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SCALAR POTENTIAL MODEL OF GALAXY CENTRAL MASS AND CENTRAL VELOCITY DISPERSION

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ABSTRACT

The galaxy central mass M_c and central velocity dispersion σ_c have been found to correlate with large scale galaxy parameters for samples of galaxies with a limited range of characteristics. A scalar potential model (SPM) derived from considerations of galaxy clusters, redshift, discrete redshift, H I rotation curves (RCs) of spiral galaxies, and RC asymmetry is applied to central region parameters. The σ_c and M_c are found to correlate to the host galaxy's and neighboring galaxy's B band luminosity. The sample included galaxies with rising, flat, and declining RCs; galaxies with a wide range of characteristics; and galaxies excluded from samples of other studies of σ c relationships. The equations have the same form as the SPM equations for the parameters of the H I RCs. Because the SPM is consistent with the σ_c and M_c observations of the sample galaxies, the Sources and Sinks act as monopoles at the center of the galaxies around them. This suggests the outward scalar potential force of a Source holds the M_c from collapse into a supermassive black hole.

Keywords: Galaxies, fundamental parameters, kinematics and dynamics of galaxies, nuclei, cosmology.
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INTRODUCTION

Because the amplitude and shape of galaxy rotation curves (RCs) correlate with galaxy luminosity (Burnstein and Rubin, 1985; Catinella *et al*., 2006; Hodge, 2022; Persic *et al*., 1996), relationships between galaxy central parameters and large-scale galaxy parameters are unexpected by Newtonian dynamics.

Whitmore *et al*. (1979) and Whitmore and Kirshner (1981) found the ratio of the rotation velocity v_c (km s^{-1}) in the flat region of the RC and the central velocity dispersion σ_c (km s^{-1}) ≈ 1.7 for a sample of S_0 and spiral galaxies. Gerhard *et al*. (2001) found the maximum circular velocity of giant, round, and nearly nonrotating elliptical galaxies is correlated to the σ_c. Ferrarese (2002) discovered a power law relationship between circular velocity v_{c25} (km s^{-1}) beyond the radius R_{25} of the 25th isophote and σ_c for a sample that also include elliptical galaxies (see in Fig. 1). Baes *et al*. (2003) expanded on the data for spiral galaxies with flat and smooth RCs. NGC 0598 was a clear outlier. The v_{c25} for NGC 0598 used by Ferrarese (2002) was 135 km s^{-1} that is the highest data point of a rising RC (Corbelli and Salucci, 2000). Galaxies with σ_c < 70 km s^{-1} (v_{c25} < 150 km s^{-1}) also deviate from the linear relation. NGC 4565 was excluded because of warps in the H I disk. Also, galaxies with significant noncircular motion of the H I gas such as NGC 3031, NGC 3079, and NGC 4736 were omitted in Ferrarese (2002). NGC 3200 and NGC 7171 were also excluded from Ferrarese (2002) because of discrepant σ_c values in the literature.

Pizzella *et al*. (2005) found the results similar to the ones by Ferrarese (2002) for high surface brightness (HSB) galaxies. Pizzella *et al*. (2005) also found the data consistent with a linear v_c–σ_c relation. HSB galaxies with flat RCs were chosen for the sample. Also, galaxies with highly asymmetric RCs and galaxies with RCs not characterized by an outer flat portion were excluded. Also, Pizzella *et al*. (2005) found the v_c–σ_c linear relation for low surface brightness (LSB) galaxies is offset with a larger v_c intercept relative to HSB galaxies. Buyle *et al*. (2006) confirmed this distinction between HSB and LSB galaxies for σ_c > 80 km s^{-1} and found that the distinction is less pronounced for galaxies with σ_c < 80 km s^{-1}. They concluded that the scatter of the v_c–σ_c relation is a function of galaxy mass or that the v_c–σ_c relation changes at σ_c ≈ 80 km s^{-1}. Hodge (2022) suggested the offset of the measurement of v_c between HSB and LSB galaxies is because the measurement is in an area of the rotation curve (RC) more influenced by neighboring galaxies and in an area of the generally rising RC of LSB galaxies. Further, the criteria for excluding galaxies describe characteristics of large influence of neighbor galaxies. Using the v_{rrmax} as defined by Hodge (2022) may be more appropriate.

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The masses of compact stellar clusters at the center of low- and intermediate-luminosity galaxies also correlate with the mass of the host galaxy (Ferrarese *et al*., 2006; Wehner and Harris, 2006). Ferrarese *et al*. (2006) suggested the compact stellar clusters and the supermassive black hole (SBH) modeled as being at the center of high-luminosity galaxies should be grouped together under the terminology of "Central Massive Objects" (CMOs) with mass M_{cmo}. The finding of the correlation between M_{cmo} and the total mass in a galaxy M_{gal} suggests a similar galaxy formation process (Ferrarese *et al*., 2006; Wehner and Harris, 2006).

Ghez *et al*. (2000) and Ferrarese and Merritt (2002) have observed Keplerian motion to within one part in 100 in elliptical orbits of stars that are from less than a pc to a few 1000 pc from the center of galaxies. The stars within nine light hours of the Galaxy center have velocities of 1300 km s^{-1} to 9000 km s^{-1} (Schödel *et al*., 2002) and high accelerations (Ghez *et al*., 2000). A huge amount of mass M_c ($M_{\otimes}$) such as millions of black holes, dense quark stars (Prasad and Bhalerao, 2004), and ionized iron (Wang *et al*., 2002) must be inside the innermost orbit of luminous matter (Ghez *et al*., 2000, 2003, 2005; Schödel *et al*., 2002; Dunning-Davies, 2004). Results concerning the Centre of our galaxy. DOI: https://doi.org/10.48550/arXiv.astro-ph/0402290).

The M_c varies among galaxies from 10^6 $M_{\otimes}$ to 10^{10} $M_{\otimes}$ (Ferrarese and Merritt, 2000; Gebhardt *et al*., 2000a). Ferrarese (2002) found the ratio of the M_c to the mass M_{DM} of the dark matter halo thought to be around spiral galaxies is a positive value that decreased with M_{DM}. The M_c can be distributed over the central volume with a density of at least 10^{12} $M_{\otimes}$ pc^{-3} (Ghez *et al*., 1998, 2000, 2005) and (Dunning-Davies, 2004. Results concerning the Centre of our galaxy. DOI: https://doi.org/10.48550/arXiv.astro-ph/0402290). The orbits of stars closest to the Center of the Galaxy are approximately 1,169 times the Schwartschild radius of a supermassive black hole (SBH) thought to be at the center of the Galaxy (Ghez *et al*., 2000; Schödel *et al*., 2002). The orbits of stars closest to the center of the Galaxy are following elliptical paths (Ghez *et al*., 2000) that suggests a net, attractive central force consistent with the Newtonian spherical property (Ghez *et al*., 2003; Schödel *et al*., 2003).

That M_c is crowded into a ball with a radius of less than 45 AU is proven (Ghez *et al*., 2005). That the structure of M_c is a SBH is widely accepted but unproven (Kormendy and Richstone, 1995); it is for a discussion. The Newtonian model implies the M_c must either quickly dissipate or must quickly collapse into a SBH (Kormendy and Richstone, 1995; Magorrian *et al*., 1998). The long-term maintenance of M_c rules out the first possibility. Mouawad *et al*. (2005) suggested there is some extended mass around Sgr A. Observations have ruled out many models of the nature of M_c of galaxies (Ghez *et al*., 2003; Schödel *et al*., 2003).

Observations inconsistent with the SBH model include shells of outward flowing, shocked gas around galactic nuclei (Binney and Merrifield, 1998) and Königl (2002). Shu *et al*. (2005) and Silk and Rees (1998) suggested a repulsive force called a "wind" (a gas) exerted a repulsive force acting on the cross-sectional area of particles. Therefore, denser particles such as black holes move inward relative to less dense particles. Less dense particles such as hydrogen gas move outward. Other observations inconsistent with the SBH model include the apparent inactivity of the central SBH (Baganoff *et al*., 2001; Nayakshin and Sunyaev, 2003; Zhao *et al*., 2003) and the multitude of X-ray point sources, highly ionized iron, and radio flares without accompanying large variation at longer wavelengths reported near the center of the Milky Way (Baganoff *et al*., 2001; Baganoff *et al*., 2003; Binney and Merrifield, 1998; Genzel *et al*., 2003; Zhao *et al*., 2003; Wang *et al*., 2002; Baganoff, 2003). American Astronomical Society HEAD meeting #35, session #03.02).

The M_c correlation with Blue band luminosity L_{bulge} of the host galaxy's bulge (Kormendy and Richstone, 1995) has a large scatter. The $M_{\text{c}} \propto \sigma_{\text{c}}^{\alpha}$, where α varies between 5.27±0.40 (Ferrarese and Merritt, 2000) and 3.75±0.3 (Gebhardt *et al*., 2000a). The M_c–σ_c relation appears to hold for galaxies of differing Hubble types, for galaxies in varying environments, and for galaxies with smooth or disturbed morphologies. Tremaine *et al*. (2002) suggested the range of α is caused by systematic differences in the velocity dispersions used by different groups. Merritt and Ferrarese (2001b, 2001c) found the range of α is partly due to the type of regression algorithm used and partly due to the velocity dispersion of the Galaxy sample selected. Also, discrepancies have been noted among the methods used to measure M_c (Gebhardt *et al*., 2000b; Merritt and Ferrarese, 2001a). Bernardi *et al*. (2007) found a selection bias or large scatter in the M_c–σ and M_c–L_{bulge} correlations that may be the result of more fundamental relations among M_c, σ, and L_{bulge}. McLure and Dunlop (2002) found the black hole - bulge mass relation in active and inactive galaxies.

A scalar potential model (SPM) was derived from considerations of galaxy clusters (Hodge, 2006). The SPM suggests the RCs of spiral galaxies are determined by a scalar potential term added to the conventional Newtonian rotation velocity equation. The scalar potential term is proportional to Blue band luminosity L (erg s^{-1}) of a galaxy. For spiral galaxies (Sources), the scalar potential term is directed outward. For other galaxies (Sinks), the scalar potential term is directed inward. The SPM found parameters P of H I RCs of spiral galaxies are related to L of the host galaxy and of nearby galaxies (Hodge, 2022). The parameters are the square of the rotation velocity, the radius, the mass, and the acceleration at discontinuities in the RC. The equation is

$$\frac{P}{unit} = K_1 B_1^{I_1} \frac{L}{10^8 \, \text{erg}\, \text{s}^{-1}} + (-1)^s K_2 B_2^{I_2} \frac{|\mathbf{K} \bullet \mathbf{a_o}|}{10^3 \, \text{kcp}^{-1}\, \text{km}^2\, \text{s}^{-2}} \pm \sigma_e \quad (1)$$

where *unit* is the units of P; K_1, K_2, B_1, and B_2 are unique constants for each P; I_1 and I_2 are integers that are unique for each galaxy; $|\mathbf{K} \cdot \mathbf{a_o}|$ is the influence of nearby galaxies and is a correction term to the primary $P - L$ relationship; s determines the sign of the $|\mathbf{K} \cdot \mathbf{a_o}|$ term; $\mathbf{K}$ is a constant vector common for all galaxies; $\mathbf{a_o}$ is the acceleration vector that is calculated from the orientation of the host galaxy, the L of the neighboring galaxies, and the relative position of the neighboring galaxies; and σ_e is the standard deviation of the relative differences ($\delta P/P$) of the sample galaxies.

This paper pursues the possibility of a relation among the M_c, σ_c, and L of the host and neighboring galaxies suggested by the SPM. A correlation is found in the form of Equation (1). Therefore, a central, repulsive force F_s exerted by the scalar potential ρ field exists to maintain the M_c of spiral galaxies from collapse.

In the following section, the sample is described. Equation (1) is used to calculate the M_c and σ_c in the third section. The discussion and conclusion are in the fourth section.

SAMPLE

The galaxies used in the calculations were those used by Hodge (2022). That is, they were selected from the NED database. The NED database is available at http://nedwww.ipac.caltech.edu. The data were obtained from NED on 5 May 2004. The selection criteria were that the heliocentric redshift z_h be less than 0.03 and that the object be classified as a galaxy. The parameters obtained from the NED database included the name, equatorial longitude E_{lon} (degrees) for J2000.0, equatorial latitude E_{lat} (degrees) for J2000.0, morphology, the B-band apparent magnitude m_b (mag.), and the extinction E_{xt} (mag.) as defined by the NED. The galactocentric redshift z was calculated from the z_h.

The σ_c, the 21-cm line width W_{20} (km s^{-1}) at 20 percent of the peak, the inclination i_n (arcdegrees), and the position angle p_a (arcdegrees) for galaxies were obtained from the LEDA database (the LEDA database is available at http://leda.univ-lyon.fr. The data were obtained from LEDA on 5 May 2004) if such data existed.

The host sample galaxies with the σ_c, m_b, W_{20}, i_n, and p_a values were (1) those used by Hodge (2022) from (Begeman *et al*., 1991; Broeils, 1992; Freedman *et al*., 2001; García-Ruiz *et al*., 2002; Guhathakurta *et al*., 1988; Kornreich *et al*., 2000, 2001; Liszt and Dickey, 1995; Macri *et al*., 2001; Rubin *et al*., 1985; Swaters *et al*., 1999; Mannheim and Kmetko, 1996). Linear potentials and galactic rotation curves - detailed fitting. http://www.arxiv.org/abs/astro-ph?9602094), (2) those used by Ferrarese (2002), and (3) those specifically excluded from Ferrarese (2002). A total of 82 host sample galaxies were used for the σ_c calculation. Of the host galaxies, 60 are Source galaxies and 22 are Sink galaxies. Tables 1 and 2 list the host galaxies used in the σ_c calculation. Table 2 lists the 29 host galaxies used in the M_c calculation.

The distance D (Mpc) data for the 29 host sample galaxies used in the M_c calculation were taken from Merritt and Ferrarese (2001a). The D to nine host galaxies was calculated using Cepheid stars from Freedman *et al*. (2001) and Macri *et al*. (2001). The D to NGC 3031 and NGC 4258 were from Merritt and Ferrarese (2001a) rather than from Freedman *et al*. (2001). The D to the remaining host sample galaxies was calculated using the Tully-Fisher relation with the constants developed by Hodge (2006). The remaining galaxies from the NED database were neighbor galaxies. The D of these galaxies was calculated from the relative z and D of the host galaxy as described by Hodge (2022). The L for the galaxies was calculated from the D, m_b, and E_{xt}.

This host galaxy sample has LSB, medium surface brightness (MSB), and HSB galaxies; includes LINER, Sy, HII, and less active galaxies; field and cluster galaxies; galaxies with rising, flat, and declining RCs; and galaxies with varying degrees of asymmetry. The host sample includes NGC 0598, NGC 3031, NGC 3079, NGC 3200, NGC 4565, NGC 4736, and NGC 7171 that were excluded from Ferrarese (2002), six galaxies with $\sigma_c < 70$ km s^{-1}, and galaxies that Pizzella *et al*. (2005) would exclude. Wandel (2004) has treated the relations between massive black holes in AGN and their host galaxies.

RESULTS

Appling the same procedure used by Hodge (2022) for finding the parametric equations yields the following results:

Table 1. The data for the host sample galaxies used in the σ_c calculation. The units: (a) 10^8 erg cm^{-2} s^{-1}, (b) 10^3 kpc^{-1} km^2 s^{-2}, (c) 10^3 km^2 s^{-2}. (d) This galaxy has a z-value too small to obtain the $|\mathbf{K} \bullet \mathbf{a}|$ measurement.

Galaxy	Morphology	$L^{(a)}$	$\lvert\mathbf{K} \bullet \mathbf{a}\rvert^{(b)}$	$\sigma_c^{(c)}$	m_1	m_2	$\delta\sigma_c/\sigma_c$
IC 0342	SAB(rs)cd HII	4.014	(d)	74	0	(d)	-0.11
IC 0724	Sa	1.796	0.057	246	5	11	-0.02
N 0224	SA(s)b LINER	1.125	20.414	170	5	6	0.03
N 0598	SA(s)cd HII	0.219	27.936	37	2	1	0.01
N 0701	SB(rs)c Sbrst	0.425	1.198	73	3	6	0.02
N 0753	SAB(rs)bc	1.255	0.584	116	3	6	0.00
N 0801	Sc	1.162	0.753	146	4	7	0.00
N 1024	(R')SA(r)ab	1.714	0.713	173	4	8	-0.02
N 1353	SA(rs)bc LINER	1.014	0.386	87	3	9	0.17
N 1357	SA(s)ab	2.063	0.270	124	3	10	0.08
N 1417	SAB(rs)b	1.580	0.613	140	3	8	0.05
N 1515	SAB(s)bc	0.745	1.896	101	4	7	-0.11
N 1620	SAB(rs)bc	1.120	0.446	124	4	9	-0.11
N 2639	(R)SA(r)a Sy1.9	4.588	0.023	198	3	13	0.04
N 2742	SA(s)c	0.750	2.353	66	2	4	-0.01
N 2775	SA(r)ab	2.987	0.103	176	3	7	0.00
N 2815	(R')SB(r)b	2.217	3.306	203	4	6	0.01
N 2841	SA(r)b ; LINER Sy1	1.822	0.524	206	4	9	0.04
N 2844	SA(r)a	0.602	0.055	110	4	9	-0.01
N 2903	SB(s)d HII	0.947	0.130	102	3	8	0.02
N 2998	SAB(rs)c	1.022	2.551	91	3	6	-0.06
N 3067	SAB(s)ab HII	0.309	0.002	80	4	12	-0.01
N 3079	SB(s)c; LINER Sy2	1.300	0.036	146	4	11	-0.07
N 3145	SB(rs)bc	1.529	0.452	169	4	8	0.03
N 3198	SB(rs)c	0.855	0.272	63	2	7	-0.08
N 3200	SA(rs)bc	1.930	0.009	177	4	14	0.12
N 3593	SA(s)0/a; HII Sy2	0.263	0.059	54	3	8	0.01
N 4051	SAB(rs)bc Sy1.5	2.166	0.653	84	1	7	-0.04
N 4062	SA(s)c HII	0.518	0.869	93	4	7	0.00
N 4216	SAB(s)b HI I/LINER	1.731	0.175	207	4	11	-0.05
N 4321	SAB(s)bc; LINER HII	2.209	2.613	86	1	5	0.04
N 4378	(R)SA(s)a Sy2	6.049	0.120	198	2	11	-0.04
N 4388	SA(s)b sp Sy2	0.791	4.067	115	4	6	0.04
N 4414	SA(rs)c LINER	1.294	2.158	110	3	6	0.01
N 4448	SB(r)ab	1.163	1.000	173	5	9	-0.07
N 4548	SBb(rs); LINER Sy	1.087	0.002	144	4	12	0.00
N 4565	SA(s)b sp Sy 3 Sy1.9	1.655	12.922	136	3	4	0.01
N 4647	SAB(rs)c	0.748	0.134	98	3	9	0.05
N 4698	SA(s)ab Sy2	1.396	3.587	133	3	6	0.05
N 4736	(R)SA(r)ab; Sy 2 LINER	1.230	1.092	104	3	7	-0.02
N 4866	SA(r)0+ sp LINER	1.904	0.416	210	4	10	-0.08
N 5033	SA(s)c Sy1.9	1.302	0.937	131	3	8	0.00
N 5055	SA(rs)bc HI I/LINER	1.383	3.582	101	3	7	0.21
N 5297	SAB(s)c sp	0.956	1.432	119	4	8	0.11
N 5457	SAB(rs)cd	2.129	0.370	73	1	7	-0.05
N 6503	SA(s)cd HI I/LINER	0.197	0.303	46	3	5	-0.01
N 6814	SAB(rs)bc Sy1.5	0.036	2.830	112	9	7	0.05
N 7171	SB(rs)b	1.006	0.457	84	2	8	-0.04
N 7217	(R)SA(r)ab; Sy LINER	2.117	0.918	127	3	8	-0.11
N 7331	SA(s)b LINER	1.570	0.711	138	3	8	-0.01
N 7506	(R')SB(r)0+	0.741	0.051	147	5	12	0.15
N 7537	SAbc	0.693	146.761	78	3	1	-0.01
N 7541	SB(rs)bc pec HII	1.397	125.361	65	1	-1	0.01

$$\frac{\sigma_c^2}{10^3\ \mathrm{km}^2\ \mathrm{s}^{-2}} = K_{\sigma 1} B_{\sigma 1}^{m_1} \frac{L}{10^8\,\mathrm{erg\,s}^{-1}} + (-1)^s K_{\sigma 2} B_{\sigma 2}^{m_2} \frac{|\mathbf{K} \bullet \mathbf{a_o}|}{10^3\,\mathrm{kcp}^{-1}\ \mathrm{km}^2\ \mathrm{s}^{-2}} \pm 6\% \tag{2}$$

$$\frac{M_c}{10^8\ M_\otimes} = K_{M1} B_{M1}^{n_1} \frac{L}{10^8\,\mathrm{erg\,s}^{-1}} + (-1)^{s_M} K_{M2} B_{M2}^{n_2} \frac{|\mathbf{K} \bullet \mathbf{a_o}|}{10^3\,\mathrm{kcp}^{-1}\ \mathrm{km}^2\ \mathrm{s}^{-2}} \pm 3\% \tag{3}$$

where $K_{\sigma 1} = 1.6 \pm 0.3$, $K_{\sigma 2} = (2.5 \pm 0.7) \times 10^{-3}$, $B_{\sigma 1} = 1.88 \pm 0.06$, $B_{\sigma 2} = 2.52 \pm 0.09$, $K_{M1} = 0.7 \pm 0.1$, $K_{M2} = (5.1 \pm 0.8) \times 10^{-3}$, $B_{M1} = 1.73 \pm 0.04$, and $B_{M2} = 1.70 \pm 0.03$. The integer values for each host sample galaxy are listed in Tables 1 and 2. In both relations, σ_e = 18% for the L term, only.

Therefore, the galaxies with larger L will have more mass in the center shell to balance the higher F_s with the gravitational force F_g. Therefore, the SPM naturally leads to the smoothness of the $M_{cmo} - M_{gal}$ relation for the full range of CMO spiral galaxies.

Table 2. The data for the host sample galaxies used in the σ_c and M_c calculations. The units: (a) 10^8 erg cm^{-2} s^{-1}, (b) 10^3 kpc^{-1} km^2 s^{-2}, (c) 10^3 km^2 s^{-2}, (d) $10^8 M_\otimes$. (e) This galaxy has a z-value too small to obtain the $|\mathbf{K} \cdot \mathbf{a}|$ measurement.

Galaxy	Morphology	$L^{(a)}$	$\lvert\mathbf{K} \cdot \mathbf{a}\rvert^{(b)}$	$\sigma_c^{(c)}$	$M_c^{(d)}$	m_1	m_2	$\delta\sigma_c/\sigma_c$	n_1	n_2	$\delta M_c/M_c$
I 1459	E3 LINER	3.757	0.809	306	4.600	4	10	0.00	5	10	-0.02
N 0221	cE2	0.021	(e)	72	0.039	8	(e)	0.03	6	(e)	0.05
N 2787	SB(r)0+ LINER	0.122	2.230	194	0.410	8	8	-0.04	7	2	-0.01
N 3031	SA(s)ab; LINER Sy1.8	1.047	0.352	162	0.680	4	10	-0.11	4	6	0.01
N 3115	S0-	1.187	322.121	252	9.200	6	11	0.05	9	13	-0.03
N 3245	SA(r)0ˆ0ˆ ; H II LINER	0.956	6.161	210	2.100	5	7	-0.02	6	5	-0.04
N 3379	E1 LINER	0.979	14.051	207	1.350	5	6	-0.05	6	3	-0.01
N 3608	E2 LINER	1.164	0.708	192	1.100	5	9	0.05	5	6	-0.01
N 4258	SAB(s)bc; LINER Sy1.9	1.188	1.536	134	0.390	4	8	0.07	3	2	0.02
N 4261	E2-3 LINER	2.972	10.588	309	5.400	5	7	0.04	6	1	0.00
N 4342	S0-	0.121	0.108	251	3.300	9	11	0.01	11	5	-0.01
N 4374	E1; LERG LINER	3.595	9.080	282	17.000	4	7	-0.06	8	7	-0.02
N 4473	E5	0.941	0.842	179	0.800	5	8	0.04	5	7	0.01
N 4486	E+0-1 pec; NLR g Sy	5.075	0.084	333	35.700	4	12	-0.02	8	19	0.00
N 4564	E6	0.362	56.704	157	0.570	6	0	0.00	6	-3	-0.01
N 4649	E2	3.699	1.337	335	20.600	5	9	-0.07	8	9	0.00
N 4697	E6	1.291	1.994	174	1.700	4	7	0.07	6	8	0.07
N 5128	S0 pec Sy2	0.655	1.739	120	2.400	4	6	0.04	7	7	-0.02
N 5845	E	0.368	0.314	234	2.900	7	10	-0.02	9	11	0.01
N 6251	E; LERG Sy2	4.990	0.016	311	5.900	4	10	0.00	5	17	0.03
N 7052	E	3.284	0.232	270	3.700	4	10	0.04	5	11	-0.02
N 3384	SB(s)0-	0.690	2.424	148	0.140	5	7	0.03	2	-4	0.00
N 4742	E4	0.193	7.798	109	0.140	6	5	0.04	4	-1	-0.02
N 1023	SB(rs)0-	0.625	2.266	204	0.440	6	6	0.00	4	3	0.01
N 4291	E3	0.816	1.414	285	1.900	7	9	-0.11	7	8	-0.06
N 7457	SA(rs)0-	0.323	0.900	69	0.036	4	7	0.00	1	-2	0.02
N 0821	E6	1.518	0.329	200	0.390	5	10	-0.15	3	8	-0.04
N 3377	E5-6	0.454	0.442	139	1.100	5	8	0.04	7	9	-0.03
N 2778	E	0.253	2.230	162	0.130	7	7	-0.10	4	1	0.01

Equation (1) was derived assuming the Newtonian spherical property applied. That is, the Source was internal to the orbits of the mass under consideration. The applicability of equation (1) to σ_c and M_c suggests the Source or Sink acts as a monopole internal to the particles of M_c.

DISCUSSION AND CONCLUSION

The SPM speculates structures of the central mass and the structure of stellar nuclear clusters are the same. The suggested CMO structure is a central Source of a matter-repulsive $\rho \propto R^{-1}$, where R is the galactocentric radius, surrounded by a spherical shell of matter. The SPM suggests the $L \propto e$, where e is the Source strength and therefore, $F_s \propto \nabla \rho$ at a given R on the cross section of matter m_s. Therefore, the density (m_s/m_i), where m_i is the inertial mass, of particles at a given radius varies with L.

If this speculation is essentially correct, then the correlation of central parameters with spiral galaxy global and RC parameters suggests not only a similar galaxy formation process but also a self-regulatory, negative feedback process continually occurring. Feedback processes have been suggested in several recent studies of galaxies with CMOs (Li *et al*., 2007; Merritt and Ferrarese, 2001a; Robertson *et al*., 2006). The author further speculate that the e is the control of the negative feedback process. If the mass of the CMO increases, the F_g increases and mass migrates inward. At very high ρ, the high repulsive F_s compresses matter, the mass (black hole) cracks like complex molecules in the high heat and pressure of a fractional distillation process, and matter is reclaimed as radiation and elementary particles that form hydrogen. This accounts for the large amount of hydrogen outflowing from the Galaxy center and shocked gas near the Galaxy center. A single black hole reclamation event is consistent with the periodic X-ray pulses from the

Galaxy center. Further, the feedback loop controlled by the e is the connection among the central parameters, outer RC parameters, and the global parameters of spiral galaxies. However, the e of a galaxy acts only radially. Therefore, the $|\mathbf{K} \bullet \mathbf{a_o}|$ terms' effects are the asymmetry and the formation, evolution, and maintenance of the rotation of particles. This effect may be calculated only if the classification of parameters is first calculated.

Another speculation is that there may be galaxies with higher and lower values of the e than in the spiral galaxies. For instance, QSOs may have a higher value of the e that ejects matter from a spiral configuration, e.g see the images in (Sulentic and Arp, 1987). A smaller value of the e would be insufficient to form a disk.

The L term is the primary, determining factor of the parameter relations. The neighboring galaxies cause the scatter noted in the previous studies. The special focus of the present investigation included galaxies that are problematic in other models. Considering the range of observations and range of galaxy characteristics with which the SPM is consistent, the SPM is a relatively simple model.

The SPM was applied to central region parameters. For a sample of 60 Source galaxies and 22 Sink galaxies, the σ_c was found to correlate to the host galaxy's and neighboring galaxy's B band luminosity. The sample included galaxies with rising, flat and declining RCs; galaxies with a wide range of characteristics; and galaxies excluded from samples of other studies of σ_c relationships. For a sample of seven Source galaxies and 22 Sink galaxies, the M_c was found to correlate to the host galaxy's and neighboring galaxy's B band luminosity. The equations have the same form as the SPM equations for the parameters of the H I RCs. The Sources and Sinks act as monopoles at the center of the galaxies around them. The SPM is consistent with M_c and σ_c observations of the sample galaxies.

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