COMETS

COMET WEST

UNLIKE METEORS, WHICH ARE FLASHES OF LIGHT, COMETS SLOWLY SHIFT THEIR POSITION IN THE SKY FROM NIGHT TO NIGHT AND REMAIN VISIBLE OVER A FEW DAYS OR A FEW MONTHS.

THERE ARE TWO TYPES:

1) MOST APPEAR ONCE, AT UNPREDICTIBLE TIMES (NONPERIODIC OR LONG-PERIOD COMETS)

2) PERIODIC COMETS, WHICH ARE OBSERVED IN REGULAR INTERVALS OF TIME NOT LONGER THAN A FEW HUNDRED YEARS (E.G. THE HALLEY'S COMET WITH A PERIOD OF 76 YEARS).

HALLEY'S COMET

IN THE PAST THE APPEARANCE OF A COMET WAS CONSIDERED AS AN OMEN.

PREVIOUS APPEARANCES OF HALLEY'S COMET:

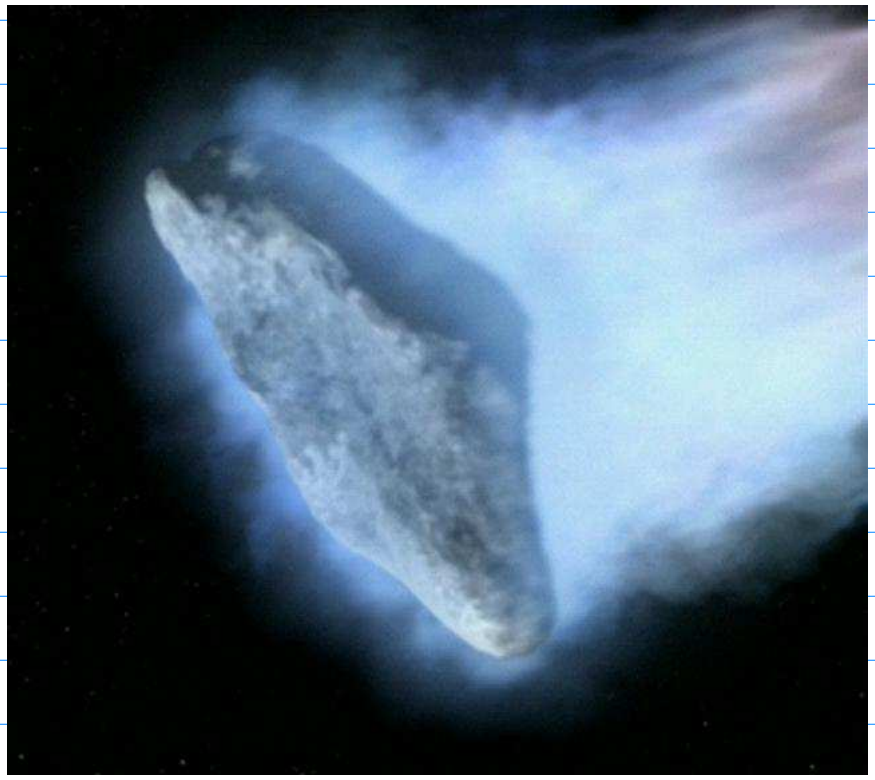
66 AD (DESTRUCTION OF JERUSALEM IN 70 AD)

451 AD (DEFEAT OF ATTILA THE HUN)

1066 AD (NORMAN CONQUEST OF ENGLAND)

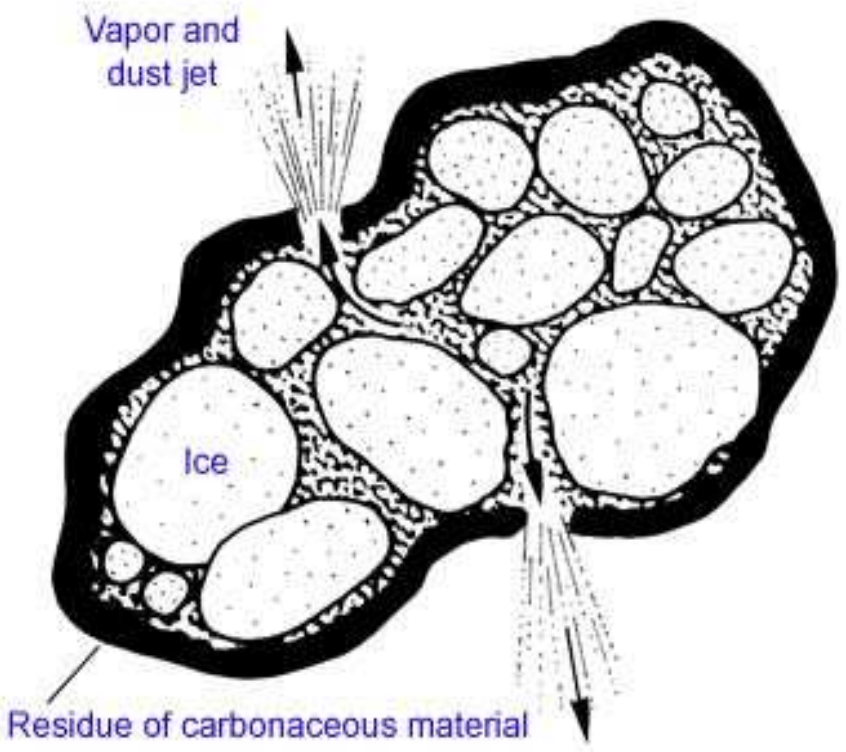
1456 AD (THREATENED INVASION OF EUROPE BY THE TURKS)

PHYSICAL PROPERTIES OF COMETS

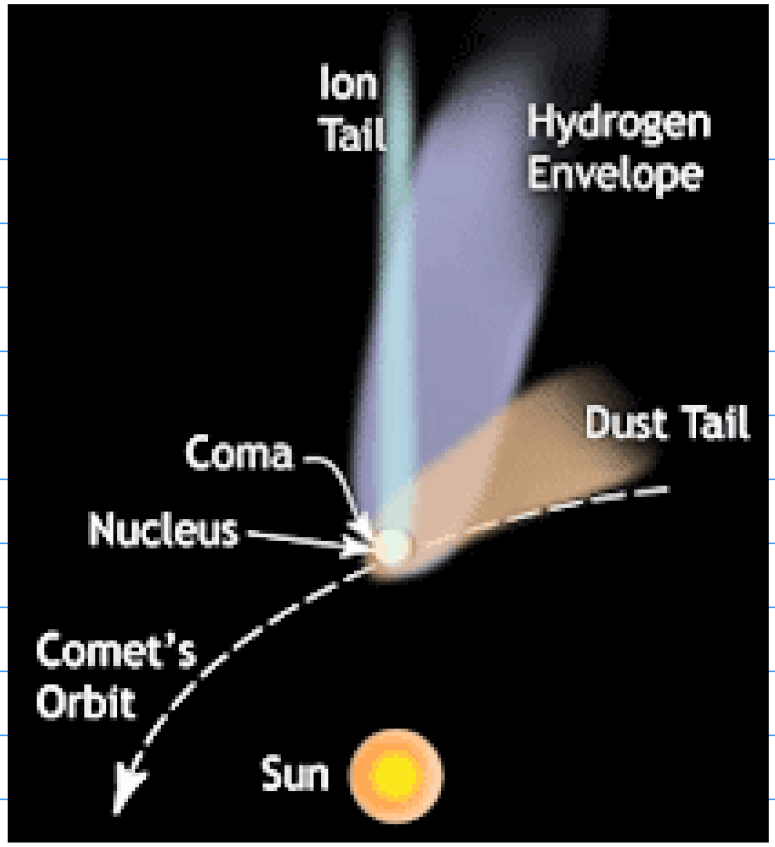


NUCLEUS OF A COMET

THE NUCLEUS OF A COMET RESEMBLES A "DIRTY SNOWBALL" – IT IS MADE UP FROM WATER ICE, FROZEN AMMONIA AND FROZEN GASES LIKE METHANE AND CO_2, WITH SMALL AMOUNTS OF ROCKS:



WHEN A COMET COMES CLOSE ENOUGH TO THE SUN, AT ABOUT 4–6 AU, THE SOLAR HEATING CAUSES EASILY VAPORIZED SUBSTANCES TO BOIL OF AND THE COMET FORMS A TAIL:



NUCLEUS: 1–40 km ACROSS

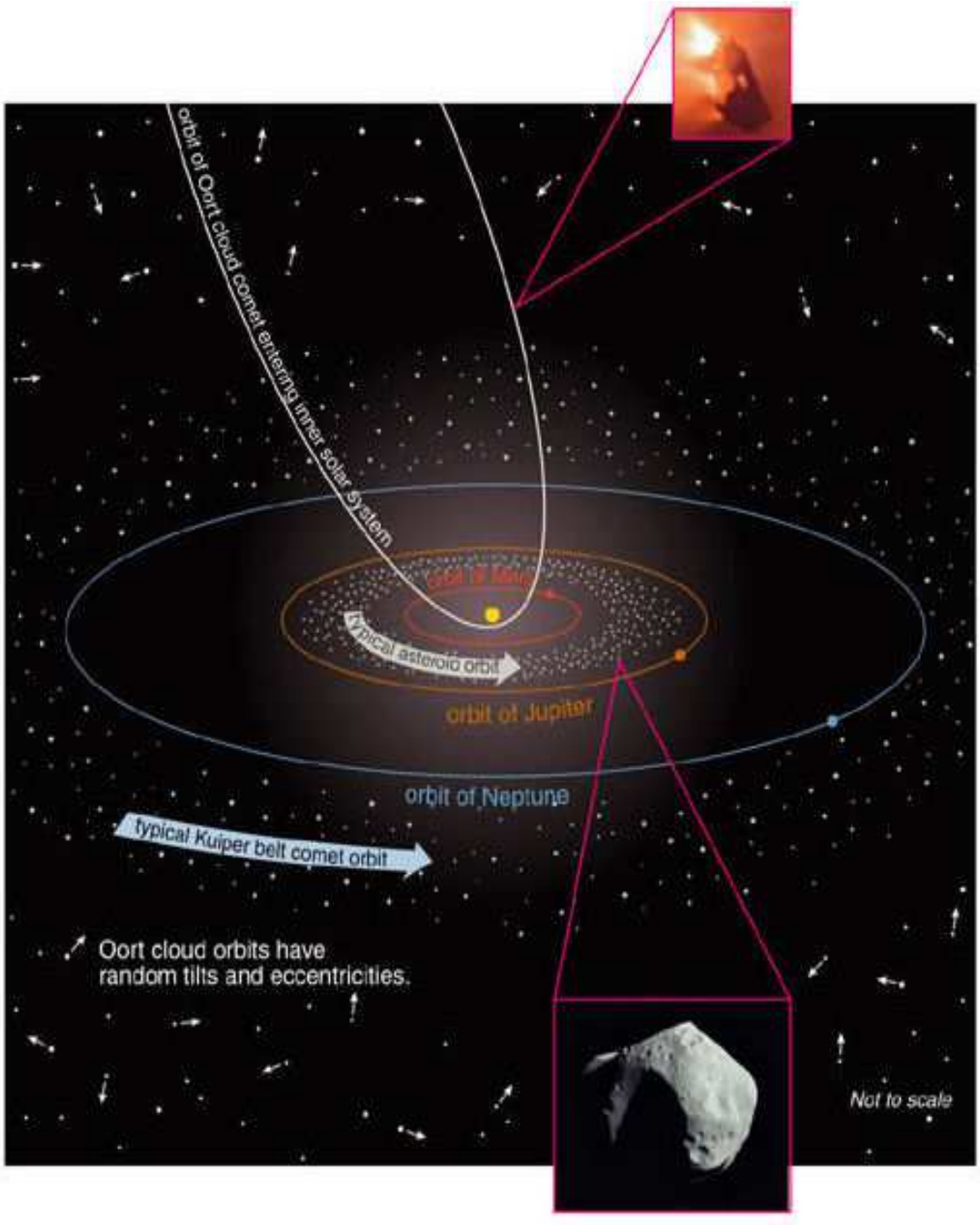
COMA: A GLOWING BALL OF GAS
100,000 km – 1,000,000 km ACROSS

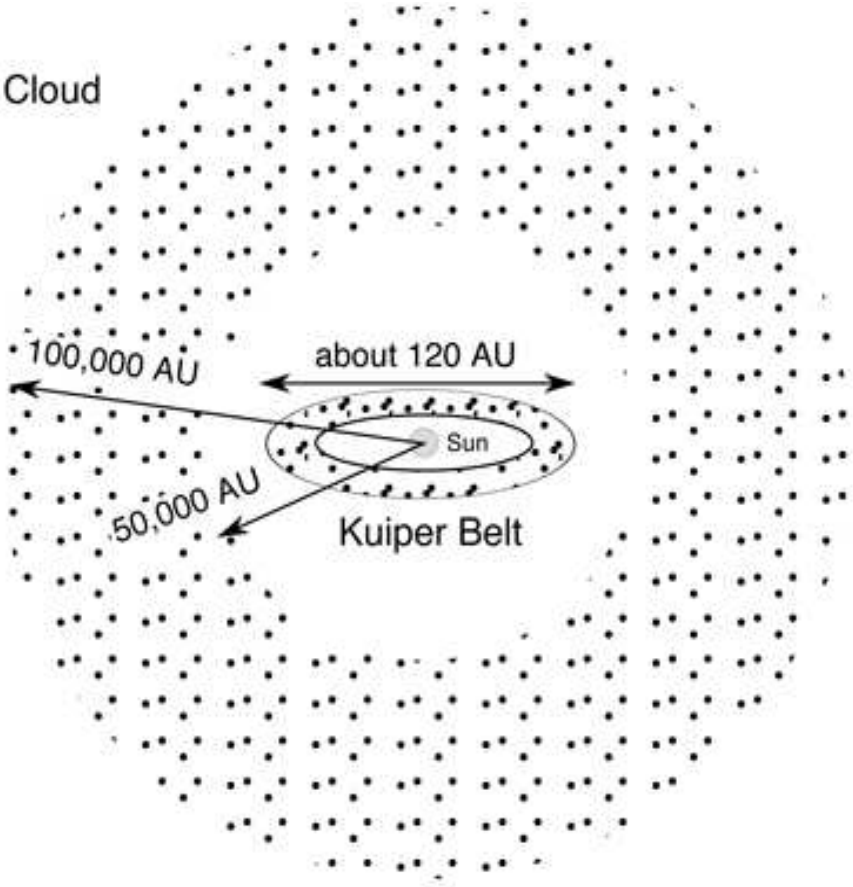
ION TAIL: SMALL CHARGED MOLECULES (IONS) ARE PUSHED AWAY FROM THE SUN BY SOLAR WIND AND RADIATION PRESSURE (PHOTONS HAVE MOMENTUM).

DUST TAIL: LARGER PARTICLES ARE PUSHED AWAY BY RADIATION PRESSURE BUT THEY MOVE MORE SLOWLY BECAUSE OF THEIR LARGER MASS;

AS A RESULT THE DUST TAIL IS SLIGHTLY CURVED.

THE ORBITS OF MOST COMETS ARE NOT IN THE PLANE OF THE ECLIPTIC – LONG PERIOD COMETS PASS THE SUN FROM ALL DIRECTIONS:





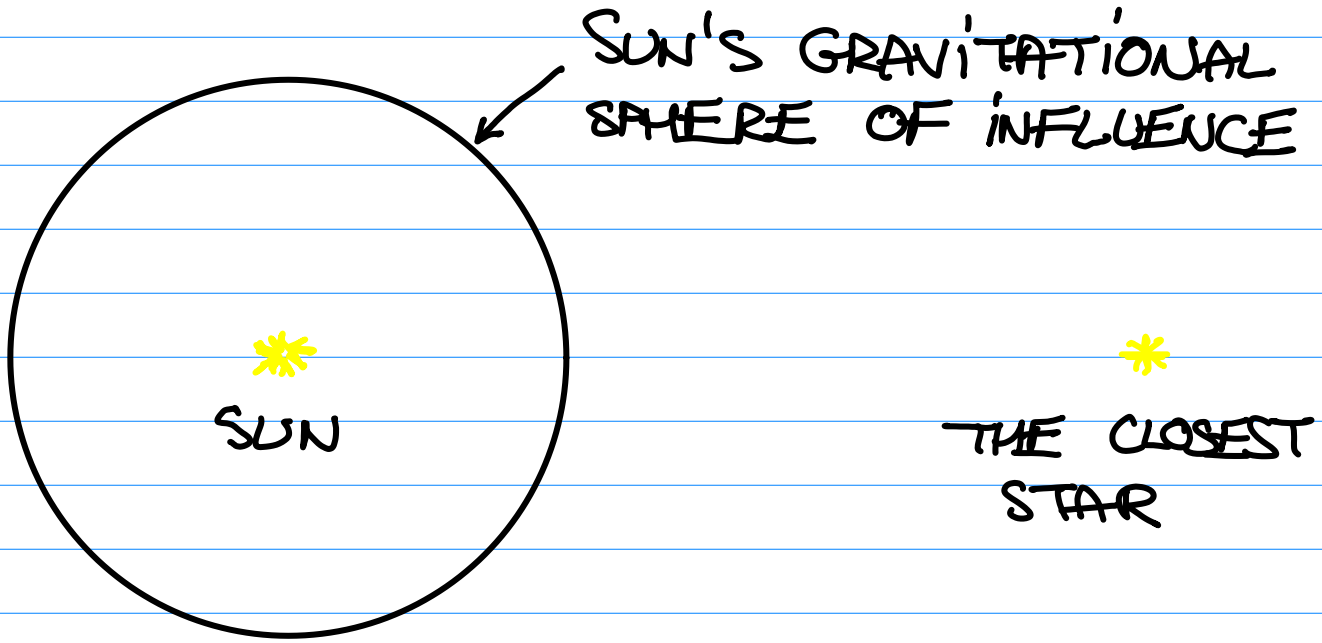
The Oort Cloud and Kuiper Belt (not to scale!). Extent of the two comet reservoirs are indicated. The nearest star is almost three times farther out than the Oort Cloud.

MOST PERIODIC (OR SHORT PERIOD) COMETS COME FROM KUIPER (PRONOUNCED COY-PER) BELT – A FLAT RING FROM ABOUT THE ORBIT OF NEPTUNE (≈30AU) UP TO ABOUT 60 AU

THE LONG PERIOD COMETS COME FROM THE OORT CLOUD – A SPHERICAL SHELL FROM ABOUT 50,000 AU TO ABOUT 100,000 AU FROM THE SUN.

HOW DO WE KNOW THIS?

THE GRAVITATIONAL SPHERE OF INFLUENCE OF A STAR (E.G. THE SUN) IS THE DISTANCE WITHIN WHICH IT CAN EXERT A SUFFICIENT GRAVITATIONAL PULL TO HOLD ONTO THE ORBITING OBJECTS. IT IS ABOUT 1/3 OF THE DISTANCE TO THE NEAREST STAR

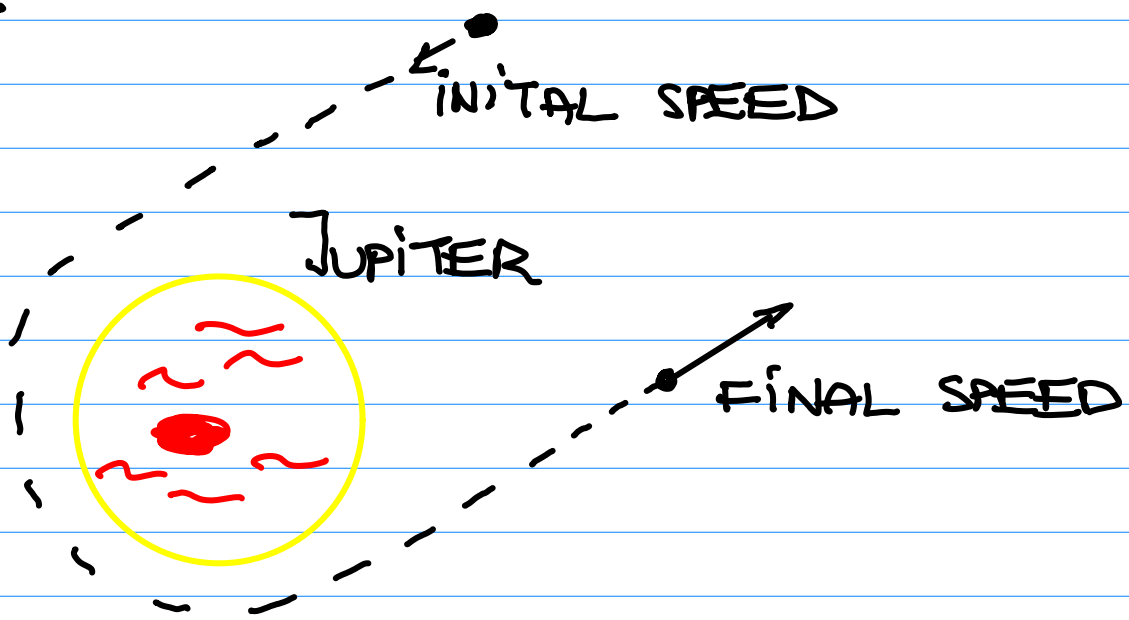


THUS FOR THE SUN IT IS ABOUT 1 ly ≃ 60,000 AU.

THE COMET NUCLEI FORMED BY AGGREGATION OF GAS CRYSTALS AND DUST GRAINS IN THE COLD, OUTER REGIONS OF THE SOLAR SYSTEM.

BEYOND THE DISTANCE OF SATURN AND URANUS. THEY ORBITED THE SUN IN THE SAME PLANE AS ALL THE PLANETS.

AS THE OUTER PLANETS GREW IN SIZE THEIR GRAVITATIONAL INFLUENCE BECAME MORE SIGNIFICANT, AND THEY WERE ABLE TO KICK OUT THE COMET NUCLEI TO GREAT DISTANCES FROM THE SUN:



SLINGSHOT EFFECT

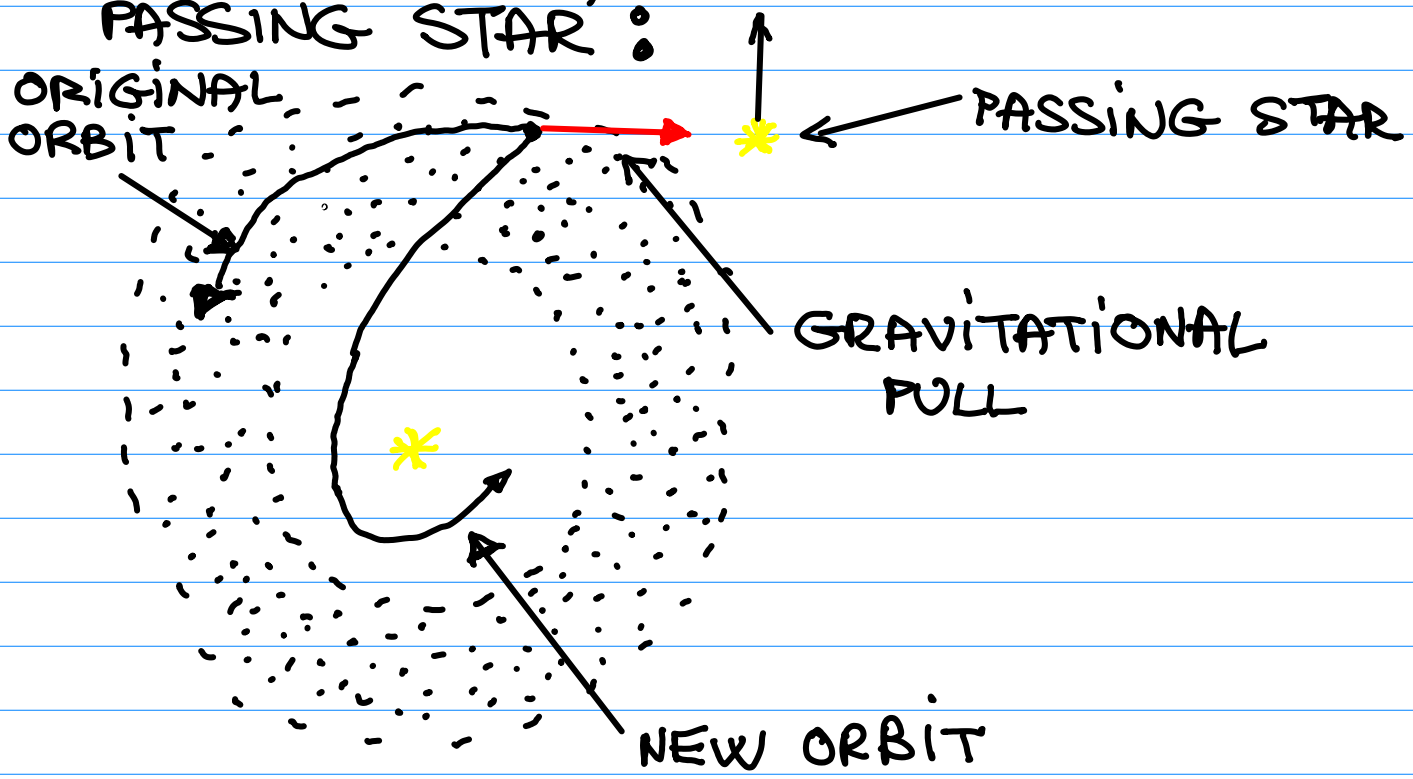
AFTER A FEW BILLION YEARS MOST OF THE NUCLEI FROM THE DISK WERE KICKED OUT FORMING THE OORT CLOUD.

THE COMET NUCLEI THAT WERE OUT OF GRAVITATIONAL REACH OF JUPITER

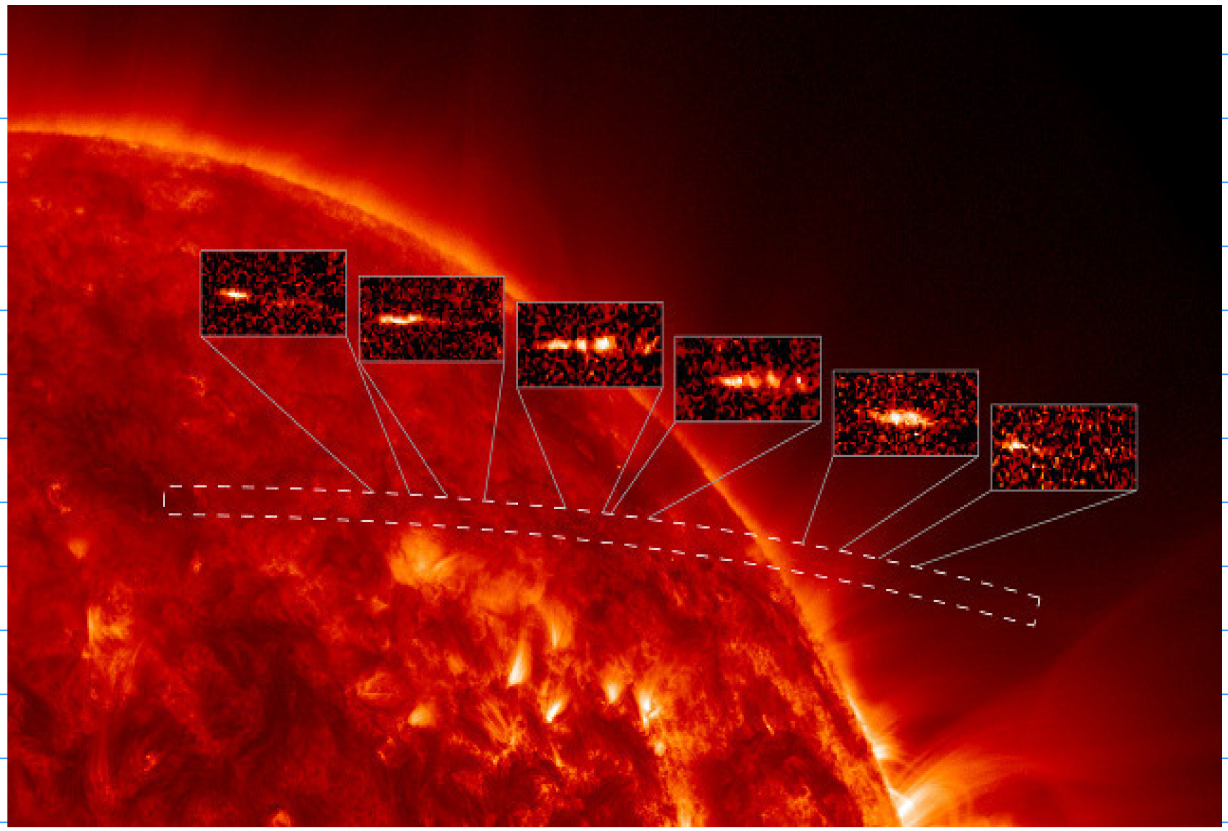
AND SATURN STAYED BEHIND FORMING THE KUIPER BELT.

HOW DOES A COMET NUCLEUS ORBITING THE SUN AT 50,000 AU TO 100,000 AU BECOME A LONG PERIOD COMET THAT WE OBSERVE AT 4-6 AU FROM THE SUN?

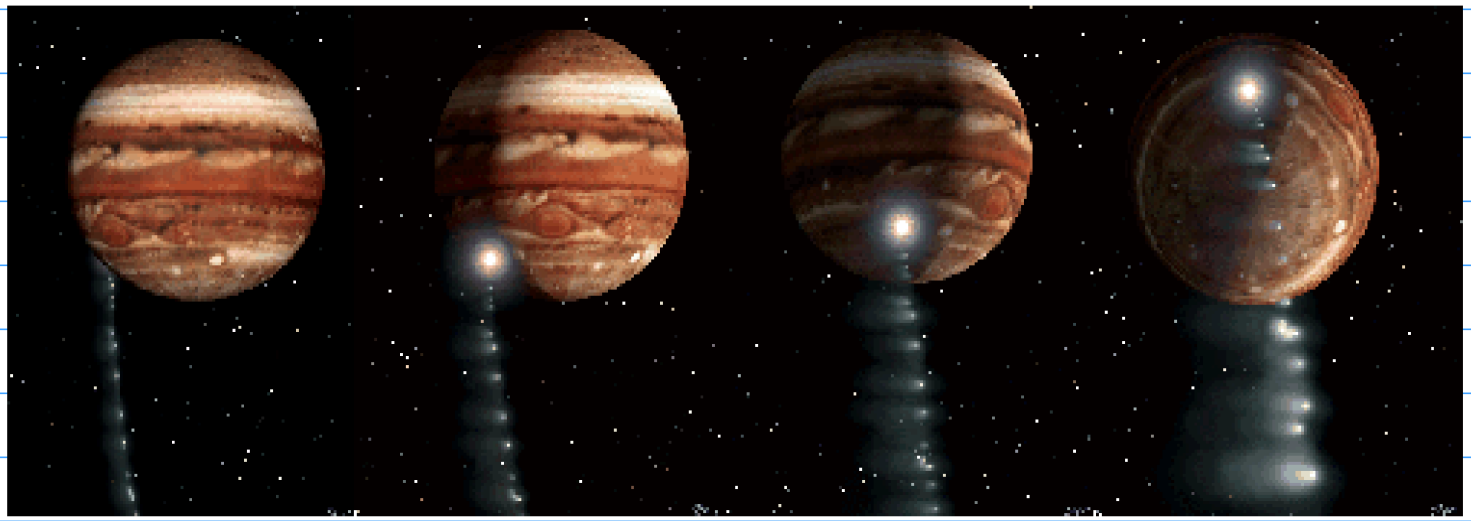
IT IS PROBABLY PUSHED IN BY A PASSING STAR:



MANY COMETS COLLIDE WITH THE SUN:



AND SOME COLLIDE WITH PLANETS:



COMET SHOEMAKER-LEVY CRUSHES INTO JUPITER (1994).