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Update on the DoITPoMS Project: A Global Resource for Web-Based Teaching and Learning of Materials Science

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Talk Outline

- History, Scope & Objectives
- Recent, Current & Projected Usage Levels
- The Micrograph and Video Clip Libraries
- Teaching and Learning Packages

Background to the initiative

- **MATTER ("MATerials Tertiary Educational Resources") - U. Liverpool (1990). Teaming of academics & professional programmers to produce educational modules. CDs marketed. Still active - now largely for industry & schools.**
- **Technical evolution during 1990's (programming languages, platforms, delivery modes etc) created uncertainties & problems. Only clear ~1998 that future in web-based delivery.**
- **DoITPoMS ("Dissemination of IT for the Promotion of Materials Science") - U. Cambridge (2000). Aims to produce "bite-sized" resources, to be used flexibly (no copyright restrictions), to combat "Not Invented Here" syndrome. Student involvement resource production (2003).**
- **UK "Subject Centres" for support of University teaching (2002). Centre for Materials Education (UKCME), directed by Peter Goodhew, now prime supporter of DoITPoMS.**

Interactivity: a key part of good educational software

Microcomputing in materials teaching and research

by T W Clyne and P J Goodhew*

SYNOPSIS

The versatility, power and availability of microcomputers has grown to the extent where their systematic use in tertiary education is now very attractive. In the field of materials, there is scope for useful exploitation of micros in a variety of ways. Some ideas are presented here about how the integration of microcomputing into teaching and research activities can be approached. Reprints are available from the authors, who will also be prepared to discuss details concerning the programmes described and other educational software they have developed.

Introduction

In the materials field, as in many others, there is considerable current interest in the use of microcomputing as a teaching tool. The increased availability of relatively powerful microcomputers has in recent years opened up a number of possibilities. Indeed, the important advantages (when compared with traditional mainframe machines) of machine dedication and real time continuous display have actually resulted in some research computation being switched to micros. An important feature of current developments is that the distinction between research and teaching usage of microcomputers is not a sharp one and the resultant cross-fertilization is potentially very valuable.

Of course, activity in this field dates back some time, and previous articles[1, 2] have covered certain features. However, it has only recently become possible to contemplate the possibility of a wide spectrum of software being integrated into materials teaching on a nationwide or even worldwide basis. In this article, an attempt is made to summarise salient features of the current position. The main types of program are categorized and illustrated by reference to a number of specific examples. These have been drawn from current teaching/research activities at Surrey, and they all run on an Acorn BBC B machine. However, the discussions presented are in general not specific to any particular type of machine. Indeed, much of the text may be considered applicable to the use of micros in any scientific field of higher education.

No attempt is made to describe individual programming points in detail, nor to consider the merits of specific commercial hardware. Such information is, of course, abundant in current computing literature. Equally, a basic background of terminology and concept is assumed. The handbook of Varey and Graham[3] is a good example of the many texts available to provide such a grounding. A prime aim of the present article is to focus attention on the most fruitful course to be followed by those concerned with materials education in the widest sense.

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Objectives

Programs designed for teaching with a microcomputer may serve a wide range of useful purposes. Although some potential benefits (such as stimulation of poorly-motivated students) are side-effects rather than objectives, it is possible to classify such software according to whether the prime aims fall into one or more of the following categories:—

(1) to give an insight into the nature of a physical phenomenon by means of a direct pictorial representation, which may be on one of a number of possible levels of scale
(2) to enable the student to explore the characteristics of a process or effect by manipulation of the conditions or parameters
(3) to facilitate visualisation of features in a spatially complex system, for example by presentation of suitable sections
(4) to encourage and demonstrate the analysis and quantification of the controlling factors in a range of situations
(5) to introduce the student to practical usage of (novel) mathematical techniques
(6) to demonstrate features of program organisation and structure.

Of course, although this list gi[illegible] indication of possible goals, a numb[illegible] factors will determine the likely de[illegible] of success. It is, for example, imp[illegible]tant that the student has some measure of involvement and control. This is useful, not only because it effectively allows more information to be

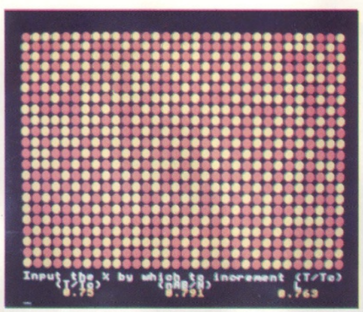

Fig 1. Representation of atomic structure in an A-50 at%B alloy, for varying values of the Bragg–Williams long range order parameter L. Also shown is the ratio of the number of A-B bonds to the total number of bonds.

Fig 2. Map of the contours of maximum shear stress as a result of the elastic strain field around a single edge dislocation for a selected set of variables.

"It's important that the student has some measure of involvement and control. This is useful, not only because it effectively allows more information to be available to the student, but also in view of the strong correlation between extent of interaction and level of interest. Furthermore, a program allowing student involvement leads to possibilities for setting problems, assignments and practicals which are centred around the software."

from Clyne & Goodhew (1984)

Ongoing activities

- ***Consolidation of Micrograph Library***
(currently ~870 micrographs, ~40 contributors)

- ***Expansion of Library of Teaching & Learning Packages***
(currently -50 titles, under 7 headings), largely via "Summer Schools" in Cambridge, with broadening participation

- ***Development of Library of Video Clips***
(~ 100 clips, under 8 headings) recently put on-line

- ***Maintenance of Website***
(contact with contributors, feedback from users (students, academics & industrialists, analysis of usage trends etc)

- ***Liaison with UKCME***
(Assessment of impact, strategies for improvement, potential sources of funding etc)

- ***Dissemination***
(Presentations at conferences, publications, links with UKCME & MATTER etc)

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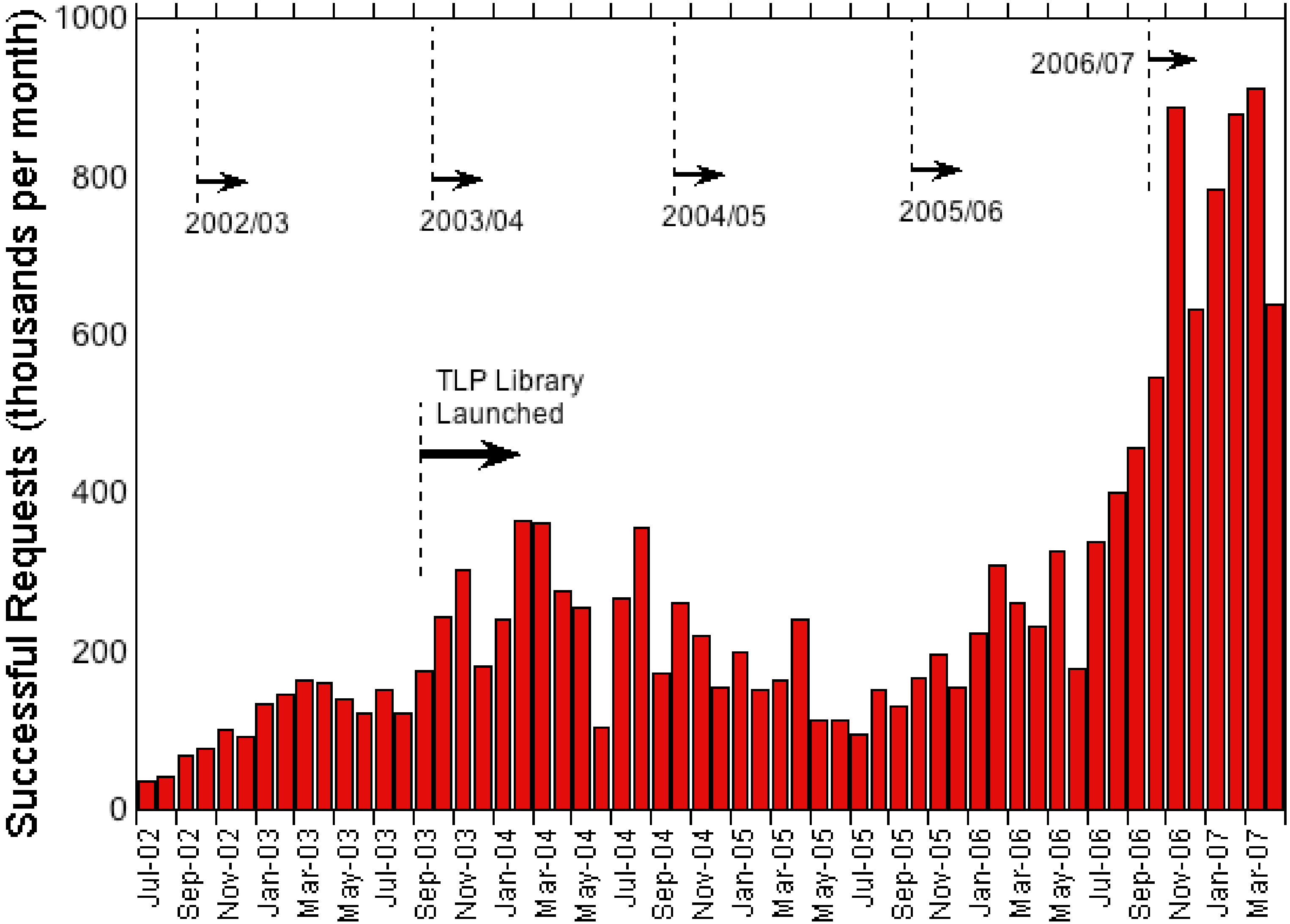
DoITPoMS access statistics - successful requests



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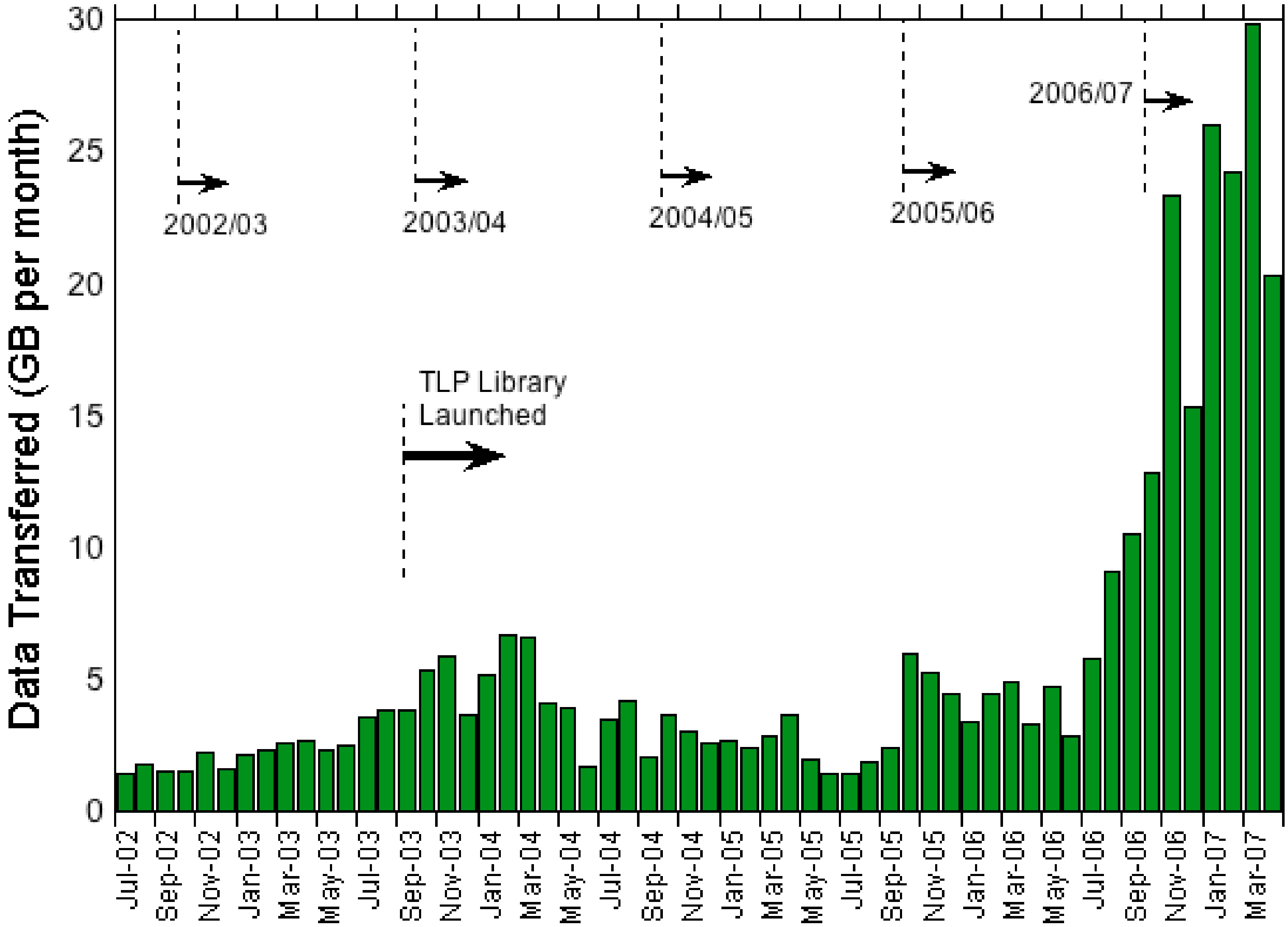
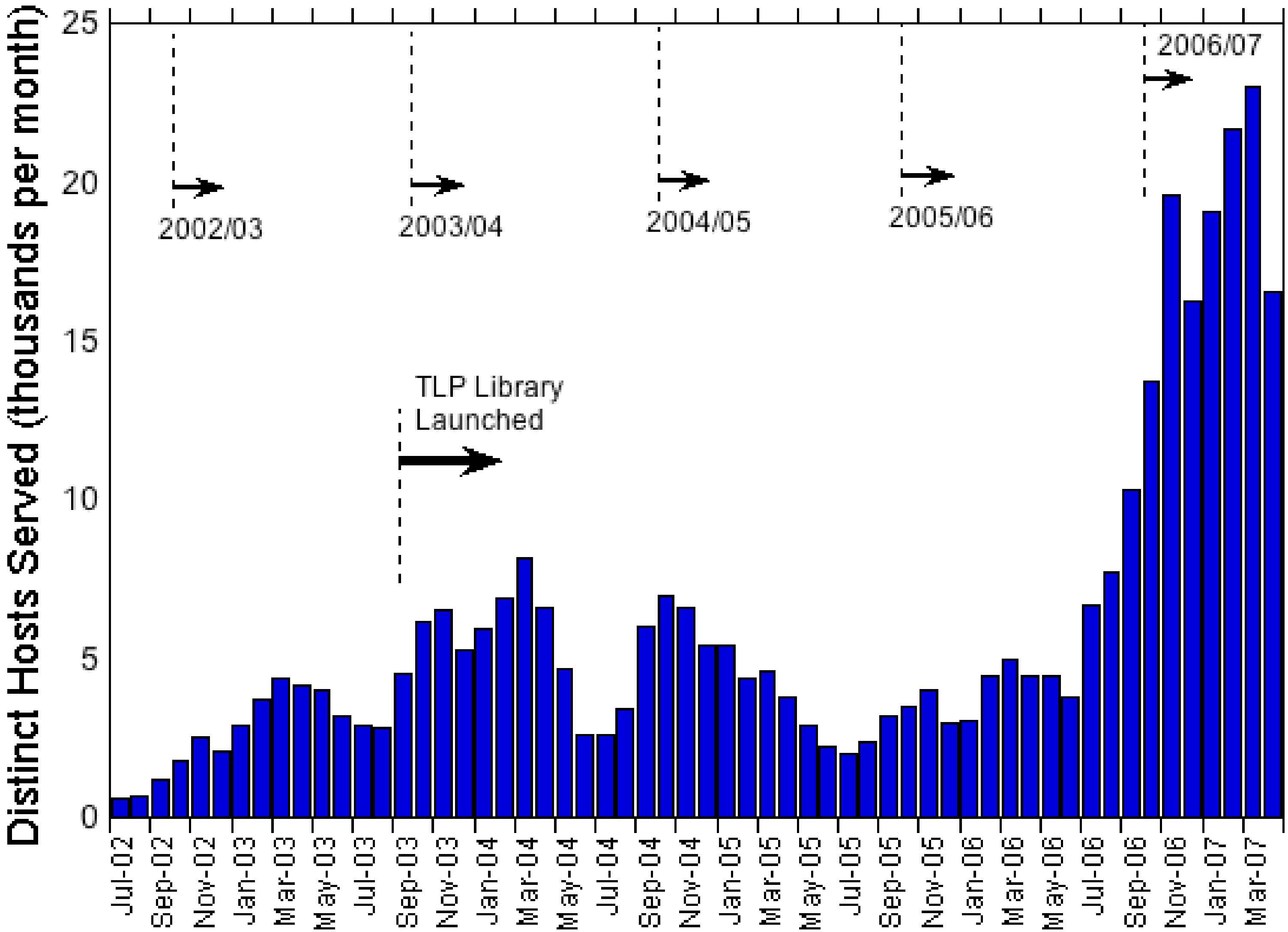
www.doitpoms.ac.uk

DoITPoMS access statistics - data downloaded



DoITPoMS access statistics - distinct hosts served



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Google lists (September 2007)

- **"Materials Science":**

1. en.wikipedia.org, 2. www.msm.cam.ac.uk, 3. www.psigate.ac.uk
4. www.springerlink.com, 5. bubl.ac.uk/link/m/**materialsscience**.htm,
6. www.materials.ox.ac.uk

- **"Diffraction Patterns":**

1. en.wikipedia.org, 2. hyperphysics.phy-astr.gsu.edu
3. www.eserc.stoneybrook.edu, 4. math.arizona.edu
5. www.doitpoms.ac.uk, 6. dev.physlab.org …..

- **"Mechanical Testing":**

1. www.doitpoms.ac.uk, 2. mt.bodycote.com, 3. www.twi.co.uk
4. www.wmtr.co.uk, 5. ww.laboratorytalk.com/indexes/categorybrowseax.html

- **"Burgers vector":**

1. www.doitpoms.ac.uk, 2. www.cmse.ed.ac.uk, 3. en.wikipedia.org, 4. www.tf.uni-kiel.de/matwis/ amat/def_en/kap_5/backbone/r5_1_1.html

- **"Jominy End Quench Test":**

1. www.doitpoms.ac.uk, 2. www.matter.org.uk, 3. info.lu.farmingdale.edu
4. www.prep.mcneese.edu

Future of DoITPoMS

- Potential market is enormous: probably ~ 200 Materials Depts, plus ~2,000 more Depts with an interest in Materials (ie ~10^5 academics & 10^6 students), plus many millions of individuals, teachers, school-children etc. Current access is probably ~1% of the market, although it does come from ~120 countries every month.

- No plans for commercial exploitation. Main benefits relate partly to internal teaching and partly to professional reputation - bite-sized approach gives scope for extensive multiple authorship. As with Wikipaedia, close quality control is critical.

- Closer links planned with UKCME.

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- Issues for the Production of new TLPs

Micrograph library

- About 850 Micrographs currently in Library
- Each comes with "Metadata" in 13 fields, giving Keywords, System, Composition, Processing, Sample Preparation, Microscopy Technique etc
- Linked in many cases to Interactive Phase Diagram
- Keywords linked to MATTER glossary
- Low- and High-Resolution Images available
- All Downloadable and Copyright-free

Video clip library

- About 100 Video Clips currently in Library

- Under 8 headings:

Applications
Atomistic Animations
Experimental Procedures
Industrial Processing
Miscellaneous Photographic
Optical Microscopy
SEM
TEM

- Metadata are in some cases incomplete

- Keywords linked to MATTER glossary

- Bite-sized philosophy retained:

time limit ~ 1 minute, size limit ~ few MB

- All Downloadable and Copyright-free

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TLP library

- Currently 50 TLPs in the Library, under 7 Headings. Further 10 shortly. Expect ~ 100 TLPs eventually?
- Unified Format, with Aims, Introduction, Summary, Questions etc
- Contain Animations, Simulations, Video Clips, Exercises etc, as well as Static Images and Text
- Some based around a Practical Experiment
- Navigation Aids and Links to External Sites
- Designed for use by Academic Staff, in creating & enhancing Lecture Courses, or by Students, independently or for Course Assignments etc

TLP library

Browsing the library

Using a TLP

Summary

• DoITPoMS is a UK product with global potential. Current access rate during the academic year is nominally of the order of 1 million hits per month.

• The concept of bite-sized resources is central to the DoITPoMS philosophy - allows local creativity in usage.

• The summer schools have emerged as an efficient and productive way to create DoITPoMS resources, with well-defined procedures and embedded quality control. Students can provide input as customers, as well as authors.

• Quality control is a key issue: TLPs should be scientifically reliable, clear, well-structured, cross-linked, searchable &, above all, interactive.