

Re: Solution to Einstein's Field Equations where $T^{uv} \neq 0$?

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- *From:* Jonathan Thornburg <jthorn@xxxxxxxxxxxxxxxxxxxx>
 - *Date:* Thu, 27 Apr 2006 21:19:57 +0000 (UTC)
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Jay R. Yablon <jyablon@xxxxxxxxxxxxxx> wrote:

Many of the widely-studied solutions to Einstein's field equations are taken in vacuo, that is, at events where the energy momentum tensor $T^{uv}=0$. This includes Schwarzschild and Kerr geometries, for example.

Have there been many exact solutions found where $T^{uv} \neq 0$? I am speaking of analytical solutions where the differential equations are solved exactly, *not* numerical approximations.

I am especially interested in any exact solutions based on the usual Maxwell energy tensor of electrodynamics $T^u_v = (1/4\pi) [F^{ut} F_{vt} - (1/4) \lambda^{u_v} F^{st} F_{st}]$. I am interested in solutions both where $F^{uv}_u=0$ (free space) and also where $F^{uv}_u=J^v$ (space with current sources). Conditions of interest include static spherical symmetry in the nature of Schwarzschild, and rotation with spherical symmetry about the z -axis in the nature of Kerr.

You might find gr-qc/0604108 of interest:

Title: Neutral perfect fluids and charged thin shells with electromagnetic mass in general relativity

Authors: Victor Varela

Abstract:

We build extended sources for the Reissner-Nordström metric. Our models describe a neutral perfect fluid core bounded by a charged thin shell, and feature everywhere positive rest mass density and everywhere non-negative active gravitational mass, as well as classical electron radius and electromagnetic total mass. We contrast our results with previously discussed models featuring similar properties at the expense of including anisotropic pressures within the fluid. Our charged thin shells are restricted by the 2D texture equation of state which causes the continuity of the active gravitational mass, in spite of the singularity of the energy-momentum tensor. We mention possible extensions of this study suggested by modified active mass formulae proposed in the literature.

ciao,

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-- "Jonathan Thornburg -- remove -animal to reply" <jthorn@xxxxxxxxxxxxxxxxxxxx>
Max-Planck-Institut fuer Gravitationsphysik (Albert-Einstein-Institut),
Golm, Germany, "Old Europe" <http://www.aei.mpg.de/~jthorn/home.html>
"Washing one's hands of the conflict between the powerful and the
powerless means to side with the power"