Heart of mercury tested for clock

The physical principles for a new atomic clock are being investigated by physics professor Dr. Hans A. Schuessler and his research group at A&M.

They set this goal when they went to work to develop the heart of a device more accurate than present atomic clocks. The present cesium beam atomic clock and the hydrogen laser are accurate to about one second in 30,000 years.

Schuessler began his work before coming to TAMU and, in 1972, became one of three scientists in the field of precision measurements to receive the Precision Measurement Grant made by the National Bureau of Standards annually.

"Time is one of the most accurately measurable quantities today," Schuessler said, "and since space flight is a reality, accurate time measurements are needed. Today's methods have reached their physical limits in their present systems. On the other hand, with our proposed method we have not yet seen our limits.

"In a clock, the pendulum determines the accuracy," he explained. "In an atomic clock, we use the internal vibration of an atom as the pendulum.

"In our project, mercury ions are prepared in such a way that they freely float in space and are unperturbed by their environment," Schuessler pointed out. "We put about a million ions in an ion cage and suspend them by electromagnetic fields in an arrangement of hyperbolic electrodes. The ions are then polarized so that they all are oriented along one axis, which is determined by an external magnetic field.

"To discover the internal vibration or hyperfine frequency of the ion, a variable frequency is applied to the ion cloud until the correct frequency depolarizes the ions," he explained. "This frequency is then measured and related to the standard definition of the second used in a normal clock.

"We chose mercury because it has the highest internal frequency (hyperfine structure) of the elements that we are interested in," Schuessler added. "The higher the frequency, the more accurate the measurement can be made."

Possible inhibitors of cancer studied

Cyclic AMP may be the answer to many questions about the growth and inhibition of cancer, A&M scientists believe.

Cyclic Adenosine Monophosphate (AMP), noted researchers Joseph Nagyvary and Robert Gillen of the Department of Biochemistry and Biophysics, is naturally occurring in the body and is implicated in many physiological problems, among them cancer.

Normally in cellular growth, there is little cyclic AMP per cell and the cells grow. As growth nears natural limits, the cyclic AMP increases and the cells stop dividing. If cyclic AMP could be introduced into cancerous cells, tumor growth would probably be halted, according to Dr. Gillen.

"However, administration of cyclic AMP is not effective because researchers found that it was rapidly destroyed by the body and didn't penetrate tissues efficiently," he continued.

To combat this, the A&M group developed a series of analogs (synthetics) of cyclic AMP which are neutral triesters.

"These compounds are not easily destroyed in the body and are more effective than cyclic AMP as a growth inhibitor of tumor cells in tissue cultures," Gillen went on. "Moreover, mice with cancer have had their life spans increased up to 50 percent when the neutral triesters have been used for chemotherapy.

"We need to know how our compounds affect other physiological processes," he observed. "Further knowledge along these lines is necessary to show the suitability of these analogs for treatments. Besides, we have hope that neutral triesters of cyclic AMP may be of benefit in diseases such as psoriasis, shingles and even obesity."

Current research by the A&M group is proceeding in three phases. First, work is continuing on improving the yield of neutral triesters in organic synthesis. Another area is devoted to animal and tissue culture studies. Finally, the interaction of neutral triesters with enzymes associated with cyclic AMP metabolism is also being investigated.