Generalised Attractors in Five Dimensional Gauged Supergravity

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Introduction: Background

- Attractor mechanism generalised for $\mathcal{N} = 2, d = 4$ gauged supergravity *Klemm et.al 09, Kachru et.al 11*. eg: Lifshitz, Schrödinger geometries.

- Bianchi attractors: Classification of near horizon geometries of homogeneous extremal black branes in $d = 5$ *Trivedi et.al 11*.

- Relevance in gravity duals to field theories (AdS/CFT)

Introduction: Our Work

- We extend the work of *Kachru et.al 11* to $\mathcal{N} = 2, d = 5$ gauged supergravity.
- We show that near horizon geometries of homogeneous extremal black branes are attractor solutions of gauged supergravity.

Generalised Attractors: Definition

The most general $\mathcal{N} = 2, d = 5$ gauged sugra has gravity coupled to vector, tensor and hypermultiplets *Dall'Agata 00*.

Ansatz:

- In tangent space, all the bosonic fields in the theory take constant values at the attractor point.
- The attractor geometries are characterised by constant anholonomy coefficients.

$$[e_a, e_b] = c_{ab}{}^{c} e_c$$

Generalised Attractors: Features

- Gauge field, Tensor field and Einstein equations reduce to algebraic equations at the attractor point.
- Scalar field equations reduce to a minimisation condition on an attractor potential.
- The attractor potential is also independently constructed from squares of fermionic shifts.
- Constant anholonomy $\Rightarrow$ regular geometries.

Generalised Attractors: Supersymmetry

- Killing spinor integrability conditions expressible in terms of fermionic shifts.
- All shifts vanish $\Rightarrow$ Maximal supersymmetry (AdS_5 vacuum, unique).
- Some shifts vanish $\Rightarrow$ partially broken supersymmetry (Lifshitz, Bianchi types)

Generalised Attractors: Examples

- The attractor geometries are characterised by constant anholonomy coefficients.
- Homogeneity implies Constant anholonomy and vice-versa *Ellis et.al 1969*.
- Homogeneous extremal black brane configurations found by *Trivedi et.al 11* are attractor solutions of gauged supergravity.

Generalised Attractors: Examples

- For illustration, take a gauged supergravity model with one vector and two tensor multiplets *Zagermann et.al 00*.
- Within this model, we realise a $z = 3$ Lifshitz solution, a Bianchi Type II and a Bianchi Type VI solution as attractors.
- The other Bianchi type metrics can be realised as attractor solutions of more generic gauged supergravity models.

Generalised Attractors: Examples

Bianchi Type VI specified by gauging parameters g, V_0, V_1 and h

$$ds^2 = L^2\Big[-\hat{r}^{2u}d\hat{t}^2 + \frac{d\hat{r}^2}{\hat{r}^2} + d\hat{x}^2 + e^{-2\hat{x}}\hat{r}^{2v}d\hat{y}^2 + e^{-2h\hat{x}}\hat{r}^{2w}d\hat{z}^2\Big]$$

$$[e_2, e_4] = e_2 \qquad [e_3, e_4] = he_3$$

$$u = \frac{1}{\sqrt{2}}(1-h); \quad v = -\frac{1}{\sqrt{2}}h; \quad w = \frac{1}{\sqrt{2}}; \quad L = \frac{(\phi_c^1)^4}{\sqrt{6}g}(1-h);$$

$$A^{0t} = \frac{1}{L\hat{r}^u}\sqrt{\frac{-2h}{(-1+h)^2}}\frac{1}{(\phi_c^1)^2}; \quad h < 0; \quad h \neq 0, 1;$$

$$\phi_c^1 = \left(\sqrt{2}\frac{V_0}{V_1}\right)^{\frac{1}{3}}; \quad V_0 V_1 > 0; \quad \frac{8(3-h+3h^2)}{(\phi_c^1)^4(-1+h)^2} \leq 1$$

Future Outlook

- Can generalised attractors be understood from Entropy function formalism ? *Sen 07*
- Are $4d$ and $5d$ generalised attractors related ? *Gaiotto et.al 05*
- Can this mechanism be extended to all gauged supergravities in any dimension ?
- Can this mechanism be understood from a 10d/M-theory perspective - string embedding.
- CFT duals of Bianchi attractors ?

Thank You![1]

[1] Ref: 1206.3887 Karthik Inbasekar, Prasanta K. Tripathy