What is the best way keeping my beer cold?

Drinking beer is doing physics. Imagine you want to keep your beer cold during a hot summer's day - the transport of heat in your beverage is described by the heat equation. In this project your objective is to numerically investigate different ways of keeping an enjoyable temperature of your beer.

You will learn: Numerically solving partial differential equations.

Suggested reading: G&N chapters 5,6,10 (note that the heat equation is the same as the Diffusion equation or the Schrödinger equation in imaginary time).

Physics considerations (possible examples):

What boundary condition does a normal glass represent? What about cooling using ice (non-melting) or thermo container? What would happen if local internal cooling is provided? What influence has the shape of the container?

An alternative project would be to consider cooking, such as boiling an egg or a ham.

The interested student could also perform measurements on their favorite liquid/food at appropriate conditions.

Numerical considerations (possible examples):

Solve the dynamic diffusion equation numerically (maybe using a finite difference method) and discuss the chosen method with respect to stability, accuracy, and speed vs size of system.

An alternative approach is to investigate the equilibrium behavior (maybe using a relaxation method) and in this case discuss the chosen method with respect to performance.

Handling of matrices

It may be a good idea to take advantage of a matrix library for updating the matrices, e.g. inverting matrices. In Matlab, the functions are built in and possible libraries for other languages are:

C++: Boost, http://www.boost.org
Java: JAMA, http://math.nist.gov/javanumerics/jama/

The report should include:

- Description of the problem you have chosen to study.
- Description and motivation of the algorithm(s) used. Discussion on stability, speed, etc. as appropriate for the chosen algorithm.
- Results of simulations (and possible measurements).
- Conclusions
- Appendix: include a listing of your program. Also, send your program by e-mail to henrik@thep.lu.se.

Deadline for the project is 23:59:59, 2010-09-24