ASTRO 160 (part deux) BLACK HOLES & RELATIVITY (note: 120 problem set tais week) BLACHS HOLES not seen sineetly use orbital dynamics. Dopples shift etc. context. relativity not Newtonian physics "escape velocity" Vesc = (2GM) 1/2 speed required to escape grav. Reld of an all Open Yale courses Object with Mass of the lectures and course material within Open Vale Countries Common Course of the lectures and course material within Open Vale Countries Courses of the lectures and course material within Open Vale Countries Courses of the lectures and course material within Open Vale Countries Courses of the lectures and course material within Open Vale Courses of the lectures and course material within Open Vale Courses of the lectures and course material within Open Vale Courses of the lectures and course material within Open Vale Courses of the lectures and course material within Open Vale Courses of the lectures of the l

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Vesc of Early 1/2 =
$$(2\pi)^{1/2}$$

Vesc = $(2\pi)^{1/2}$
 $V = V_{esc}$
 $V = V_{es$

NIOLak

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Vesc of human

$$M = 10049$$
 $R = 1m$
 $V_{rsc} = \left(\frac{2GM}{R}\right)^{1/2}$
 $= \left(\frac{2 \times 7 \cdot 10^{-11} \times 10^{2}}{1}\right)^{1/2}$
 $= \left(\frac{1.4 \times 10^{4} \times 8}{1}\right)^{1/2}$
 $= 1 \times 10^{-4} \times 10^{5}$
 $= 1 \times 10^{-4} \times 10^{5}$

Block Hole: Vesc ≥ C 3×10 m/s

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R, = ZGM

C. Schwarzschild radius

black hole: R L Rs

FABLE: Mrshell's "discourg"

Of block holes

MORAL: importunce of result

chayes with contact

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how big is Rs of Son? Rs = 2GM = 2x7,10" 2x1000 = (3x100)2 = 36 1/019 = 3×103 M 16 ×1016 3 lum

Known for 3.70 yrs Mat black Lobs SHOULD exist - endpoints of stellar evolution

stor's evolution determined gravity (pulls m)
pressure (push out) Open Yale courses

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inside T, S bigger tea

only p vares inner regions -> bigher previly no belouse is possible => mner parts of star MUST be hother has outer part inside of Sun 10³ degres Surface of Sure 6x103 degrees

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une: an every source at carter of star -> replaces lost heat -> preserves equilibrium NUCLEAR FUSION eur holly nuclear feel > many advertises SO COLLAPS 65 et high dansity - other Unds of pressure " election dequieres priseurs (fermi pressive) Steebilies start of event radas of Ewh Open Yale courses © Yale University 2012. Most of the lectures and course material within Open Yale Courses are licer

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1 2 × 1636 2 × 1636 4 x 350 x 10 3866 × 10 18 = 10 49/2 million hus dens such stors called white dwof encloset of 1930s Chardrasekhar proves that M>1.4 MO ell electron pressure vise Africat Open Yale courses

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Chardra's Limit FABLE: believe your sklut NORAL: net your inhition who while dwarf collapses e+p -> n+ o -> newhines whole she tems into neckons NEUTRON STARS (discovered in 1960s) M=2.MO Ba-10 Cam is a billrow ! greater!

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W.M. M = 3 MG palius of newhoush neuhon ster with M>3MO ET RCRS Week mitial wass will > 30 140 will and op who M23M collapse -> black loker PEXPECT THERE ARE MANY Open Yale courses Tale University 2012. Most of the lectures and course material within Open Yale Courses are/licensed under a Creative Commons Attribution-Noncommercial-Share Alike 3.0 license. Unless explicitly set forth in the applicable Credits section of a lecture, third-party content is not covered under the Creative Commons discense. Please consult the Open Yale Courses Terms of Use for timilations of the Creative Commons.