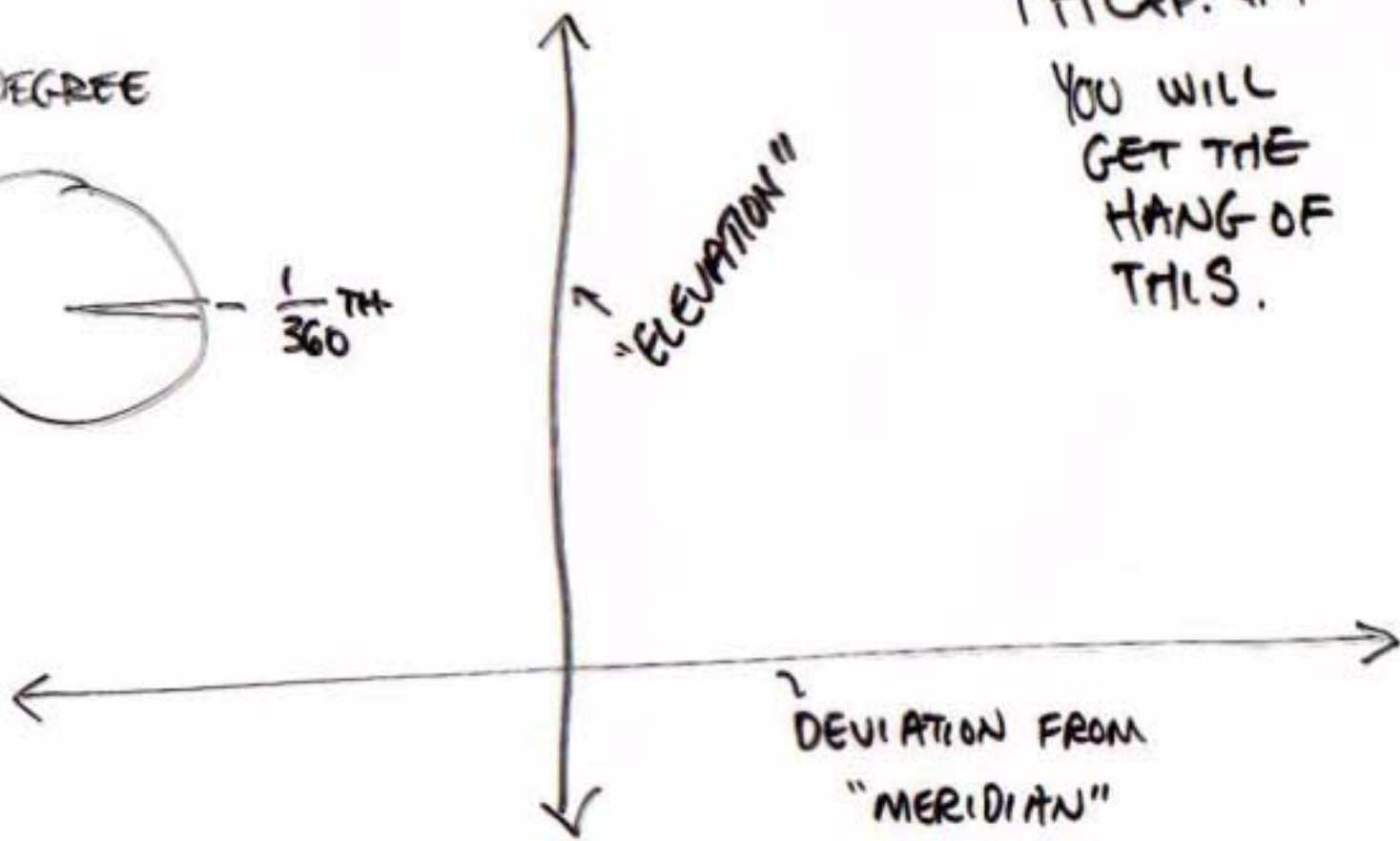
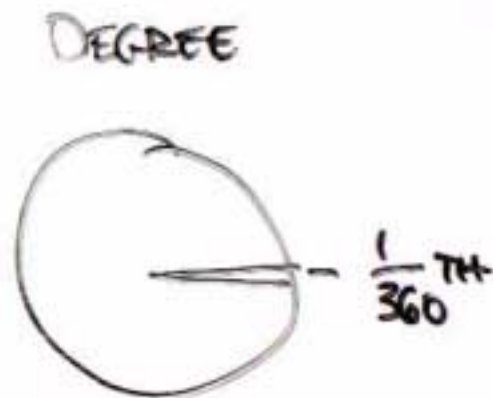


□ IN THE SKY - ANGLES ARE EVERYTHING -

NEED 2 ANGLES TO LOCATE SOMETHING



THEXP. #1

YOU WILL
GET THE
HANG OF
THIS.

□ RELIABLE NAKED-EYE STAR-MEASUREMENT (ASTRONOMY)

- ANGLES ARE MOST NATURAL MEANS.

☆ ← 5 INCHES "ON PAPER" → ☆

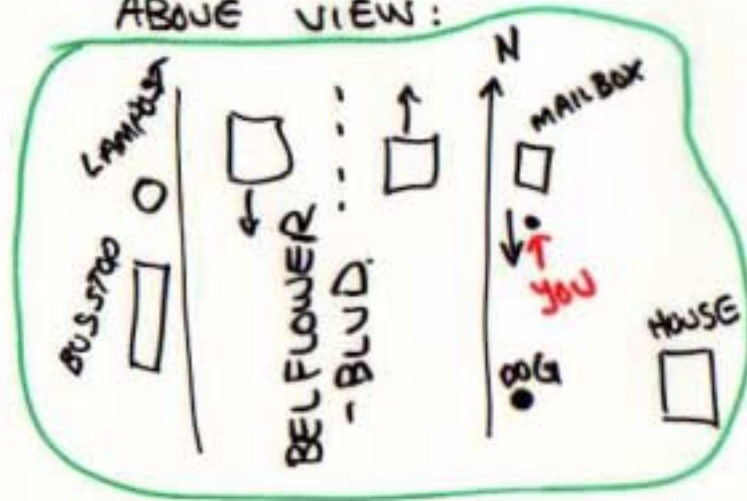
Q: HOW FAR APART ARE THESE STARS?

- FRAME OF REFERENCE

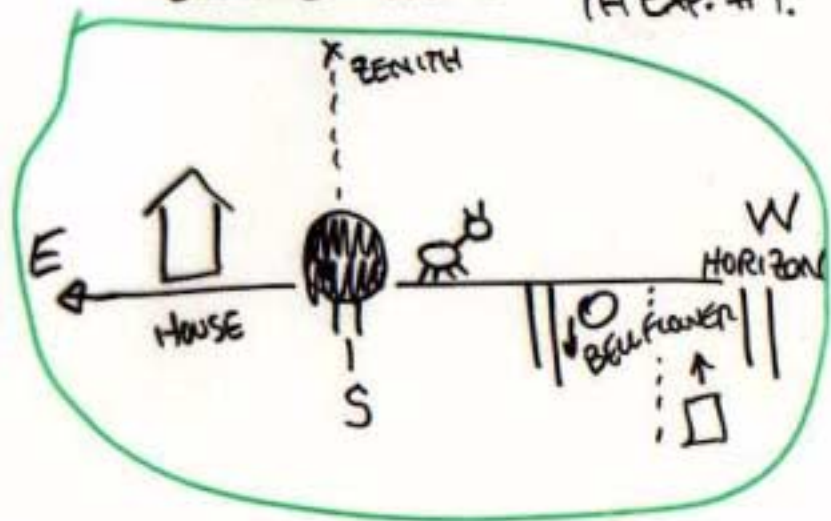
EVERYTHING IN THE SKY MOVES!

START WITH GROUND ← TREES, HOUSES, MOUNTAINS
DEFINE THE REF. FRAME.

ABOVE VIEW:



"BEHIND HEAD" THE EXP. # 1.



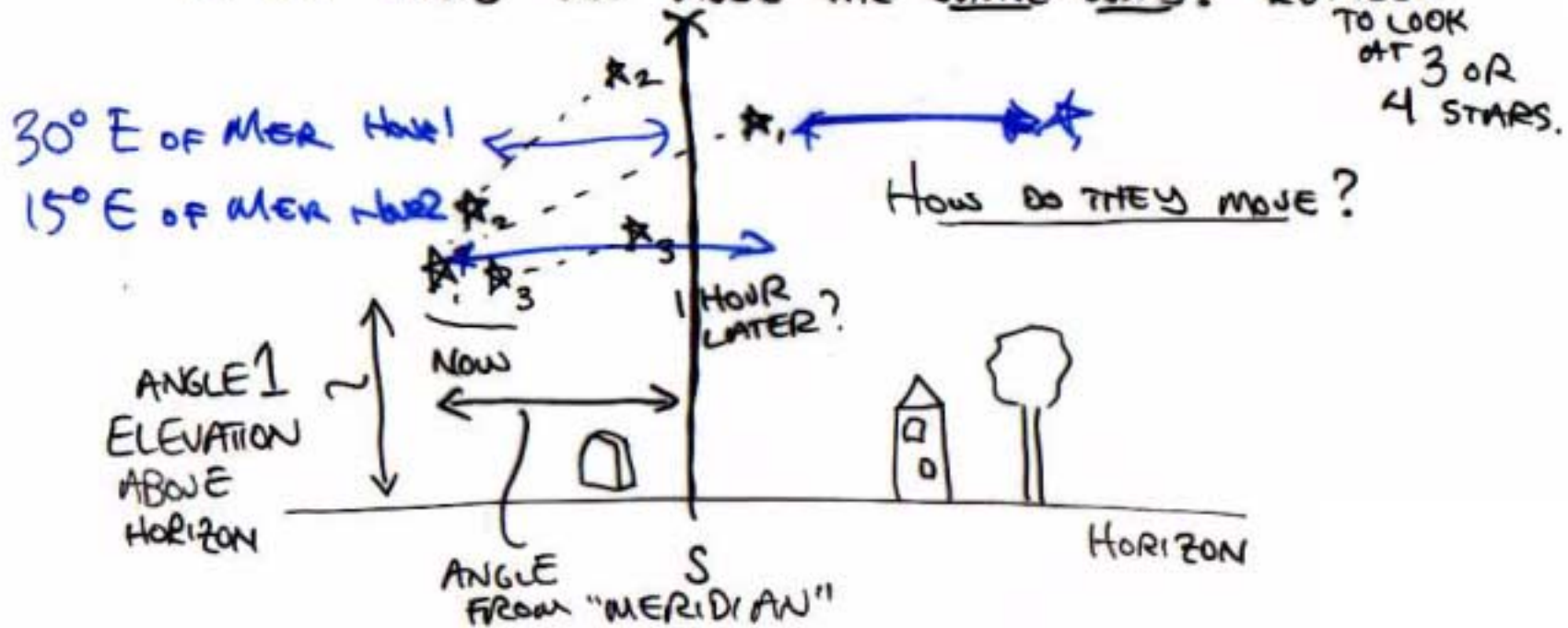
□ REPEATABLE, RELIABLE FRAME OF REF.

THEXP. #1

ALLOWS YOU TO ANSWER A QUESTION. (EXPERIMENT?)

1. Do STARS MOVE IN THE SKY?

2. Do THEY ALL MOVE THE SAME WAY? NEED TO LOOK AT 3 OR 4 STARS.



2 ANGLES LOCATE EACH STAR.

DUE Thursday
1 week from
today

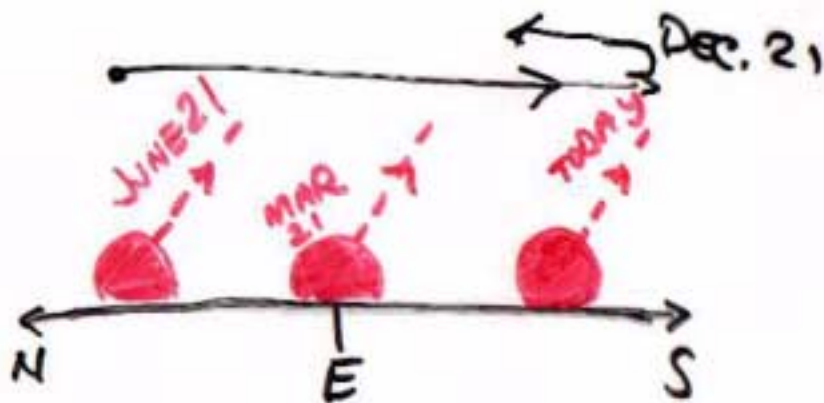
☐ CONSTANCIES + REGULARITIES TO EXPLAIN
IN NAKED-EYE ASTRONOMY

PAGE 1-3

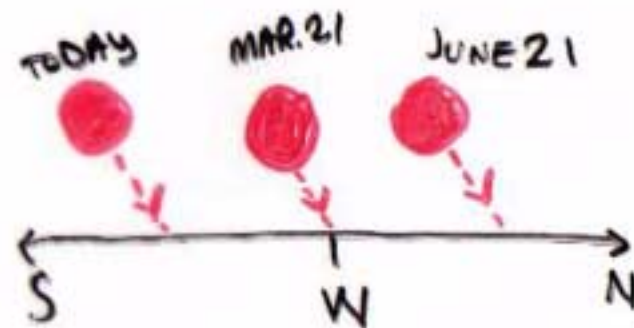
- ? NAKED-EYE? - WITHOUT A TELESCOPE
- WITHOUT A SPACESHUTTLE
- YOU CAN USE EYEGASSES - THOUGH

THE SUN COMES UP

THE SUN GOES DOWN.



THE SUN DOESN'T ALWAYS COME UP IN THE SAME PLACE! / NOT EVEN THE SAME TIME!



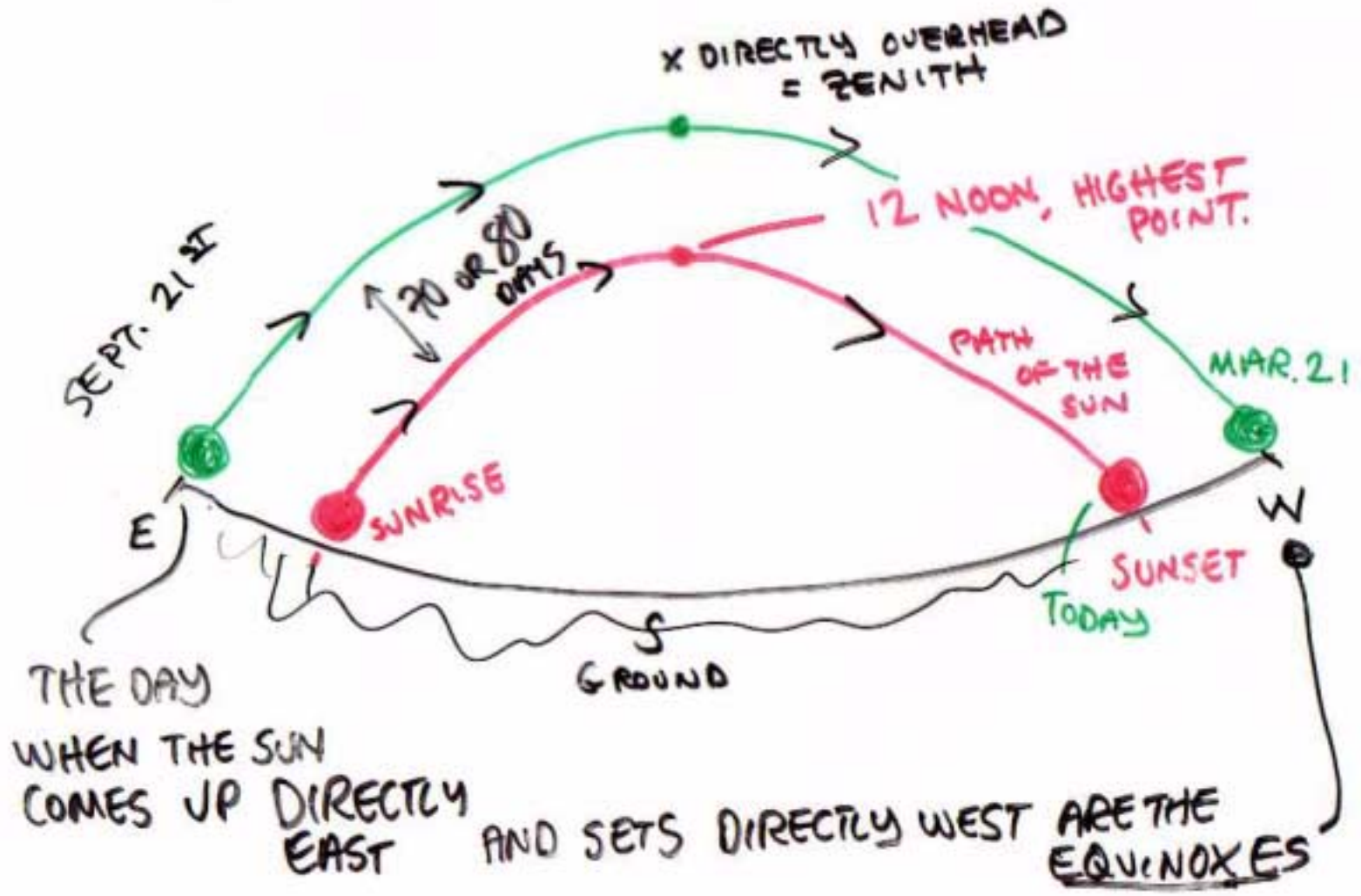
DOESN'T GO AWAY IN THE SAME SPOT... DEPENDS ON TIME OF YEAR!

CAN IT BE SO?

☐ LOOK IN THE SKY + EVERYTHING IS MOVING:

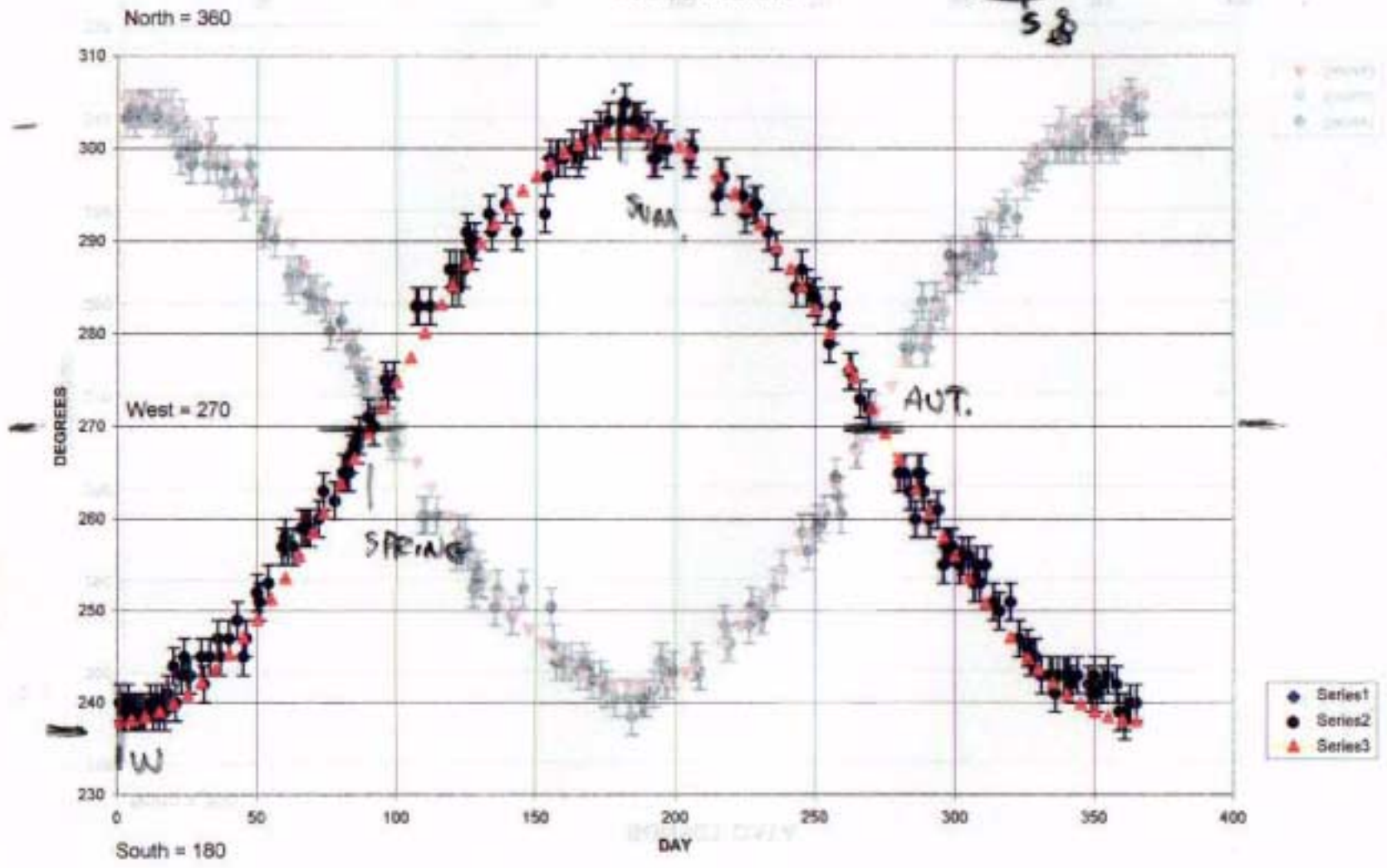
OVER 24 HOURS, EVERYTHING - ALMOST COMES BACK TO EXACTLY SAME SPOT. - DAY

OVER A COUPLE OF DAYS, THINGS CHANGE





SUNSET DATA

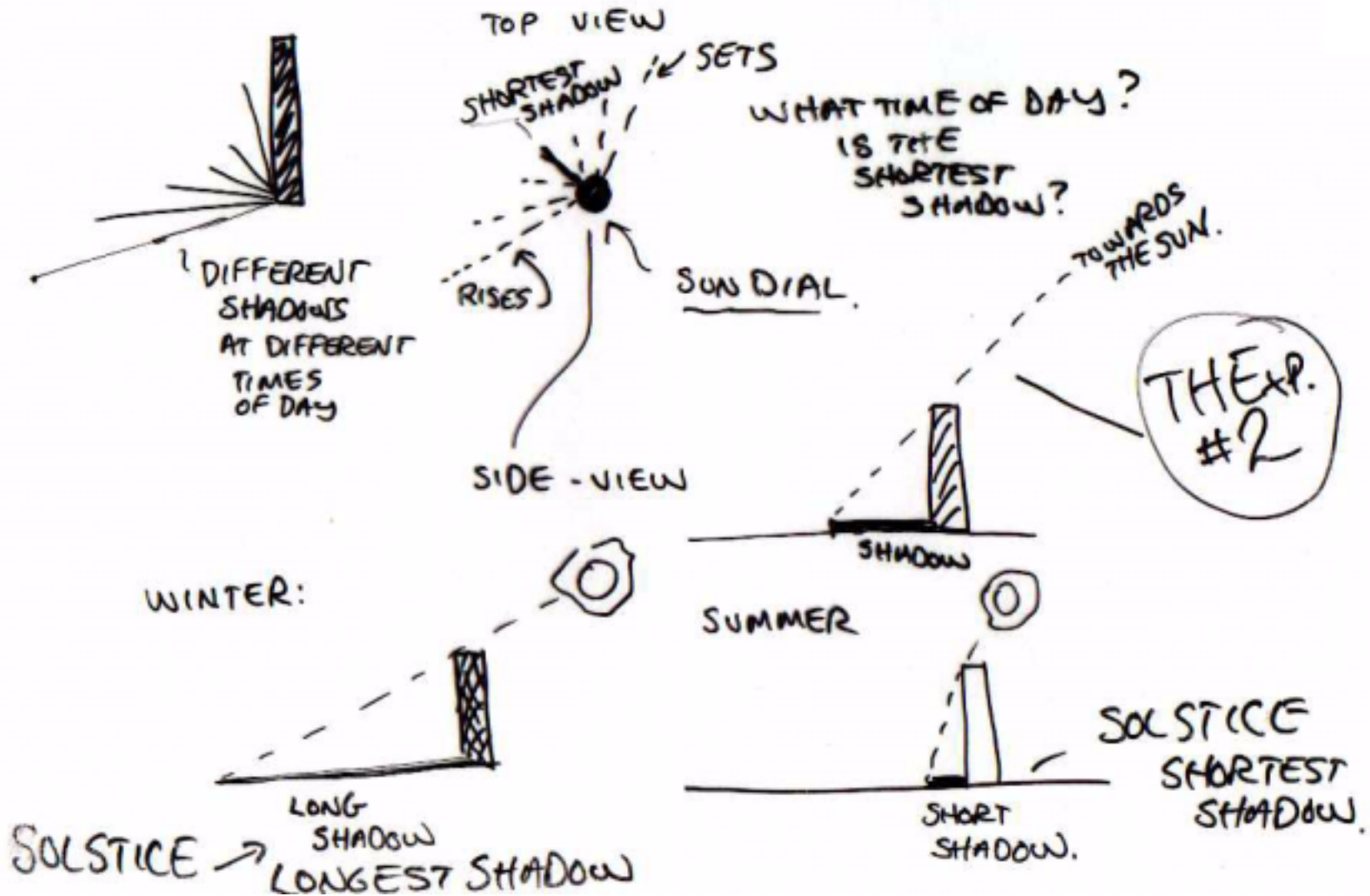


SOLSTICE

OTHER PATTERNS:

PUT A STICK IN THE GROUND, + LOOK AT ITS SHADOW:

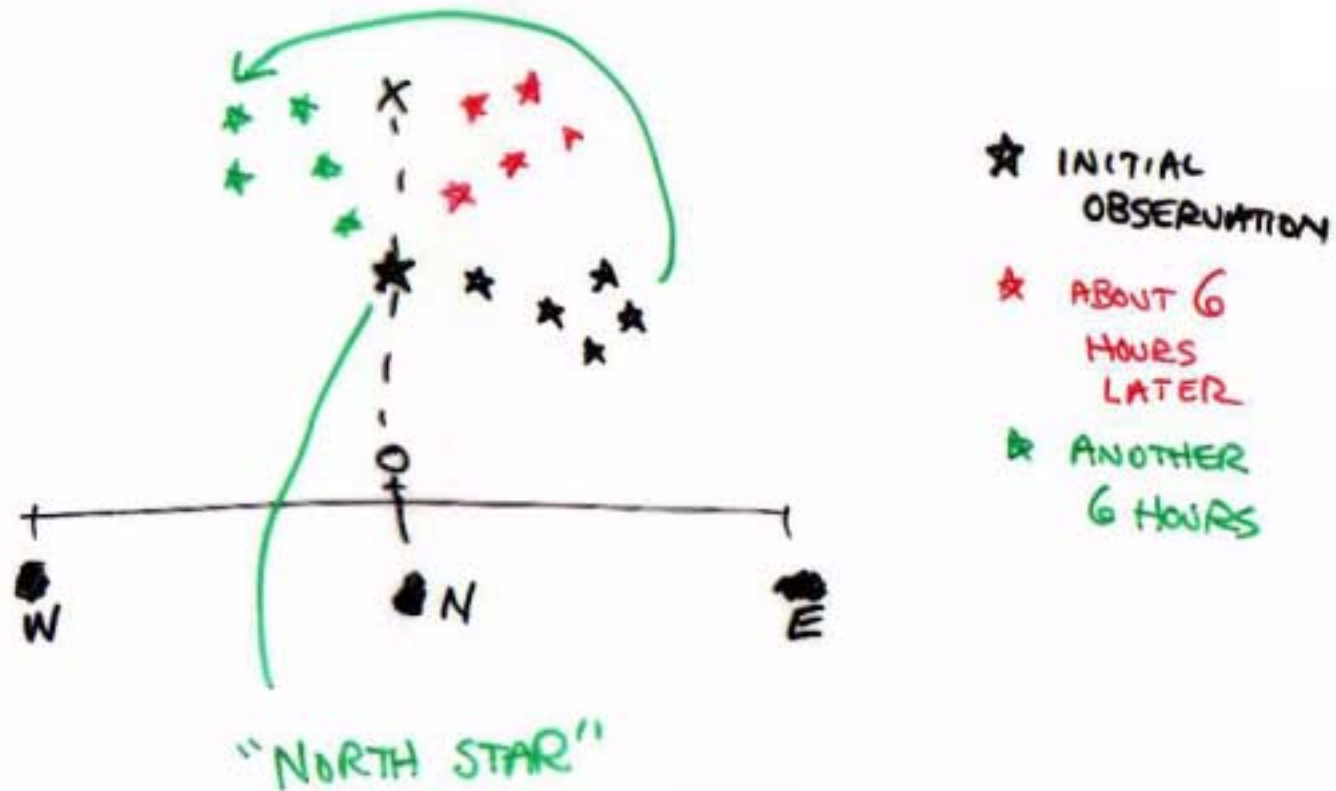
YEARLY PATTERNS



□ SOMETHINGS NEVER CHANGE:

ONE STAR DOESN'T SEEM TO MOVE AT ALL!

HYPOTHETICAL OBSERVATIONS:



IS IT SO, + WHAT COULD BE THE EXPLANATION?!

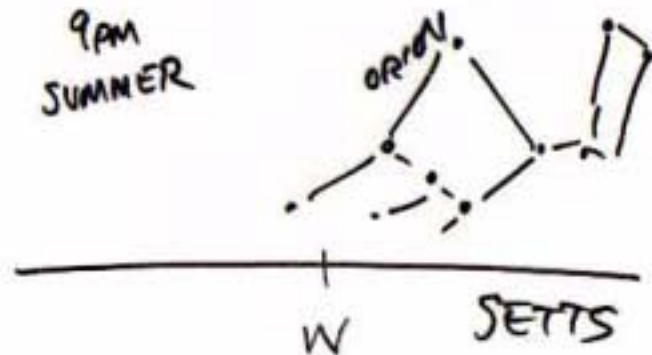
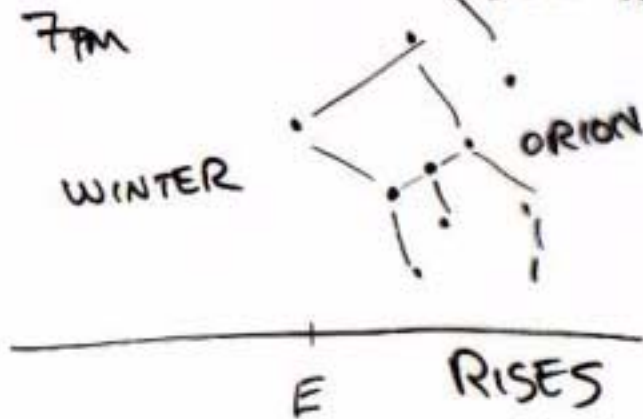
□ SOME THINGS DON'T MOVE WITH THE STARS.

- SUN MOVES ...

MOON ISN'T ALWAYS NEAR THE SAME SET OF STARS

5 STAR LIKE "PLANETS" ARE FREE TO MOVE AMONGST THE STARS

WHILE STARS THEMSELVES ROTATE AS A "TIGHT PACKAGE" - WE DON'T ALWAYS SEE THE SAME STARS!

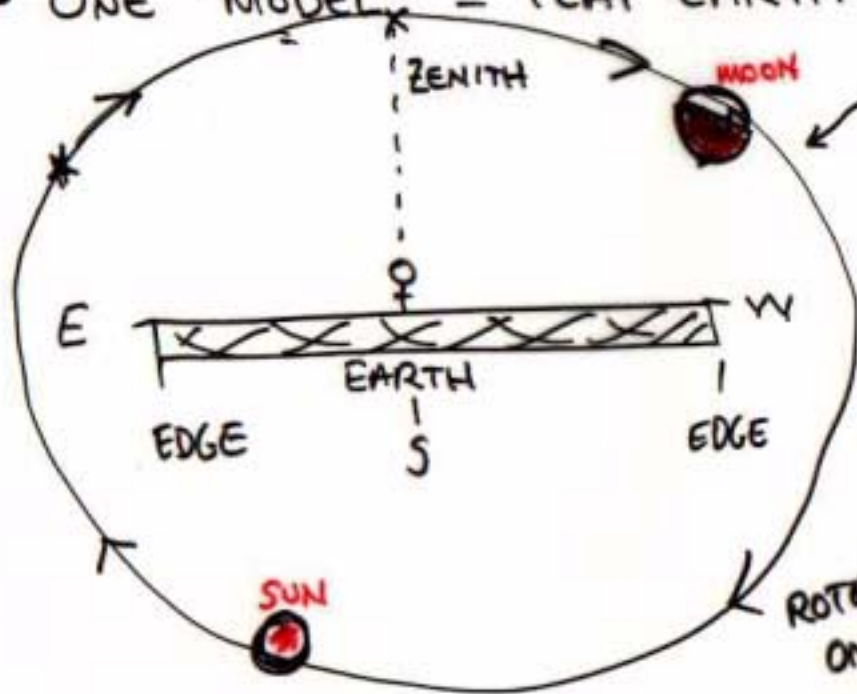


□ 2 MODELS FOR THE OBSERVATIONS

BASIC OBSERVATION: ALL STARS MOVE TOGETHER
ANGLES BETWEEN STARS ARE FIXED!

- ONE "MODEL" - FLAT EARTH

"NIGHT,
ONE STAR
OUT,
MOON ABOUT
TO SET"



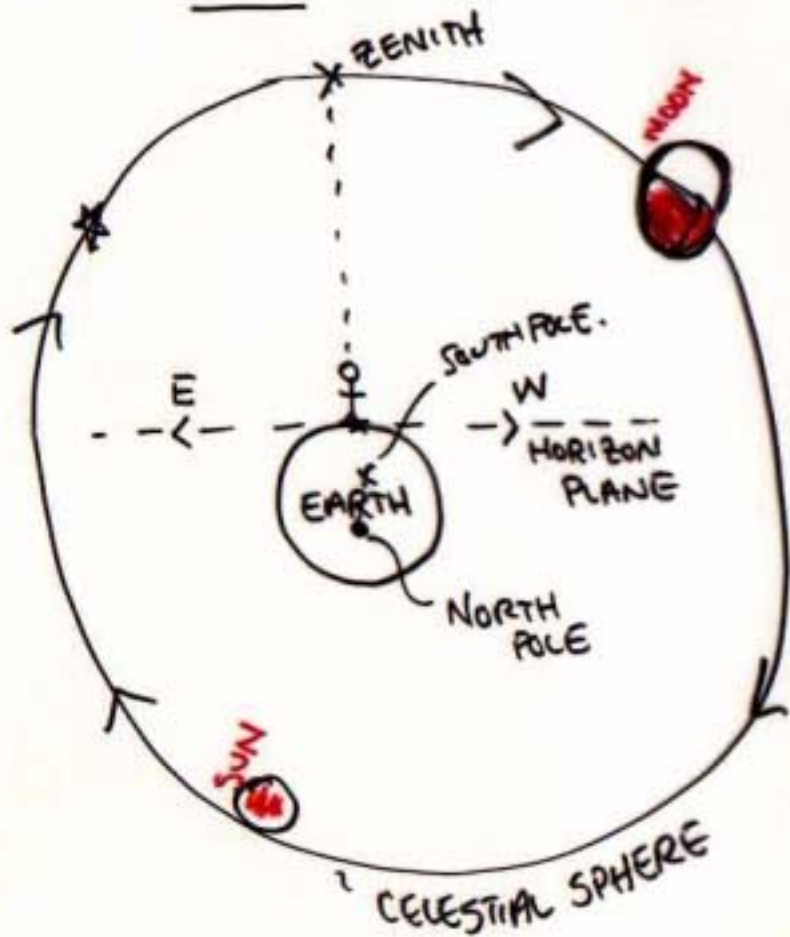
GIANT BALL
"SPHERE"
STARS ARE CONNECTED
TO BALL,
+ BALL ROTATES
AROUND EARTH!

ROTATES
ONCE/DAY

YOU CAN'T EVEN FORMULATE THIS MODEL
WITHOUT RELIABLE ANGULAR MEASUREMENTS
+ A REPRODUCIBLE FRAME OF REF.

□ SECOND MODEL (CONT.)

● ROUND EARTH + CELESTIAL SPHERE

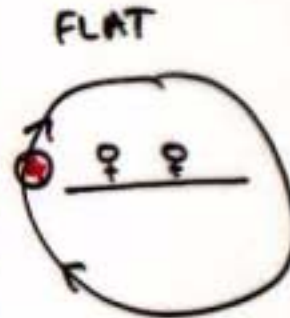


CLASSICAL ANTIQUITY

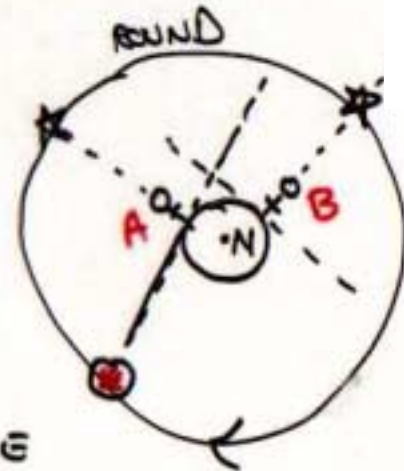
BC ~ 1000 - AD 500

KNEW THIS TO BE THE CASE.

DIFFERENCES BETWEEN
FLAT + ROUND MODELS?



SUN RISES
FOR EVERYONE
AT SAME
TIME!



SUN RISES
FIRST FOR A
THEN FOR B
A + B HAVE
DIFFERENT
STARS OVERHEAD
"ZENITH".

BOTH PREDICT ★'S MOVE
TOGETHER.

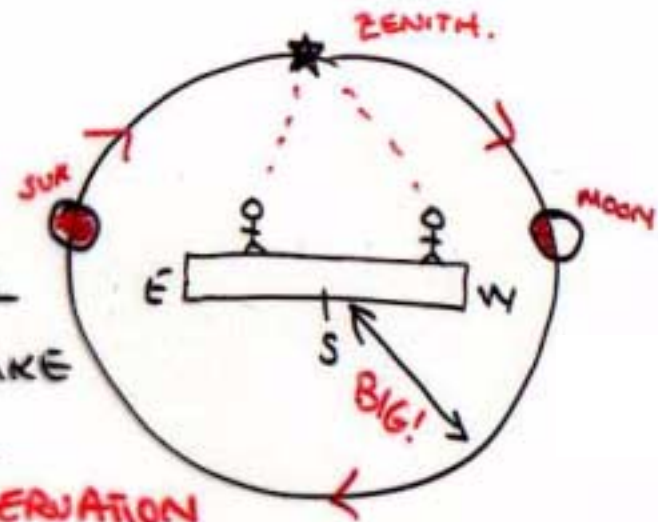
□ MODEL COMPARISONS + ASSUMPTIONS

• FLAT EARTH MODEL

SIMPLE,
ELEGANT
IDEA.

ASSUMES EVERY TERRESTRIAL
FRAME OF REF. IS JUST LIKE
ANY OTHER (IF SPHERE IS BIG
ENOUGH. —

NOT SO - BY OBSERVATION
+ MEASUREMENT.



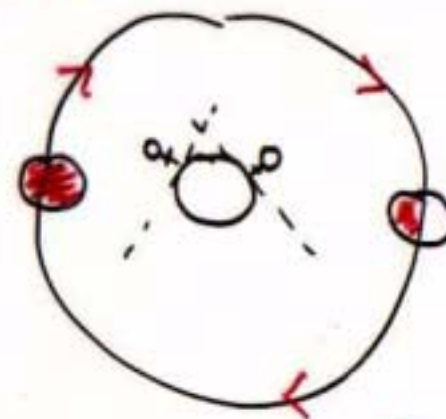
• CELESTIAL SPHERE + ROUND EARTH

MORE
COMPLICATED
BUT MORE
POWERFUL.

1) YOUR HORIZON, ZENITH DEPEND
ON YOUR POSITION!

2) MOTION IN THE HEAVENS IS
DIFFERENT FROM MOTION ON
EARTH

3) NEED ANOTHER SPHERE FOR SUN, MOON, EACH PLANET -
THEY DON'T MOVE RIGIDLY WITH THE STARS!



□ NOT A "UNIVERSAL" EXPLANATION, BUT IT WORKS IN
SOME LIMITS.