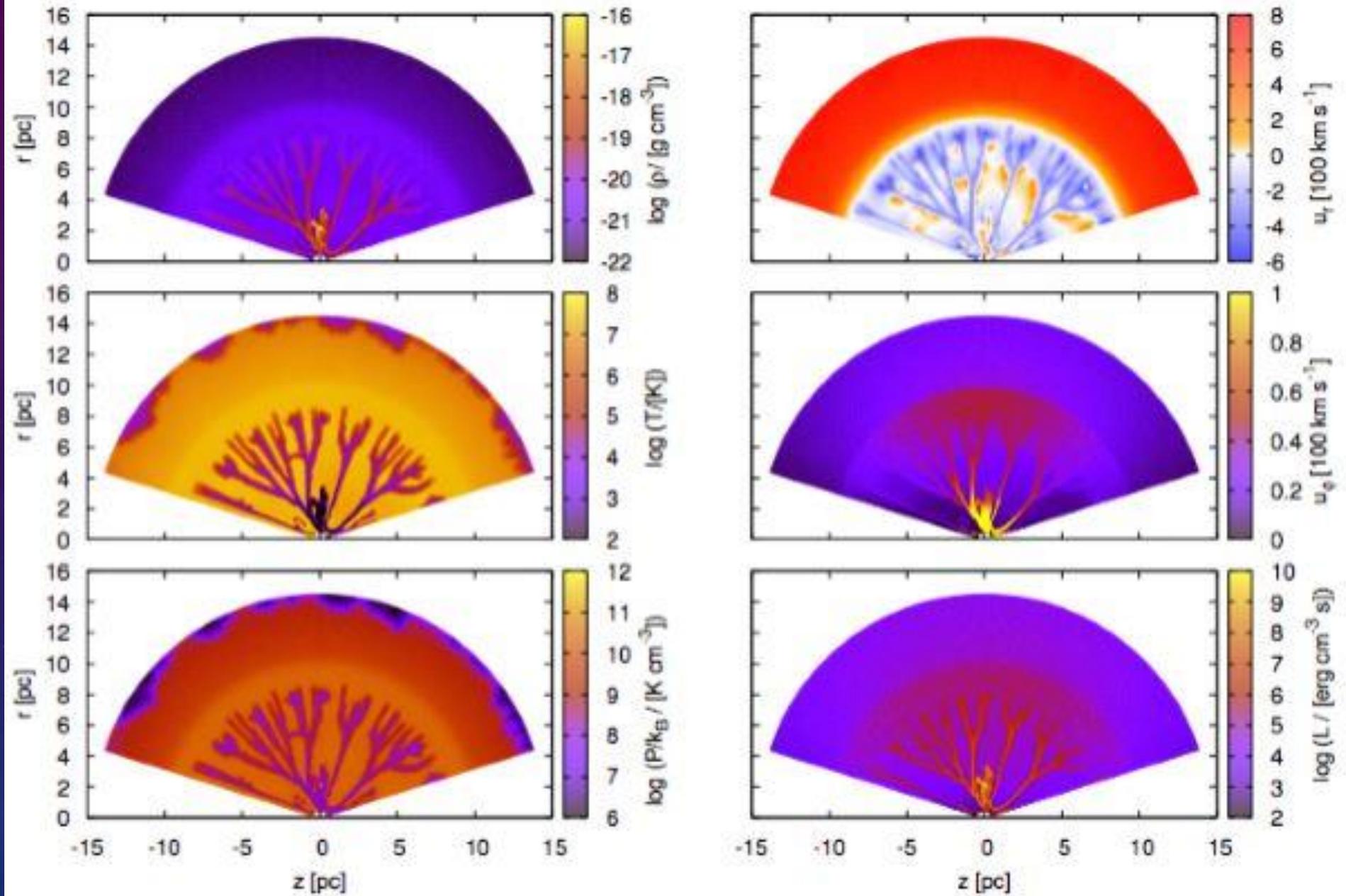
Resuelto con ZEUS (Stone & Norman)

# RESULTADOS:

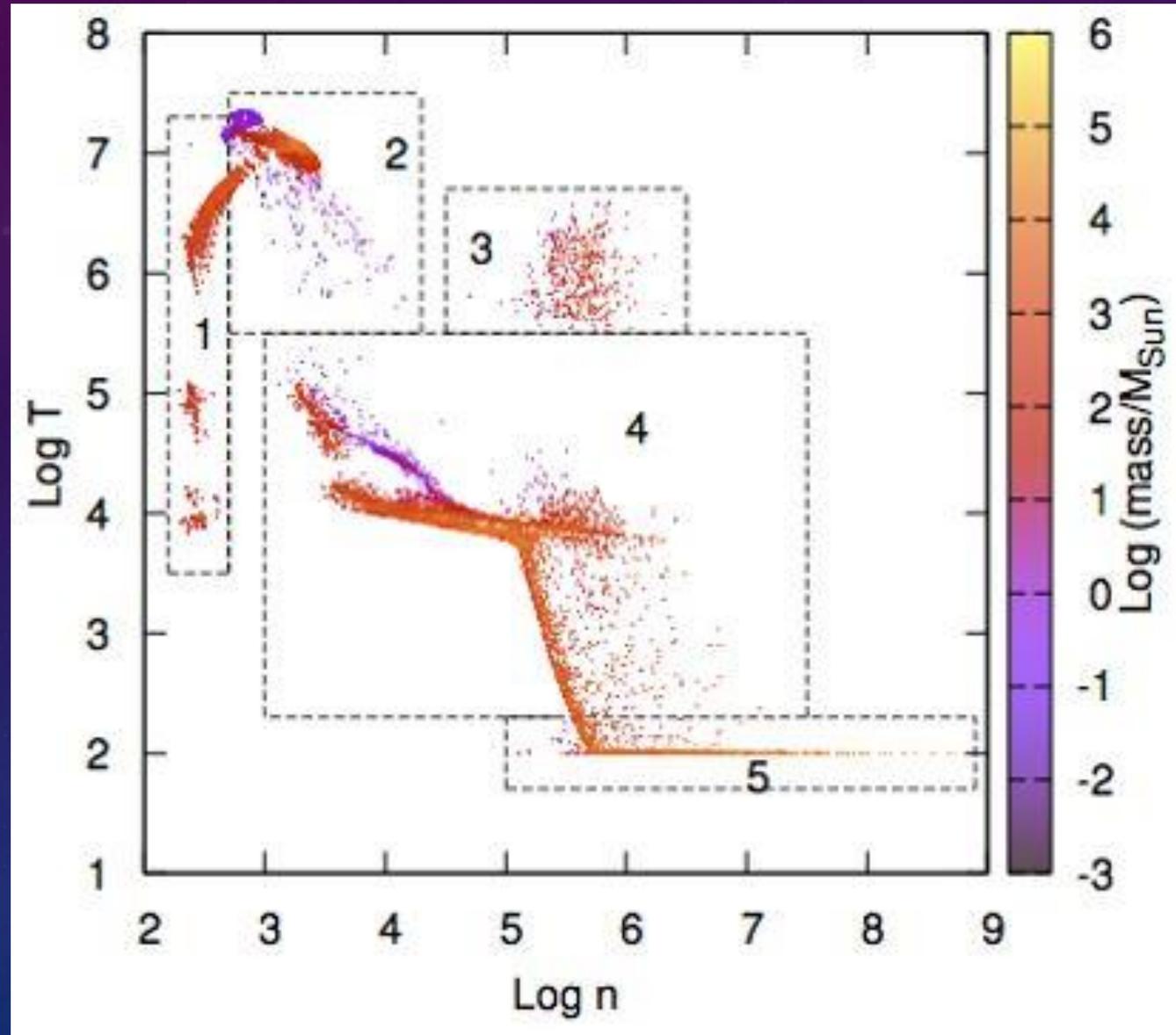
$$Q = H_{\text{AGN}} = 0$$



# ENFRIAMIENTO CATASTRÓFICO



# IDENTIFICACIÓN DE LAS DIFERENTES FASES DEL ISM



# OBSCURECIMIENTO DEL NÚCLEO

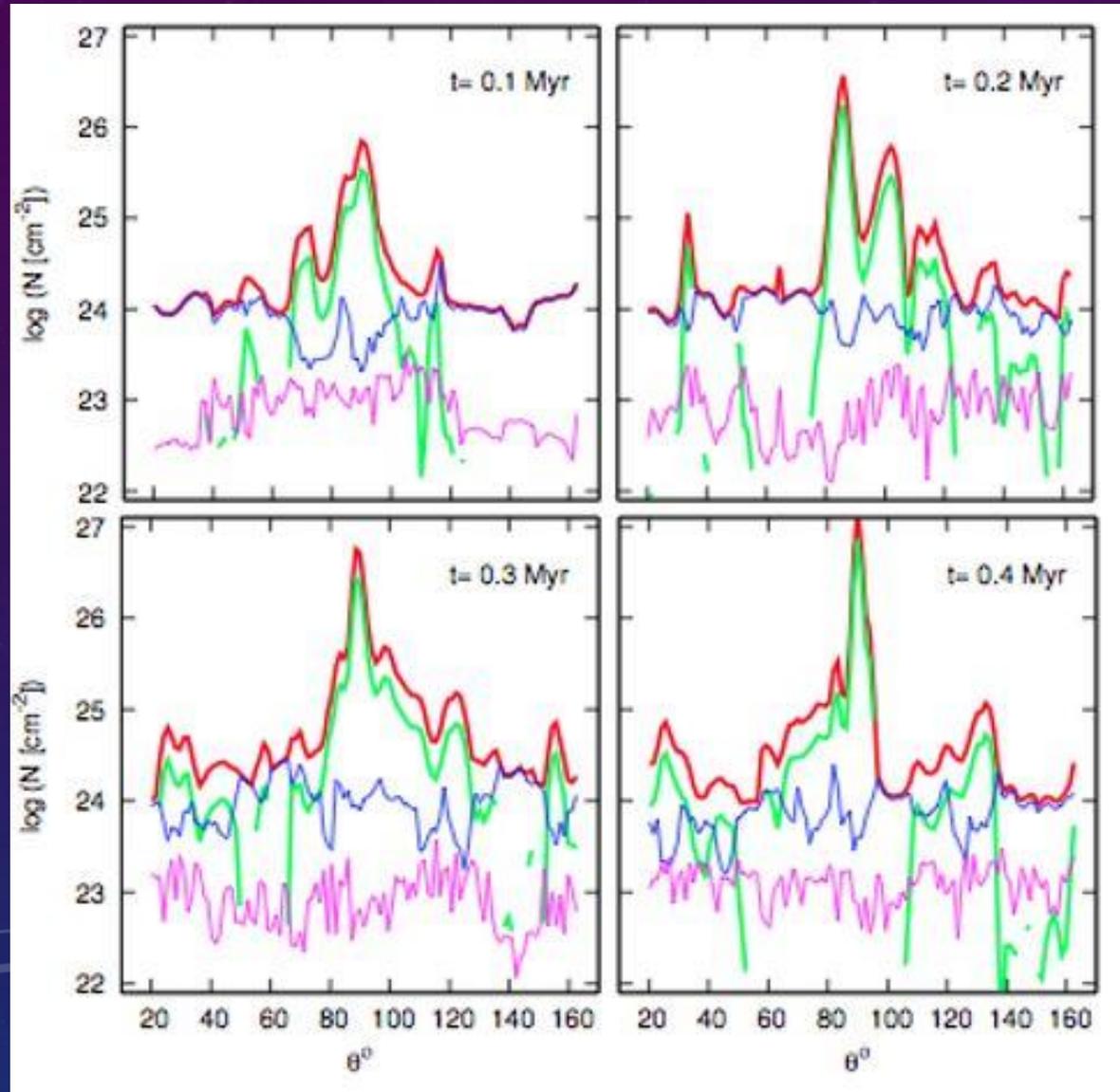


Fig. 4.—: Column densities as seen from the central SMBH for the reference model. The red line displays the total column density along each line of sight. The magenta line shows the column density for hot gas,  $T \geq 3 \times 10^5 \text{ K}$ . The blue line represents the column density for warm phase,  $1500 \text{ K} < T < 3 \times 10^5 \text{ K}$ . The column densities of cold matter ( $T \leq 1500 \text{ K}$ ) are shown by green lines. The cold gas does not cover all the sky.

# CONCLUSIONES

Table 2:: Mass accumulation rate.

Model	$M_{\text{NSC}}$	$M_{\text{SMBH}}$	$R_{\text{NSC}}$	$R_{\text{st}}$	$\dot{M}_{\text{NSC}}$	$\dot{M}_{\text{wind}}$	$\dot{M}_{\text{acc}}$	$\dot{M}_{\text{in}}$
	$(M_{\odot})$	$(10^6 M_{\odot})$	$(\text{pc})$		$(M_{\odot} \text{ yr}^{-1})$			
1	$3.3 \times 10^8$	1	10	9.2	31.2	7.3	22.1	1.8
2	$3.3 \times 10^8$	1	10	9.2	31.2	7.2	23.9	0
4	$3.3 \times 10^8$	1	40	31.3	31.2	15.9	14.6	0

- El toro se compone de filamentos y nubes dentro de una zona de estancamiento definido por el enfriamiento radiativo.
- La temperatura en la región de obscurecimiento permitiría la existencia de polvo cerca del núcleo.
- La acumulación de gas molecular permitiría la formación de nuevas estrellas.
- El viento generado por el cúmulo nuclear podría inhibir el crecimiento de material de escalas más grandes.

# IDEAS

- Considerar distribuciones estelares más realistas
- Considerar la evolución estelar
- Considerar radiación no isotrópica del núcleo
- Considerar una mejor receta para el calentamiento (otras fuentes de calentamiento)