DARK MATTER

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IARD2020

OR TRANSPARENT MATTER?

History

Before and after Zwicki (1933) many others used both expressions to describe the missing mass that determined the motions of stars and galaxies

but

was *not*

shining as stars do

AFTER ABOUT 1980 THE EXPRESSION *DARK MATTER* TOOK OVER, CAUSING RESEARCHERS TO FORGET THAT THE MISSING MATTER CAN BE *TRANSPARENT*

- **PHOTONS PASS THROUGH EACH OTHER AS IF THEY ARE TRANSPARENT TO EACH OTHER.**
- **THIS FEATURE IS CHARACTERISTIC TO BOSONS BUT NOT TO FERMIONS.**
- **USUAL MATTER BEHAVES LIKE FERMIONS.**

HELIUM 4 ATOM = ^{4}He IS BOSON.

BELOW 2.17 DEGREES KELVIN IT IS SUPERFLUID.

THE TEMPERATURE OF THE SPACE IS ABOUT 2.7 DEGREES KELVIN, WHICH IS JUST 0.55 DEGREES ABOVE 2.17 DEGREES KELVIN.

AT THIS TEMPERATURE HELIUM 4 ATOM IS A BOSON.

USUAL MATTER INCLUDING HELIUM 4 ATOMS BEHAVE LIKE FERMIONS.

HOWEVER, AT ULTRACOLD TEMPERATURE HELIUM 4 ATOMS BEHAVE AS BOSONS.

HERE WE DEDUCE THAT AS BOSONS, ULTRACOLD HELIUM 4 ATOMS ARE TRANSPARENT, TO PHOTONS, AND TO OTHER HELIUM 4 ATOMS, AND EVEN TO USUAL MATTER FERMIONS.

CONSEQUENTLY, WE DEDUCE THE IMPLICATIONS.

IMPLICATIONS

- **FIRST IMPLICATION IS THAT ULTRACOLD HELIUM 4 IS A CANDIDATE FOR THE LONG SOUGHT FOR**

  ***TRANSPARENT MATTER*.**
- **CONSEQUENT IMPLICATIONS ARE THE STRUCTURE OF THE UNIVERSE AND ITS EVOLUTION:**

  GALAXIES, CLUSTERS, CELLS

- AS FULLY TRANSPARENT, IT LEAVES NO TRACES OF THE SPECTRUM OF HELIUM.
- SPACE MAY INCLUDE 90% HELIUM 4 ATOMS, WITHOUT ANY HINT OF SPECTRUM.
- THE ONLY INTERACTION IS THE GRAVITATIONAL ATTRACTION TO BOTH USUAL MATTER AND OTHER TRANSPARENT ^{4}He BOSON ATOMS.

- **SOME OTHER ATOMS CAN BE BOSONS, BUT ONLY IN MUCH LOWER TEMPERATURES, WHICH DO NOT EXIST IN SPACE.**
- **This leaves ultracold bosonic helium 4 atoms as the only possible candidate to be the *transparent matter.***

- **The accepted age of the universe is about 14 milliard years, which are not sufficient to produce so much baryonic matter, especially helium 4. However, in IARD2012 my lecture and paper, also repeated in detail in the introduction of the paper in the proceedings of IARD2020, enabled further calculation, resulting in about 90 milliard years since the Cosmic Microwave Background radiation (CMB).**

- MY PAPER OF IARD2018 PROCEEDINGS DESCRIBED HOW QUASARS AND ACTIVE GALACTIC NUCLEI PRODUCE HELIUM 4 AND EJECT IT IN JETS IN A PROCESS MUCH FASTER THAN THE FUSION OF HYDROGEN IN THE CENTERS OF STARS. TOGETHER THEY ENABLE SUFFICIENT PRODUCTION OF HELIUM 4.

- **WHY DOES TRANSPARENT MATTER REMAIN IN A HALO AROUND A SPIRAL GALAXY, BUT DOES NOT ACCRETE INWARD AS THE USUAL MATTER DOES?**

- **WHY DOES TRANSPARENT MATTER REMAIN IN A HALO AROUND A SPIRAL GALAXY, BUT DOES NOT ACCRETE INWARD AS THE USUAL MATTER DOES?**
- **BECAUSE OF**

ROTATION

ORBITING MATTER MUST OBEY THE CONSERVATION OF ANGULAR MOMENTUM AND ENERGY.

TO ACCRETE INWARD IT MUST FIRST DECREASE THEM.

USUAL MATTER DOES IT BY FRICTION BETWEEN THE ORBITING ATOMS.

- **TRANSPARENT BOSONIC MATTER IS FRICTIONLESS AND COLLISIONLESS. IT'S ATOMS PASS THROUGH EACH OTHER AS IF THEY ARE TRANSPARENT TO EACH OTHER. THEREFORE THEY CANNOT GET RID OF THEIR ANGULAR MOMENTUM, AND REMAIN STABLE IN THEIR EXTERNAL ORBITS.**

IN THIS WAY A SPHERE OF TRANSPARENT MATTER REMAINS STABLE, WHILE ONLY THE USUAL MATTER ACCRETES INWARD AND TAKES THE SHAPE OF A DISK.

MORE DETAILS WILL BE GIVEN IN THE PAPER IN THE PROCEEDINGS, AS WELL AS A SIMILAR EXPLANATION FOR CLUSTERS OF GALAXIES.

STRUCTURE AND EVOLUTION OF THE UNIVERSE

- THE STRUCTURE OF THE UNIVERSE IS OBSERVED AS HUGE CELLS AROUND EMPTY VOIDS.
- MOST OF THE USUAL MATTER IS IN THE CURVED SHELLS THAT SURROUND THE EMPTY VOIDS.
- THESE SHELLS INCLUDE MOST GALAXIES AND ALL THE GALAXY CLUSTERS.

THIS CELL STRUCTURE OF THE UNIVERSE WAS FOUND BY THE ESTONIAN ASTRONOMER JAAN EINASTO IN 1977.

HERE WE USE THE TRANSPARENT HELIUM 4 TO EXPLAIN THIS

NOT-YET-UNDERSTOOD

STRUCTURE OF THE UNIVERSE.

WE SUGGEST THAT VOIDS INSIDE THE CELLS ARE FULL OF TRANSPARENT ULTRACOLD BOSONIC HELIUM 4 ATOMS.

THE UNIVERSE EVOLVED FROM HOT TO COLD DURING ITS EXPANSION.

WHEN THE UNIVERSE WAS HOT, IT'S HOT HELIUM BEHAVED AS USUAL MATTER, NOT APPLYING ITS POTENTIAL AS COLD BOSONIC MATTER.

HELIUM IS HEAVIER THAN HYDROGEN, AND THE ROTATION OF HUGE CLOUDS OF GAS WAS VERY SLOW, SO THEN BUOYANCY TOOK OVER:

THE LIGHTER HYDROGEN FLOATED AROUND THE HELIUM AND PRODUCED THE CURVED SHELLS OF THE CELLS AROUND THE HEAVIER HELIUM.

- LATER THE UNIVERSE EXPANDED AND COOLED.
- THE ULTRACOLD HELIUM 4 AT THE VOIDS BECAME TRANSPARENT AND LOOKED LIKE EMPTY VOIDS.
- THE MIXTURE OF HYDROGEN AND HELIUM AT THE SHELLS AROUND THE VOIDS WAS ALSO COOLED TO BE ULTRACOLD.

- BEING ULTRACOLD, THE HYDROGEN AT THE SHELLS STILL CONTINUED TO BEHAVE AS USUAL MATTER THAT IS ABLE TO GET RID OF ANGULAR MOMENTUM AND ACCRETE TO GALAXY CLUSTERS AND GALAXIES.
- THE ULTRACOLD HELIUM AT THE SHELLS BEHAVED AS BOSONIC AND REMAINED IN SPHERICAL HALOES AROUND THE HYDROGEN, UNABLE TO GET RID OF IT'S ANGULAR MOMENTUM.

IN THIS WAY THE GALAXY CLUSTERS AND SPIRAL GALAXIES EVOLVED IN THE SHELLS AROUND THE VOIDS.

MORE DETAILS WILL BE GIVEN IN THE PAPER IN THE PROCEEDINGS, AS WELL AS EXPLANATIONS OF ELLIPTICAL GALAXIES AND ADDITIONAL ASTRONOMICAL OBSERVATIONS, RESULTING IN A DETAILED EVOLUTION OF THE UNIVERSE.

ONLY THE UNIQUE FEATURES OF HELIUM 4 CAN EXPLAIN BOTH THE MISSING MASS AS THE BOSONIC ULTRACOLD TRANSPARENT MATTER, AND ALSO EXPLAIN THE EVOLUTION OF THE UNIVERSE BY QUASARS, CELLS, GALAXY CLUSTERS, SPIRAL GALAXIES, AND ELLIPTICAL GALAXIES, IN THIS ORDER.

THIS REMINDS ME CHARLES DARWIN, WHO SAID ABOUT *HIS* THEORY OF *EVOLUTION* OF THE SPECIES:

- **“I cannot believe that an incorrect theory could be able, as this theory is able, to explain facts in so many levels.”**

- **END OF LECTURE**