**Brown Dwarfs**

“The Failed Stars”

**I. Physical Characteristics**

- **Definition** : A celestial mass between the largest gas giants and the smallest red dwarfs (not large enough to start nuclear fusion)

- **Mass** : 13 to 80 times Jupiter’s mass

- **Chemical Composition** : Fuse deuterium and burn lithium (if on the larger end of the mass spectrum)

- **Temperature** : 800 to 1880 ˚ F (too cool for fusion)

- **Luminosity** : Emit almost no visible light

**- Lithium Test**

- Lithium is present in brown dwarfs but not low-mass stars

- Stars capable of hydrogen fusion usually burn up their lithium

- Temps to burn off lithium fall just below hydrogen fusion temps

- A large presence of lithium is a strong indicator of a brown dwarf

- Large amounts of methane and iron rain are also indicators of brown dwarfs

**II. Examples**

- **Luhman-16** : Closest known brown dwarf (6.5 light years away) / binary star system

- **DENIS-P J082303.1-491201 b** : Most-massive known brown dwarf / exoplanet - (About 29X more massive than Jupiter)

- **Epsilon Indi Ba & Bb** : Brown dwarf pair 12 light years from the Sun

- **Cha Halpha 1** : X-Ray emitting brown dwarf (found by Chandra X-Ray Observatory)

- **WISE 0855-0714** : Coldest known brown dwarf (-48 to -13 ˚C)

**III. Existence**

- **Years Of Existence** : Cease deuterium fusion after 10 million year / presence of lithium after 100 million years

- **Formation** : Form in nebula clusters; Isolated; Around stars in a disk

- **Stage of Stellar Evolution** : Not a stage of stellar evolution - (Not large enough or hot enough to become a red dwarf proto-star)

- **Future Of The Object** : Could be “lost dark matter” - (which could help cause the expanding universe to collapse)

- Will eventually cool to become a black dwarf

**IV. Discovery**

- Teide-1 : First discovered brown dwarf

- **Discovered By** **:** Rafael Rebolo, Maria Rosa Zapatero Osorio, Eduardo Martin

- **Date Discovered** : 1995

- Currently located using the Hubble Space Telescope, Spitzer Infrared Telescope, & Chandra X-Ray Observatory

- NASA’s WISE telescope has located 200 new brown dwarfs since 2009

**V. Facts**

- Planets and disks are found around some brown dwarfs (thought to be mainly terrestrial and devoid of water)

- Strong tidal forces on these planets would cause a major greenhouse effect

- Not really brown in color

- **Three Types**

- L Dwarf : red-brown in color (1300 to 2000K)

- T Dwarf : dark magenta (700 to 1300 K)

- Y Dwarf : theoretical, very dark color (less than 600 K)

- Nibiru thought to be a brown dwarf en-route to destroy life on Earth in outer Solar System