Gravitational Collapse of Monopole Radiating Dyon Solution in (N+2)-Dimensional Space-Time

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Abstract

We investigate the possibility of cosmic censorship violation in the gravitational collapse of monopole radiating dyon solution in (n+2)-dimensional space-times. It is shown that nature of the singularity does not depends on monopole field, it depends sensitively on the electric and magnetic charge parameters. Earlier work is generalized to higher dimensional space-times to allow a study of the effect of number of dimensions on the possibility of cosmic censorship violation. No restriction is adopted on the number of dimensions. These results might be important in the light of recent proposal that there may exist extra dimensions in the universe.

Keywords: Cosmic censorship, naked singularity, gravitational collapse, radiating dyon solution.
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I Introduction

The cosmic censorship conjecture (CCC) articulated by Penrose [1] is fundamental to many aspects of theory and astrophysical applications of black hole physics today. Despite many attempts over past decades no theoretical proof or even any satisfactory mathematical formulation of CCC is available as of today in the case of dynamical gravitational collapse. In the mean time, many authors have studied mainly spherical gravitational collapse of a massive matter cloud within the framework of general relativity. As the nuclear fuel of a massive star exhausts, it loses its equilibrium and gravity becomes the central dominant force which lends the star to its perpetual collapse. The gravitational collapse studies then show that the collapse end state is either a black hole (BH) or a naked singularity (NS), depending on the nature of the initial data from which the collapse evolves, arising from a regular initial state to the final super dense state. The continual gravitational collapse of a massive matter cloud within the framework of general relativity was investigated for the first time by the classic works of Oppenheimer and Snyder, and Datt (OSD) [2]. Such a treatment of dynamical collapse would be essential to determine the final fate of a massive collapsing star which shrinks catastrophically under the force of its own gravity when its internal nuclear fuel is exhausted. The outcome in the above case is seen to be a black hole developing in the spacetime. As the gravitational collapse progresses, an event horizon forms within the collapsing cloud and from the region within the horizon no material particles or light rays can escape, thus forming a black hole. The continually collapsing star enters the horizon and finally ends up forming a spacetime singularity, which is hidden inside the black hole and which is unseen to all the outside observers in the universe. The matter and energy densities, spacetime curvatures, and all physical quantities blow up and take extreme values in the limit of approach to such a spacetime singularity [3].

It was pointed out by S. Chandrasekhar in 1935:"...The life history of a star of small mass must be essentially different from that of a star of large mass... A small mass star passes into White-dwarf stage... A star of large mass cannot pass into this stage and one is left speculating on other possibilities." The question that what happens when a star dies has been a key problem in astronomy and astrophysics for past decades. If the star is sufficiently massive, beyond the white dwarf or neutron star mass limits, then a continued gravitational collapse must ensue when the star has exhausted its nuclear fuel.

What are the possible end states of such a continued gravitational collapse? To answer this question, one must study dynamical collapse scenarios within the framework of a gravitation theory such as Einstein's theory. Penrose conjectured in 1969, that the ultra-dense regions i.e. the spacetime singularities (where the physical quantities e.g. densities, curvatures are having extreme values) forming in gravitational collapse must be hidden within the event horizon of gravity, that is, the collapse must end in a black hole. This is called the Cosmic Censorship Conjecture. There is however no proof, or any suitable mathematical formulation of the same, available as of today[4].

Inspired by work in the string theory and other field theories, there has been considerable interest in recent times to find solutions of the Einstein equation in dimensions greater than four [5-8]. It is believed that underlying space-time in the large energy limit of the Planck energy may have higher dimensions than the usual four. Higher dimensional gravity theories have been considered as possible avenues to unify the basic forces of nature. 5D Kaluza-Klein [9] theory unifies gravity and electromagnetism and extensions of this have been investigated in [10]. The extra dimensions have been assumed to be small, typically of the order of the Planck length and so Kaluza-Klein Models are highly massive.

Nevertheless, the extra dimensions will not be directly observable in experiments. The success of string theories gave encouragement to search for indirect methods to detect the extra dimensions. Possible effects of the extra dimensions considered as bulk in the standard model have been suggested by Arkani-Hamid, Dimopoulos [11]. Higher dimensional space-time is now an active field of research in its attempts to unify gravity with all other forces of nature. It is particularly relevant in cosmology where it is shown that under certain situations, Einstein field equations dictate that as the usual 3D space expands the extra dimensions contract with time via the well known process of dimensional reduction. The results on gravitational collapse in higher dimensions are of interest in view of the current possibilities being explored for higher dimensional gravity. A large family of inhomogeneous non-static spherically symmetric solutions of the Einstein equation for null fluid in higher dimensions has been obtained by L. K. Patel and Naresh Dadhich [12].

In this paper, we study the gravitational collapse of monopole radiating dyon solution in (n+2) dimensional space-times. We show that the naked singularities occurred in (n+2)-dimensional monopole radiating dyon solution.

II Monopole Radiating Dyon Solution in (n+2)-Dimensional Space-time

The metric in (n+2)-dimensional radiating dyon space-time is given by

$$ds^2 = -\left[1 - \frac{2m(u,r)}{(n-1)r^{n-1}}\right] du^2 + 2dudr + r^2 d\omega_n^2 \quad (1)$$

Where u is advanced Eddington time co-ordinate, r is the radial co-ordinate with $0 < r < \infty$ and $m(u,r)$ gives the gravitational mass inside the sphere of radius r .

$$m(u,r) = \frac{1}{2}\left[\lambda(n-1)u^{n-1} - \frac{q_e^2(u)+q_m^2(u)}{nr^{n-1}}\right] \quad (2)$$

and $d\omega_n^2 = d\theta_1^2 + sin^2\theta_1 d\theta_2^2 + sin^2\theta_1 sin^2\theta_2 d\theta_3^2 + \cdots + sin^2\theta_1 sin^2\theta_2 \cdots sin^2\theta_{n-1} d\theta_n^2$ (3)

is the line element in a n-sphere in polar co-ordinate and $n = D - 2$, where D is the total number of dimensions.

Here, q_e^2 and q_m^2 are electric and magnetic charge respectively.

Non-vanishing components of the Einstein tensor are given by

$$G_{00} = \frac{n\dot{m}}{(n-1)r^n} - \frac{nm'}{(n-1)r^n}\left[1 - \frac{2m}{(n-1)r^{n-1}}\right]$$

$$G_{01} = -\frac{nm'}{(n-1)r^n}, \qquad G_{22} = \frac{m''}{(n-1)r^{n-3}},$$

$$G_2^2 = G_3^3 = \cdots\cdots = G_{n+1}^{n+1} \quad (4)$$

Here dash and dot denote derivative with respect to r and u respectively.

The energy momentum tensor for type II fluid is given by [13-15].

$$T_{ik} = T_{ik}^n + T_{ik}^m \quad (5)$$

Where, $T_{ik}^n = \mu l_i l_k$ and $T_{ik}^m = (\rho + p)(l_i \eta_k + l_k \eta_i) - p g_{ik}$

Therefore,

$$T_{ik} = \mu l_i l_k + (\rho + p)(l_i \eta_k + l_k \eta_i) - p g_{ik} \quad (6)$$

Where,

$$l_i l^i = \eta_i \eta^i = 0 \ , \ l_i \eta^i = 1 \quad (7)$$

The null vector l_i is a double null eigen vector of T_{ik}. Physically occurring distribution is null radiation flowing in the radial direction corresponding to $\rho = p = 0$, the Vaidya space-time of radiating star. When $\mu = 0$, T_{ik} reduces to degenerate type I fluid and further it represents string dust for $\mu = 0 = p$. The energy condition for such a distribution are as follows [16, 17].

(a) Weak and strong energy condition

$$\mu > 0, \quad \rho > 0, \quad p \geq 0 \quad (8)$$

(b) Dominant energy condition

$$\mu > 0, \quad \rho \geq 0, \quad p \geq 0 \quad (9)$$

In the case of $\mu = 0$, the energy conditions would become,

(c) Weak condition

$$\rho + p \geq 0, \quad \rho \geq 0 \quad (10)$$

(d) Strong condition

$$\rho + p \geq 0, \quad p \geq 0 \quad (11)$$

(e) Dominant condition

$$\rho \geq 0, \quad -\rho \leq p \leq \rho \quad (12)$$

The energy –momentum tensor (6) has support along both the two future pointing null vectors l_i and η_i, and it is exactly, as we shall show later, in the form to give Bonnor-Vaidya metric in higher dimensions [18-22]. We also note that $T_{ik} l^i l^k = 0$ and $T_{ik} \eta^i \eta^k = \mu$.

For the metric (1) we write,

$$l_i = g_i^0, \ \eta_i = g_i^1 + \frac{1}{2}\left(1 - \frac{2m}{(n-1)r^{n-1}}\right) g_i^0 \ , \quad (13)$$

Now the Einstein field equations

$$G_{ik} = -T_{ik} \quad (14)$$

Equation (6) satisfies the condition (12)

Substituting (4) in (14) we obtain,

$$\sigma = \mu = -\frac{n\dot{m}}{(n-1)r^n}, \qquad \rho = \frac{nm'}{(n-1)r^n} \ ,$$

$$p = -\frac{m''}{(n-1)r^{n-1}} \quad (15)$$

Now coupling above space-time with (n+2)-dimensional monopole field we get mass function for (n+2)-dimensional monopole radiating Dyon solution as

$$m(u,r) = \frac{1}{2}\left[ar^{n-1} + \lambda(n-1)u^{n-1} - \frac{\left(q_e^2(u)+q_m^2(u)\right)}{nr^{n-1}}\right] \quad (16)$$

Let the electric charge parameter $q_e^2(u) = \delta u^{2n-2}$

and

the magnetic charge parameter

$$q_m^2(u) = \Upsilon u^{2n-2} \quad (17)$$

Using the equation (16) and (17) equation (1) becomes,

$$ds^2 = -\left[1 - \frac{a}{(n-1)} - \frac{\lambda u^{n-1}}{r^{n-1}} + \frac{\delta u^{2n-2}}{n(n-1)r^{2n-2}} + \frac{\Upsilon u^{2n-2}}{n(n-1)r^{2n-2}}\right] du^2 + 2dudr + r^2 d\omega_n^2 \quad (18)$$

III Nature of the singularity

We now study the nature of singularity in the presence of monopole field with radiating Dyon solution. To investigate the nature of singularity, we follow the method given in references [23]. The singularity is said to be naked, if the radial null geodesic equation admits at least one real and positive root [23, 24].

The outgoing radial null geodesic equation for metric (18) is given by

$$\frac{dr}{du} = \frac{1}{2}\left[1 - \frac{a}{(n-1)} - \frac{\lambda u^{n-1}}{r^{n-1}} + \frac{\delta u^{2n-2}}{n(n-1)r^{2n-2}} + \frac{\Upsilon u^{2n-2}}{n(n-1)r^{2n-2}}\right] \quad (19)$$

It can be observed that the above differential equation has singularity at $r \to 0$, $u \to 0$. To discuss the nature of singularity , to classify the radial and non radial outgoing non space like geodesics terminating at this singularity in the past, we need to consider the limiting value of $X = \frac{u}{r}$ along a singular geodesic at the singularity is approached[19,25,26]

Let $\quad X_0 = \lim_{\substack{u\to 0 \\ r\to 0}} X = \lim_{\substack{u\to 0 \\ r\to 0}} \frac{u}{r} = \lim_{\substack{u\to 0 \\ r\to 0}} \frac{du}{dr}$

Hence $X_0 = \frac{2}{\left[1-\frac{a}{(n-1)}-\frac{\lambda u^{n-1}}{r^{n-1}}+\frac{\delta u^{2n-2}}{n(n-1)r^{2n-2}}+\frac{\Upsilon u^{2n-2}}{n(n-1)r^{2n-2}}\right]}$ (20)

$$\frac{(\Upsilon+\delta)}{n(n-1)}X_0^{2n-1} - \lambda X_0^n + \left(1-\frac{a}{(n-1)}\right)X_0 - 2 = 0 \quad (21)$$

The above polynomial equation decides the nature of the singularity. In order for the singularity at $u = 0,\ \ r = 0$ to be naked, radial null geodesics should be able to propagate outwards, starting from the singularity. The variable X can be interpreted as tangent to the outgoing geodesics, hence if equation (21) has at least one positive and real root, then the singularity is said to be naked. If the equation (21) has no real and positive root, then collapse ends into a black hole and the singularity will be covered [27].

It can be checked from the theory of equations that above equation has at least three positive real roots. To study the nature of singularity of equation (21) for different values of $n, a, \gamma, \delta, and\ \lambda$.

Case-I Let us consider $n = 2$, then the space time (18) reduces to four dimensional monopole radiating Dyon space time . This four dimensional monopole radiating Dyon solution admits strong naked singularities.

In particular if we chooses $n = 2,\ a = 0.1,\ \lambda = 0.01,\ \gamma = 0.01,\ \delta = 0.001$, then the equation (21) reduces to

$$0.0055X_0^3 - 0.01X_0^2 + 0.9X_0 - 2 = 0 \quad (22)$$

then one of the real and positive root to the equation (22) is $X_0 = 2.2105$, which ensures that the singularity is naked.

Case-II For $n = 3$, then space time (18) reduces to five dimensional monopole radiating Dyon space time. In particular if we consider $a = 0.1,\ \lambda = 0.01,\ \gamma = 0.01,\ \delta = 0.001$ then equation (21) reduces to

$$0.00183X_0^5 - 0.01X_0^3 + 0.95X_0 - 2 = 0 \quad (23)$$

then one of the positive real roots of equation (23) is $X_0 = 2.1229$, which state that the singularity is naked.

Case-III For $n = 4$, then space time (18) reduces to six dimensional monopole radiating Dyon space time. In particular if we consider $a = 0.1,\ \lambda = 0.01,\ \gamma = 0.01,\ \delta = 0.001$ then equation (21) reduces to

$$0.0009167X_0^7 - 0.01X_0^4 + 0.9667X_0 - 2 = 0 \quad (24)$$

then one of the positive real roots of equation (24) is $X_0 = 2.0994$, which shows that the singularity is naked in six dimensional.

For $n = 5$ (i.e. for 7D) then equation (21) reduces to

$$\frac{(\gamma+\delta)}{20}X_0^9 - \lambda X_0^5 + \left(1-\frac{a}{4}\right)X_0 - 2 = 0 \quad (25)$$

fixed $a = 0.5\ and\ \delta = 0.001$ then the real and positive roots of equation (25) obtained for different values of $\lambda\ and\ \gamma$ in seven dimensional monopole radiating Dyon solution are shown in the following table.

Table 1 Values of X0 for different values of $\lambda\ and\ \gamma$

	X0				
λ	ϒ=0.01	ϒ=0.02	ϒ=0.03	ϒ=0.04	ϒ=0.05
0.1	3.6551	3.1044	2.8154	2.6269	2.4907
0.2	4.3605	3.7067	3.3611	3.1331	2.9662
0.3	4.8293	4.1067	3.7244	3.4721	3.2871
0.4	5.1909	4.4148	4.0044	3.7334	3.5346
0.5	5.4895	4.6692	4.2353	3.9489	3.7388
0.6	5.7459	4.8876	4.4336	4.1339	3.914
0.7	5.972	5.08	4.6083	4.2968	4.0684
0.8	6.1749	5.2528	4.7651	4.4431	4.2069
0.9	6.3596	5.4099	4.9077	4.5762	4.333

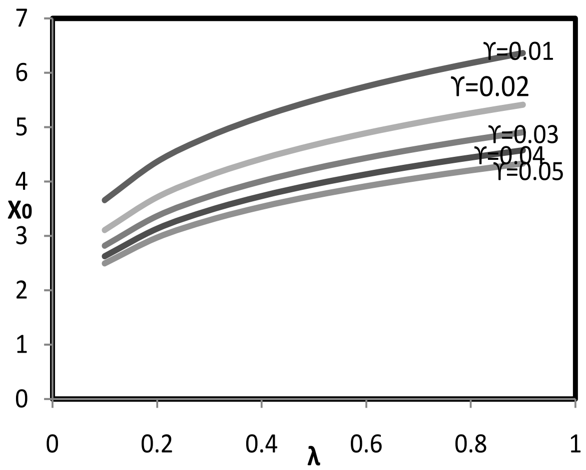

Figure 1: Graph of the values of X_0 against the value of λ.

From the graph we may observe that the values of X_0 have positive real roots. It is also observe that if we increase the value of λ then X_0 also increases.

For $n = 6$ (i.e. for 8D) then equation (21) reduces to

$$\frac{(\gamma+\delta)}{30}X_0^{11} - \lambda X_0^6 + \left(1-\frac{a}{4}\right)X_0 - 2 = 0 \quad (26)$$

fixed $a = 0.5$ *and* $\delta = 0.001$ then the real and positive roots of equation (26) obtained for different values of λ *and* γ in eight dimensional monopole radiating Dyon solution are shown in the following table.

Table 2 Values of X0 for different values of λ *and* γ

	X0				
λ	ϒ=0.01	ϒ=0.02	ϒ=0.03	ϒ=0.04	ϒ=0.05
0.1	2.6947	2.5079	2.2644	2.162	2.0916
0.2	3.0261	2.8163	2.5417	2.4255	2.3451
0.3	3.2381	3.0137	2.7198	2.5954	2.5092
0.4	3.3974	3.1619	2.8536	2.7231	2.6327
0.5	3.5262	3.2818	2.9619	2.8264	2.7325
0.6	3.6351	3.3832	3.0534	2.9137	2.8169
0.7	3.7297	3.4713	3.1329	2.9896	2.8903
0.8	3.8137	3.5494	3.2035	3.0569	2.9554
0.9	3.8893	3.6198	3.267	3.1175	3.014

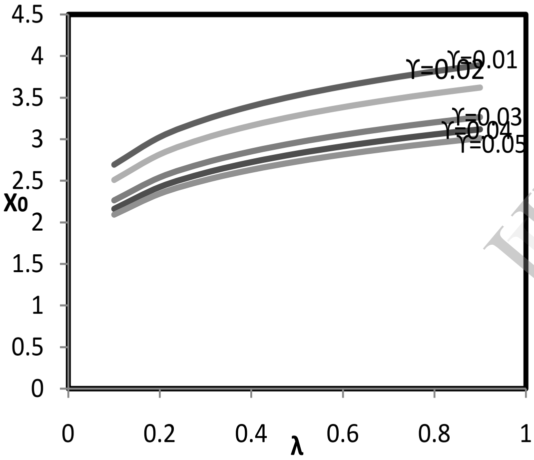

Figure 2: Graph of the values of X_0 against the value of λ.

From the graph we may observe that the values of X_0 have positive real roots in the eight dimensional. It is pointed out that as γ increases the value of X_0 decreases very slowly.

For $n = 7$ (i.e. for 9D) then equation (21) reduces to

$$\frac{(\gamma+\delta)}{42} X_0^{13} - \lambda X_0^7 + \left(1 - \frac{a}{4}\right) X_0 - 2 = 0 \qquad (27)$$

fixed $a = 0.5$ *and* $\delta = 0.001$ then the real and positive roots of equation (27) obtained for different values of λ *and* γ in eight dimensional monopole radiating Dyon solution are shown in the following table.

Table 3 Values of X0 for different values of λ *and* γ

	X0				
λ	ϒ=0.01	ϒ=0.02	ϒ=0.03	ϒ=0.04	ϒ=0.05
0.1	3.0588	2.6916	2.5067	2.3453	2.2579
0.2	3.518	3.096	2.8824	2.6946	2.592
0.3	3.8164	3.3589	3.1273	2.9235	2.8121
0.4	4.0429	3.5585	3.3132	3.0974	2.9793
0.5	4.2276	3.7212	3.4648	3.2391	3.1157
0.6	4.3848	3.8596	3.5937	3.3597	3.2317
0.7	4.5222	3.9806	3.7064	3.4651	3.333
0.8	4.6447	4.0885	3.8069	3.559	3.4234
0.9	4.7554	4.186	3.8977	3.6439	3.5051

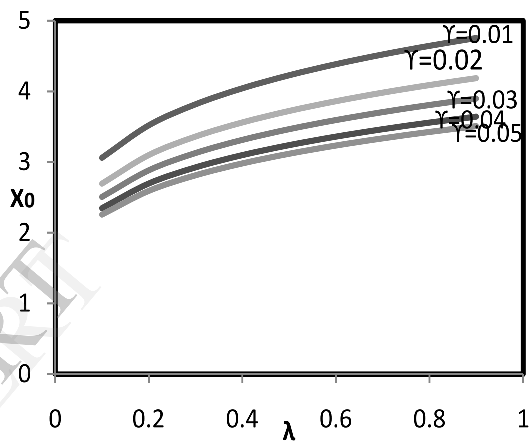

Figure 3: Graph of the values of X_0 against the value of λ.

From the graph we may observe that the values of X_0 have positive real roots in the nine dimensional. It shows that naked singularity is formed in nine dimensional spacetime.

For $n = 8$ (i.e. for 10 D) then equation (21) reduces to

$$\frac{(\gamma+\delta)}{56} X_0^{15} - \lambda X_0^8 + \left(1 - \frac{a}{4}\right) X_0 - 2 = 0 \qquad (28)$$

fixed $a = 0.5$ *and* $\delta = 0.001$ then the real and positive roots of equation (28) obtained for different values of λ *and* γ in eight dimensional monopole radiating Dyon solution are shown in the following table.

Table 4 Values of X_0 for different values of λ *and* γ

λ	X0				
	ϒ=0.01	ϒ=0.02	ϒ=0.03	ϒ=0.04	ϒ=0.05
0.1	2.4361	2.2166	2.1032	2.0208	1.9592
0.2	2.6901	2.4473	2.3214	2.2295	2.1606
0.3	2.8507	2.5934	2.4599	2.3624	2.2892
0.4	2.9704	2.7023	2.5632	2.4616	2.3853
0.5	3.0666	2.7898	2.6463	2.5414	2.4626
0.6	3.1476	2.8635	2.7161	2.6085	2.5276
0.7	3.2177	2.9273	2.7766	2.6666	2.5839
0.8	3.2796	2.9837	2.8301	2.7179	2.6337
0.9	3.3353	3.0343	2.8782	2.7641	2.6784

Figure 3: Graph of the values of X_0 against the value of λ.

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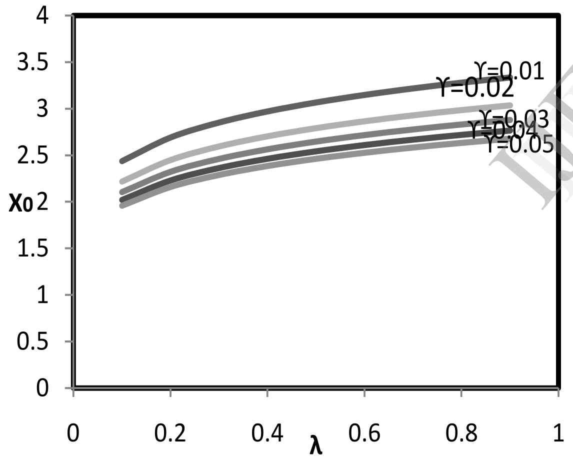

Figure 4: Graph of the values of X_0 against the value of λ.

From the graph we may observe that the values of X_0 have positive real root and are closest for increasing the value of γ. It shows that singularity is not covered in the event horizon.

For $n = 9$ (i.e. for 11 D) then equation (21) reduces to

$$\frac{(\gamma+\delta)}{72} X_0^{17} - \lambda X_0^9 + \left(1 - \frac{a}{4}\right) X_0 - 2 = 0 \qquad (29)$$

fixed $a = 0.5$ *and* $\delta = 0.001$ then the real and positive roots of equation (29) obtained for different values of λ *and* γ in eight dimensional monopole radiating Dyon solution are shown in the following table.

Table 5 Values of X_0 for different values of λ *and* γ

λ	X0				
	ϒ=0.01	ϒ=0.02	ϒ=0.03	ϒ=0.04	ϒ=0.05
0.1	2.254	2.0761	1.9769	1.9092	1.8583
0.2	2.4581	2.2636	2.155	2.0805	2.0243
0.3	2.5859	2.3814	2.267	2.1885	2.1293
0.4	2.6806	2.4686	2.35	2.2686	2.2072
0.5	2.7565	2.5384	2.4164	2.3328	2.2696
0.6	2.82	2.5969	2.4722	2.3866	2.322
0.7	2.8749	2.6475	2.5203	2.433	2.3671
0.8	2.9233	2.692	2.5627	2.474	2.407
0.9	2.9666	2.732	2.6007	2.5107	2.4427

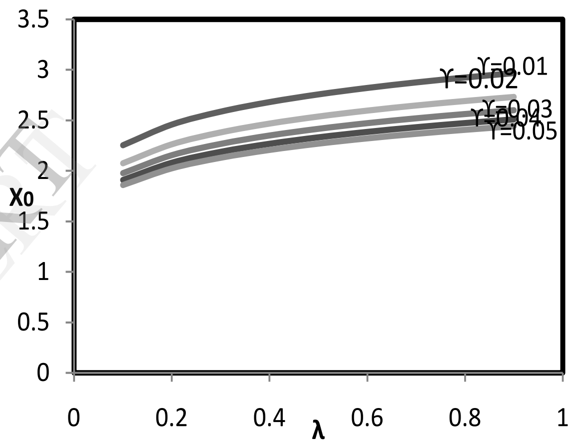

Figure 5: Graph of the values of X_0 against the value of λ.

From the graph we may observe that the values of X_0 have positive real root and are closest for increasing the value of γ. It shows that the naked singularity is formed in eleven dimensional also.

For $n = 10$ (i.e. for 12 D) then equation (21) reduces to

$$\frac{(\gamma+\delta)}{90} X_0^{19} - \lambda X_0^{10} + \left(1 - \frac{a}{4}\right) X_0 - 2 = 0 \qquad (30)$$

fixed $a = 0.5$ *and* $\delta = 0.001$ then the real and positive roots of equation (30) obtained for different values of λ *and* γ in eight dimensional monopole radiating Dyon solution are shown in the following table.

Table 6 Values of X_0 for different values of λ *and* γ

λ	X0				
	Υ=0.01	Υ=0.02	Υ=0.03	Υ=0.04	Υ=0.05
0.1	2.1112	1.9644	1.8814	1.8198	1.7776
0.2	2.2802	2.1212	2.0312	1.9642	1.9181
0.3	2.3853	2.219	2.1247	2.0545	2.0062
0.4	2.4628	2.291	2.1937	2.1212	2.0713
0.5	2.5246	2.3486	2.2487	2.1745	2.1233
0.6	2.5763	2.3966	2.2948	2.219	2.1667
0.7	2.6208	2.438	2.3344	2.2573	2.2042
0.8	2.66	2.4745	2.3693	2.291	2.2371
0.9	2.695	2.5071	2.4005	2.3212	2.2666

Table 7: Values of X_0 for different values of λ *and* n

λ	X0					
	n=5	n=6	n=7	n=8	n=9	n=10
0.1	3.6551	3.0588	2.6947	2.4361	2.254	2.1112
0.2	4.3605	3.518	3.0261	2.6901	2.4581	2.2802
0.3	4.8293	3.8164	3.2381	2.8507	2.5859	2.3853
0.4	5.1909	4.0429	3.3974	2.9704	2.6806	2.4628
0.5	5.4895	4.2276	3.5262	3.0666	2.7565	2.5246
0.6	5.7459	4.3848	3.6351	3.1476	2.82	2.5763
0.7	5.972	4.5222	3.7297	3.2177	2.8749	2.6208
0.8	6.1749	4.6447	3.8137	3.2796	2.9233	2.66
0.9	6.3596	4.7554	3.8893	3.3353	2.9666	2.695

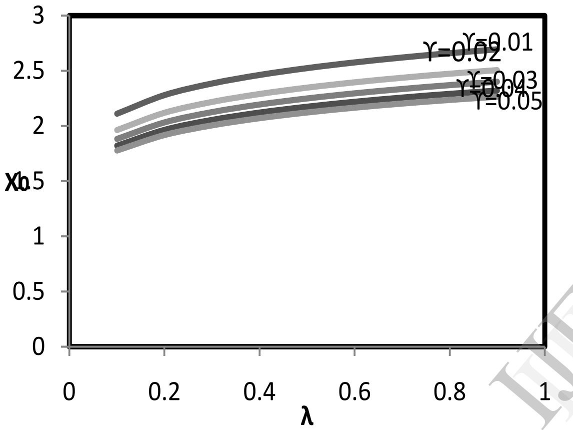

Figure 6: Graph of the values of X_0 against the value of λ.

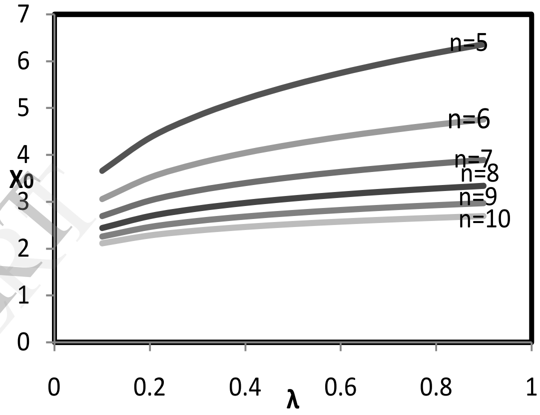

Figure 7: Graph of the values of X_0 against the value of λ.

From the graph we may observe that the values of X_0 have positive real root in twelve dimensional also, which insures that the singularity is naked.

For fixed $\gamma = 0.01,\ \delta = 0.001\ and\ a = 0.5$ then equation (21) reduces to

$$\frac{0.011}{n(n-1)} X_0^{2n-1} - \lambda X_0^n + \left(1 - \frac{0.5}{n-1}\right) X_0 - 2 = 0 \qquad (31)$$

then the values of X_0 for different dimensions and different values of λ are as shown in the following table.

From the graph we observe that the values of X_0 have positive real roots. When we increases the dimensions the value of X_0 decreases, it means for higher and higher dimensions it may be a black hole.

For fixed $\lambda = 0.1,\ \delta = 0.001\ and\ a = 0.5$ then equation (21) reduces to

$$\frac{(\gamma + 0.001)}{n(n-1)} X_0^{2n-1} - 0.1 X_0^n + \left(1 - \frac{0.5}{n-1}\right) X_0 - 2 = 0 \quad (32)$$

then the values of X_0 for different dimensions and different values of γ are as shown in the following table.

Table 8: Values of X_0 for different values of γ and n

Υ	X0					
	n=5	n=6	n=7	n=8	n=9	n=10
0.01	3.6551	3.0588	2.6947	2.4361	2.254	2.1112
0.02	3.1044	2.6916	2.5079	2.2166	2.0761	1.9644
0.03	2.8154	2.5067	2.2644	2.1032	1.9769	1.8814
0.04	2.6269	2.3453	2.162	2.0208	1.9092	1.8198
0.05	2.4907	2.2579	2.0916	1.9592	1.8583	1.7776
0.06	2.3861	2.1817	2.0284	1.9105	1.8186	1.7443
0.07	2.3025	2.1181	1.9791	1.8705	1.7853	1.7158
0.08	2.2337	2.0667	1.9378	1.8368	1.7561	1.6916
0.09	2.1758	2.0228	1.9023	1.8077	1.7333	1.6708

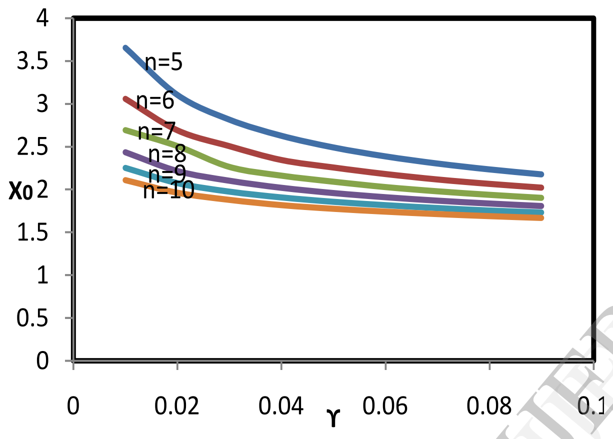

Figure 8: Graph of the values of X_0 against the value of γ.

From the graph we may observe that initially the value of X_0 is at peak but when we increase the value of γ then X_0 decreases slowly.

IV Concluding Remarks

Perhaps the most important open problem of the classical general relativity is to prove (or disprove) the CCH. In the absence of the proof, finding an acceptable counter example is very important, as it would resolve the issue, one way or the other. Here we have presented a scenario for the gravitational collapse of monopole radiating dyon solution in (n+2)-dimensional spacetime.

In the present work we have shown that the result in 4-dimensional space time are also valid in (n+2)-dimensional spacetime. Using electric and magnetic charge parameter in mass function, it has been shown that singularities arising in (n+2)-dimensional monopole radiating dyon solution are naked in any arbitrary dimensions. It is also pointed out when the dimensions are increases then the root of polynomial decreases it means the naked singularity is found. It is also note that monopole field does not affect the naked singularity in any arbitrary dimensions.

Thus one may argue that the dimensions of the spacetime does not play any fundamental role in the formation of naked singularities since in this case there is no more horizon, so that a singularity is visible to an external observer. Hence the occurrence of naked singularities in (n+2)-dimensional monopole radiating dyon solution violates the cosmic censorship hypothesis.

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