

DARK MATTER

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IARD2020

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OR
TRANSPARENT
MATTER?

History

**Before and after Zwicky (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.**

Spherical halo

The spherical halo of the dark matter was followed by the assumption that it is spherical because of dark matter *pressure*, without orbital rotation.

However, being collisionless and frictionless, the dark matter particles can pass freely through each other, so that the motion of the particles resembles the motion of the stars in elliptical galaxies. In this case, the conservation of angular momentum prevents the dark matter to descend toward the center of the galaxy, ***NOT THE PRESSURE.***

HELIUM 4 ATOM = ${}^4\text{He}$ 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 ${}^4\text{He}$
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**