Title: Professional development for physics teachers: A UK perspective

Date: May 25, 2006 07:00 PM

URL: http://pirsa.org/06050012

Abstract: <kw> Institute of Science, A levels, boring, difficult, support for schools, girls in physics, advancing physics, physics education, celestia, videshell, quantum atomica, walter fend, physics lab, phet, modellus, clea, lancaster particle physics, many paths, seismology, stellarium, Alice law, warp, wintreb, datapoint, tinycad, falstad applets, spektrus, emanim </kw>

Institute *of* **Physics**

(Science) Education in the (UK)

Age	Subject	Number	Assessment
5- 7	Science	~ 500K	National Test
7-11	Science	~ 500K	National Test
11-14	Science	~ 500K	National Test
14-16	Sciences(?) Core. Applied. Academic	~ 250K (A-C) Physics ~33K	GCSE
16-18	Physics	~ 28K	AS A2

Institute *of* **Physics**

Physics in Schools (Numbers)

- **Physics A-level in 2005,**
  - 28,119 UK candidates (12th most popular)
    - 21,922 (6th most popular (M))
    - 6197 (19th most popular (F))

Institute *of* **Physics**

Physics in Schools (Attitudes)

- **Physics is difficult**
  - Research backs this up but probably not to the extent that it is perceived
- **Physics is irrelevent**
  - Poor careers advice and lack of contemporary physics is an issue
- **Physics is boring**
  - Non specialist teaching, plus a didactic approach to learning

Institute *of* **Physics**

Physics Teachers (Numbers)

- **Trainee Teachers 2005 (England)**
  - 301 Physics (not all physicists),
  - 434 Chemistry
  - 862 Biology
  - 977 Science (almost no physicists)

~ 15% of trainee science teachers are physicists

- **Physics Teachers in Schools**
  - 19% of science teachers are physicists
  - No physicist in 26 per cent of 11-16 schools

Institute *of* **Physics**

What the education department does

- Support for schools
  - Professional Development for Teachers
  - Affiliation Scheme
  - Teacher Network
  - Websites
  - Email lists
  - Publications
  - Current and forthcoming projects

Institute *of* **Physics**

Professional Development for Teachers

- Physics Teacher Network
  - 33 local physicists coordinating a variety of training oportunities
- Physics Updates
  - 3 day residential courses
  - April, July and December
- Meetings
- Email Lists
  - PTNC (Physics Teachers News and Comment)
  - PEPD (Physics Early Professional Development)

Institute *of* **Physics**

SPT Project

- professional development programmes
- supported by a series of CD-ROMs
  - **Electricity & magnetism**
  - **Forces & motion**
  - **Light & sound**
  - **The Earth & beyond**
  - **Energy resources and energy transfer**
- each CD ROM covers a chunk of the 11-14 physics curriculum

Institute *of* **Physics**

Practical Physics

- www.practicalphysics.org

  A website listing practical activities, equipment and advice on how to carry out practicals and build them into a teaching sequence
- New section being developed to help teach 'How science works' through practical activities.
- Please Contribute!

Institute *of* **Physics**

Girls in Physics

- Girls are under represented at A-level – everyone knows this but no one has found a way of changing this.
- Two research studies have been commissioned:
  - Case studies from schools that are successful in recruiting girls to A-level physics
  - A review of the research that has been done in this area

Institute *of* **Physics**

Teaching Advanced Physics

www.tap.iop.org

- **Contains detailed ideas and resources for teaching physics to students aged 16-19.**
- **Aims to help those new to teaching this age group**
  - Electricity
  - Mechanics
  - Vibrations and Waves
  - Atomic and Nuclei
  - Fields
  - Energy
  - Astronomy

Institute *of* **Physics**

Advancing Physics AS

- **Physics in Action**
  - Communication is about imaging and instrumentation.
  - Designer materials looks at the way the world is made
- **Understanding Processes**
  - Waves and quantum behaviour introduces some simple quantum ideas
  - Space and time moves from vectors to modelling

Institute *of* **Physics**

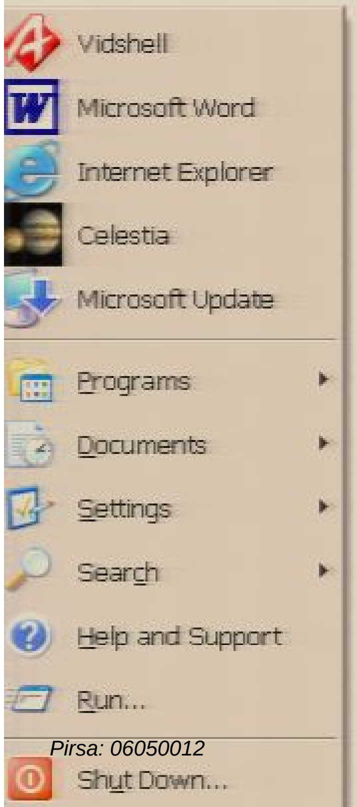
Advancing Physics A2

- **The Rise and Fall of the Clockwork Universe**
  - Models and Rules introduces the use of mathematical modelling in physics
  - Matter in Extremes develops a bridge between random events and empirical laws
- **Field and particle pictures**
  - Fields develops ideas about magnetic and electric fields
  - Fundamental particles considers the structure and binding of atoms and nuclei and introduces ideas about risk
- **Advances in Physics**
  - Draws together and uses physics ideas from the whole course in looking at new contexts

Institute *of* **Physics**

Advancing Physics A2

- **The Rise and Fall of the Clockwork Universe**
  - Models and Rules introduces the use of mathematical modelling in physics
  - Matter in Extremes develops a bridge between random events and empirical laws
- **Field and particle pictures**
  - Fields develops ideas about magnetic and electric fields
  - Fundamental particles considers the structure and binding of atoms and nuclei and introduces ideas about risk
- **Advances in Physics**
  - Draws together and uses physics ideas from the



Institute *of* **Physics**

Advancing Physics A2

- **The Rise and Fall of the Clockwork Universe**
  - Models and Rules introduces the use of mathematical modelling in physics
  - Matter in Extremes develops a bridge between random events and empirical laws
- **Field and particle pictures**
  - Fields develops ideas about magnetic and electric fields
  - Fundamental particles considers the structure and binding of atoms and nuclei and introduces ideas about risk
- **Advances in Physics**
  - Draws together and uses physics ideas from the

Folio Views - [Advancing Physics AS 2000 Teacher's Version]

olio Views - [Advancing Physics AS 2000 Teacher's Version]

File View Search Tools Help

None

Home
- Imaging
- Sensing
- Signalling
- Testing Materials
- Looking Inside Materials
- Wave Behaviour
- Quantum Behaviour
- Mapping Space and Time
- Computing the Next Move

How to
Teacher and Technician Information
Specification
A–Z of Key Terms

7: Quantum Behaviour

7: Quantum Behaviour

Fundamental particles of matter – electrons, quarks, neutrinos, and others – act like nothing you have seen before. But they all share the same remarkable style of acting: 'quantum behaviour'. Photons, the fundamental particles of light, do it too. In this chapter we will:

- explain why light needs to be thought of as photons
- use photons as a simple example of quantum behaviour

Browse Document HitList Object

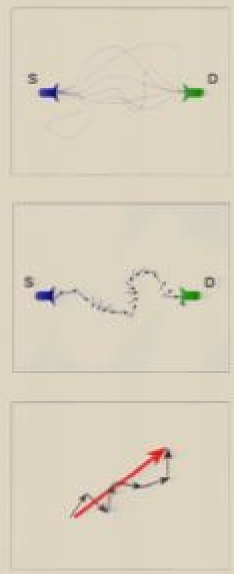
olio Views - [Advancing Physics AS 2000 Teacher's Version]

File View Search Tools Help

None

7: Quantum Behaviour

7: Quantum Behaviour



'TRY ALL PATHS'

Fundamental particles of matter – electrons, quarks, neutrinos, and others – act like nothing you have seen before. But they all share the same remarkable style of acting: 'quantum behaviour'. Photons, the fundamental particles of light, do it too. In this chapter we will:

- explain why light needs to be thought of as photons
- use photons as a simple example of quantum behaviour

Local Area Connection

A network cable is unplugged.

Browse Document HitList Object

7: Quantum Behaviour

7: Quantum Behaviour

'TRY ALL PATHS'

Fundamental particles of matter – electrons, quarks, neutrinos, and others – act like nothing you have seen before. But they all share the same remarkable style of acting: 'quantum behaviour'. Photons, the fundamental particles of light, do it too. In this chapter we will:

- explain why light needs to be thought of as photons
- use photons as a simple example of quantum behaviour

Local Area Connection
A network cable is unplugged.

Browse Document HitList Object

olio Views - [Advancing Physics AS 2000 Teacher's Version]

File View Search Tools Help

None

Home
: Imaging
: Sensing
: Signalling
: Testing Materials
: Looking Inside Materials
: Wave Behaviour
: Quantum Behaviour
Teacher's Guide
⊞ Overview
⊞ Teaching Plan
⊞ Further teaching notes
Resource Manager
Student's Checklist
: Mapping Space and Time
: Computing the Next Move
How to
Teacher and Technician Information
Specification
A–Z of Key Terms

7: Quantum Behaviour
Teacher's Guide

Teacher's Guide

Overview

Aims

Introducing quantum ideas early

We believe that a first introduction to quantum ideas is an essential part of a physics A-level course, to be started as early as possible. We want students to get a clear and simple picture of what is characteristic of quantum behaviour, so as to be able to understand what they read in newspapers and magazines, perhaps detecting misinformed views. Quantum ideas, in various guises, have entered our culture and its debates about the nature of things, and physics students above all ought to be given the means to join in. And they need such an introduction so that their physics is not cut off from what they hear in other sciences, especially in chemistry.

Going for essentials

We want students to grasp the essentials of the quantum world view, with at this stage the minimum of technicalities. One way of achieving this was worked out by Richard Feynman, in his popular book 'QED' (1985 Penguin). This little book is required – and easy – reading for any teacher embarking on this part of the course. And in this book Feynman concentrates on the deepest essential features of quantum physics, in a strikingly simple way. A deep unification is that quantum behaviour is shown both by photons and electrons; by in classical terms both 'radiation' and 'matter'.

Localised or non-localised – 'Try all paths'

One essential is that in quantum physics the classical distinction between non-localised things like fields and waves which are 'everywhere', and things like particles which are localised in space, simply doesn't apply. Quantum objects manage both at once. Feynman's picture brings this out by making the fundamental command to particles (such as photons or electrons) be 'Try all paths'. The imagined world is one in which quantum particles go everywhere and try everything all at once.

ll Browse Document HitList Object

olio Views - [Advancing Physics AS 2000 Teacher's Version]

File View Search Tools Help

None

Teacher's Guide

Overview

Aims

Introducing quantum ideas early

We believe that a first introduction to quantum ideas is an essential part of a physics A-level course, to be started as early as possible. We want students to get a clear and simple picture of what is characteristic of quantum behaviour, so as to be able to understand what they read in newspapers and magazines, perhaps detecting misinformed views. Quantum ideas, in various guises, have entered our culture and its debates about the nature of things, and physics students above all ought to be given the means to join in. And they need such an introduction so that their physics is not cut off from what they hear in other sciences, especially in chemistry.

Going for essentials

We want students to grasp the essentials of the quantum world view, with at this stage the minimum of technicalities. One way of achieving this was worked out by Richard Feynman, in his popular book 'QED' (1985 Penguin). This little book is required – and easy – reading for any teacher embarking on this part of the course. And in this book Feynman concentrates on the deepest essential features of quantum physics, in a strikingly simple way. A deep unification is that quantum behaviour is shown both by photons and electrons; by in classical terms both 'radiation' and 'matter'.

Localised or non-localised – 'Try all paths'

One essential is that in quantum physics the classical distinction between non-localised things like fields and waves which are 'everywhere', and things like particles which are localised in space, simply doesn't apply. Quantum objects manage both at once. Feynman's picture brings this out by making the fundamental command to particles (such as photons or electrons) be 'Try all paths'. The imagined world is one in which quantum particles go everywhere and try everything all at once.

Browse Document HitList Object

olio Views - [Advancing Physics AS 2000 Teacher's Version]

ile View Search Tools Help

None

Teaching Plan

Section 7.1: Quantum behaviour

Teaching time: 4 hours

What we are trying to achieve

The aim of this section is to introduce 'quantum behaviour' as its own unique self, as a new way of imagining the behaviour of quantum objects.

The first step is to go beyond the wave picture of chapter 6 by insisting on the lumpy nature of the energy exchanges between photons and matter, and the random nature of the arrival of that energy. The simple experience of listening to gamma ray photons arriving in a detector one by one, at random, is key. This is supported by a sample of evidence for the Planck relationship $E = hf$.

The second step is to begin to see how, given the lumpy nature of the exchange of quantum energy, quantum behaviour still accounts for superposition effects. So we introduce the 'try all paths' story, but with just two paths. The photon has to be thought of as trying **both** paths. The way to calculate phase differences for the paths, with rotating arrows, carries over, but not the commitment to waves which previously lay behind it.

The case of two paths is just a start on the many paths construction, to be deepened in section 7.2. Discussion about the implications can begin, but it is too soon to reach for conclusions.

What to cover

You need to cover the lumpy nature of photons, and one example of the evidence for the relation $E = hf$, for instance measuring the minimum striking potential difference of LEDs of different colour. Other evidence might be discussed, but more important is to show a clear case of lumpy behaviour such as the detection of gamma ray photons, which brings out well the random nature of their arrival. At the other extreme, with microwaves, you need to remind students that photons still superpose.

Secondly, you need to show how the 'try all paths' argument works, getting an arrow direction for each path, and adding

ll Browse Document HitList Object

olio Views - [Advancing Physics AS 2000 Teacher's Version]

ile View Search Tools Help

None

Section 7.2: 'Try all paths' at work

Teaching time: 4 hours

What we are trying to achieve

We want students to grasp something at once very simple and quite difficult: the fact that the rule of quantum behaviour 'try all paths' accounts for well known familiar optical phenomena, such as reflection, in which quite to the contrary the photons appear to take just one path, not many. Examples are reflection, refraction, straight line propagation, the design of lenses and curved mirrors, and the action of a grating.

The explanation always has the same form: only along paths very close to a special one do the phasor arrows line up. All other paths, though tried, add up to a negligible contribution.

In the *Advancing Physics AS* student's book, these examples are presented briefly, one after the other, to give an impression of the scope of the argument, of the wide range of phenomena it accounts for.

In class, because the argument is subtle and seemingly self-contradictory (photons ending up at one place **because** they take all paths), the opposite strategy is likely to be better, looking at one or two examples in detail and arguing them through carefully. After that, readings from the *Advancing Physics AS* student's book may suffice.

For a first run through, we suggest:

1. The case of reflection at a plane mirror, including the least time principle.
2. Rectilinear propagation.
3. The reflection grating, showing that the photons do in fact try all paths.
4. Engineering a curved mirror, putting the least time principle to work.

In this guide these are therefore described first, followed by the other examples which you may wish to consider, or on which you may want to draw.

With more experience, you may want to make a different selection. Alternatively, you may wish to divide the various

ll Browse Document HitList Object

olio Views - [Advancing Physics AS 2000 Teacher's Version]

- That gratings get certain definite paths to have phasors which 'line up' by removing paths which when added in make the phasors 'curl up'.

Reflection at a mirror

Remind the class, perhaps by flashing a beam of light around the room, that the photons take the special path for which the angle of reflection is the same as the angle of incidence. Tell them that, strangely, this fact follows from the photons trying all paths, as the rule of quantum behaviour insists they do.

Make a start with paper-and-pencil work with a trundle wheel, showing that the phasor arrows from paths near the 'true' path more or less line up, whilst paths for which the angles are unequal tend to curl up. Move to the same thing shown in software, where the effects can be explored much more quickly.

Three regions dominate: two are the ends which produce arrows that curl up, and the third is the middle which produces arrows that line up.

The software written in Modellus uses a defined set of paths, a few at a time, concentrating on identifying adjacent paths that produce arrows which line up or curl up. The other software, due to Edwin Taylor, is more flexible and allows freer exploration. The combination of both is very profitable.

Activities

Activity 80E Experiment 'Calculating for a mirror on the bench'

Activity 90S Software Based 'Calculating for a mirror on the screen'

Question

Question 40S Short Answer 'Three paths on a mirror'

Files

File 50I Image 'Paths for a mirror'

File 60I Image 'A hexagonal grid'

File 70L Launchable File 'Many-paths software'

olio Views - [Advancing Physics AS 2000 Teacher's Version]

File Edit View Insert Search Layout Tools Table Help

None

The software written in Modellus uses a defined set of paths, a few at a time, concentrating on identifying adjacent paths that produce arrows which line up or curl up. The other software, due to Edwin Taylor, is more flexible and allows freer exploration. The combination of both is very profitable.

Activities

Activity 80E — Experiment 'Calculating for a mirror on the bench'

Activity 90S — Software Based 'Calculating for a mirror on the screen'

Question

Question 40S — Short Answer 'Three paths on a mirror'

Files

File 50I — Image 'Paths for a mirror'

File 60I — Image 'A hexagonal grid'

File 70L — Launchable File 'Many-paths software'

Display Materials

Display Material 80P — Poster 'Many paths for a mirror'

The least time path

The minimum here is simply to draw students' attention to the fact that the path which obeys the law of reflection is also the one which takes the least time. They can see the minimum in the graphical output of a spreadsheet set up to calculate trip times, and have it pointed out that near the minimum the trip times change very little with change of path, so that their phasors should line up.

Display Materials

Display Material 90O — OHT 'Mirror: Contributions from different paths'

Display Material 100O — OHT 'Calculated trip times for a mirror'

Browse | Document | HitList | Object

olio Views - [Advancing Physics AS 2000 Teacher's Version]

File View Search Tools Help

None

Resource Manager

Listening to photons arriving

Activity 20D: Demonstration

When and where

You are seeking to find out more about the photon, so finding out more about where and when they travel is a good start. What we can know about these two aspects of their travel helps to determine the kind of theory we can develop about them.

You will need

- ✓ pure gamma source
- ✓ one or more Geiger–Müller tubes with counter with audio signal

What to do

1. Place the source and counter so you can hear a few counts a minute. Each count should be distinct.
2. Listen carefully. Can you predict the arrival of the next photon?
3. Alter the separation of the counter and source. Can you describe the changes in what you hear?

Browse Document HitList Object

olio Views - [Advancing Physics AS 2000 Teacher's Version]

File View Search Tools Help

None

Resource Manager

Listening to photons arriving

Activity 20D: Demonstration

When and where

You are seeking to find out more about the photon, so finding out more about where and when they travel is a good start. What we can know about these two aspects of their travel helps to determine the kind of theory we can develop about them.

You will need

- ✓ pure gamma source
- ✓ one or more Geiger–Müller tubes with counter with audio signal

What to do

1. Place the source and counter so you can hear a few counts a minute. Each count should be distinct.
2. Listen carefully. Can you predict the arrival of the next photon?
3. Alter the separation of the counter and source. Can you describe the changes in what you hear?

Browse Document HitList Object

olio Views - [Advancing Physics AS 2000 Teacher's Version]

File View Search Tools Help

None

Home
Imaging
Sensing
Signalling
Testing Materials
Looking Inside Materials
Wave Behaviour
Quantum Behaviour
Teacher's Guide
Overview
Aims
Reasons why
Plan of work
Organising the work
Teaching Plan
Section 7.1: Quantum b
Section 7.2: 'Try all patl
Section 7.3 Electrons do
Further teaching notes
Resource Manager
Activities
Demonstrations
Presentations
Software Based
Random arrival of photor
How exploring paths lea
Curl up and line up
A photon explores two h
Calculating for a mirror c
Trip times for a mirror
A few mirror paths
Many photons make a b
Photons propagating
Checking the ends of th
Engineering a focusing r
Least time and refractior
Least time and refractior
Engineering a lens
Photons explore a narro

7: Quantum Behaviour
Resource Manager
Activities
Software Based

Random arrival of photons

Activity 30S: Software Based

What does randomness look like?

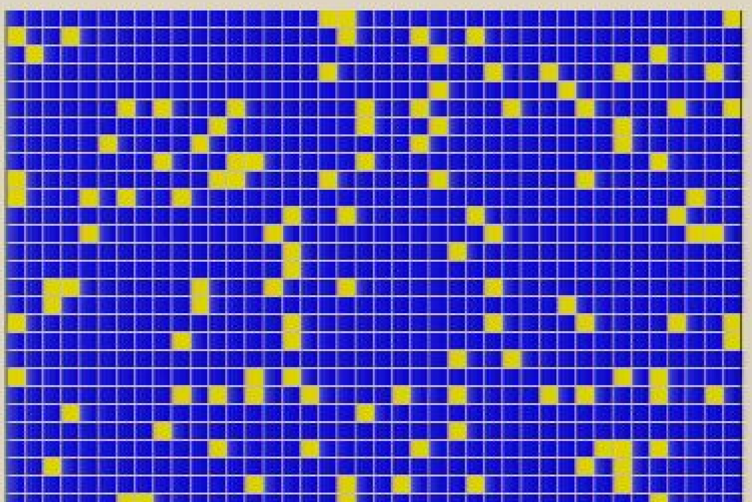
This computer model shows you what the random arrival of photons at a screen looks like. You will see that randomly placed photons are far from evenly placed!

This activity is designed for use with File 10L 'A model for the random arrival of photons'.

You will need

✓ computer with *Advancing Physics* CD-ROM

Photons come at random



Browse Document HitList Object

How exploring paths leads to arrows

Activity 50S: Software Based

Paths contribute

Photons explore all paths from source to detector and each path contributes to the probability of finding a photon at the detector. Each path contributes an arrow. This activity explores how different paths contribute and how the contributions of those paths are aggregated. Each step makes one simple point only. Do not spend a long time on any one step.

This activity is designed for use with File 20L 'Getting arrows from paths' and File 40L 'Getting arrows from more complex paths'.

You will need

✓ PC running Modellus

✓ four or six model files

One path contributes

This first step shows how a single path generates a single arrow.

1. Launch the model. Make sure you can see the Animation Window.

One path contributes

olio Views - [Advancing Physics AS 2000 Teacher's Version]

File Edit View Insert Search Layout Tools Table Help

None

From small to large

Small things, whether electrons or other particles, have their own special quantum nature. At larger scales, collections made of these same small things behave in ways that are much more familiar. This activity shows how increasing the kinetic energy makes their quantum nature less evident.

You will need to remember that the phasor rotates at a frequency given by

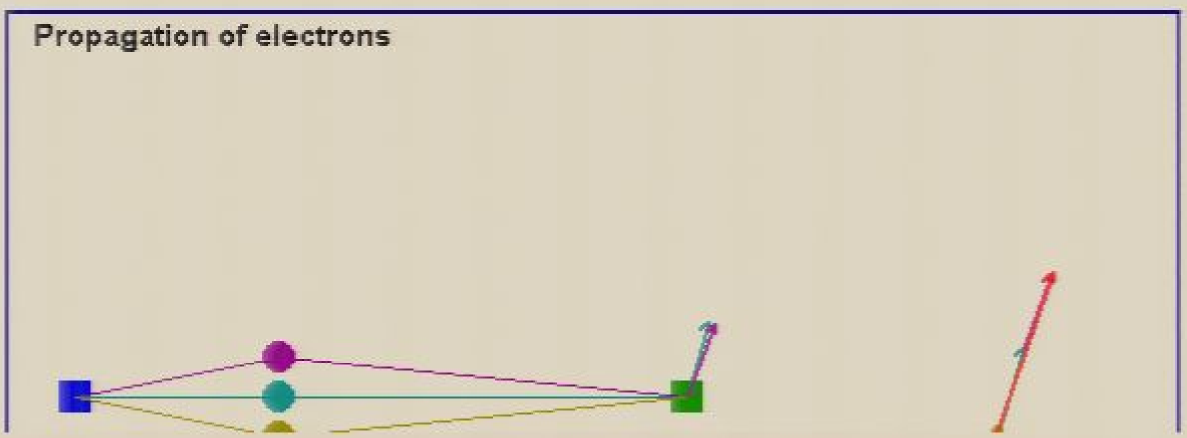
$$f = \frac{E_K}{h}.$$

This activity is designed to go with File 180L 'Changing kinetic energy'.

You will need

- ✓ computer running Modellus
- ✓ the Modellus model 'Changing kinetic energy'

Looking at propagation



Browse | Document | HitList | Object

olio Views - [Advancing Physics AS 2000 Teacher's Version]

File View Search Tools Help

None

From small to large

Small things, whether electrons or other particles, have their own special quantum nature. At larger scales, collections made of these same small things behave in ways that are much more familiar. This activity shows how increasing the kinetic energy makes their quantum nature less evident.

You will need to remember that the phasor rotates at a frequency given by

$$f = \frac{E_K}{h}.$$

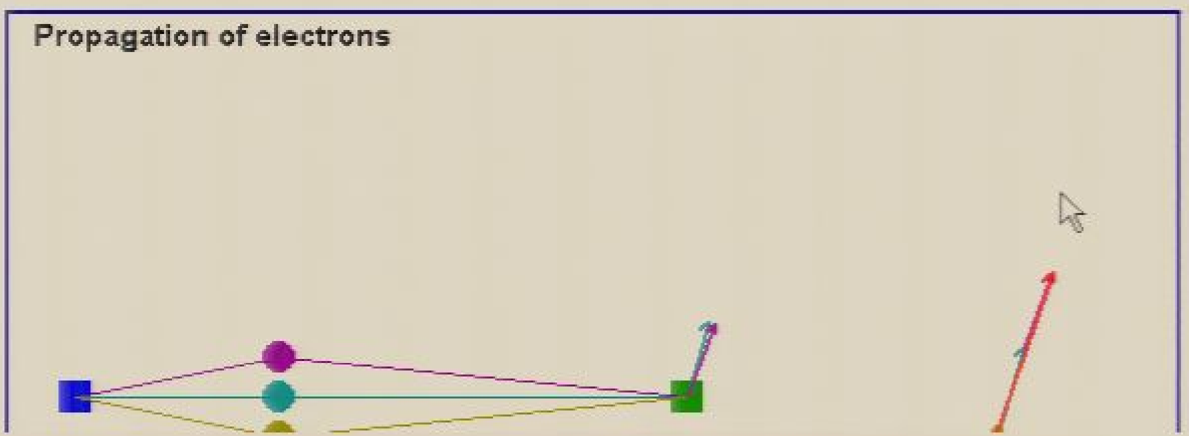
This activity is designed to go with File 180L 'Changing kinetic energy'.

You will need

✓ computer running Modellus

✓ the Modellus model 'Changing kinetic energy'

Looking at propagation



Browse Document HitList Object

olio Views - [Advancing Physics AS 2000 Teacher's Version]

File Edit View Insert Search Layout Tools Table Help

None

How exploring paths leads to arrows

Activity 50S: Software Based

Paths contribute

Photons explore all paths from source to detector and each path contributes to the probability of finding a photon at the detector. Each path contributes an arrow. This activity explores how different paths contribute and how the contributions of those paths are aggregated. Each step makes one simple point only. Do not spend a long time on any one step.

This activity is designed for use with File 20L 'Getting arrows from paths' and File 40L 'Getting arrows from more complex paths'.

You will need

✓ PC running Modellus

✓ four or six model files

One path contributes

This first step shows how a single path generates a single arrow.

1. Launch the model. Make sure you can see the Animation Window.

One path contributes

Browse Document HitList Object

olio Views - [Advancing Physics AS 2000 Teacher's Version]

File Edit View Insert Search Layout Tools Table Help

None

2. Run the model once using the 'go' button in the Control Window.

Note how the phasor, the spinning, rotating arrow, marks the exploration of the path by the photon. Only when the phasor reaches the detector does the arrow freeze.

3. You can place the waypoint in different positions by clicking on the 'case' buttons on the menu bar of the Animation Window. To see how the arrows are generated for these different cases, click on the 'go' button in the Control Window with the case you want to see selected.

The greater the distance to be covered the longer the trip time to explore the path. The longer the trip time the more rotations for the phasor. The final angle of the phasor fixes the arrow. For this simple model the length of the phasor does not change as the path is explored.

Varying one path and seeing the contribution change

Now cut out the spinning and translating. The number of rotations can be worked out from the trip time, which in turn can be calculated from the path length. So now you can see how the arrow responds to changes in path length.

4. Launch the model. Make sure you can see the Animation Window.

A path contributes

Browse Document HitList Object

olio Views - [Advancing Physics AS 2000 Teacher's Version]

File Edit View Insert Search Layout Tools Table Help

None

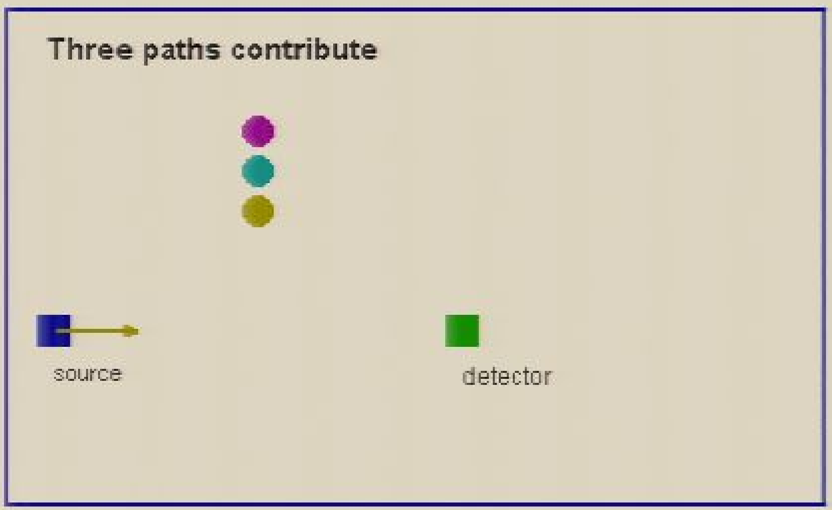
5. Run the model once using the 'go' button in the Control Window.
6. Drag the waypoint to different positions and see how the arrow responds.

At this stage you might be looking for regions from which the arrows tend to line up. These will be places where the trip times for adjacent waypoints are not so different.

Three paths contribute

As a further step we consider how the exploration of three paths generates three arrows. These three arrows are then summed to make an amplitude (imagine that there are only three paths – this reduces the problem of sampling all paths to manageable proportions). This will turn out to be a useful trick.

7. Launch the model. Make sure you can see the Animation Window.



Browse Document HitList Object

olio Views - [Advancing Physics AS 2000 Teacher's Version]

File Edit View Insert Search Layout Tools Table Help

None

11. Run the model once using the 'go' button in the Control Window.

12. Drag the waypoints to different positions and see how the arrows respond and how the amplitude changes.

In this more unstructured exploration it is harder to find significant areas – but it does show the need for a planned attack on exploring all paths.

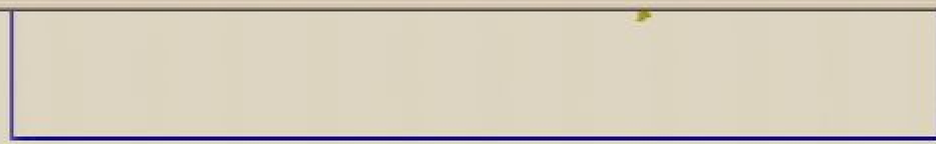
Extension:
Paths with two waypoints
The contribution of the path depends on the trip time. The trip time depends on the path length.

Browse Document HitList Object

olio Views - [Advancing Physics AS 2000 Teacher's Version]

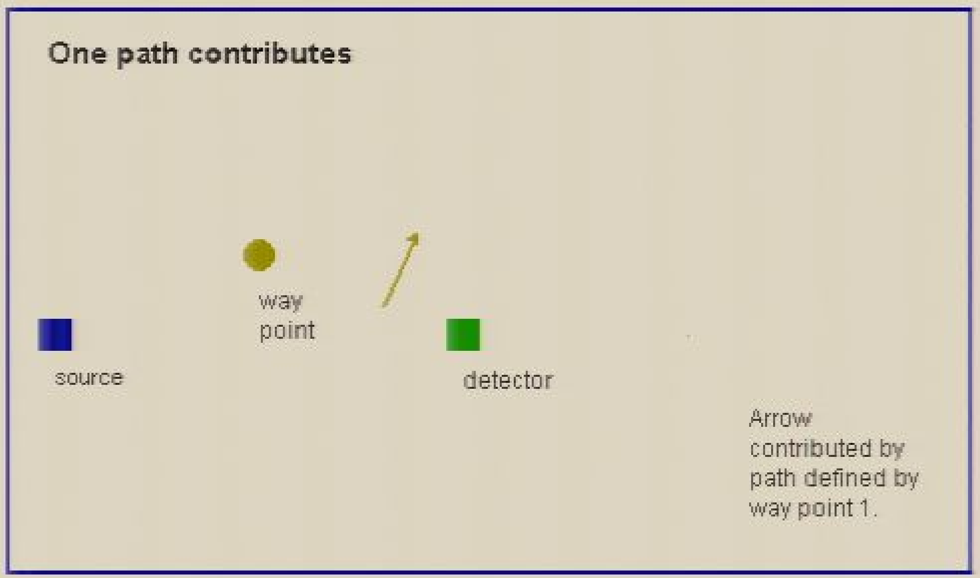
File Edit View Insert Search Layout Tools Table Help

None



14. Drag the waypoints and see the path vector change smoothly.

15. Look at the model. Only the first line – which is heavy Pythagoras – should be at all intimidating. Perhaps compare it with this one:



Extension:

Browse Document HitList Object

olio Views - [Advancing Physics AS 2000 Teacher's Version]

File Edit View Insert Search Layout Tools Table Help

None

11. Run the model once using the 'go' button in the Control Window.

12. Drag the waypoints to different positions and see how the arrows respond and how the amplitude changes.

In this more unstructured exploration it is harder to find significant areas – but it does show the need for a planned attack on exploring all paths.

Extension:
Paths with two waypoints
The contribution of the path depends on the trip time. The trip time depends on the path length.

Browse Document HitList Object

olio Views - [Advancing Physics AS 2000 Teacher's Version]

File Edit View Insert Search Layout Tools Table Help

None

Imaging
Sensing
Signalling
Testing Materials
Looking Inside Materials
Wave Behaviour
Quantum Behaviour
Teacher's Guide
Overview
Aims
Reasons why
Plan of work
Organising the work
Teaching Plan
Section 7.1: Quantum b
Section 7.2: 'Try all patl
Section 7.3 Electrons dc
Further teaching notes
Resource Manager
Activities
Demonstrations
Presentations
Software Based
Random arrival of photor
How exploring paths lea
Curl up and line up
A photon explores two h
Calculating for a mirror c
Trip times for a mirror
A few mirror paths
Many photons make a b
Photons propagating
Checking the ends of th
Engineering a focusing r
Least time and refractior
Least time and refractior
Engineering a lens
Photons explore a narro
Exploring paths with cha

7: Quantum Behaviour
Resource Manager
Activities
Software Based
How exploring paths leads to arrows

4. Launch the model. Make sure you can see the Animation Window.

5. Run the model once using the 'go' button in the Control Window.

6. Drag the waypoint to different positions and see how the arrow responds.

At this stage you might be looking for regions from which the arrows tend to line up. These will be places where the trip times for adjacent waypoints are not so different.

Three paths contribute

As a further step we consider how the exploration of three paths generates three arrows. These three arrows are then summed to make an amplitude (imagine that there are only three paths – this reduces the problem of sampling all paths to manageable proportions). This will turn out to be a useful trick.

Browse Document HitList Object

Folio Views - [Advancing Physics AS 2000 Teacher's Version]

File Edit View Insert Search Layout Tools Table Help

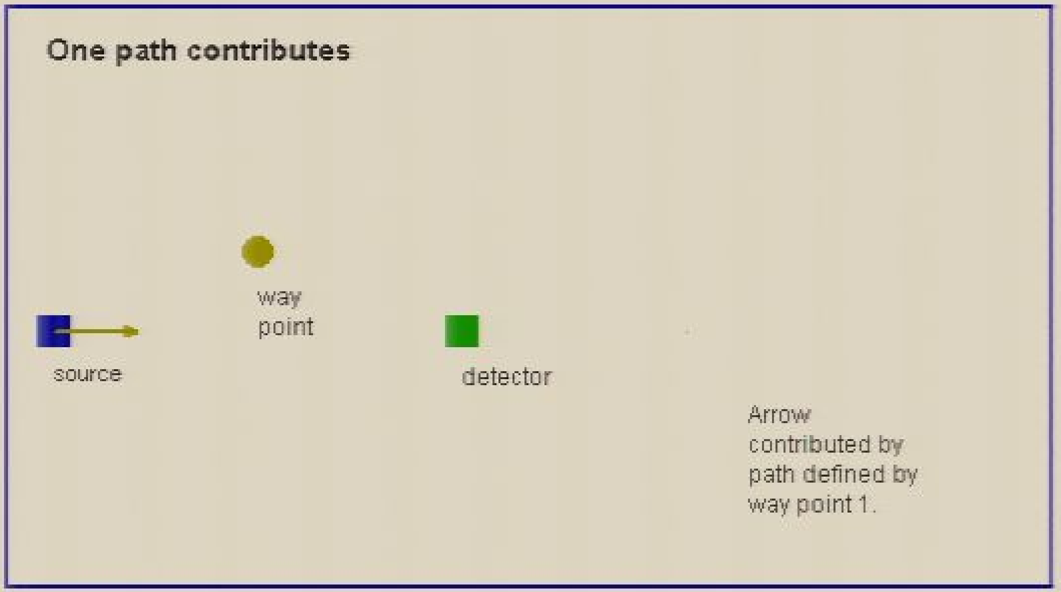
None

7: Quantum Behaviour
Resource Manager
Activities
Software Based
How exploring paths leads to arrows

One path contributes

This first step shows how a single path generates a single arrow.

1. Launch the model. Make sure you can see the Animation Window.



2. Run the model once using the 'go' button in the Control Window.

Note how the phasor, the spinning, rotating arrow, marks the exploration of the path by the photon. Only when the phasor reaches the detector does the arrow freeze.

3. You can place the waypoint in different positions by clicking on the 'case' buttons on the menu bar of the Animation

Browse Document HitList Object

olio Views - [Advancing Physics AS 2000 Teacher's Version]

File Edit View Insert Search Layout Tools Table Help

None

detector. Each path contributes an arrow. This activity explores how different paths contribute and how the contributions of those paths are aggregated. Each step makes one simple point only. Do not spend a long time on any one step.

This activity is designed for use with File 20L 'Getting arrows from paths' and File 40L 'Getting arrows from more complex paths'.

You will need

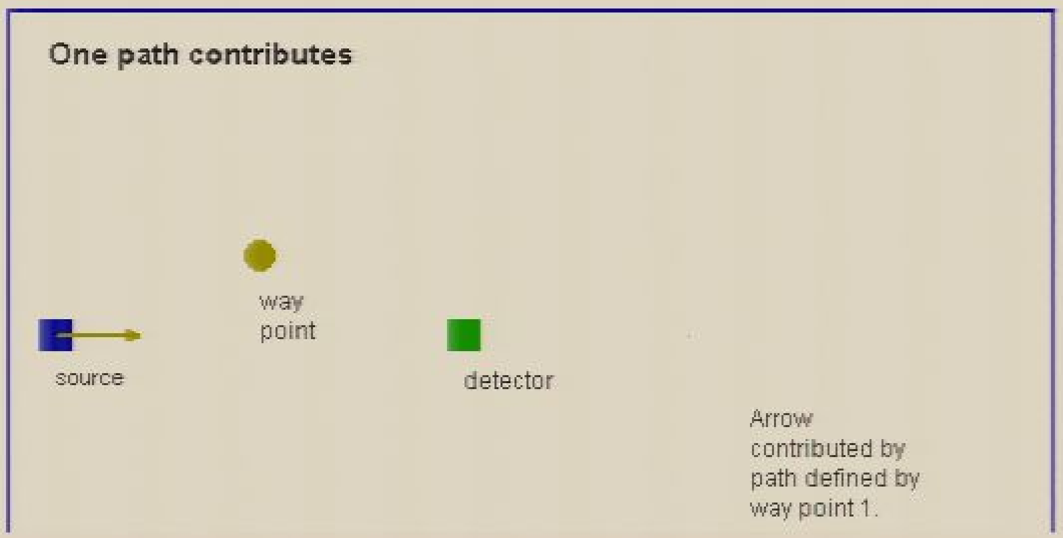
✓ PC running Modellus

✓ four or six model files

One path contributes

This first step shows how a single path generates a single arrow.

1. Launch the model. Make sure you can see the Animation Window.



Browse Document HitList Object

olio Views - [Advancing Physics AS 2000 Teacher's Version]

File Edit View Insert Search Layout Tools Table Help

None

Teaching Notes | Key Terms | Resources

Getting arrows from paths

File 20L: Launchable File

A single arrow

The first pair looks at the process of getting a single arrow from a single explored path. Each is a simple moving model to make one point.

This file is designed to go with Activity 50S 'How exploring paths leads to arrows'.

An arrow from a path

One path contributes

Browse Document HitList Object

olio Views - [Advancing Physics AS 2000 Teacher's Version]

File Edit View Insert Search Layout Tools Table Help

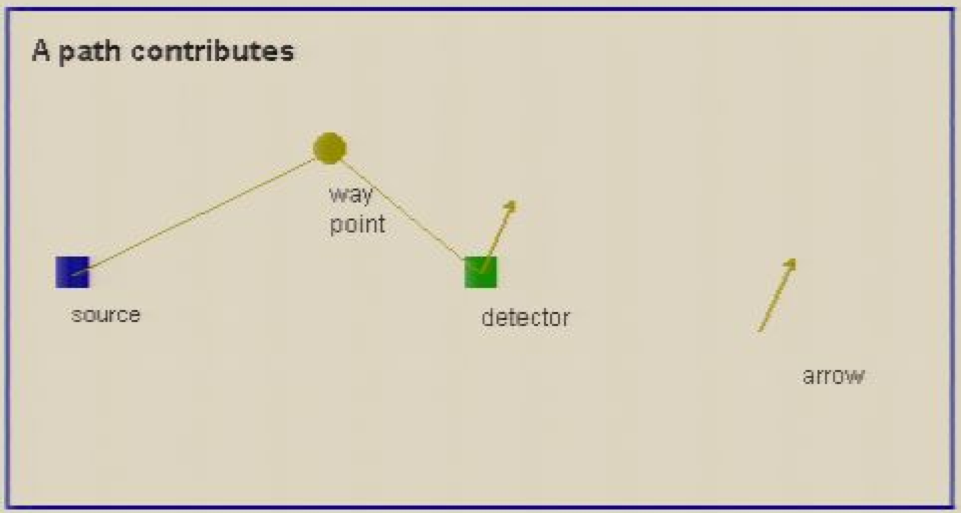
None

7: Quantum Behaviour
Resource Manager
Files
Launchable Files
Getting arrows from paths

This model runs through the process of a photon exploring a path using a phasor. You see the path being explored.

Open the Modellus file

One arrow from dragged waypoints

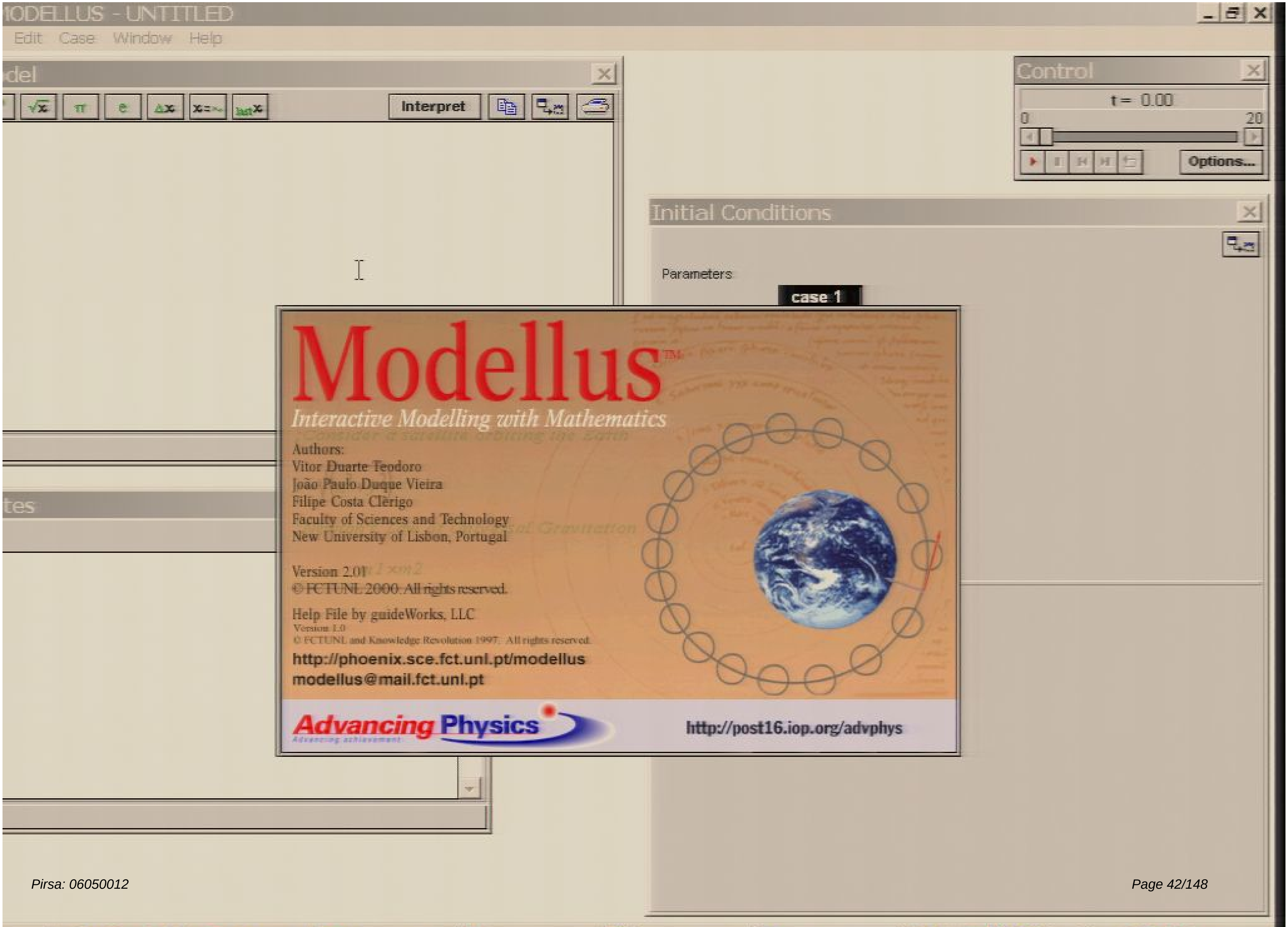


Here you see only the result of the path being explored. As you alter the path, so you see the resulting arrow. The longer the path, the more spins for the phasor.

Open the Modellus file

Three spinning

Browse Document HitList Object



MODELLUS - UNTITLED
Edit Case Window Help
Interpret
Control
t = 0.00
0
20
Options...
Initial Conditions
Parameters
case 1
Modellus™
Interactive Modelling with Mathematics
Authors:
Vitor Duarte Teodoro
João Paulo Duque Vieira
Filipe Costa Clérigo
Faculty of Sciences and Technology
New University of Lisbon, Portugal
Version 2.01
© FCTUNL 2000. All rights reserved.
Help File by guideWorks, LLC
Version 1.0
© FCTUNL and Knowledge Revolution 1997. All rights reserved.
http://phoenix.sce.fct.unl.pt/modellus
modellus@mail.fct.unl.pt
Advancing Physics
http://post16.iop.org/advphys

IODELLUS - D:\APPS\ADVANC~1\CACHE\070010F1.MDL

Edit Case Window Help

Model

Interpret

;path calculations

$hyp = \sqrt{(ywp1^2 + (xwp1)^2)}$

if $(x1 <= xwp1)$ and $(x1 < detectx)$ then $\left(y1 = v \times \frac{ywp1}{hyp} \times t\right)$

if $(x1 > xwp1)$ and $(x1 < detectx)$ then $\left(y1 = 2 \times ywp1 - \left(v \times \frac{ywp1}{hyp} \times t\right)\right)$

if $(x1 < detectx)$ then $\left(x1 = v \times \left(\frac{xwp1}{hyp} \times t\right)\right)$

;spinning

if $(x1 < detectx)$ then $(p1y = A1 \times \sin(2 \times \pi \times f1 \times t))$ and $(p1x = A1 \times \cos(2 \times \pi \times f1 \times t))$

ase 3	case 4	case 5
.00	100.00	100.00
.00	200.00	200.00
00	100.00	120.00
00	20.00	20.00
0	4.00	4.00
.00	100.00	100.00

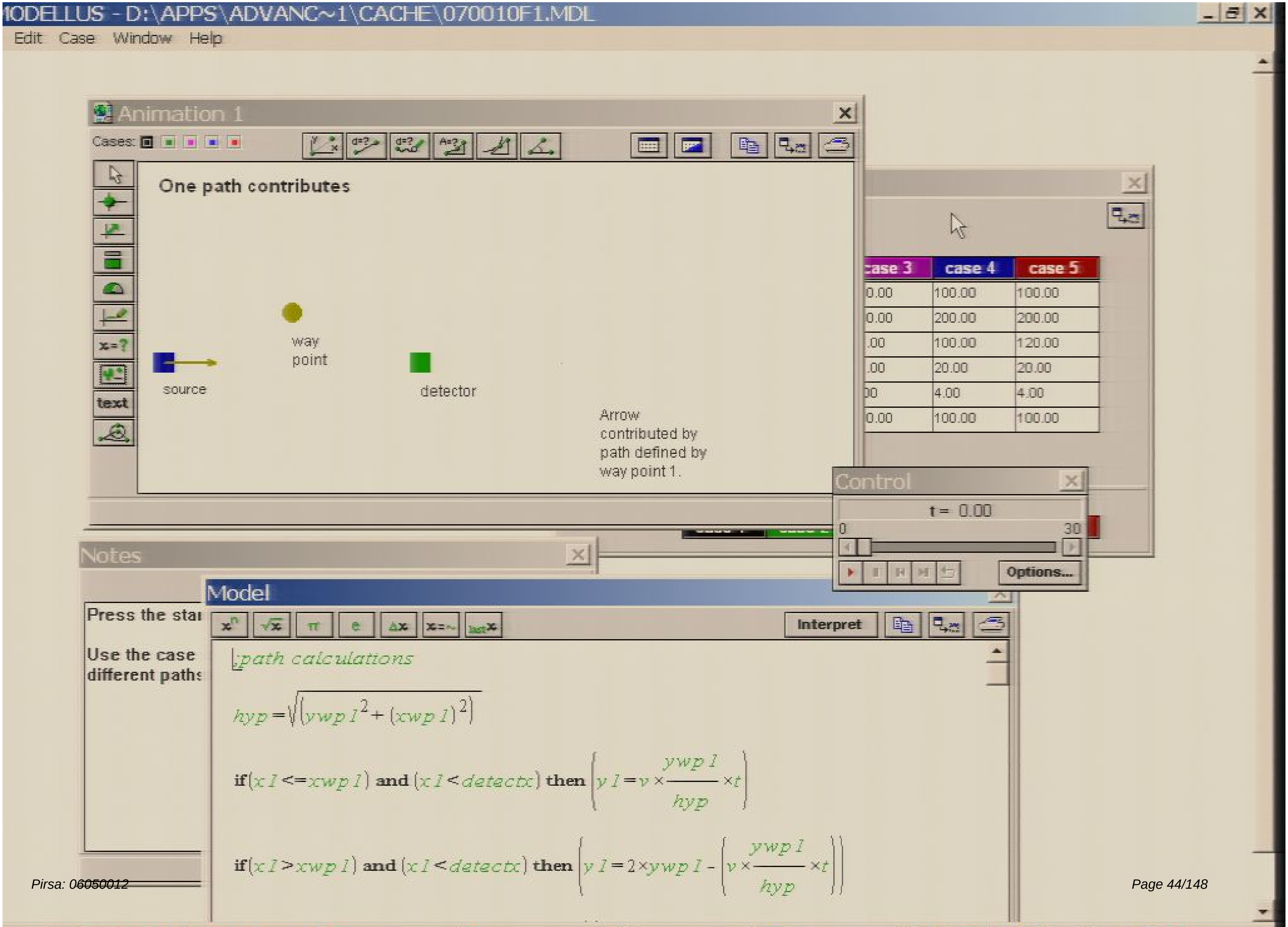
Control

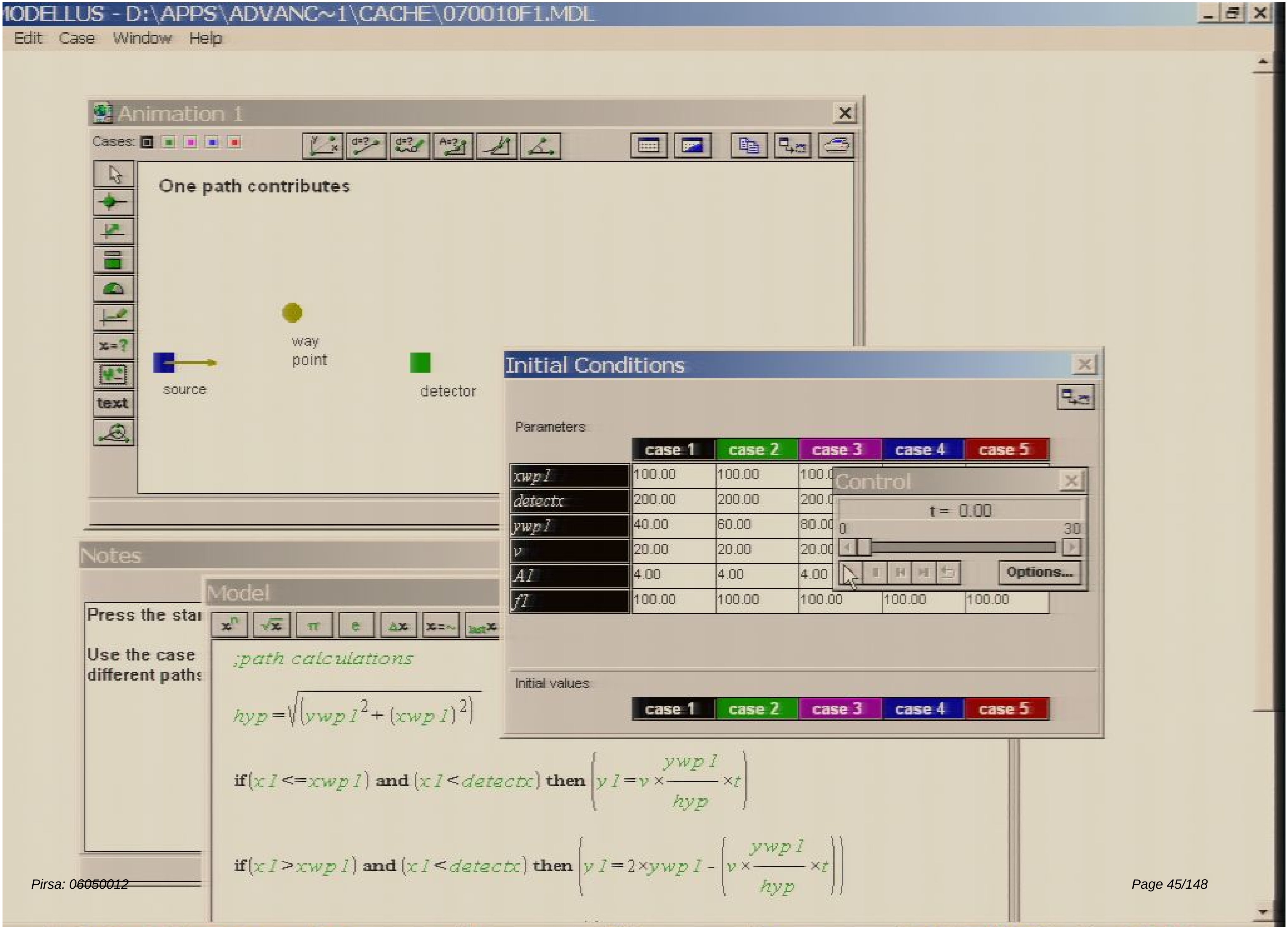
t = 0.00

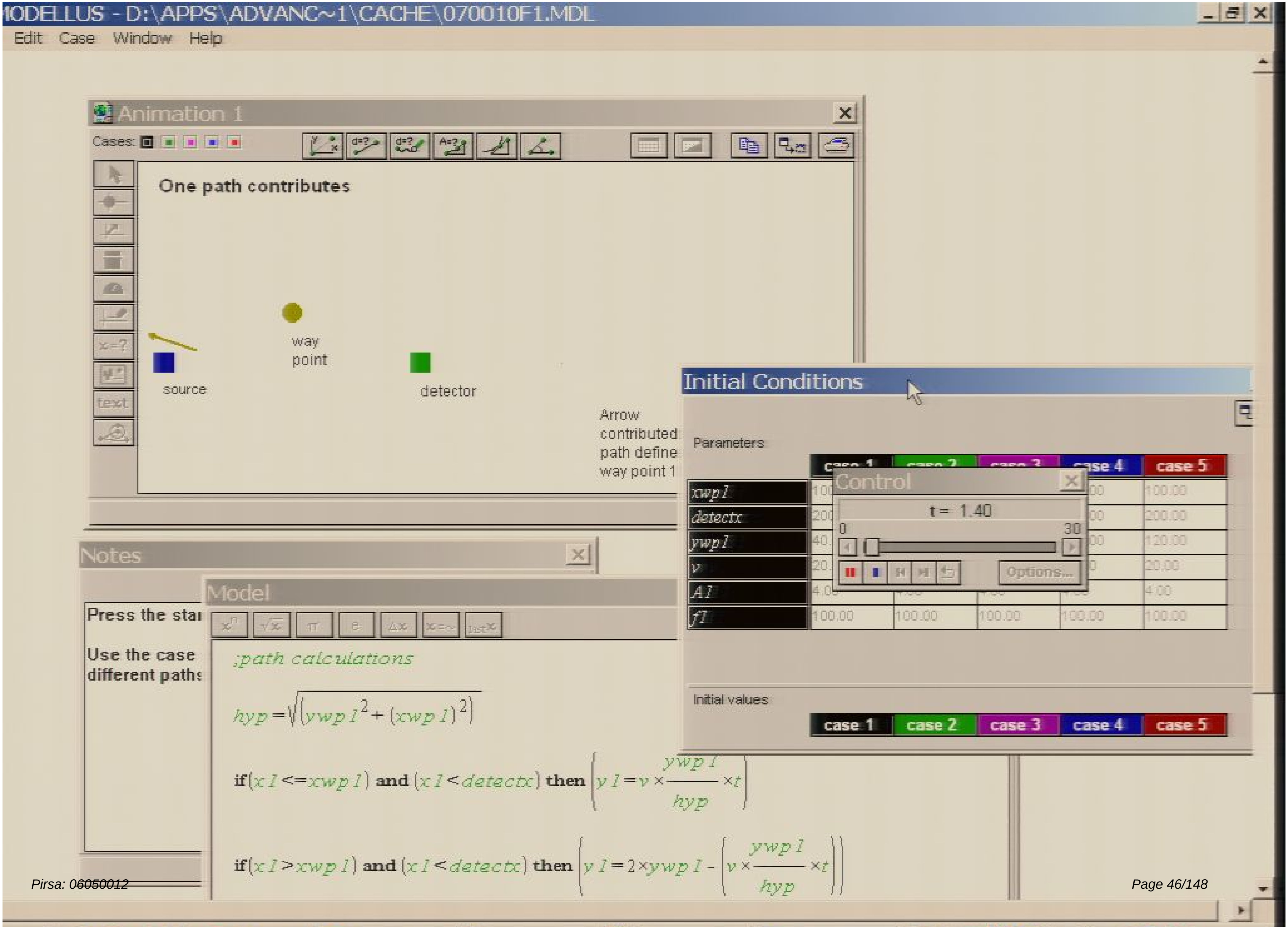
0 30

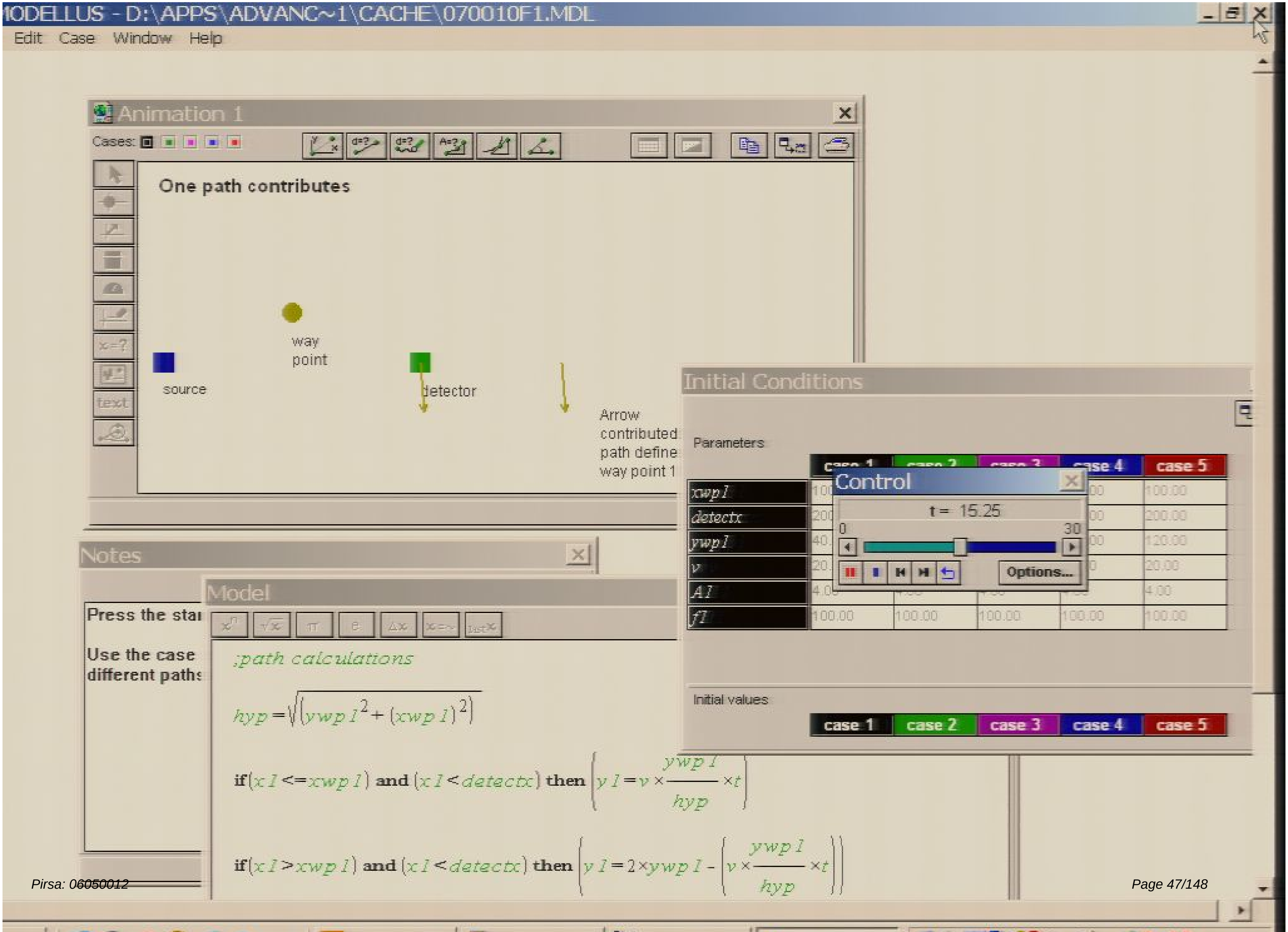
Options...

Use the case buttons to find the arrows contributed by different paths, defined by different way points.


MODELLUS - D:\APPS\ADVANC~1\CACHE\070010F1.MDL
Edit Case Window Help
Animation 1
Cases:
One path contributes
way
point
source
detector
Arrow
contributed by
path defined by
way point 1.
case 3
case 4
case 5
0.00 100.00 100.00
0.00 200.00 200.00
.00 100.00 120.00
.00 20.00 20.00
00 4.00 4.00
0.00 100.00 100.00
Control
t = 0.00
0
30
Options...
Notes
Press the star
Use the case
different paths
Model
Interpret
;path calculations
hyp = √((ywp1)² + (xwp1)²)
if (x1 <= xwp1) and (x1 < detectx) then (y1 = v × ywp1/hyp × t)
if (x1 > xwp1) and (x1 < detectx) then (y1 = 2 × ywp1 - (v × ywp1/hyp × t))


MODELLUS - D:\APPS\ADVANC~1\CACHE\070010F1.MDL
Edit Case Window Help
Animation 1
Cases:
One path contributes
way
point
source
detector
text
Notes
Press the star
Use the case
different paths
Model
;path calculations
$hyp=\sqrt{(ywp1^2+(xwp1)^2)}$
if $(x1<=xwp1)$ and $(x1<detectx)$ then $\left(y1=v\times\frac{ywp1}{hyp}\times t\right)$
if $(x1>xwp1)$ and $(x1<detectx)$ then $\left(y1=2\times ywp1-\left(v\times\frac{ywp1}{hyp}\times t\right)\right)$
Initial Conditions
Parameters
case 1 case 2 case 3 case 4 case 5
xwp1 100.00 100.00 100.0
detectx 200.00 200.00 200.0
ywp1 40.00 60.00 80.00
v 20.00 20.00 20.00
A1 4.00 4.00 4.00
f1 100.00 100.00 100.00 100.00 100.00
Initial values
case 1 case 2 case 3 case 4 case 5
Control
t = 0.00
0
30
Options...


MODELLUS - D:\APPS\ADVANC~1\CACHE\070010F1.MDL
Edit Case Window Help
Animation 1
Cases:
One path contributes
way point
source
detector
Arrow contributed path define way point 1
Initial Conditions
Parameters
case 1 case 2 case 3 case 4 case 5
xwp1
detectx
ywp1
v
A1
f1
100.00
200.00
120.00
20.00
4.00
100.00 100.00 100.00 100.00 100.00
Control
t = 1.40
0
30
Options...
Initial values
case 1 case 2 case 3 case 4 case 5
Notes
Press the star
Use the case different paths
Model
;path calculations
hyp = √((ywp1)² + (xwp1)²)
if(x1 <= xwp1) and (x1 < detectx) then (y1 = v × ywp1/hyp × t)
if(x1 > xwp1) and (x1 < detectx) then (y1 = 2×ywp1 - (v × ywp1/hyp × t))



MODELLUS - D:\APPS\ADVANC~1\CACHE\070010F1.MDL
Edit Case Window Help
Animation 1
Cases:
One path contributes
way point
source
detector
Arrow contributed path define way point 1
Initial Conditions
Parameters
case 1 case 2 case 3 case 4 case 5
xwp1
detectx
ywp1
v
A1
f1
100.00
200.00
120.00
20.00
4.00
100.00
Control
t = 15.25
0
30
Options...
Initial values
case 1 case 2 case 3 case 4 case 5
Notes
Press the star
Use the case different paths
Model
;path calculations
hyp = √((ywp1)² + (xwp1)²)
if(x1 <= xwp1) and (x1 < detectx) then (y1 = v × ywp1/hyp × t)
if(x1 > xwp1) and (x1 < detectx) then (y1 = 2×ywp1 - (v × ywp1/hyp × t))

olio Views - [Advancing Physics AS 2000 Teacher's Version]

File Edit View Insert Search Layout Tools Table Help

None

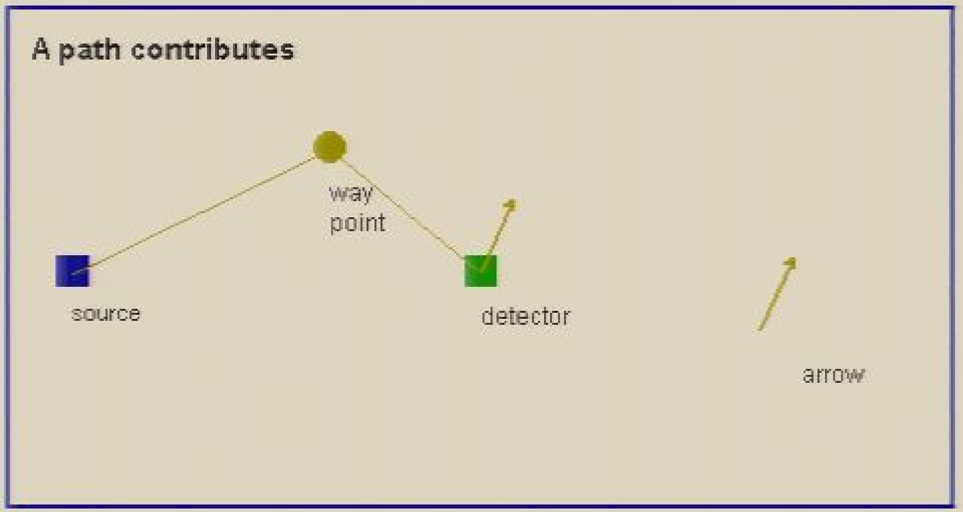
Files
Questions
Readings
Student's Checklist
: Mapping Space and Time
: Computing the Next Move
How to
Teacher and Technician Information
Specification
A–Z of Key Terms

7: Quantum Behaviour
Resource Manager
Files
Launchable Files
Getting arrows from paths

This model runs through the process of a photon exploring a path using a phasor. You see the path being explored.

Open the Modellus file

One arrow from dragged waypoints



Here you see only the result of the path being explored. As you alter the path, so you see the resulting arrow. The longer the path, the more spins for the phasor.

Open the Modellus file

Three spinning

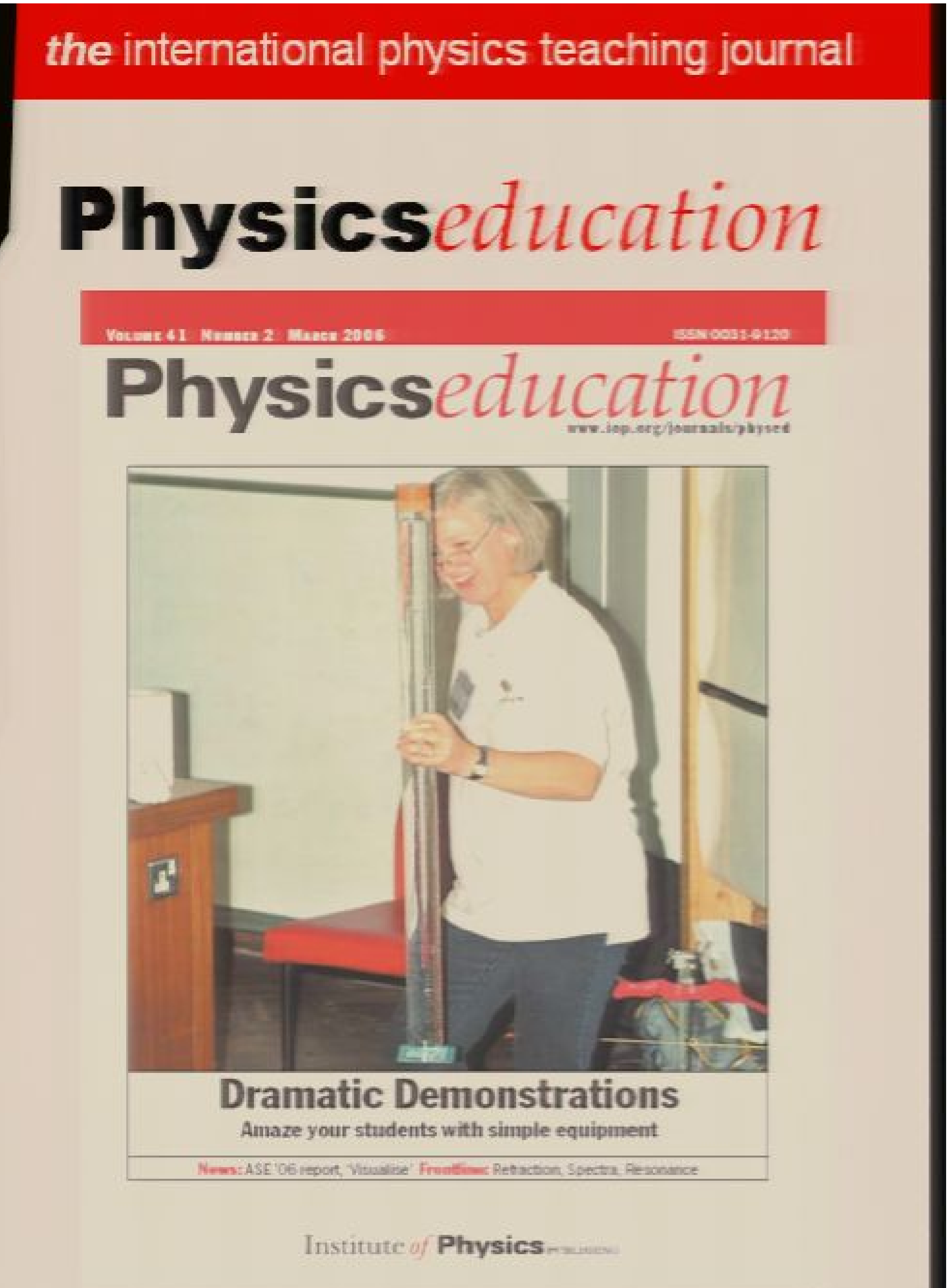
Browse Document HitList Object

Institute *of* **Physics**

Advancing Physics A2

- **The Rise and Fall of the Clockwork Universe**
  - Models and Rules introduces the use of mathematical modelling in physics
  - Matter in Extremes develops a bridge between random events and empirical laws
- **Field and particle pictures**
  - Fields develops ideas about magnetic and electric fields
  - Fundamental particles considers the structure and binding of atoms and nuclei and introduces ideas about risk
- **Advances in Physics**
  - Draws together and uses physics ideas from the whole course in looking at new contexts

IoP Teachers Network



the international physics teaching journal

Physics*education*

Six issues a year

Access to 10 years of electronic archive

www.iop.org/journals/physed

Physics*education*

the international physics teaching journal

Can you write?

*2006 individual rate - **$137***

(US$122)

YOU WILL NOT SEE THIS ADVERTISED

E-mail: ped@iop.org

Physics*education*

IoP Teachers Network

Institute of Physics
Teaching Physics

Aim..

Institute of Physics
Teaching Physics

Aim..

- The aim of the Physics Teacher Network is to provide support for those involved with the teaching of physics, at an individual level.

Aim..

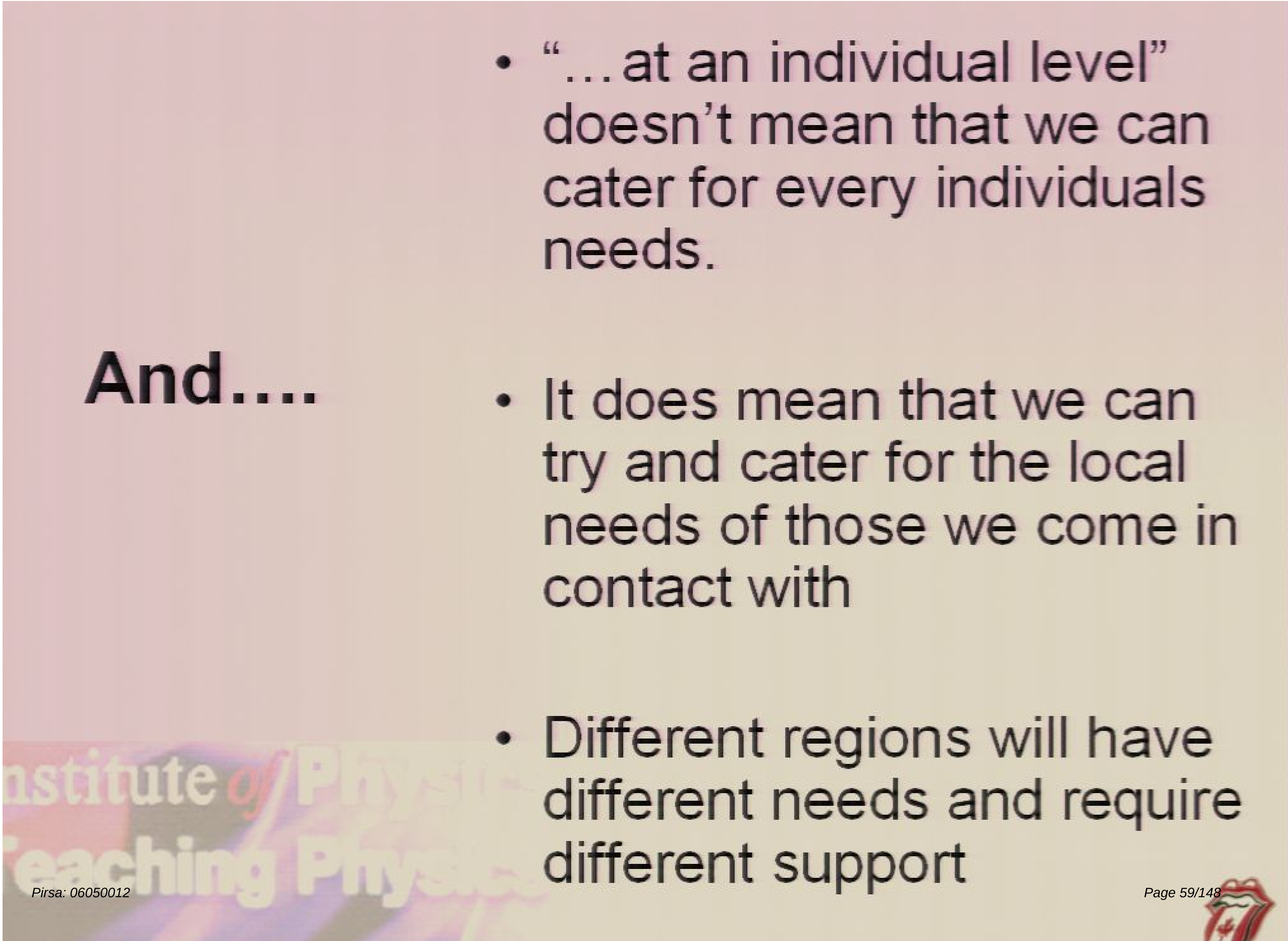
- The aim of the Physics Teacher Network is to provide support for those involved with the teaching of physics, at an individual level.

- We want to engage with as many science and physics teachers and technicians as we can, helping them to improve the experience that students associated with them undergo.

And….

- “…at an individual level” doesn’t mean that we can cater for every individuals needs.

And….


And….
• "…at an individual level" doesn't mean that we can cater for every individuals needs.
• It does mean that we can try and cater for the local needs of those we come in contact with
• Different regions will have different needs and require different support
Institute of Physics
Teaching Physics

Now…

So what do we do…?

Institute of Physics Teaching Physics

So what do we do…?

- Coordinators own sessions

So what do we do…?

- Coordinators own sessions
- Centrally resourced sessions

Institute of Physics
Teaching Physics

So what do we do…?

- Coordinators own sessions
- Centrally resourced sessions
- Newsletters

Institute of Physics
Teaching Physics

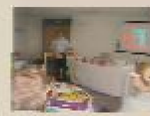
So what do we do…?

- Coordinators own sessions
- Centrally resourced sessions
- Newsletters
- Anything and everything!

NPL
National Physical Laboratory

The National Physical Laboratory and A-Level Physics

Monday 3rd July 2006
09:30 – 16:00
The National Physical Laboratory, Teddington

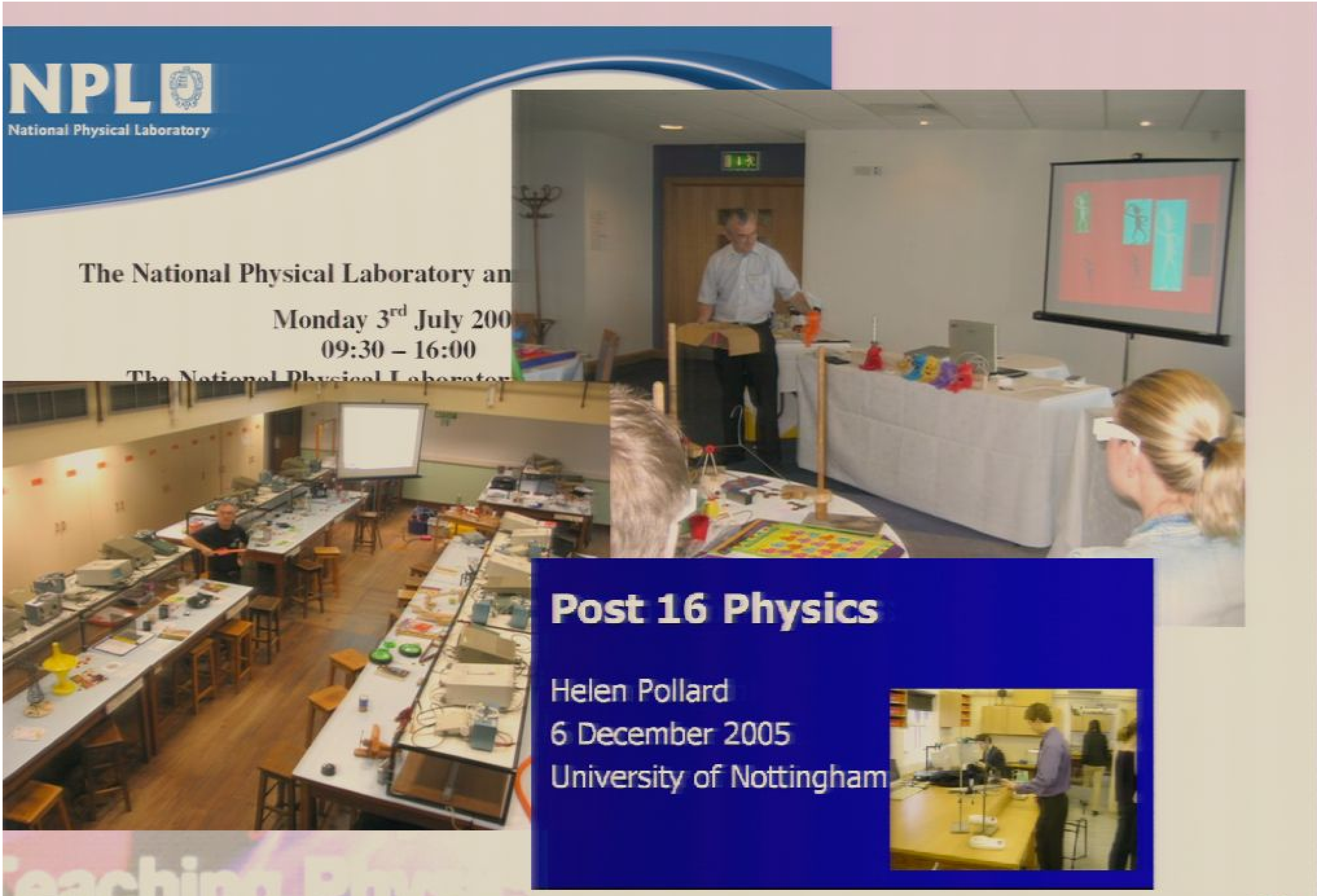


NPL
National Physical Laboratory

The National Physical Laboratory an

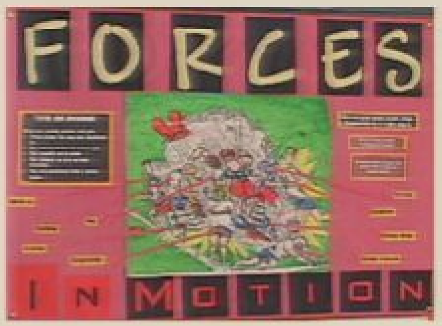
Monday 3rd July 200
09:30 – 16:00
The National Physical Laborator

nstitute of Physic
Teaching Physics


NPL
National Physical Laboratory
The National Physical Laboratory an
Monday 3rd July 200
09:30 – 16:00
Post 16 Physics
Helen Pollard
6 December 2005
University of Nottingham

NPL

The winners from the Y10 category were three girls
from Edgbaston High School



The winners from the Y9 category were from King Edward VI Handsworth School,

Physics

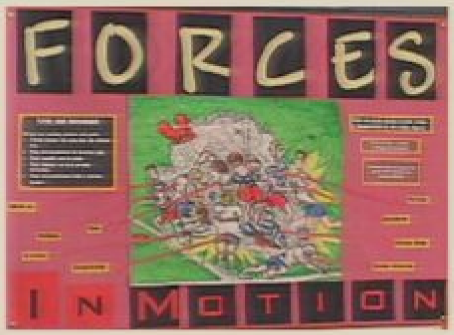
d

2005

f Nottingham

with runners up from Edgbaston High School

The winners from the Y10 category were three girls
from Edgbaston High School



The winners from the Y9 category we
Edward VI Handsworth School,

with runners up from Edgbaston High School

Rocket Day at Swanshurst School June 30th 2005

Customising the designs..............

Displaying the finished rockets...................

Centrally resourced sessions

Centrally resourced sessions

- Software for Skint Schools

Centrally resourced sessions

- Software for Skint Schools
- New Ideas?

Institute of Physics
Teaching Physics

Centrally resourced sessions

- Software for Skint Schools
- New Ideas?
- Son of New Ideas?

Centrally resourced sessions

- Software for Skint Schools
- New Ideas?
- Son of New Ideas?
- SEP - Energy Boards

Institute of Physics
Teaching Physics

Centrally resourced sessions

- Software for Skint Schools
- New Ideas?
- Son of New Ideas?
- SEP - Energy Boards
- SEP - Thermochromic sheet

Centrally resourced sessions

- Software for Skint Schools
- New Ideas?
- Son of New Ideas?
- SEP - Energy Boards
- SEP - Thermochromic sheet

In the pipeline:

- Shocked and Stunned
- New Ideas Rides Again?
- More from SEP

Institute of Physics
Teaching Physics

Software for Skint Schools

Westpoint Bridge Designer

From Westpoint Military

Academy. Allows you to design, build and test bridges.

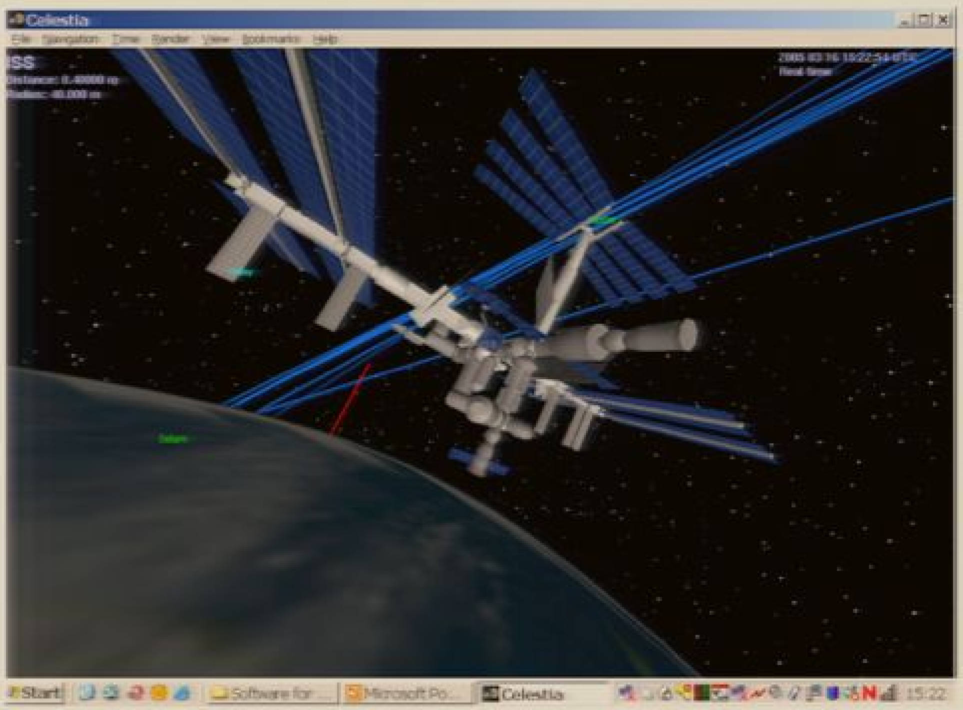
It also has information

about the materials used and their cost.

Easy to use and very stable, very popular with all ages from 4 up.

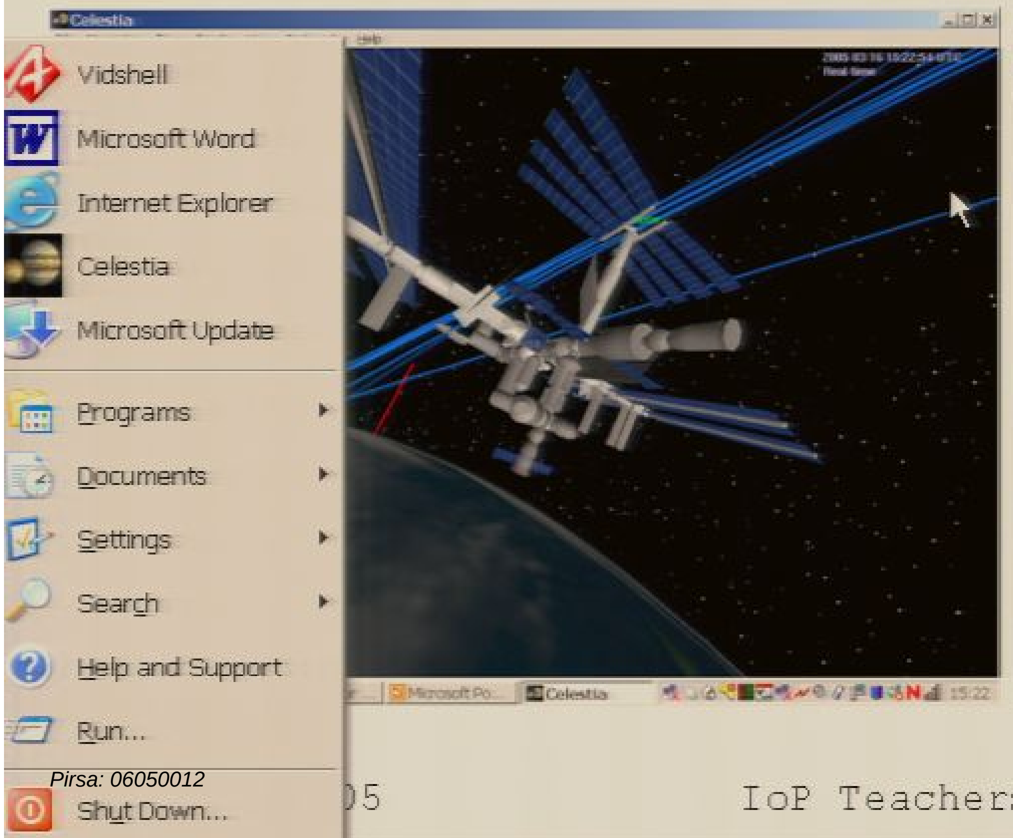
Celestia

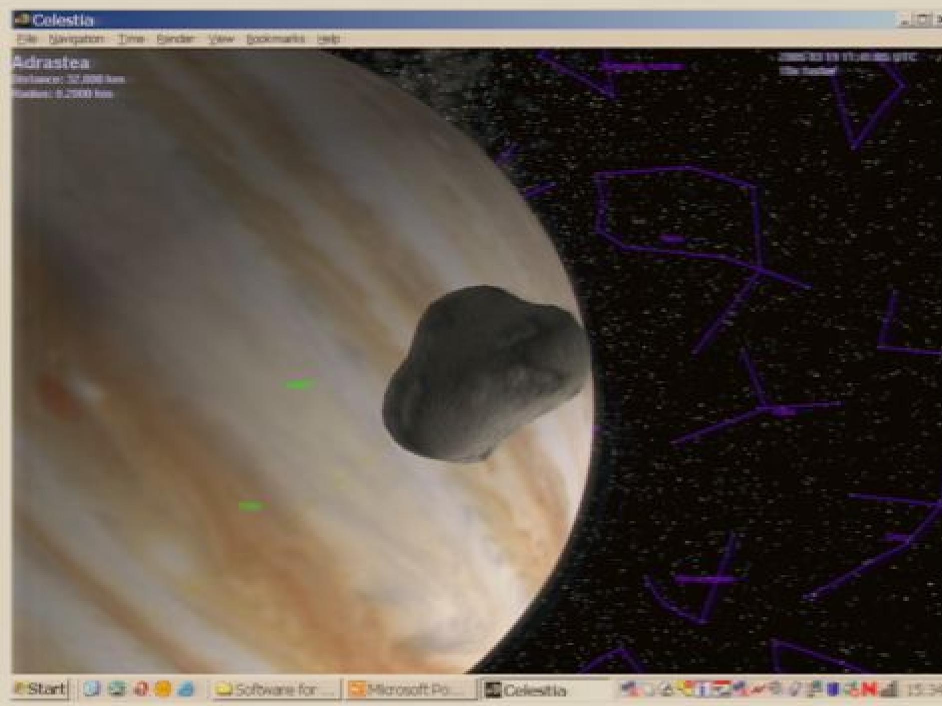
A virtual chunk of the Galaxy. Really needs a good computer to do the software justice. You have to see this to appreciate how good it is.



Celestia

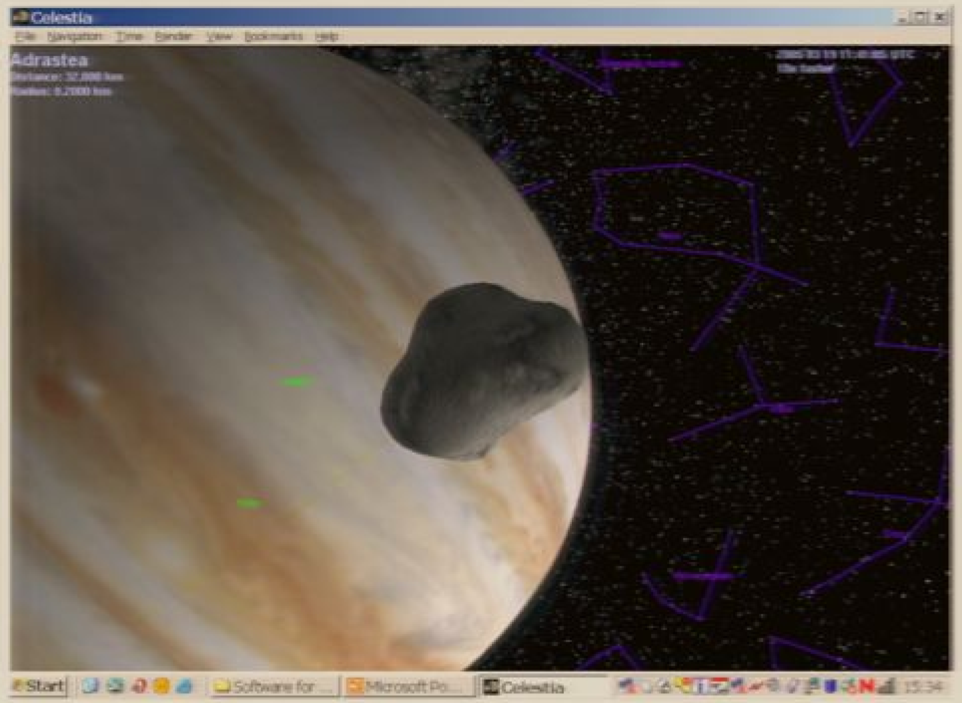
A virtual chunk of the Galaxy. Really needs a good computer to do the software justice. You have to see this to appreciate how good it is.





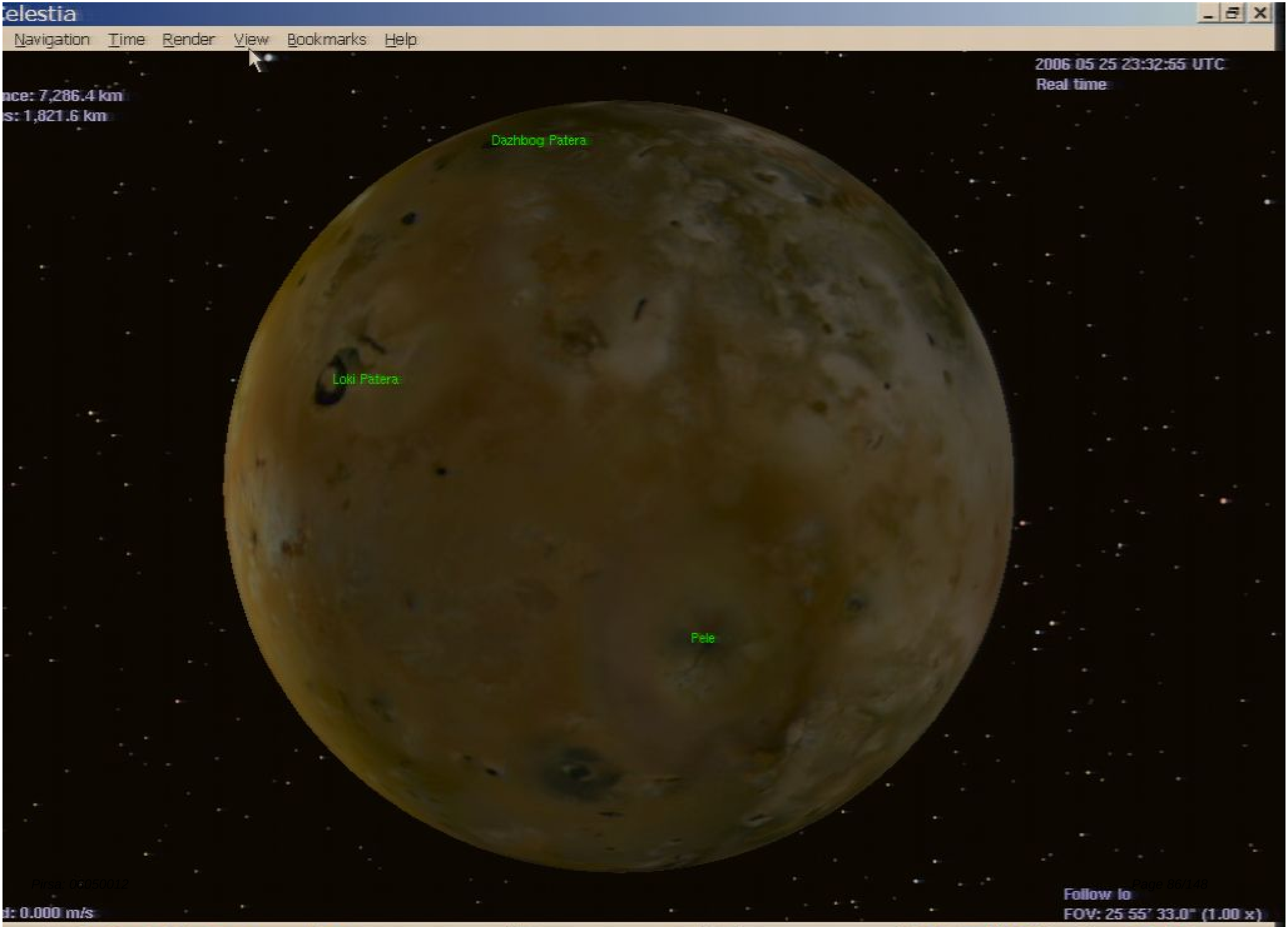
Celestia

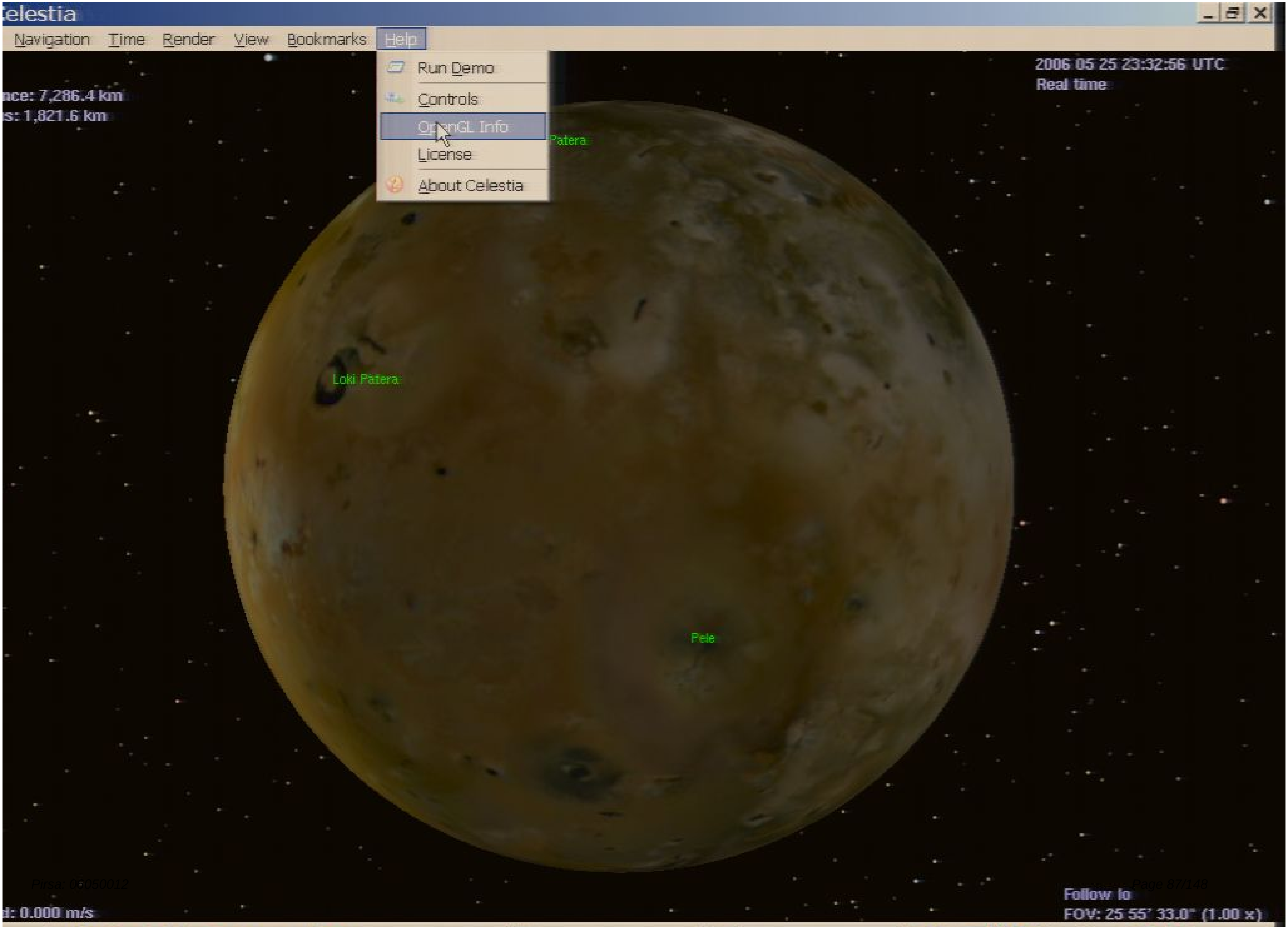
A virtual chunk of the Galaxy. Really needs a good computer to do the software justice. You have to see this to appreciate how good it is.



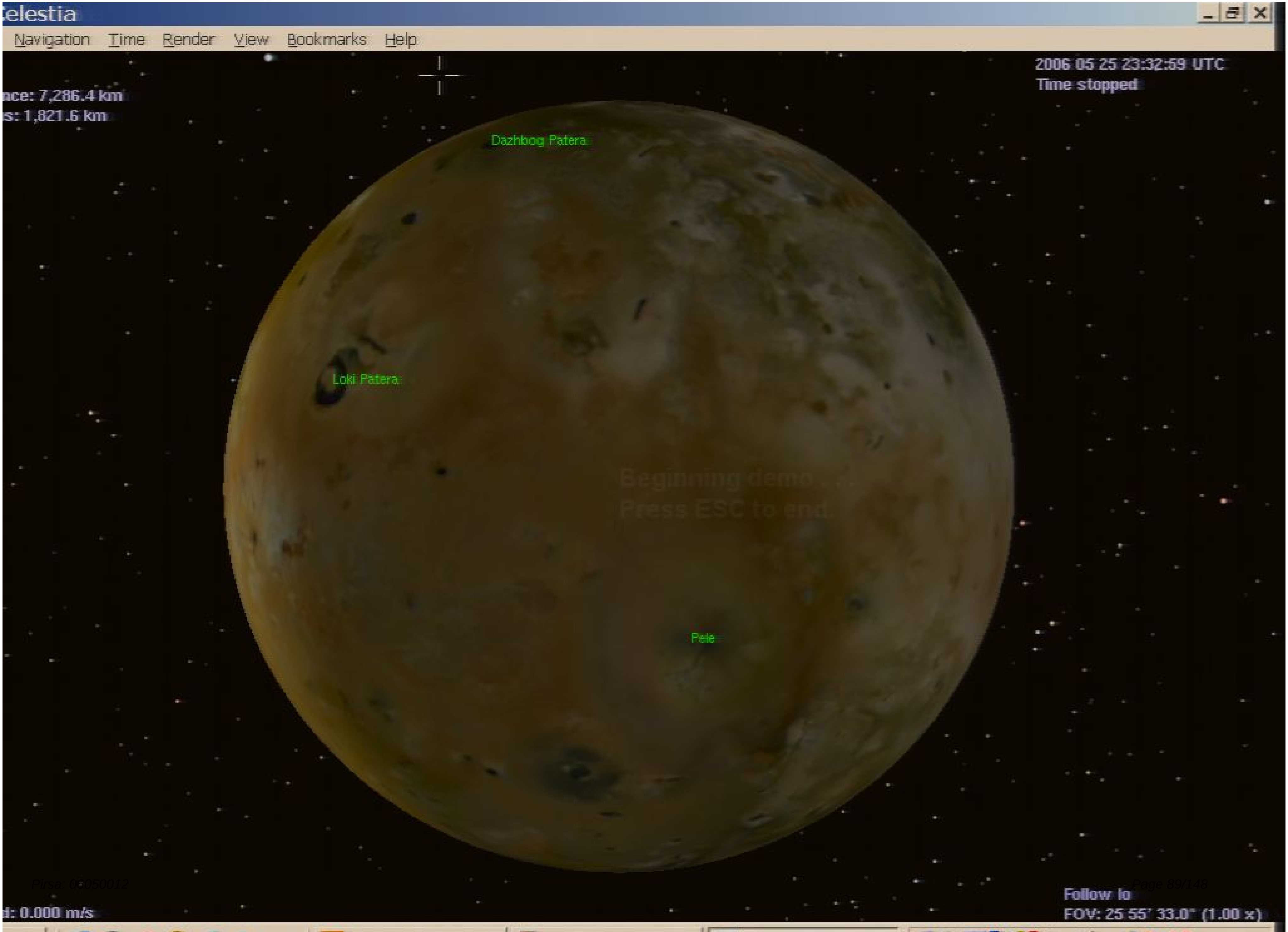

Celestia
Navigation Time Render View Bookmarks Help
2006 05 25 23:32:51 UTC
Real time
nce: 3,266,200 km
us: 1,821.6 km
CELESTIA
Travelling
Follow Io
FOV: 20 26' 7.0" (1.00 x)
d: 0.000 m/s


Celestia
Navigation Time Render View Bookmarks Help
2006 05 25 23:32:52 UTC
Real time
ance: 7,286.4 km
us: 1,821.6 km
Loki Patera
Pele
Follow Io
FOV: 20 26' 7.0" (1.00 x)
ed: 0.000 m/s

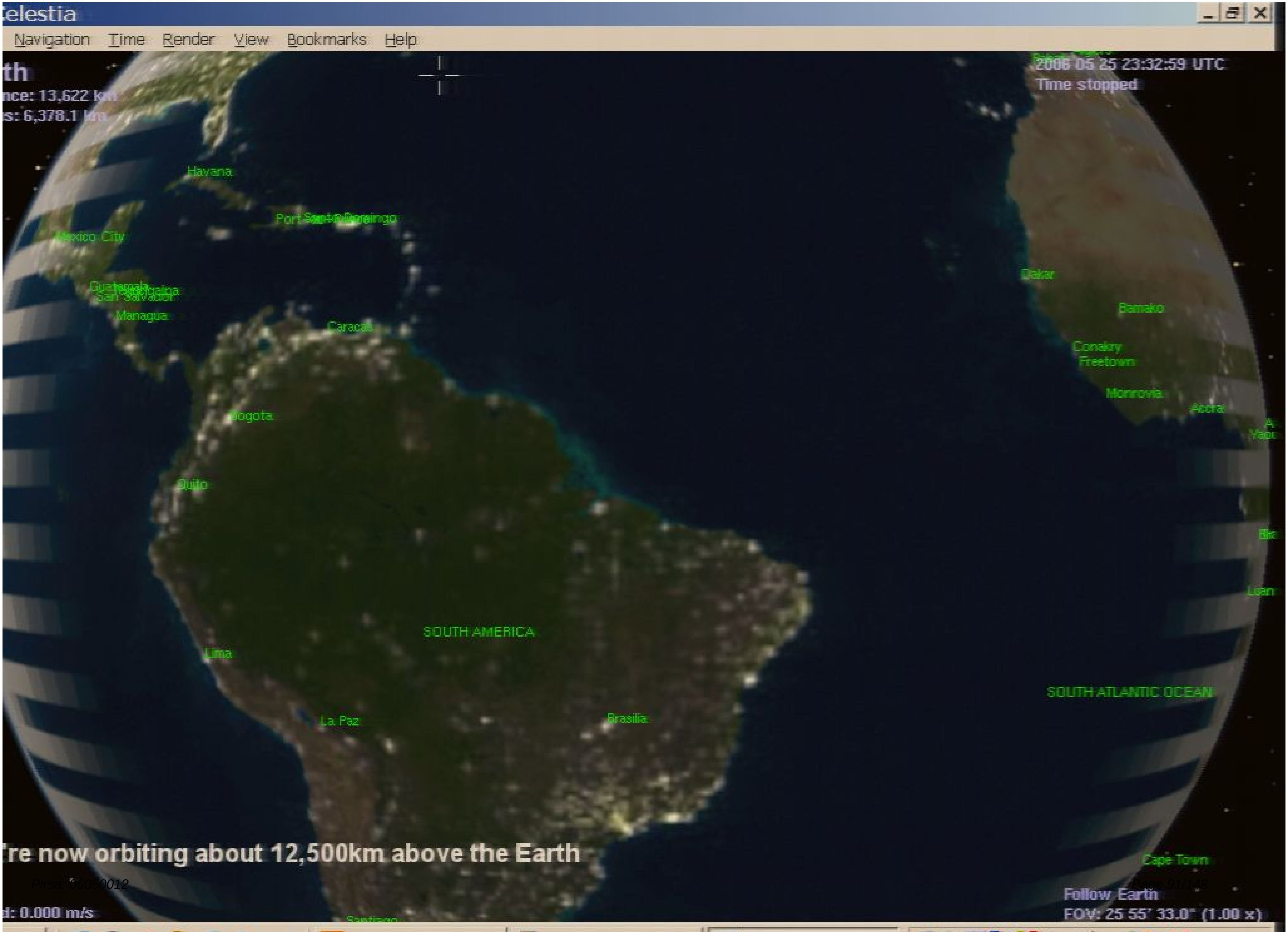

elestia
Navigation
Time
Render
View
Bookmarks
Help
2006 05 25 23:32:55 UTC
Real time
nce: 7,286.4 km
s: 1,821.6 km
Dazhbog Patera
Loki Patera
Pele
Follow Io
FOV: 25 55' 33.0" (1.00 x)
d: 0.000 m/s


elestia
Navigation Time Render View Bookmarks Help
Run Demo
Controls
OpenGL Info
License
About Celestia
nce: 7,286.4 km
s: 1,821.6 km
2006 05 25 23:32:56 UTC
Real time
Patera
Loki Patera
Pele
Follow Io
FOV: 25 55' 33.0" (1.00 x)
d: 0.000 m/s

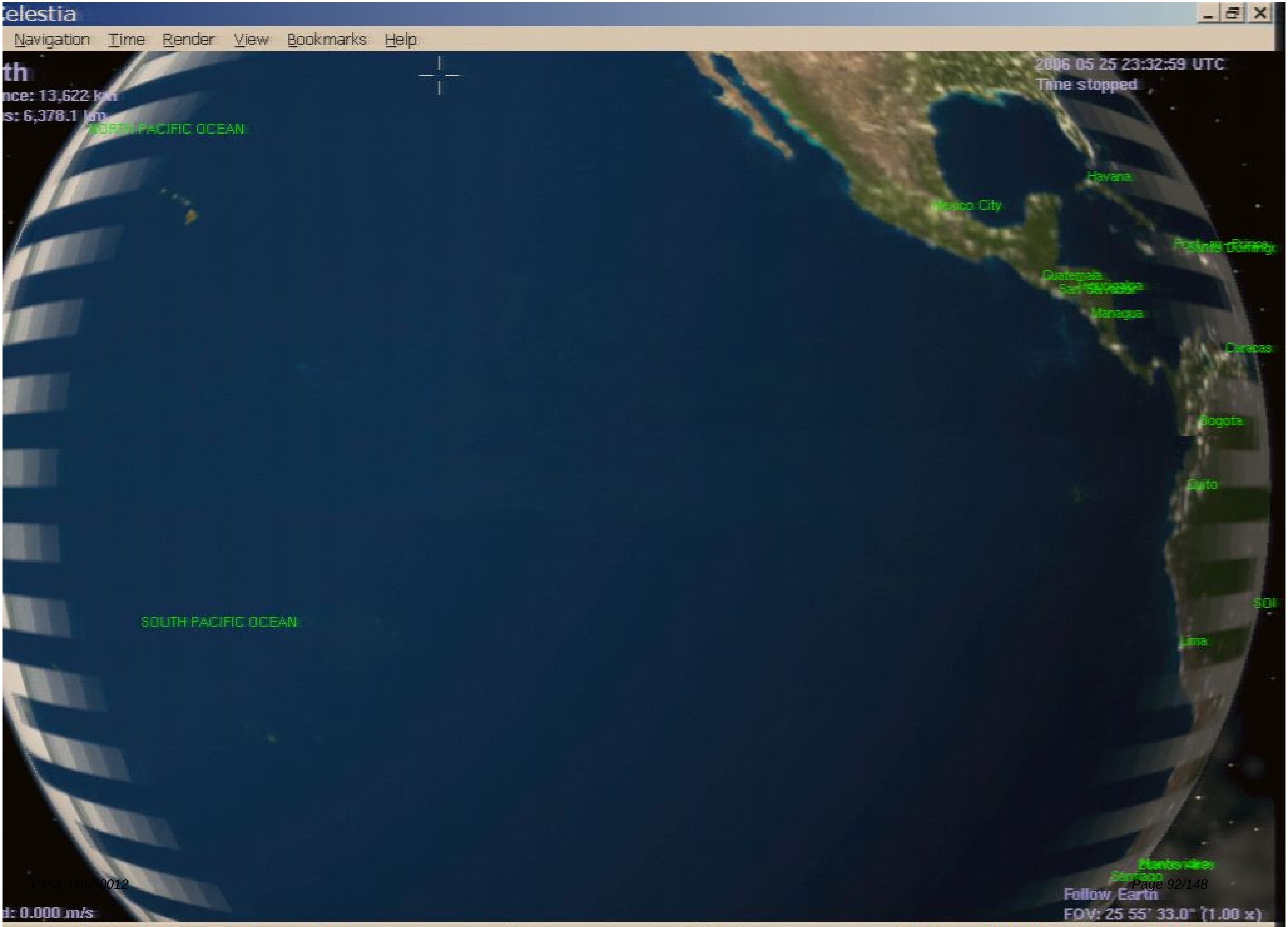

elestia
Navigation Time Render View Bookmarks Help
nce: 7,286.4 km
s: 1,821.6 km
2006 05 25 23:32:59 UTC
Time stopped
Dazhbog Patera
Loki Patera
Beginning demo . . .
Press ESC to end.
Pele
Follow Io
d: 0.000 m/s
FOV: 25 55' 33.0" (1.00 x)

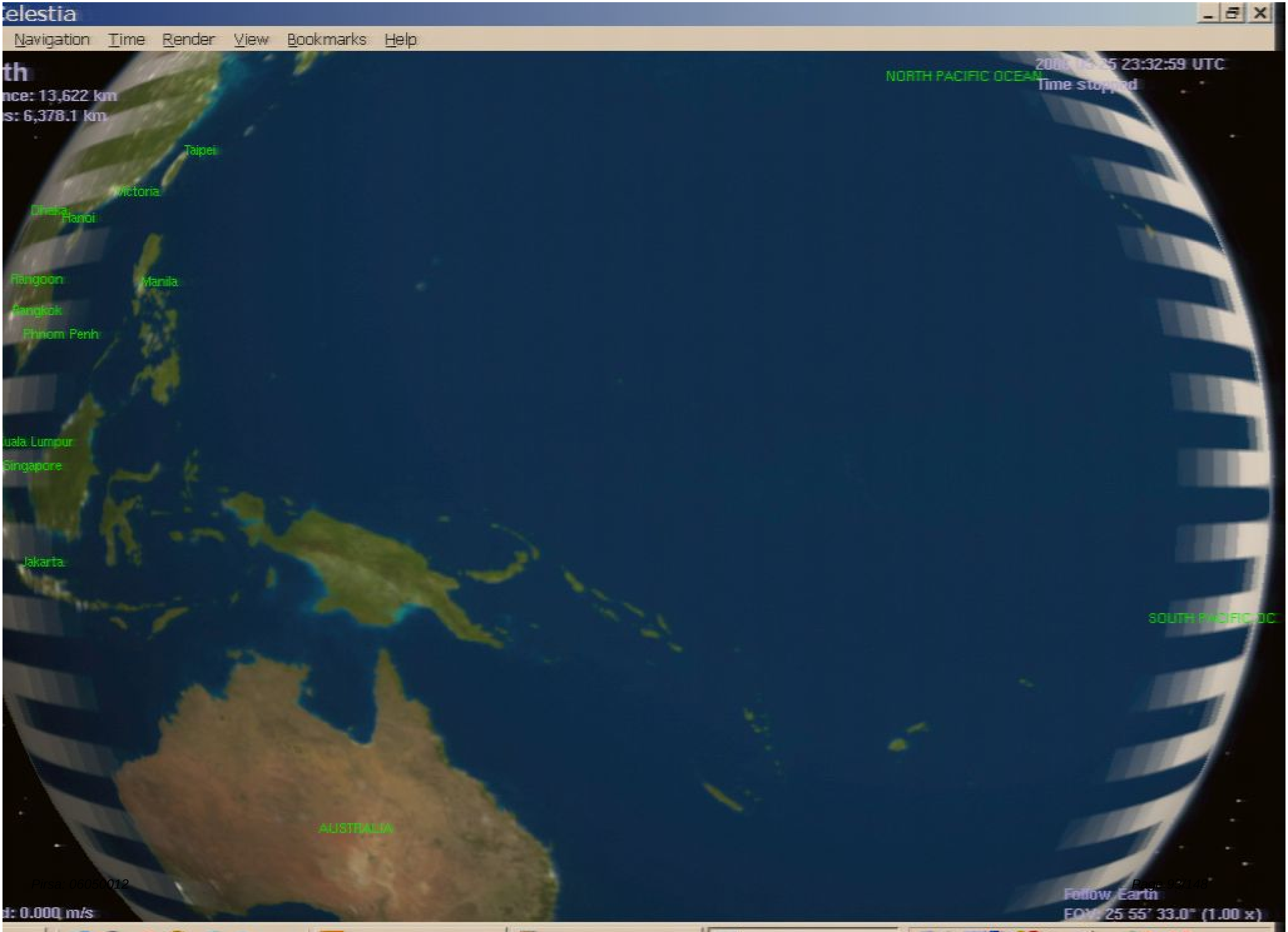

elestia
Navigation Time Render View Bookmarks Help
2006 05 25 23:32:59 UTC
Time stopped
nce: 7,286.4 km
s: 1,821.6 km
Dazhbog Patera
Loki Patera
Beginning demo ...
Press ESC to end.
Pele
Follow Io
FOV: 25 55' 33.0" (1.00 x)
d: 0.000 m/s

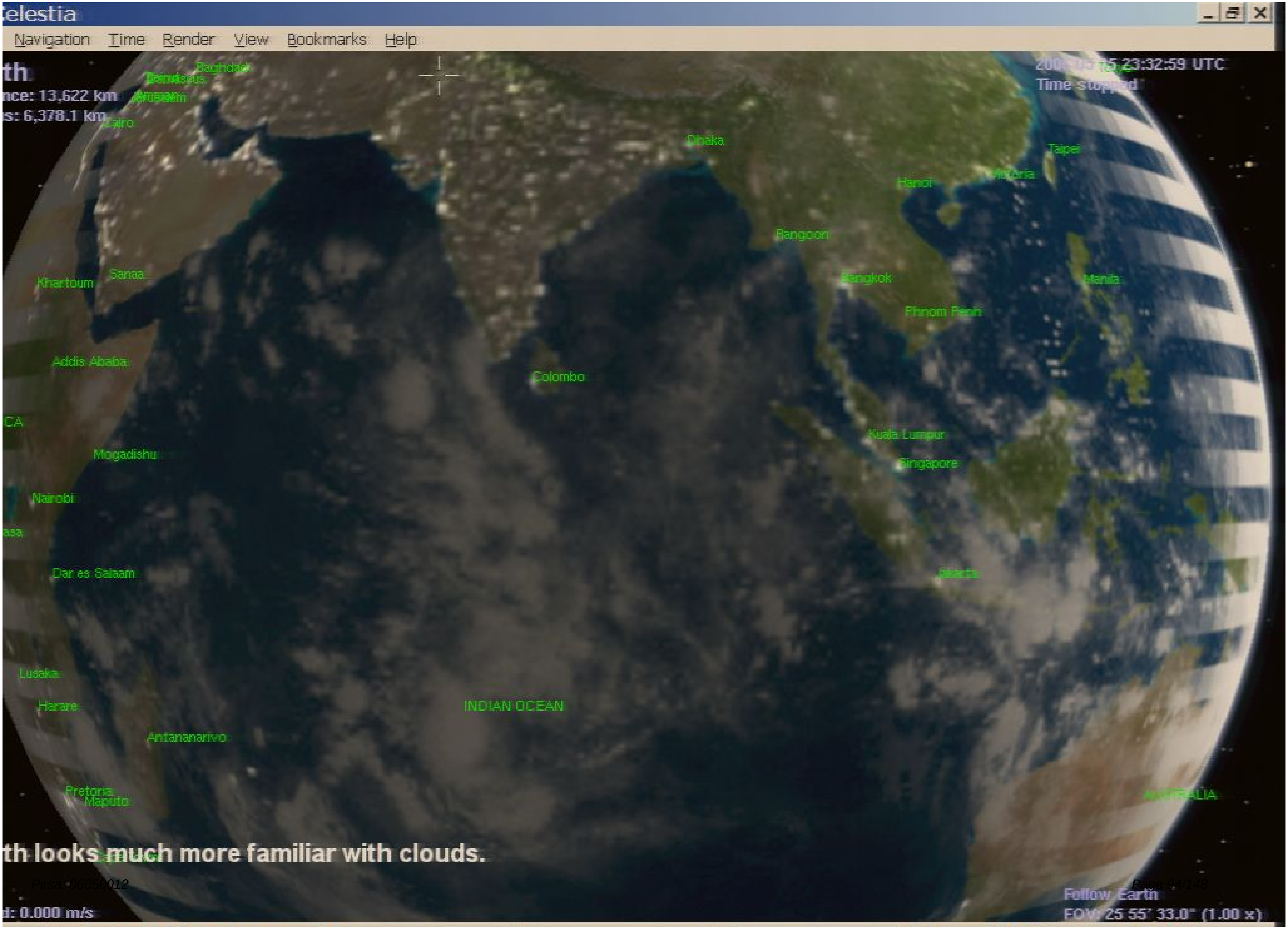

elestia
Navigation Time Render View Bookmarks Help
th
nce: 13,622 km
s: 6,378.1 km
2006 05 25 23:32:59 UTC
Time stopped
Rabat
Cairo
Riyadh
Khartoum
Sanaa
Dakar
Bamako
Conakry
Freetown
Monrovia
Accra
Addis Ababa
AFRICA
Bangui
Yaounde
Colombo
Mogadishu
Kampala
Nairobi
Dar es Salaam
Luanda
SOUTH ATLANTIC OCEAN
INDIAN OCEAN
Lusaka
Harare
Antananarivo
Maputo
're now orbiting about 12,500km above the Earth
Follow Earth
FOV: 25 55' 33.0" (1.00 x)
d: 0.000 m/s

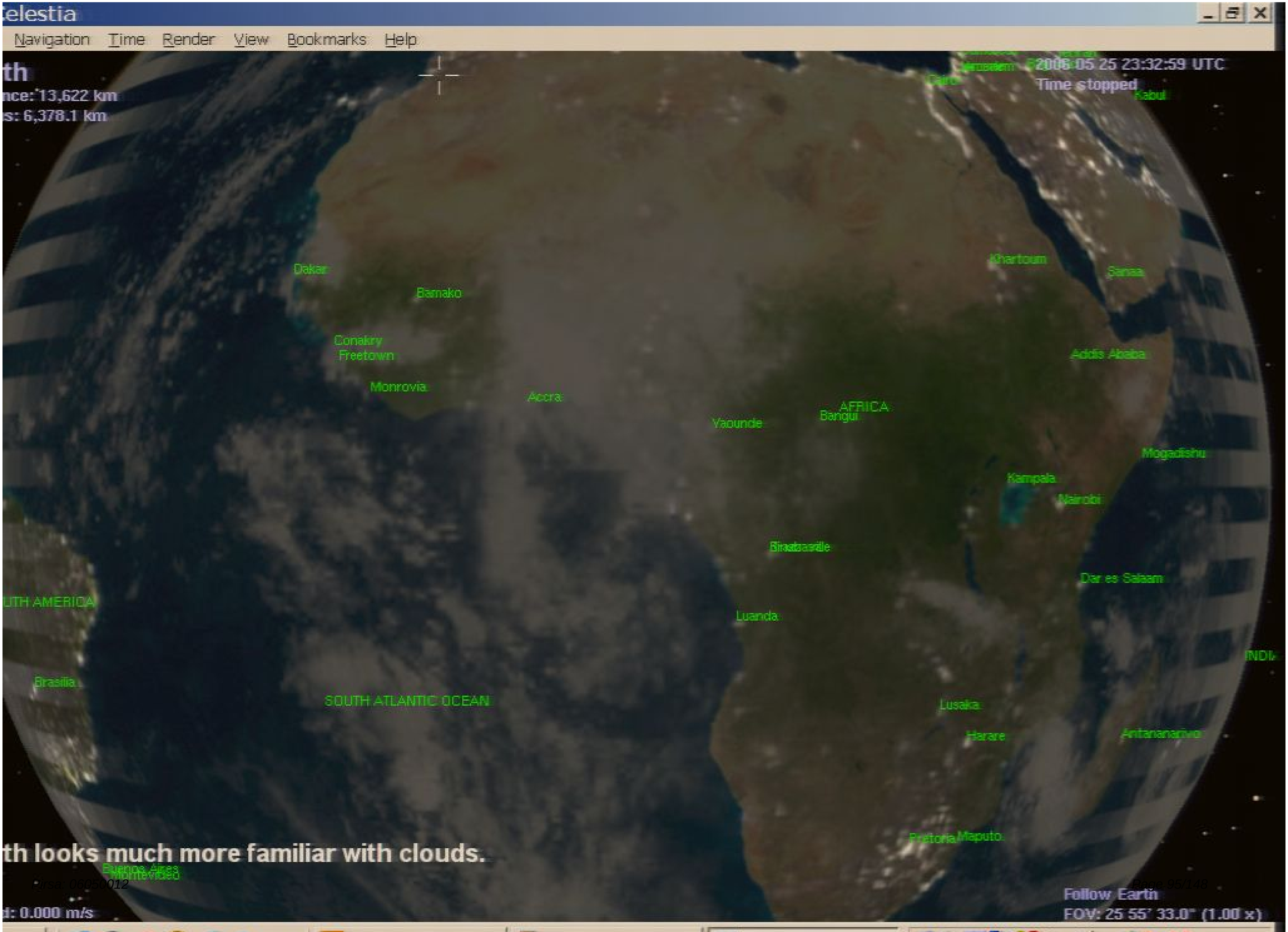


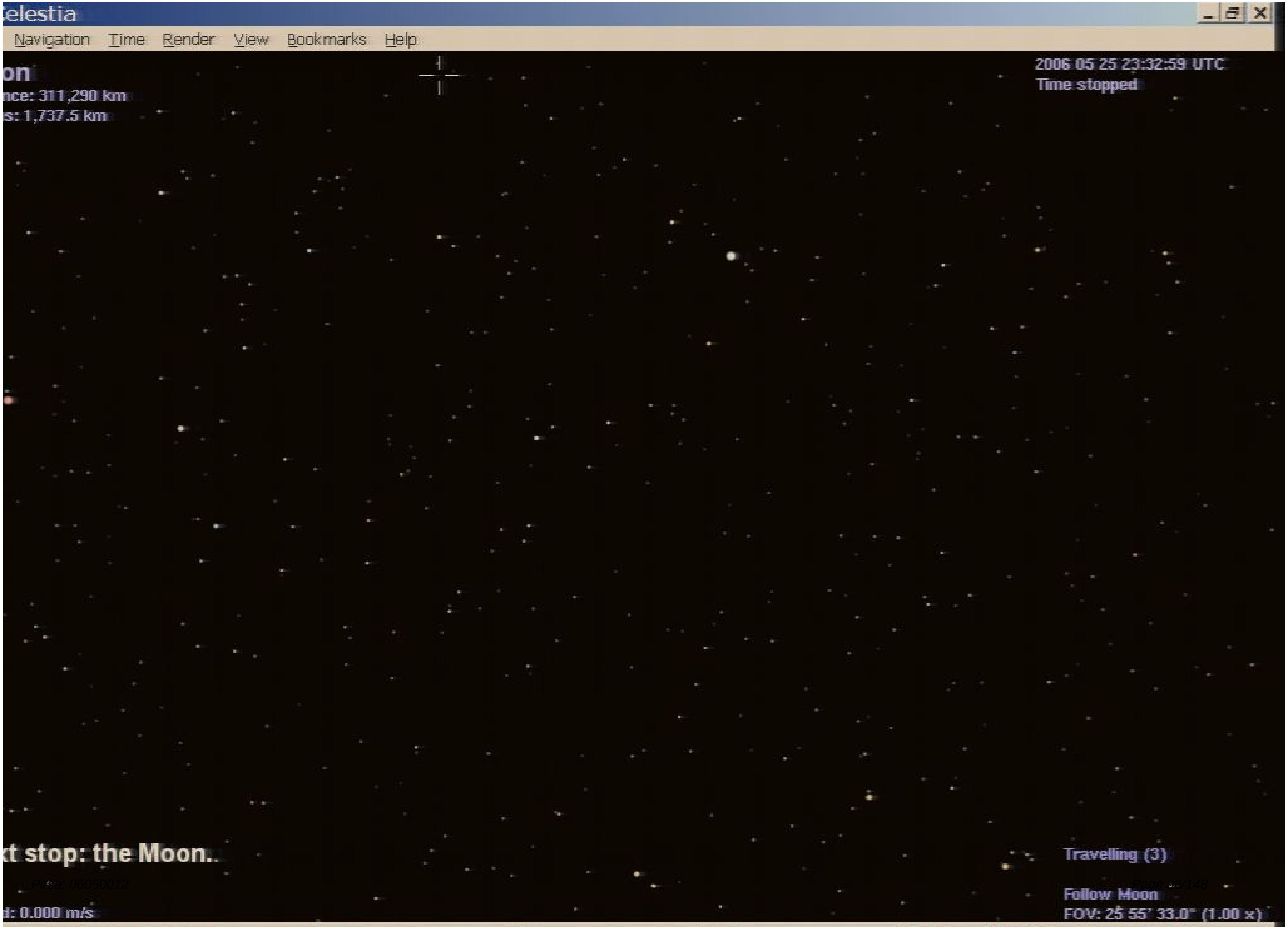
elestia
Navigation Time Render View Bookmarks Help
th
nce: 13,622 km
s: 6,378.1 km
2006 05 25 23:32:59 UTC
Time stopped
Havana
Mexico City
Guatemala
San Salvador
Managua
Caracas
Dakar
Bamako
Conakry
Freetown
Monrovia
Accra
Bogota
Quito
SOUTH AMERICA
Lima
La Paz
Brasilia
SOUTH ATLANTIC OCEAN
're now orbiting about 12,500km above the Earth
Cape Town
Follow Earth
d: 0.000 m/s
FOV: 25 55' 33.0" (1.00 x)


elestia
Navigation Time Render View Bookmarks Help
th
nce: 13,622 km
s: 6,378.1 km
2006 05 25 23:32:59 UTC
Time stopped
NORTH PACIFIC OCEAN
Havana
Mexico City
Guatemala
Managua
Caracas
Bogota
Quito
Lima
SOUTH PACIFIC OCEAN
Follow Earth
FOV: 25 55' 33.0" (1.00 x)
d: 0.000 m/s


elestia
Navigation Time Render View Bookmarks Help
th
nce: 13,622 km
s: 6,378.1 km
23:32:59 UTC
Time stopped
NORTH PACIFIC OCEAN
Taipei
Victoria
Dhaka
Hanoi
Rangoon
Manila
Bangkok
Phnom Penh
uala Lumpur
Singapore
Jakarta
SOUTH PACIFIC OC
AUSTRALIA
Follow Earth
FOV: 25 55' 33.0" (1.00 x)
d: 0.000 m/s


elestia
Navigation Time Render View Bookmarks Help
th
nce: 13,622 km
s: 6,378.1 km
23:32:59 UTC
Time stopped
Baghdad
Cairo
Dhaka
Taipei
Hanoi
Rangoon
Bangkok
Manila
Phnom Penh
Khartoum
Sanaa
Addis Ababa
Colombo
Mogadishu
Kuala Lumpur
Singapore
Nairobi
Dar es Salaam
Lusaka
Harare
INDIAN OCEAN
Antananarivo
Pretoria
Maputo
th looks much more familiar with clouds.
Follow Earth
FOV: 25 55' 33.0" (1.00 x)
d: 0.000 m/s

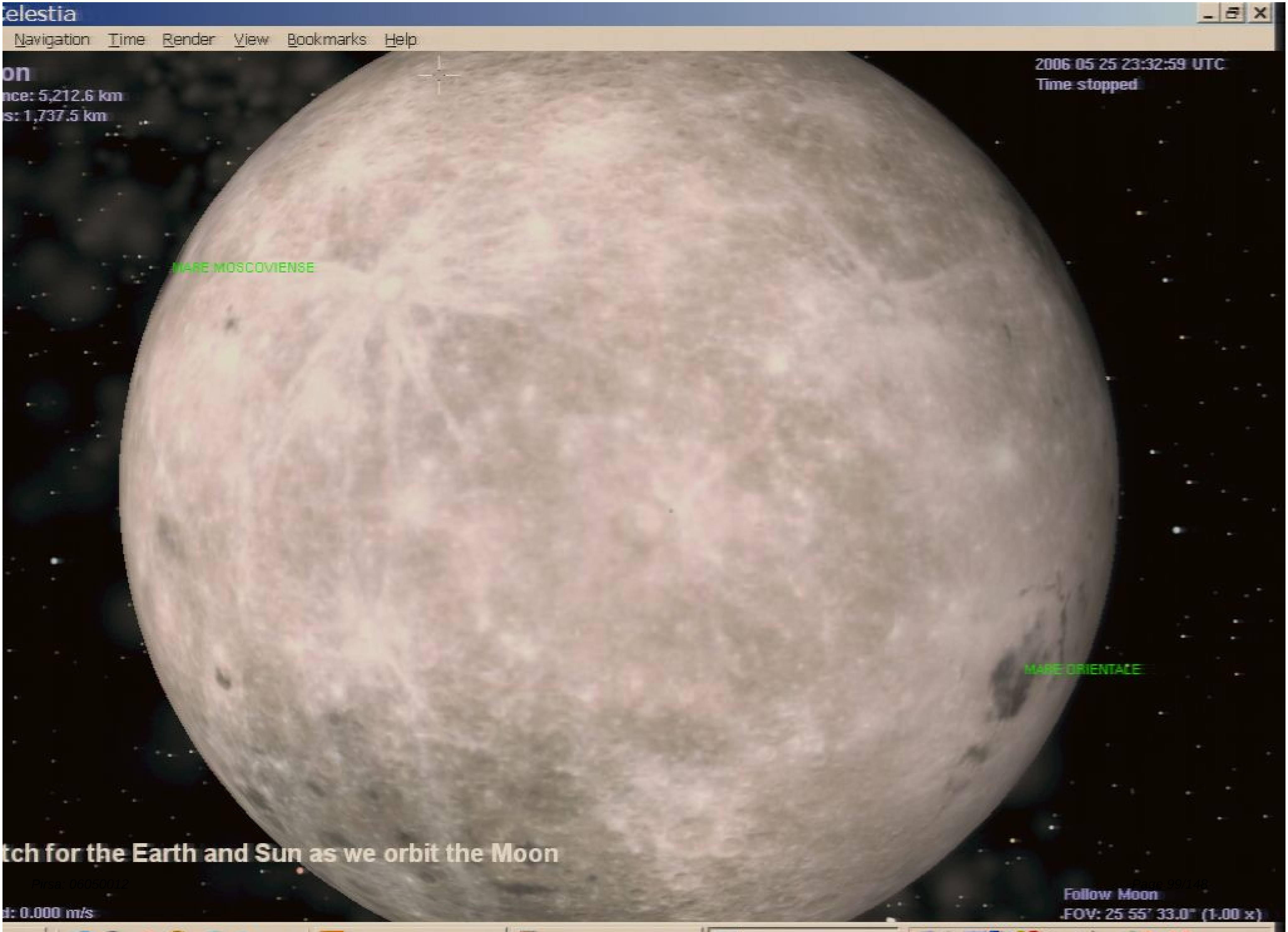

elestia
Navigation
Time
Render
View
Bookmarks
Help
th
nce: 13,622 km
s: 6,378.1 km
2006 05 25 23:32:59 UTC
Time stopped
Kabul
Cairo
Khartoum
Sanaa
Dakar
Bamako
Conakry
Freetown
Monrovia
Accra
Addis Ababa
AFRICA
Bangui
Yaounde
Mogadishu
Kampala
Nairobi
Dar es Salaam
UTH AMERICA
Luanda
INDI
Brasilia
SOUTH ATLANTIC OCEAN
Lusaka
Harare
Antananarivo
Pretoria
Maputo
th looks much more familiar with clouds.
Buenos Aires
Montevideo
d: 0.000 m/s
Follow Earth
FOV: 25 55' 33.0" (1.00 x)

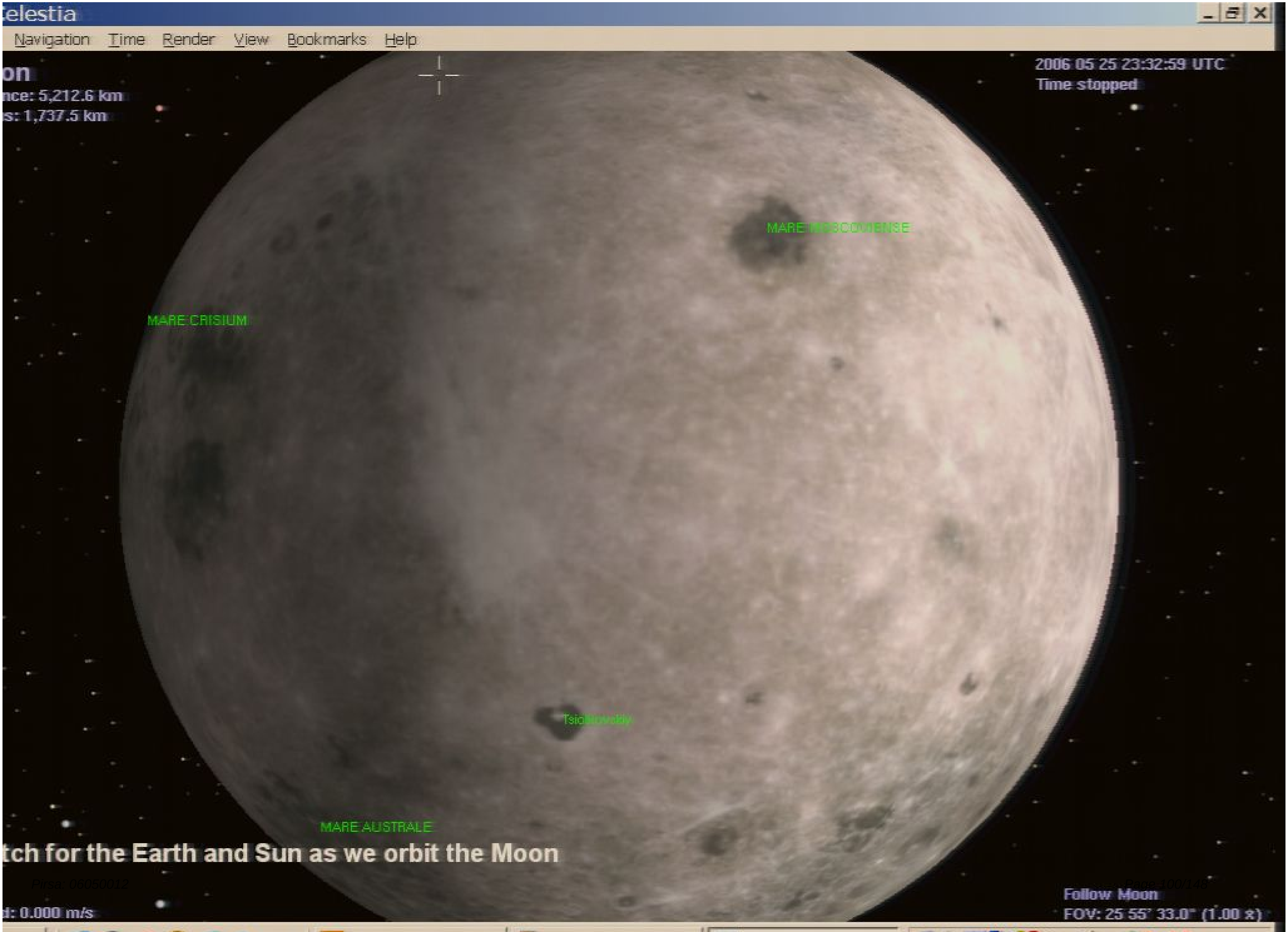


:elestia
Navigation Time Render View Bookmarks Help
on
nce: 311,290 km
s: 1,737.5 km
2006 05 25 23:32:59 UTC
Time stopped
xt stop: the Moon..
Travelling (3)
Follow Moon
d: 0.000 m/s
FOV: 25 55' 33.0" (1.00 x)


elestia
Navigation
Time
Render
View
Bookmarks
Help
on
nce: 5,617.5 km
s: 1,737.5 km
2006 05 25 23:32:59 UTC
Time stopped
MARE IMBRIUM
MARE SERENITATIS
OCEANUS PROCELLARUM
MARE CRISIUM
Copernicus
MARE INSULARUM
MARE TRANQUILLITATIS
MARE FECUNDITATIS
MARE NUBIUM
Tycho
xt stop: the Moon.
Travelling
Follow Moon
d: 0.000 m/s
FOV: 25 55' 33.0" (1.00 x)


elestia
Navigation Time Render View Bookmarks Help
on
nce: 5,212.6 km
s: 1,737.5 km
2006 05 25 23:32:59 UTC
Time stopped
MARE IMBRIUM
MARE SERENITATIS
OCEANUS PROCELLARUM
Copernicus
MARE INSULARUM
MARE TRANQUILLITATIS
MARE ORIENTALE
MARE NUBIUM
tch for the Earth and Sun as we orbit the Moon
Tycho
Follow Moon
d: 0.000 m/s
FOV: 25 55' 33.0" (1.00 x)

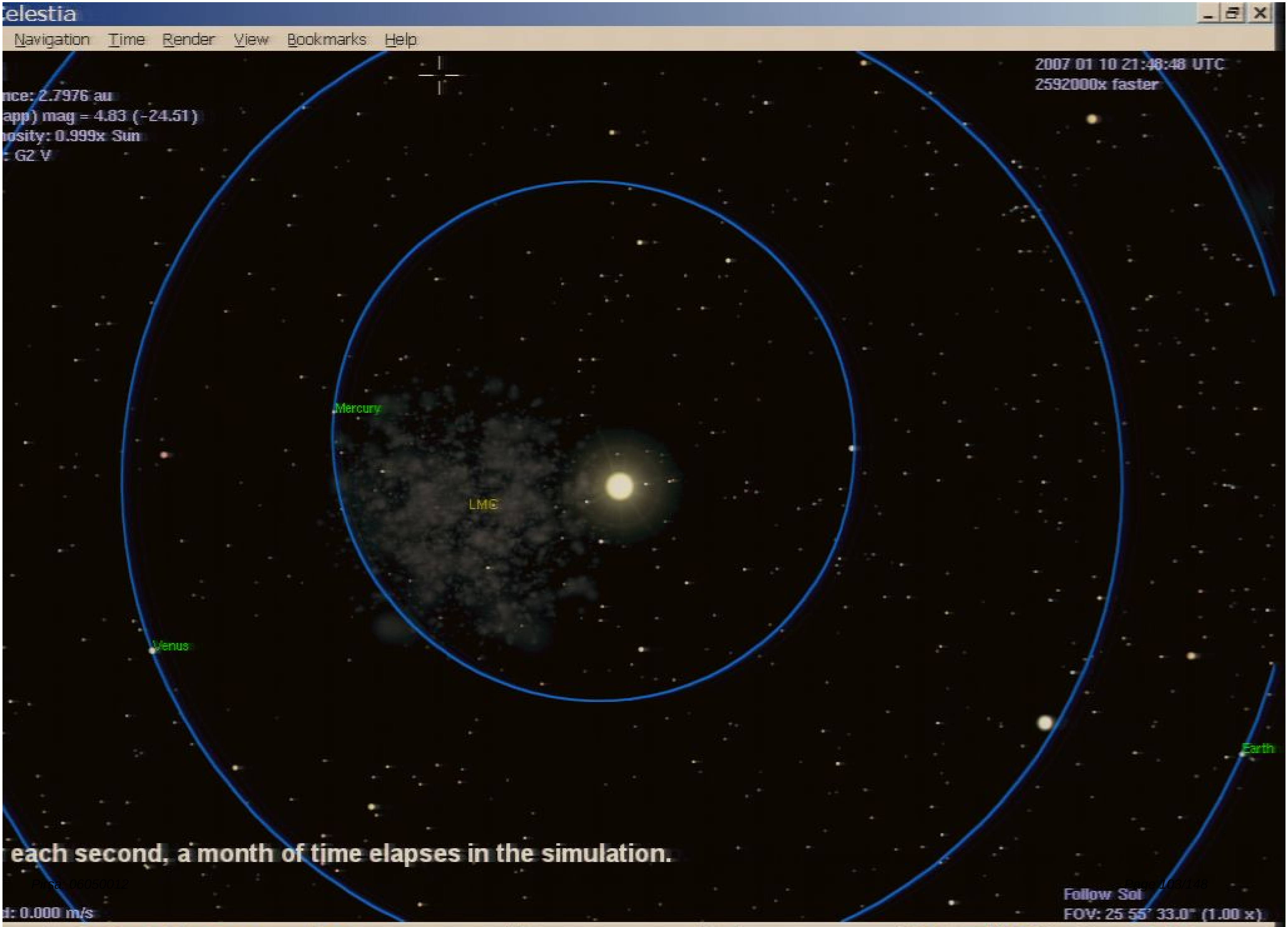

elestia
Navigation Time Render View Bookmarks Help
on
nce: 5,212.6 km
s: 1,737.5 km
2006 05 25 23:32:59 UTC
Time stopped
MARE MOSCOVIENSE
MARE ORIENTALE
tch for the Earth and Sun as we orbit the Moon
d: 0.000 m/s
Follow Moon
FOV: 25 55' 33.0" (1.00 x)

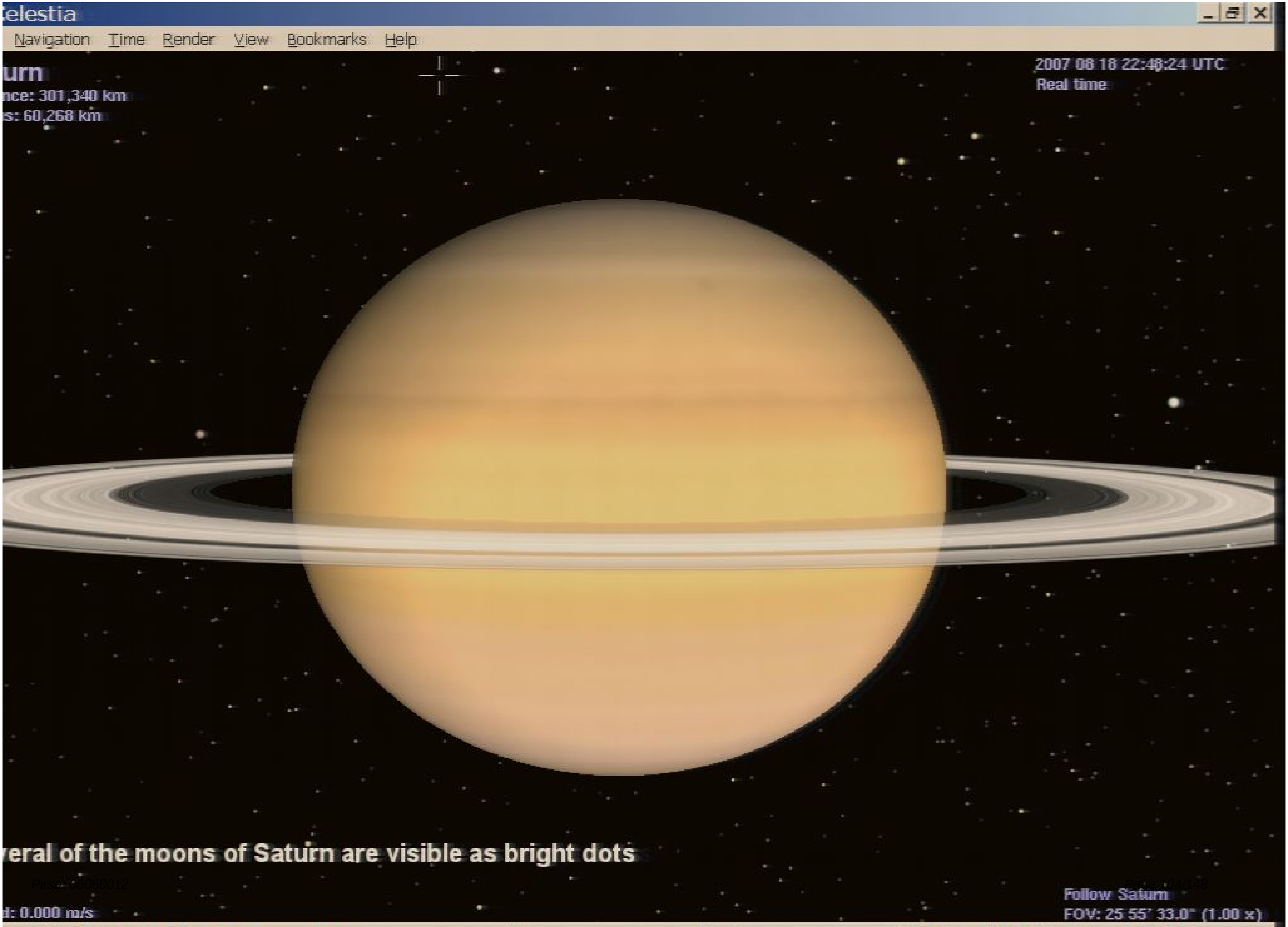


elestia
Navigation Time Render View Bookmarks Help
on
nce: 5,212.6 km
s: 1,737.5 km
2006 05 25 23:32:59 UTC
Time stopped
MARE CRISIUM
MARE AUSTRALE
tch for the Earth and Sun as we orbit the Moon
d: 0.000 m/s
Follow Moon
FOV: 25 55' 33.0" (1.00 x)

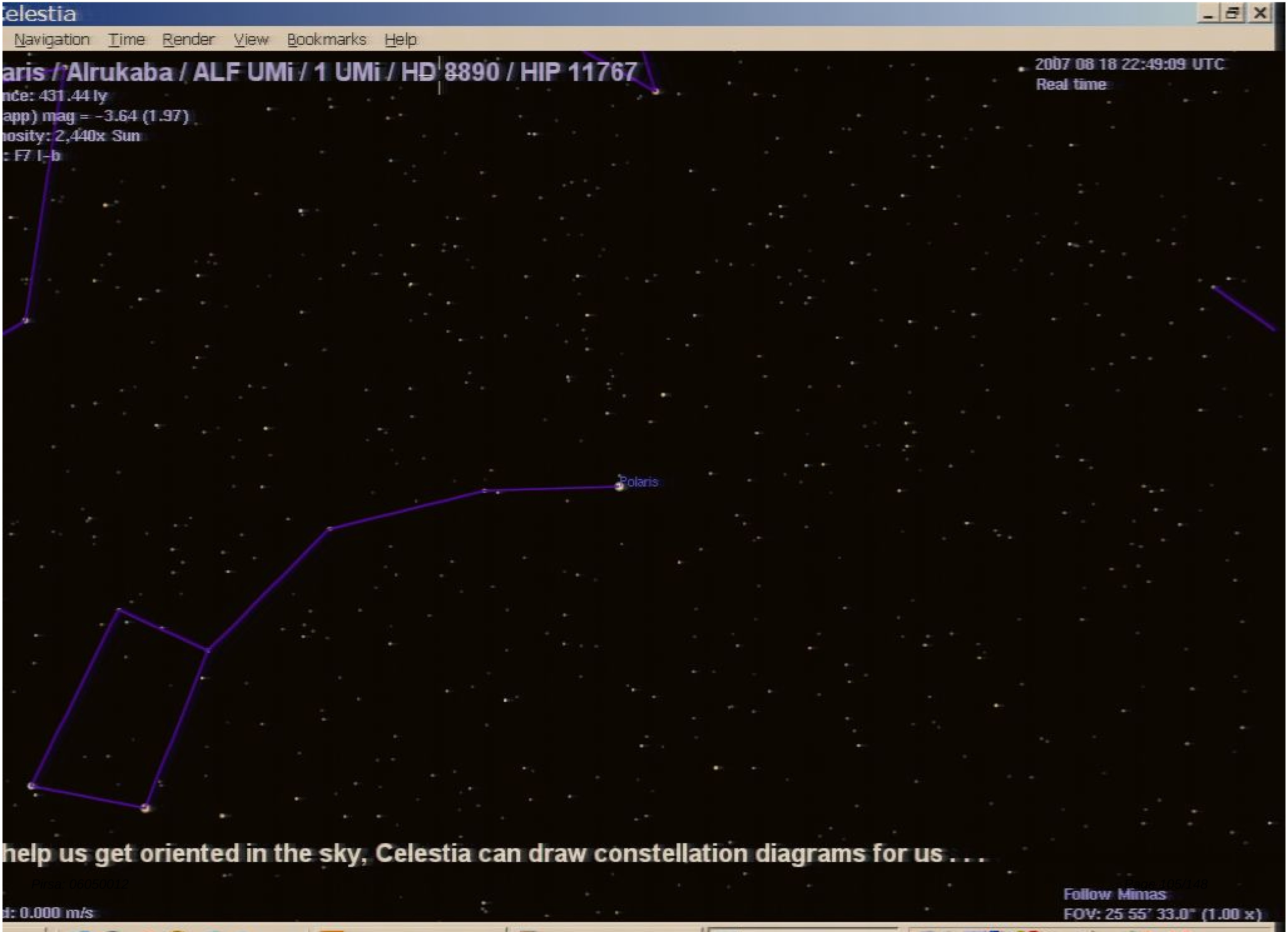

elestia
Navigation Time Render View Bookmarks Help
2006 05 25 23:32:59 UTC
Time stopped
nce: 0.45214 au
app) mag = 4.83 (-28.47)
osity: 0.999x Sun
: G2 V
toward the Sun.
Travelling (3)
Follow Sol
d: 0.000 m/s
FOV: 25 55' 33.0" (1.00 x)

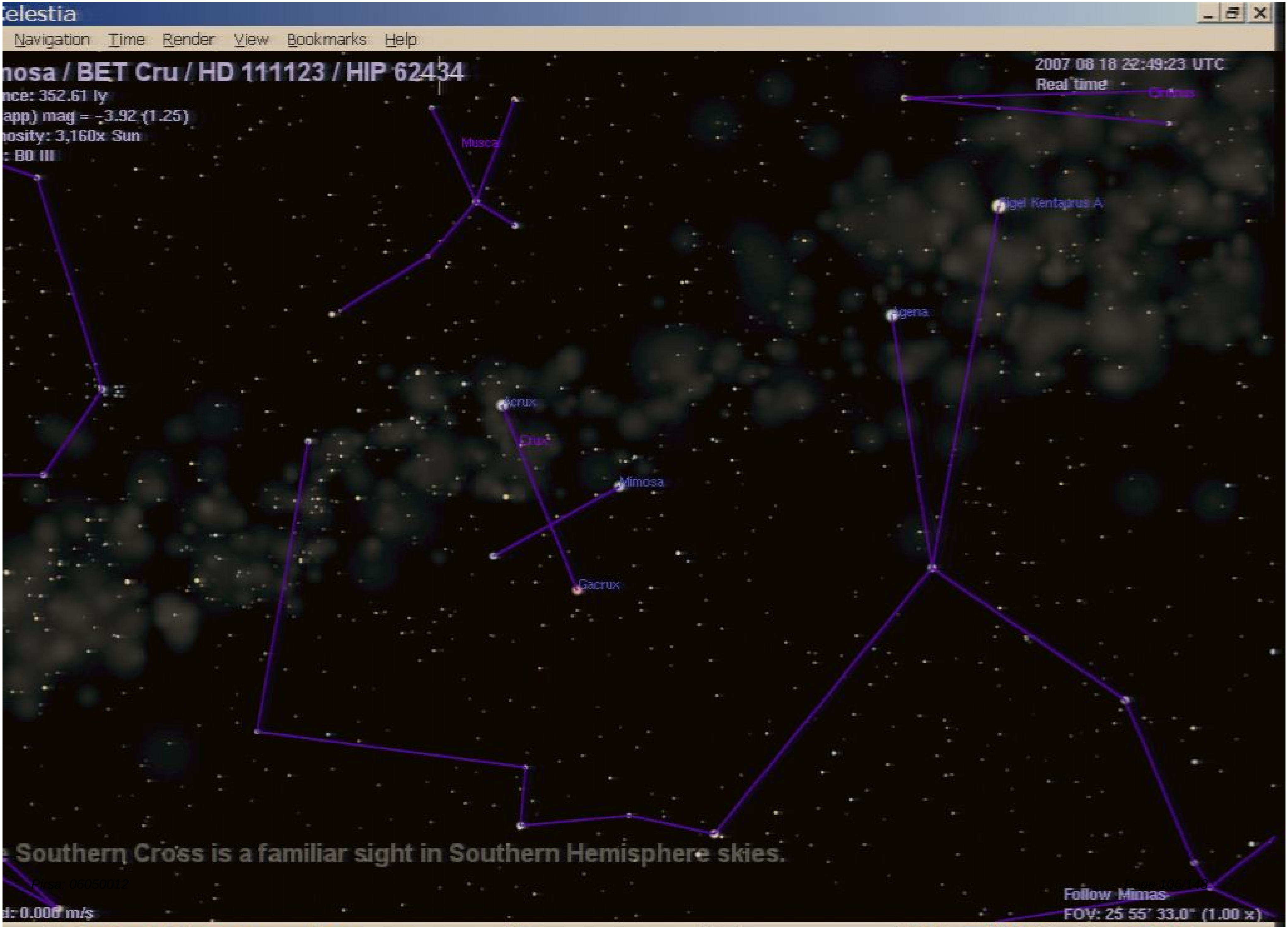

elestia
Navigation Time Render View Bookmarks Help
2006 05 25 23:32:59 UTC
Time stopped
nce: 8,348,500 km
app) mag = 4.83 (-33.01)
nosity: 0.999x Sun
: G2 V
his distance, dark sunspots are visible on the Sun's surface.
Follow Sol
d: 0.000 m/s
FOV: 25 55' 33.0" (1.00 x)


elestia
Navigation Time Render View Bookmarks Help
2007 01 10 21:48:48 UTC
2592000x faster
nce: 2.7976 au
app) mag = 4.83 (-24.51)
nosity: 0.999x Sun
: G2 V
Mercury
LMC
Venus
Earth
each second, a month of time elapses in the simulation.
Follow Sol
FOV: 25 55' 33.0" (1.00 x)
d: 0.000 m/s

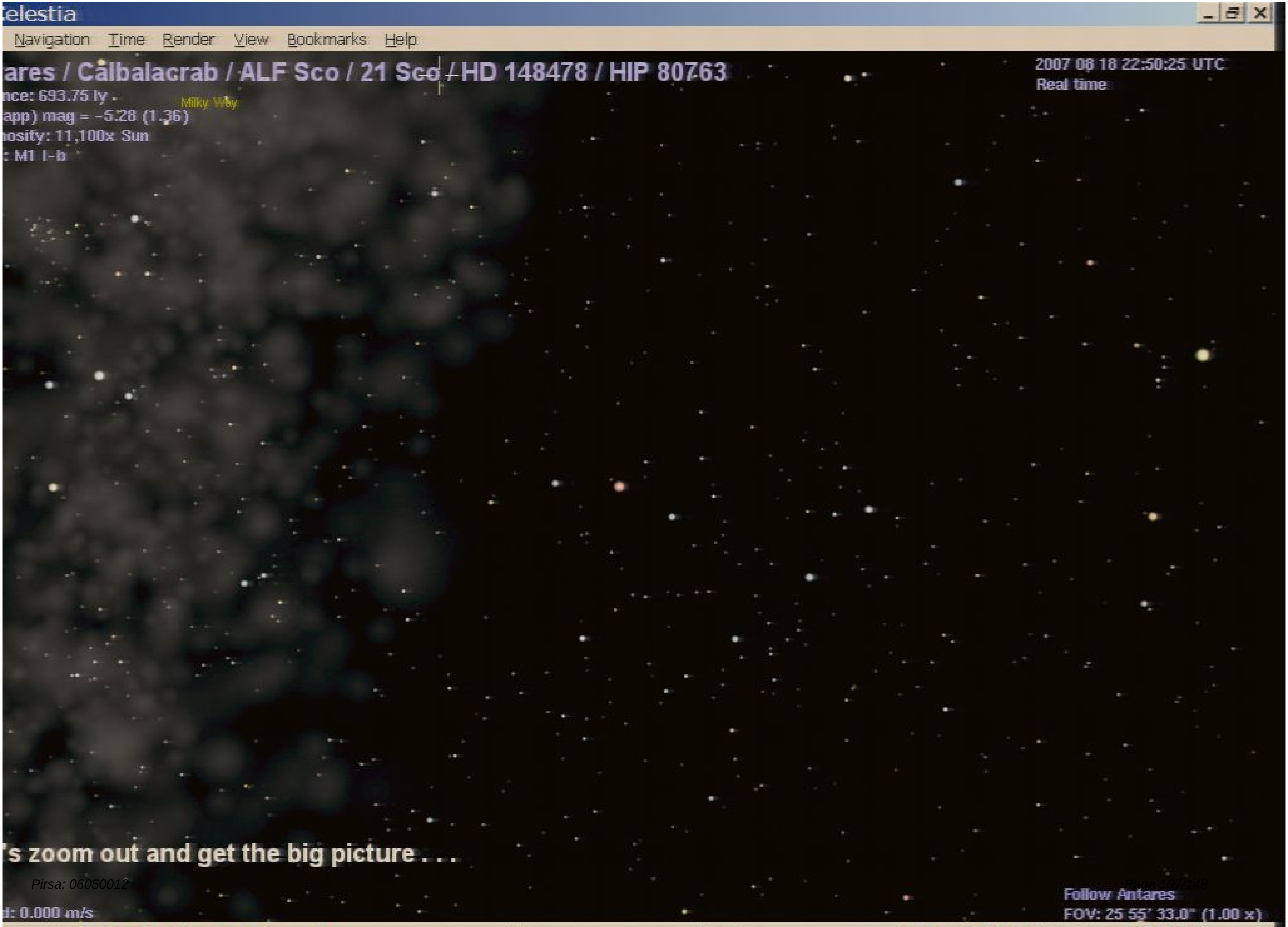


elestia
Navigation Time Render View Bookmarks Help
urn
nce: 301,340 km
s: 60,268 km
2007 08 18 22:48:24 UTC
Real time
veral of the moons of Saturn are visible as bright dots
d: 0.000 m/s
Follow Saturn
FOV: 25 55' 33.0" (1.00 x)

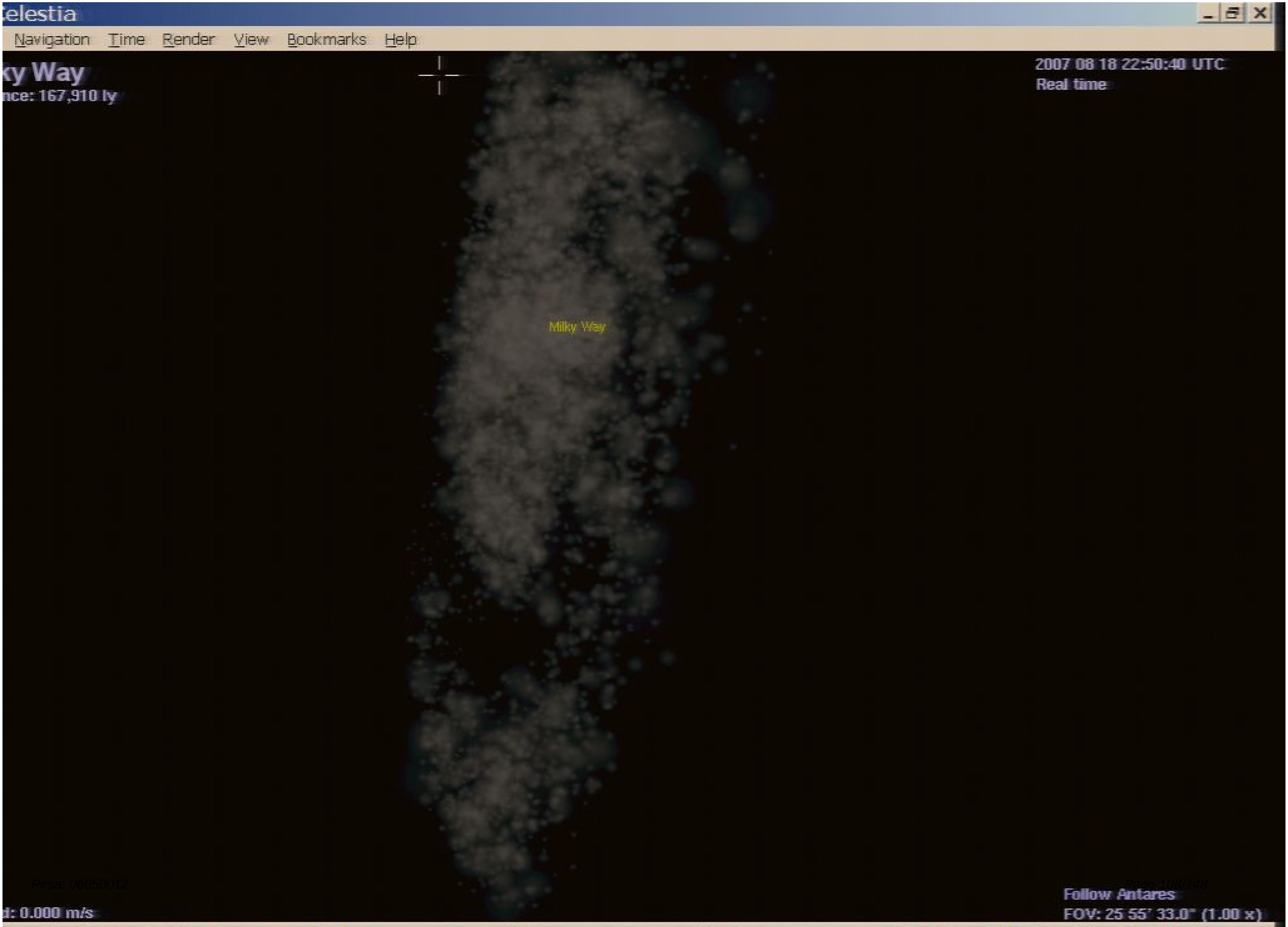

elestia
Navigation Time Render View Bookmarks Help
aris / Alrukaba / ALF UMi / 1 UMi / HD 8890 / HIP 11767
nce: 431.44 ly
app) mag = -3.64 (1.97)
nosity: 2,440x Sun
: F7 I-b
2007 08 18 22:49:09 UTC
Real time
Polaris
help us get oriented in the sky, Celestia can draw constellation diagrams for us . . .
d: 0.000 m/s
Follow Mimas
FOV: 25 55' 33.0" (1.00 x)

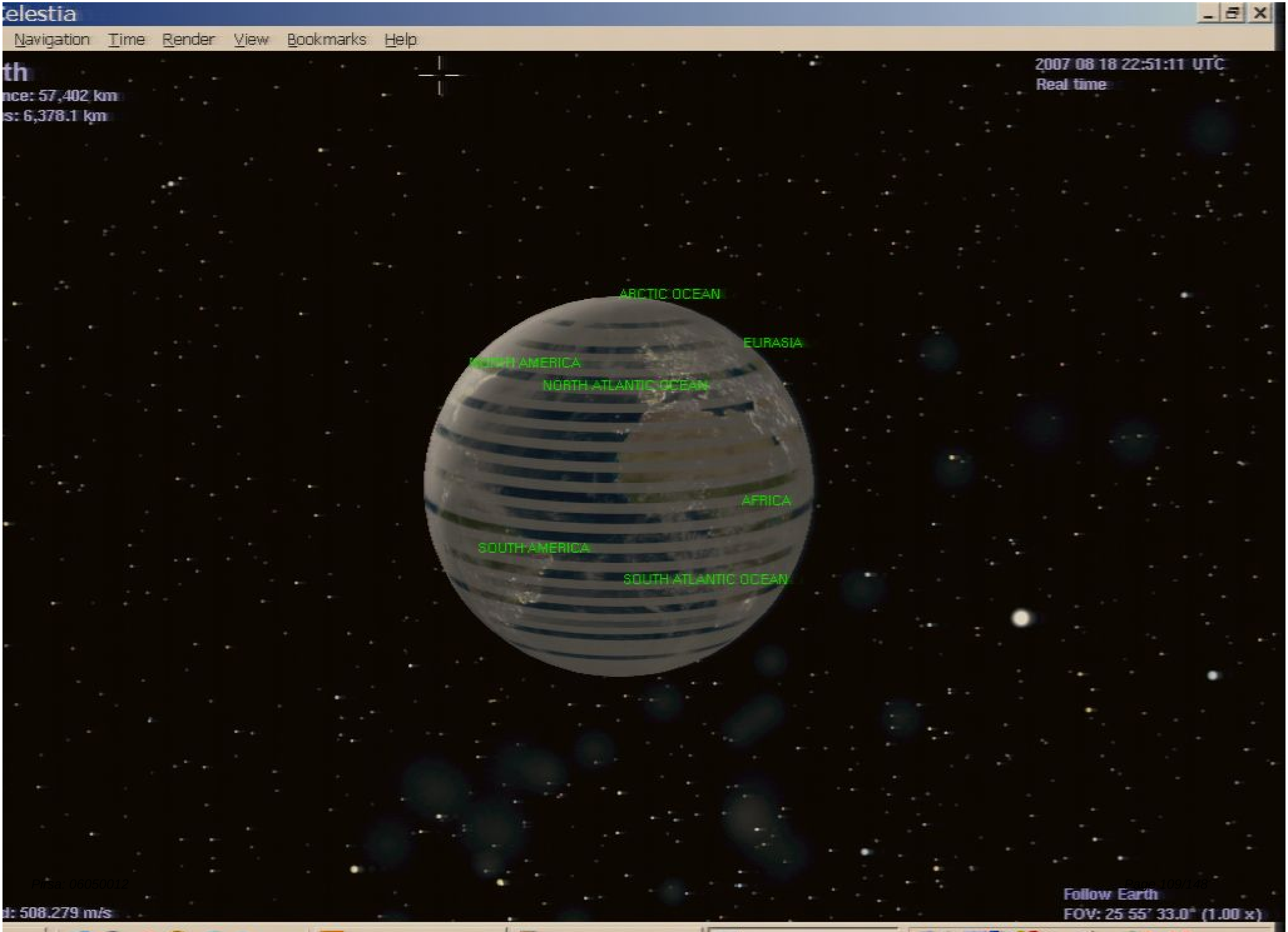


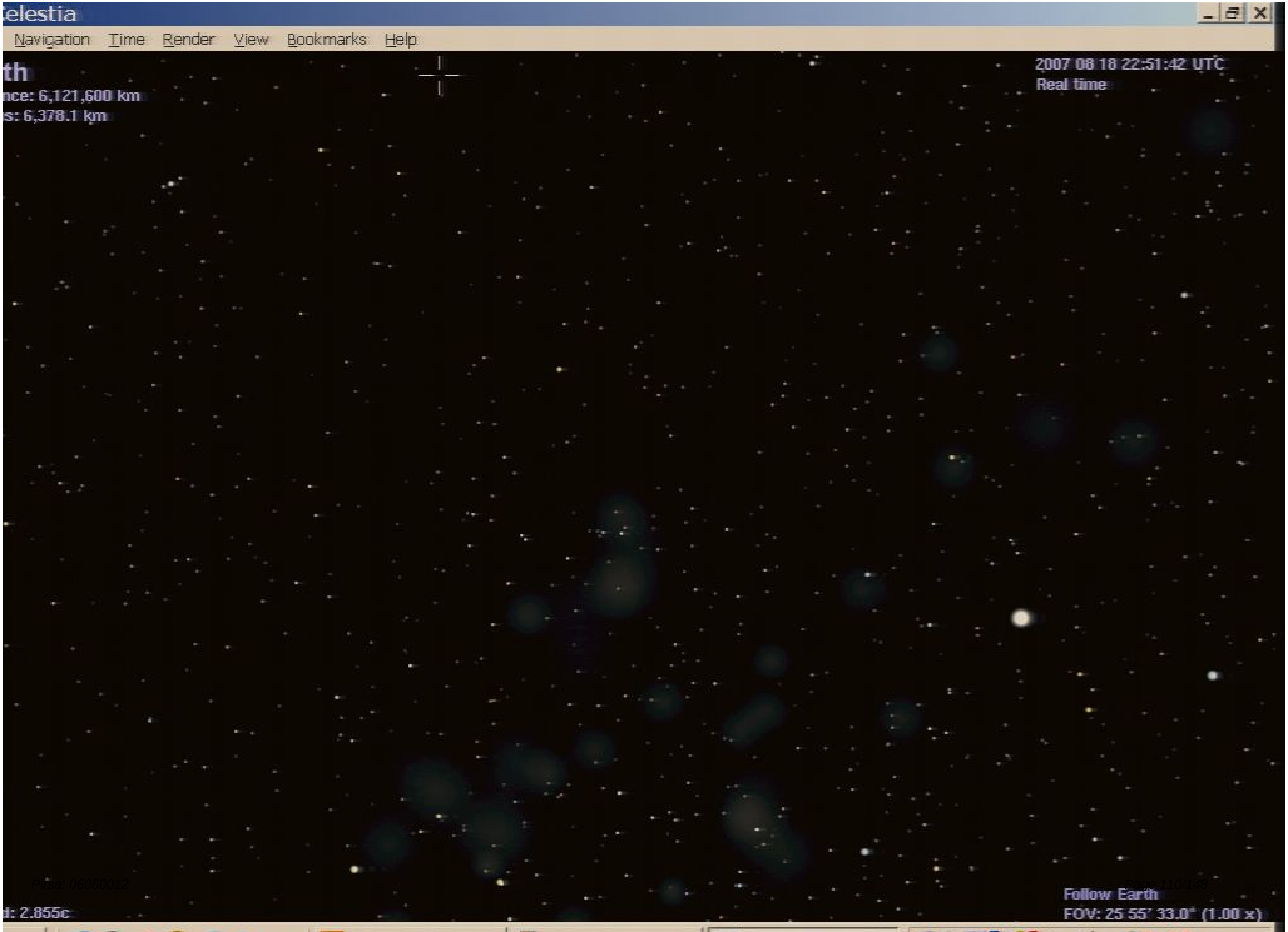
elestia
Navigation Time Render View Bookmarks Help
nosa / BET Cru / HD 111123 / HIP 62434
nce: 352.61 ly
app) mag = -3.92 (1.25)
nosity: 3,160x Sun
: B0 III
2007 08 18 22:49:23 UTC
Real time
Musca
Rigel Kentaurus A
Agena
Acrux
Crux
Mimosa
Gacrux
e Southern Cross is a familiar sight in Southern Hemisphere skies.
d: 0.000 m/s
Follow Mimas
FOV: 25 55' 33.0" (1.00 x)



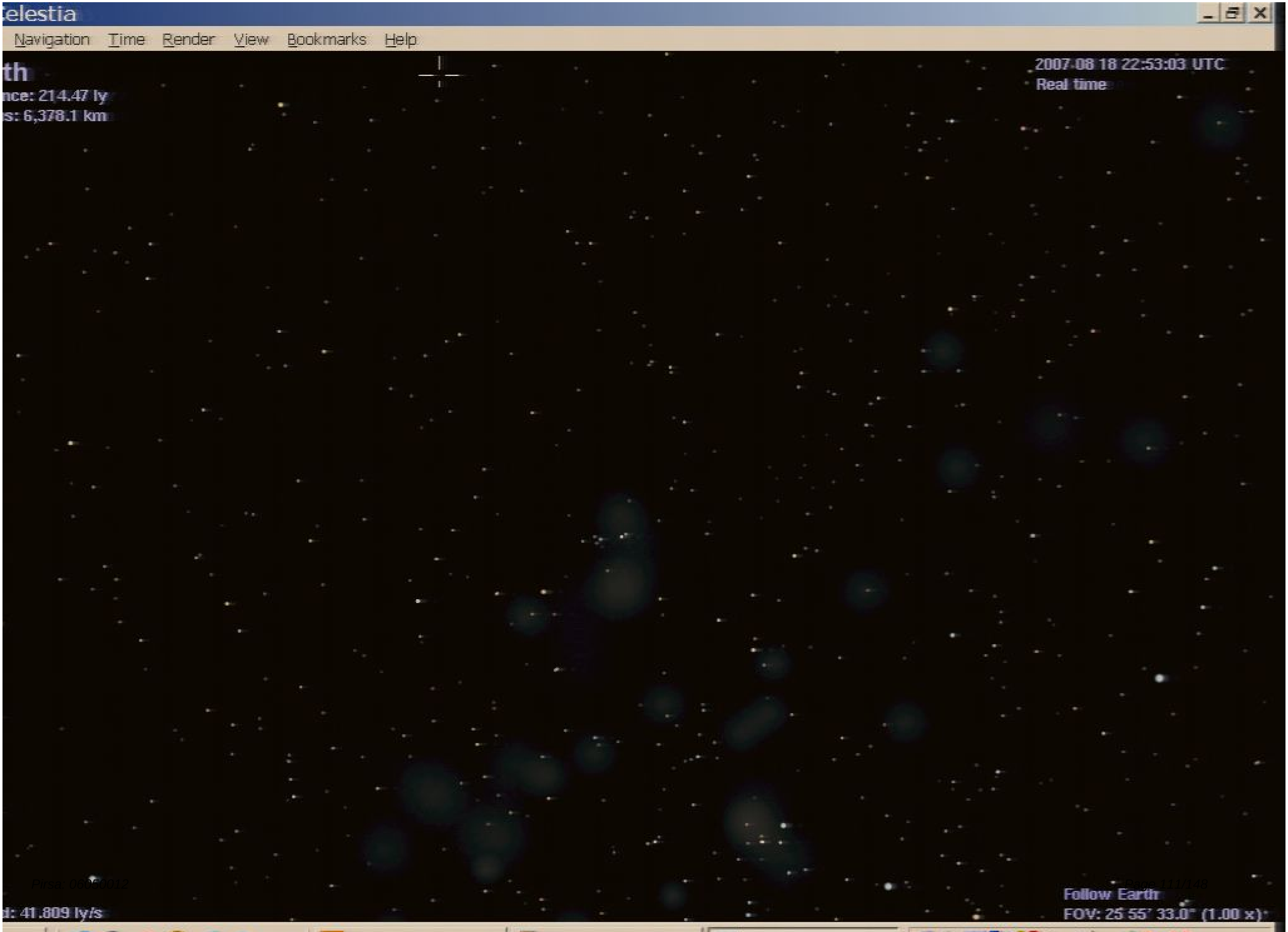
elestia
Navigation Time Render View Bookmarks Help
ares / Calbalacrab / ALF Sco / 21 Sco / HD 148478 / HIP 80763
nce: 693.75 ly
app) mag = -5.28 (1.36)
osity: 11,100x Sun
: M1 I-b
Milky Way
2007 08 18 22:50:25 UTC
Real time
's zoom out and get the big picture . . .
d: 0.000 m/s
Follow Antares
FOV: 25 55' 33.0" (1.00 x)

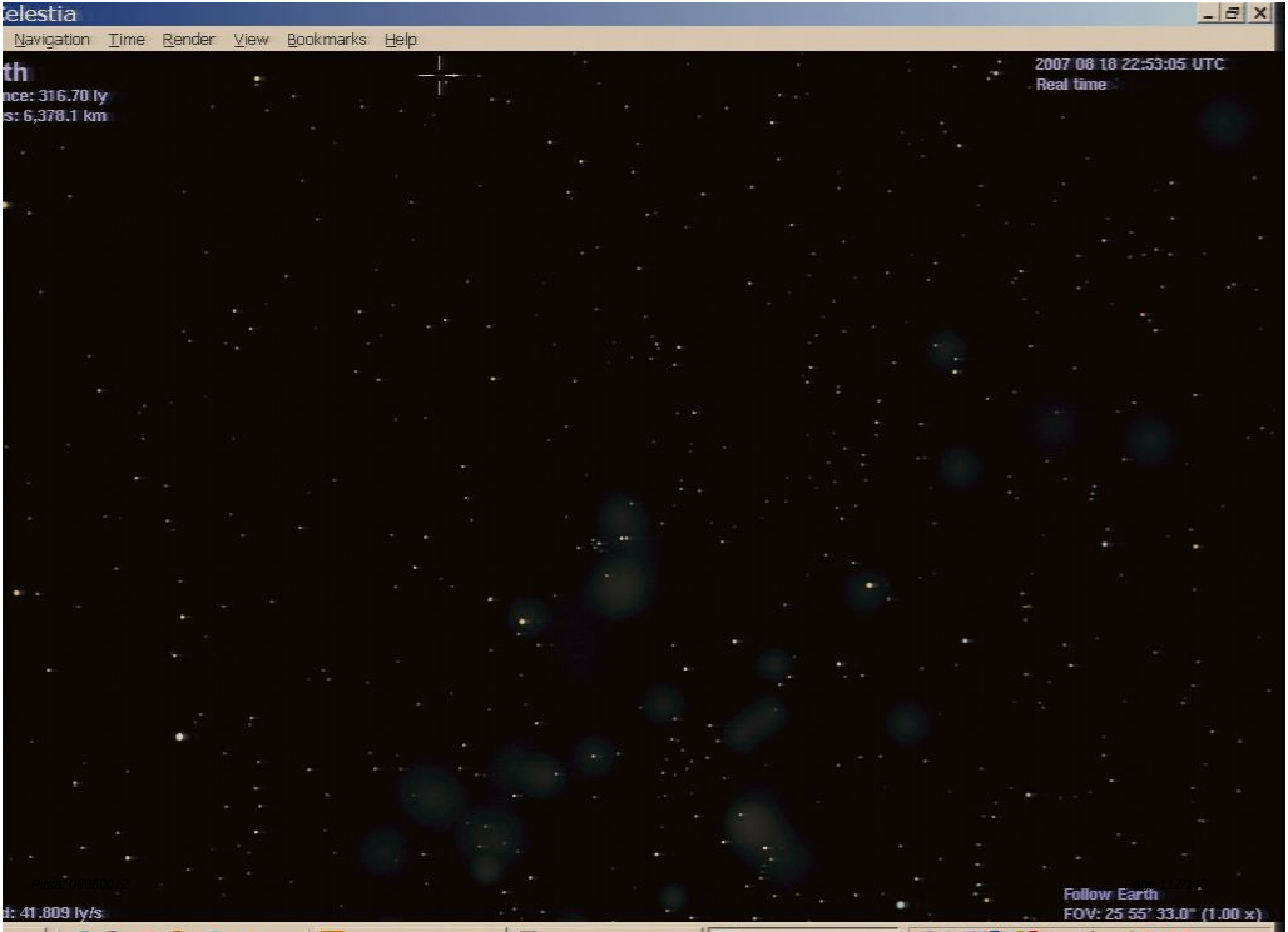

elestia
Navigation Time Render View Bookmarks Help
ky Way
nce: 167,910 ly
2007 08 18 22:50:40 UTC
Real time
Milky Way
Follow Antares
FOV: 25 55' 33.0" (1.00 x)
d: 0.000 m/s


elestia
Navigation Time Render View Bookmarks Help
th
nce: 57,402 km
s: 6,378.1 km
2007 08 18 22:51:11 UTC
Real time
ARCTIC OCEAN
EURASIA
NORTH AMERICA
NORTH ATLANTIC OCEAN
AFRICA
SOUTH AMERICA
SOUTH ATLANTIC OCEAN
Follow Earth
d: 508.279 m/s
FOV: 25 55' 33.0" (1.00 x)



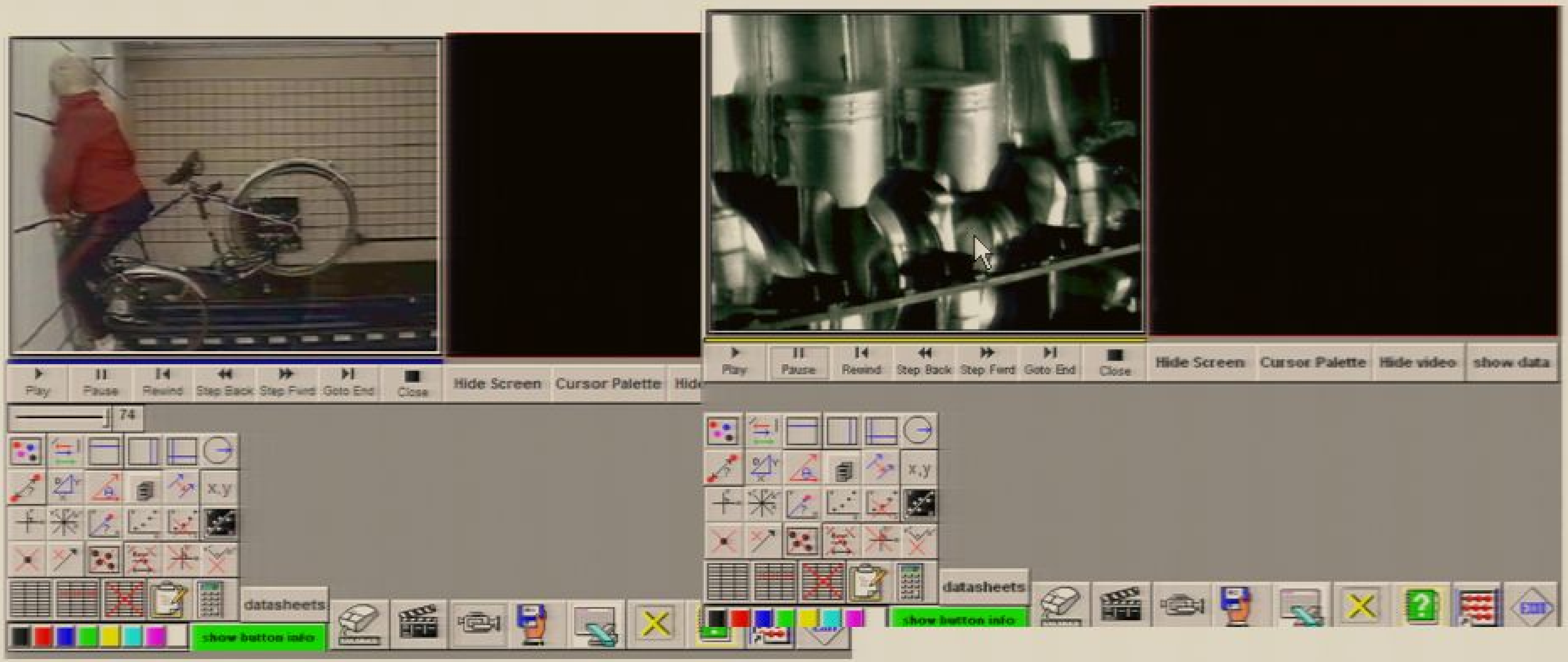
elestia
Navigation Time Render View Bookmarks Help
th
nce: 6,121,600 km
s: 6,378.1 km
2007 08 18 22:51:42 UTC
Real time
d: 2.855c
Follow Earth
FOV: 25 55' 33.0" (1.00 x)


elestia
Navigation Time Render View Bookmarks Help
th
nce: 214.47 ly
s: 6,378.1 km
2007 08 18 22:53:03 UTC
Real time
Follow Earth
FOV: 25 55' 33.0" (1.00 x)
d: 41.809 ly/s


elestia
Navigation Time Render View Bookmarks Help
th
nce: 316.70 ly
s: 6,378.1 km
2007 08 18 22:53:05 UTC
Real time
Follow Earth
FOV: 25 55' 33.0" (1.00 x)
d: 41.809 ly/s

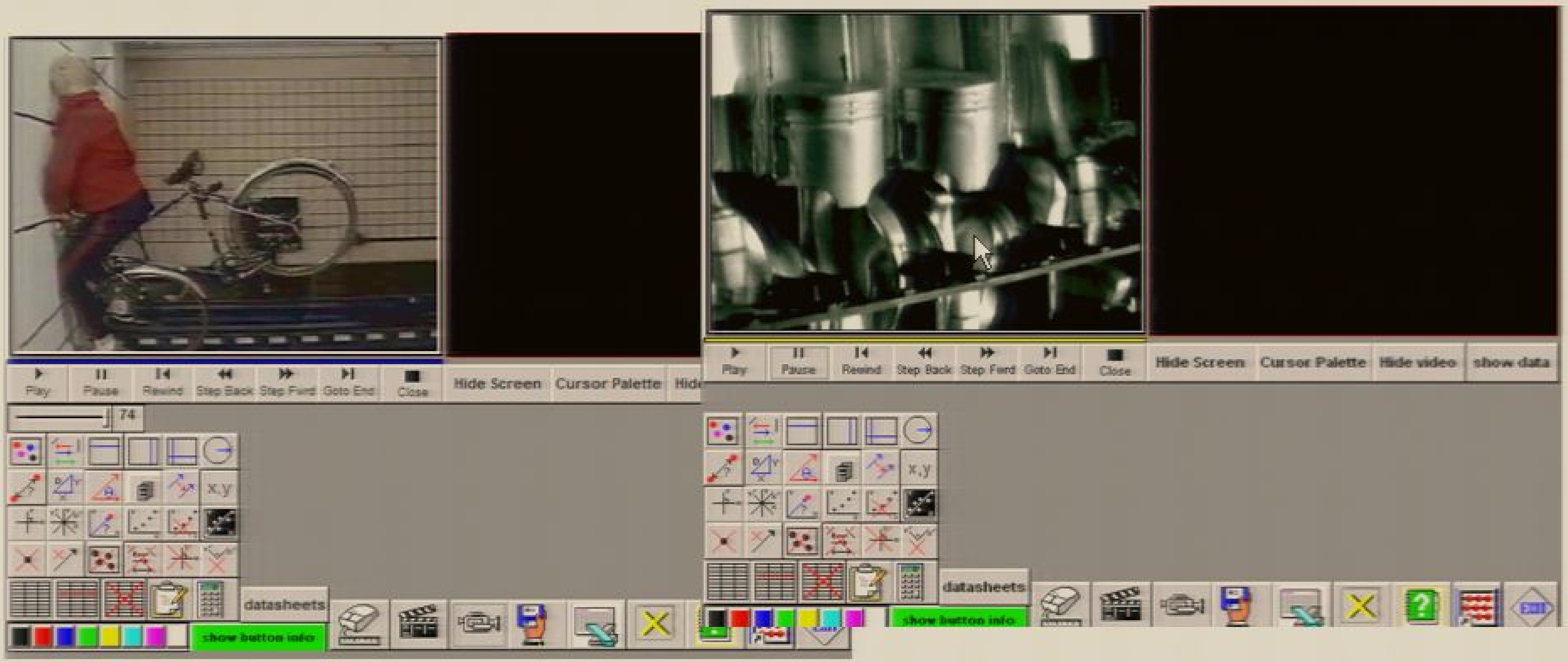
Vidshell

Motion analysis software that comes with video clips. It lets you measure and draw all sorts of things on the screen. You can also import your own video clips and export data to a spreadsheet. Written by Doyle V. Davis.

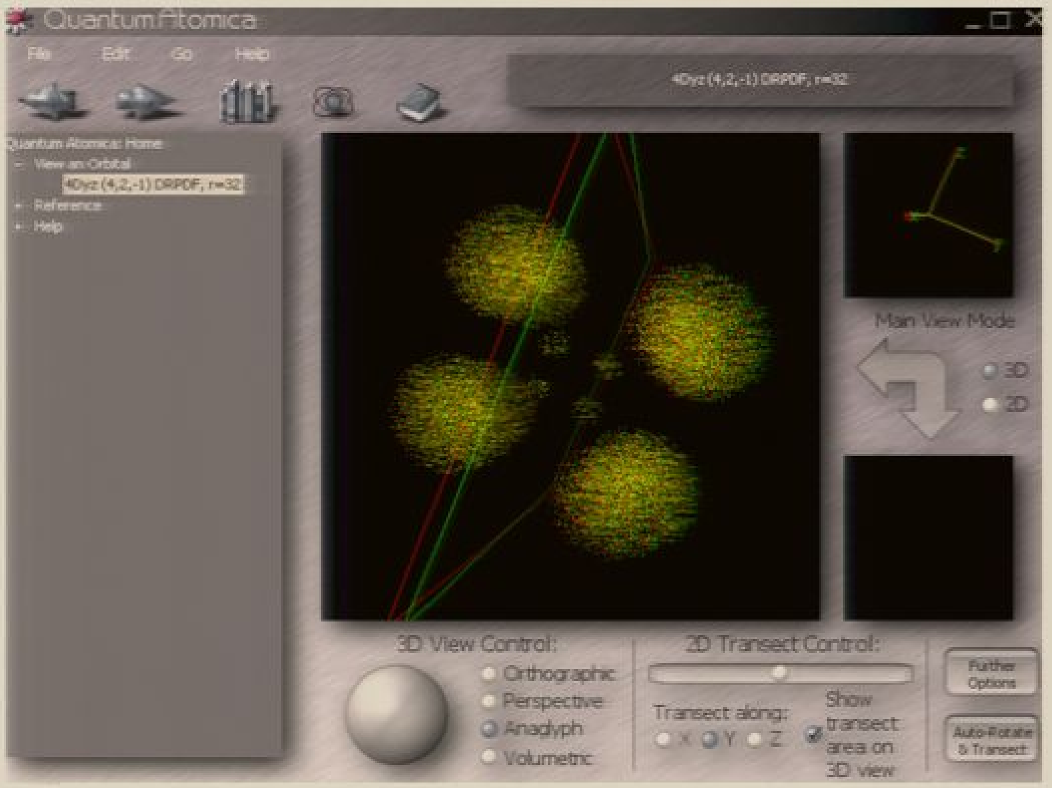


Vidshell

Motion analysis software that comes with video clips. It lets you measure and draw all sorts of things on the screen. You can also import your own video clips and export data to a spreadsheet. Written by Doyle V. Davis.

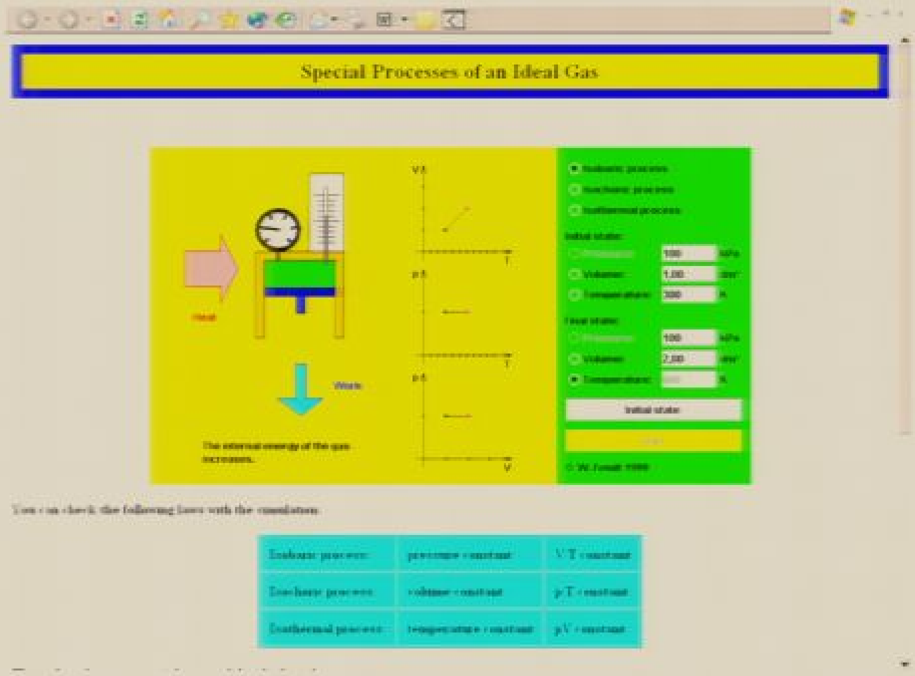


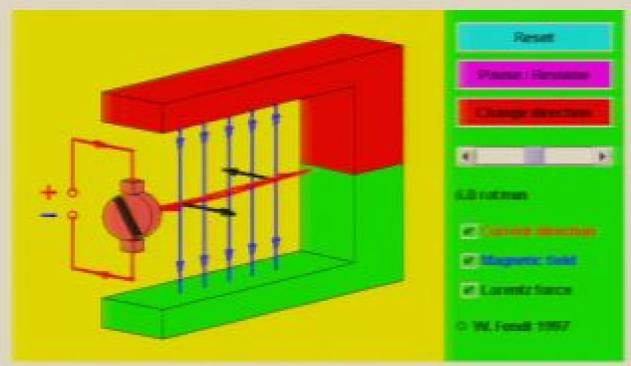
Quantum Atomica

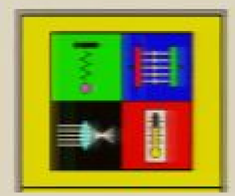


Shows the shapes of electron orbitals in 3D. Allows you to change the viewpoint and look at the orbitals with 3D glasses!

Walter Fendt

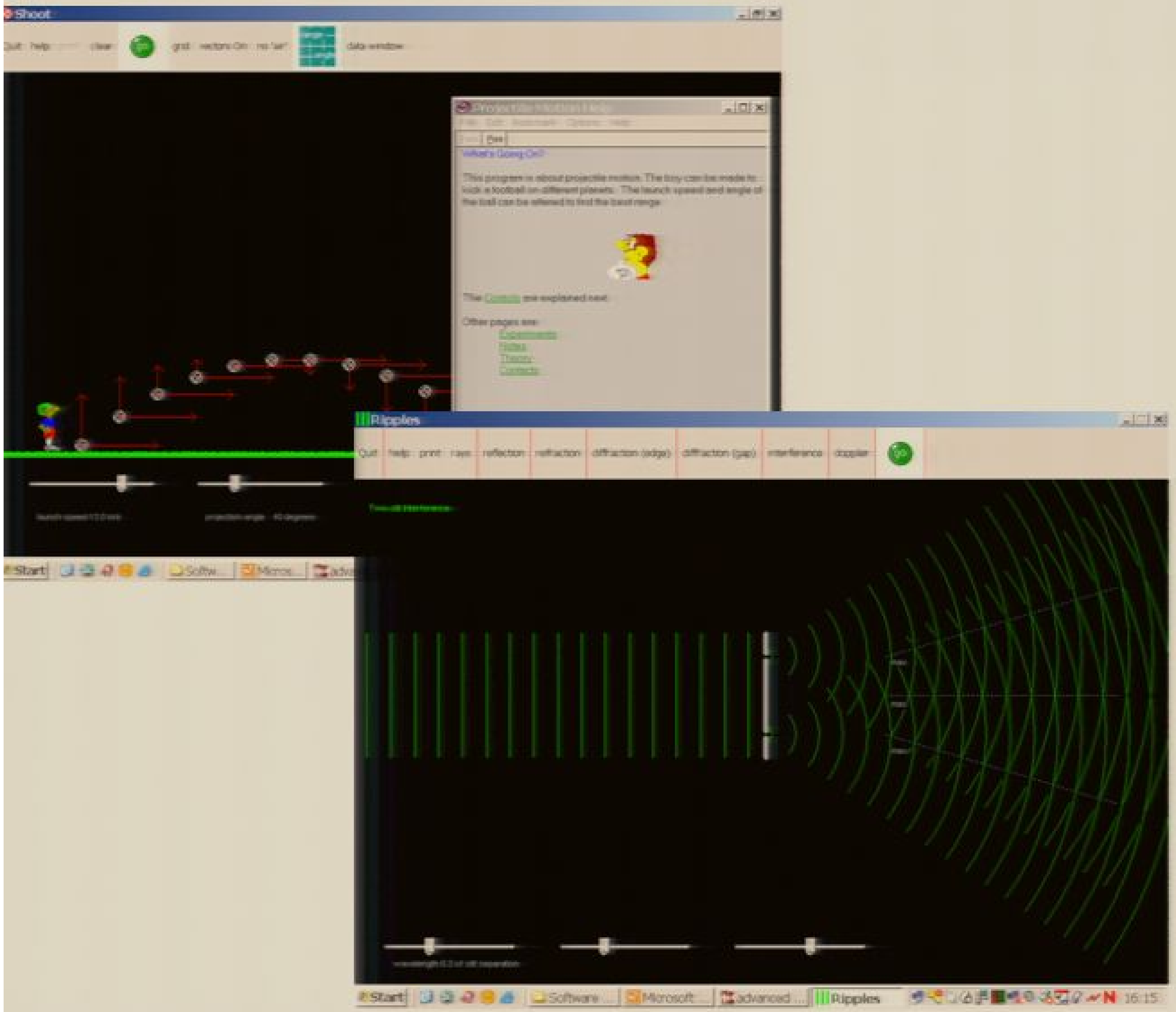






A whole load of applets that are ideal for displaying with a data projector. Highly rated.

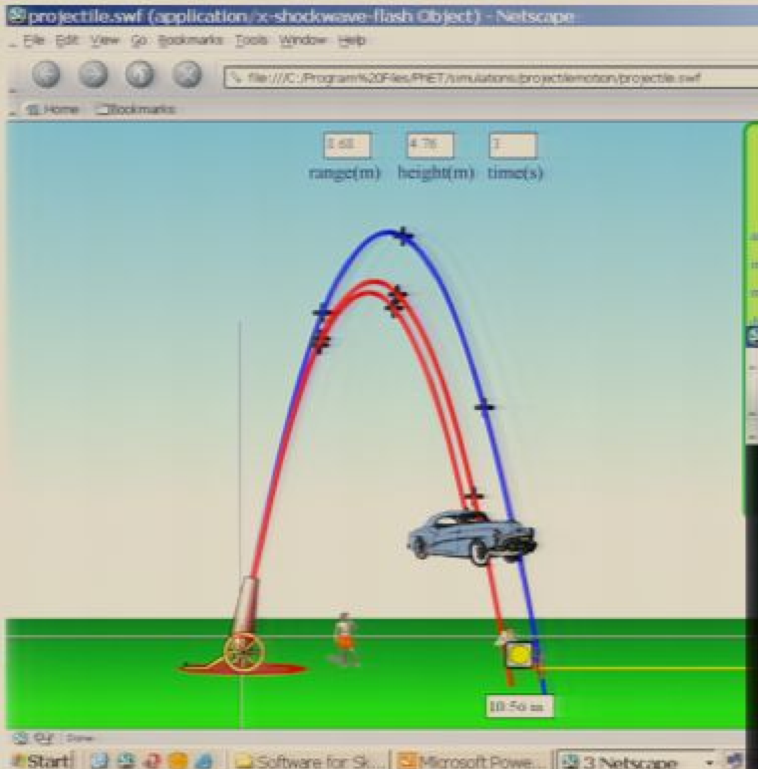
Physics Lab

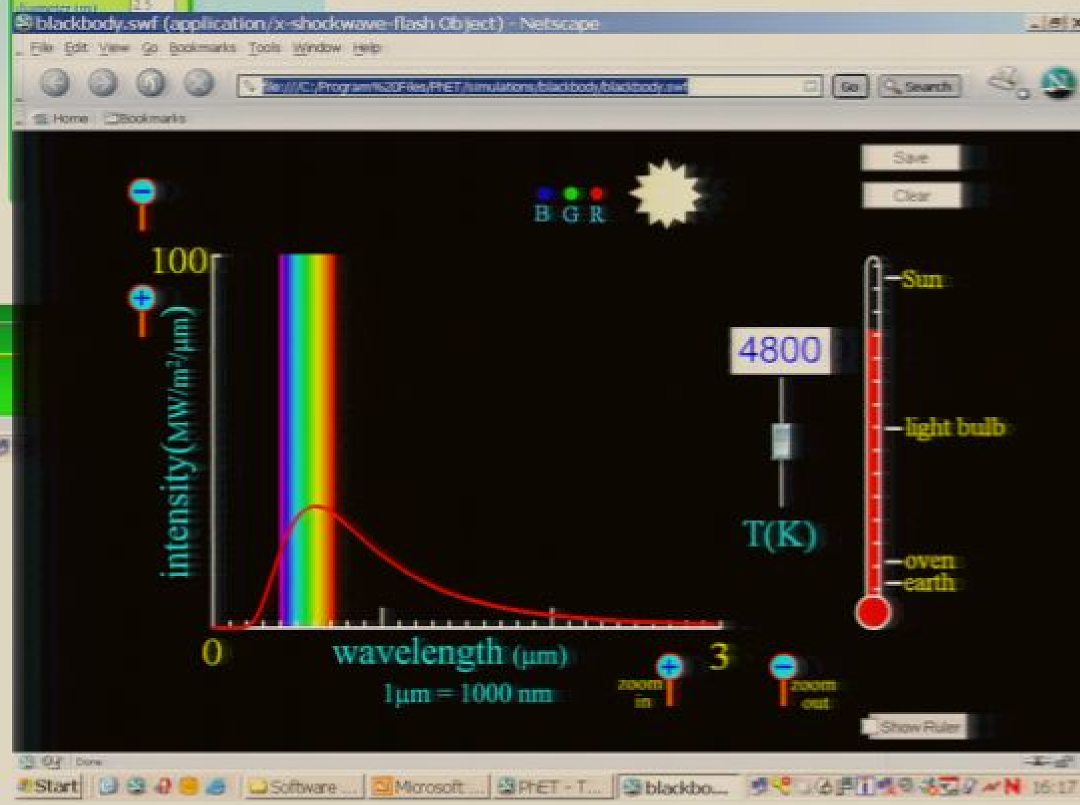


A set of experiment simulations that pupils can work through – clear and entertaining.

PhET

A set of applets and flash animations that cover a wide range of topics.

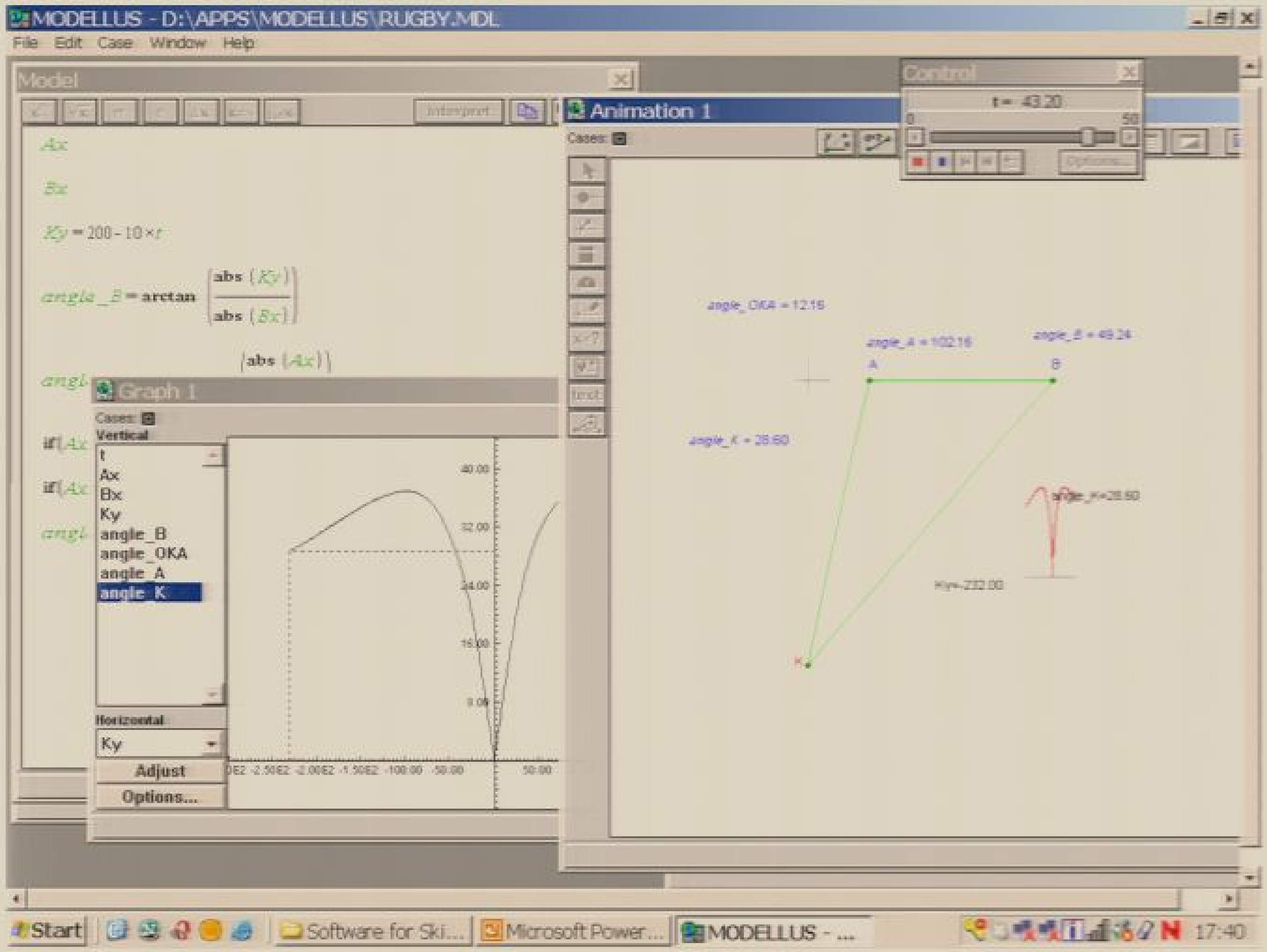




Can be installed and run offline.

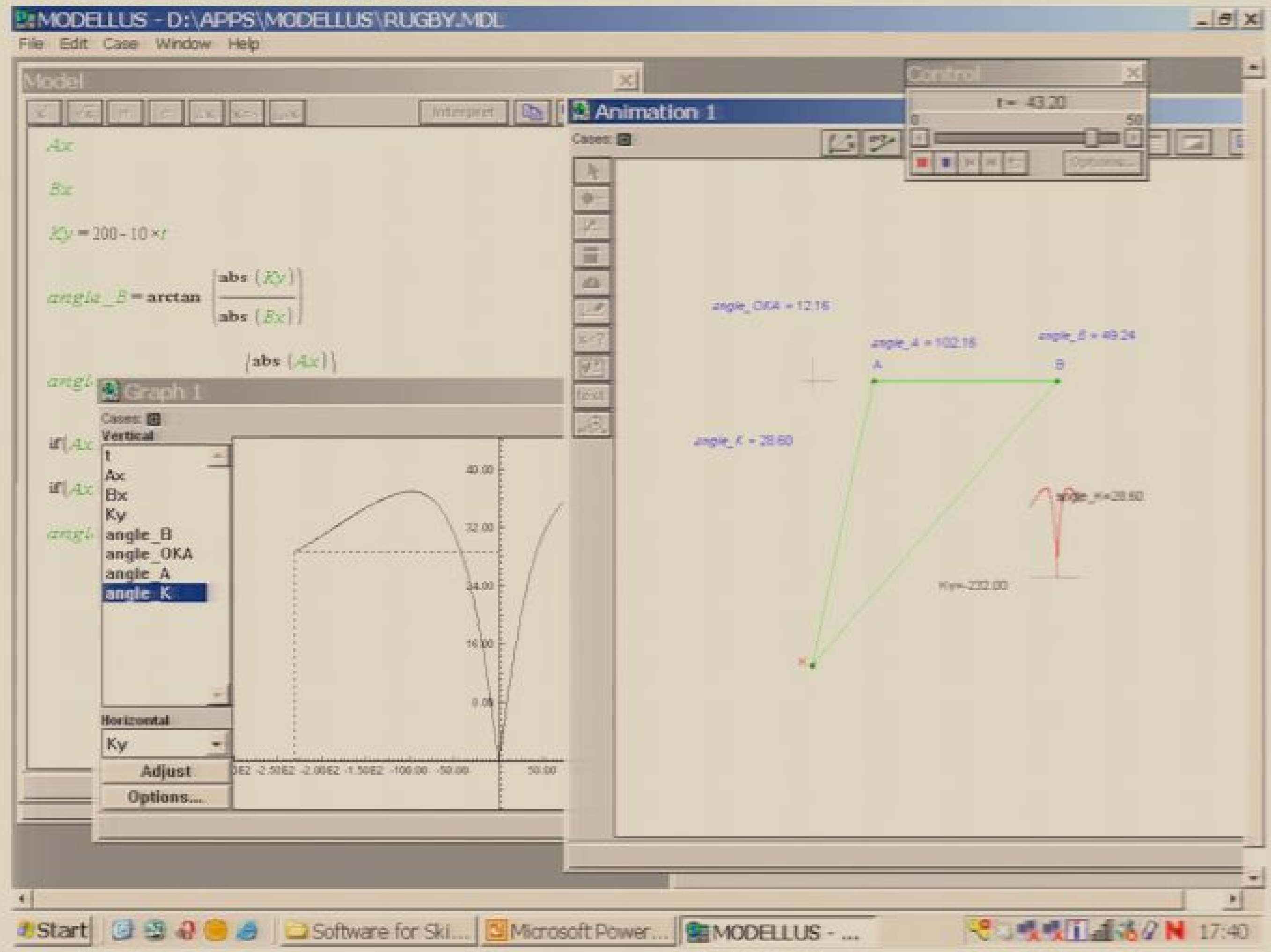
Modellus

Mathematical modelling software, create models and draw graphs and animations. Very professional

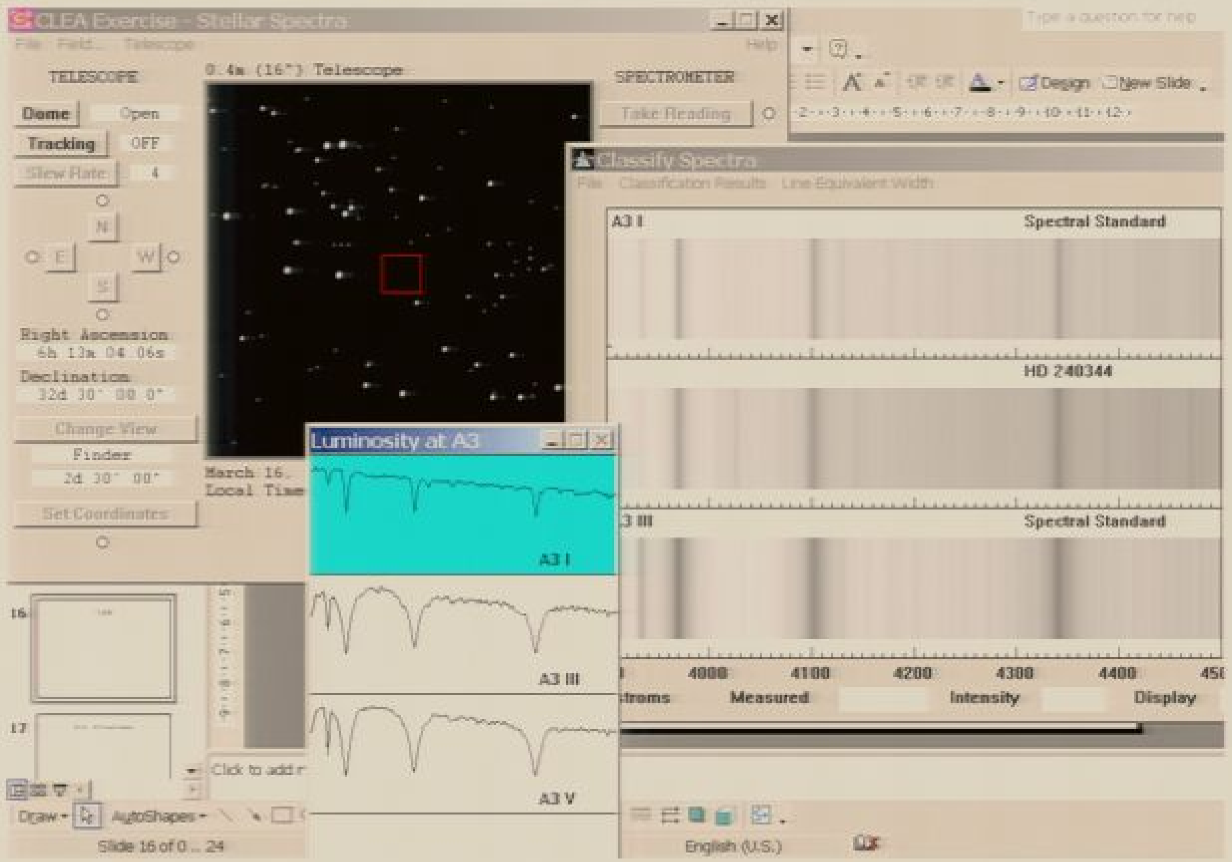


Modellus

Mathematical modelling software, create models and draw graphs and animations. Very professional

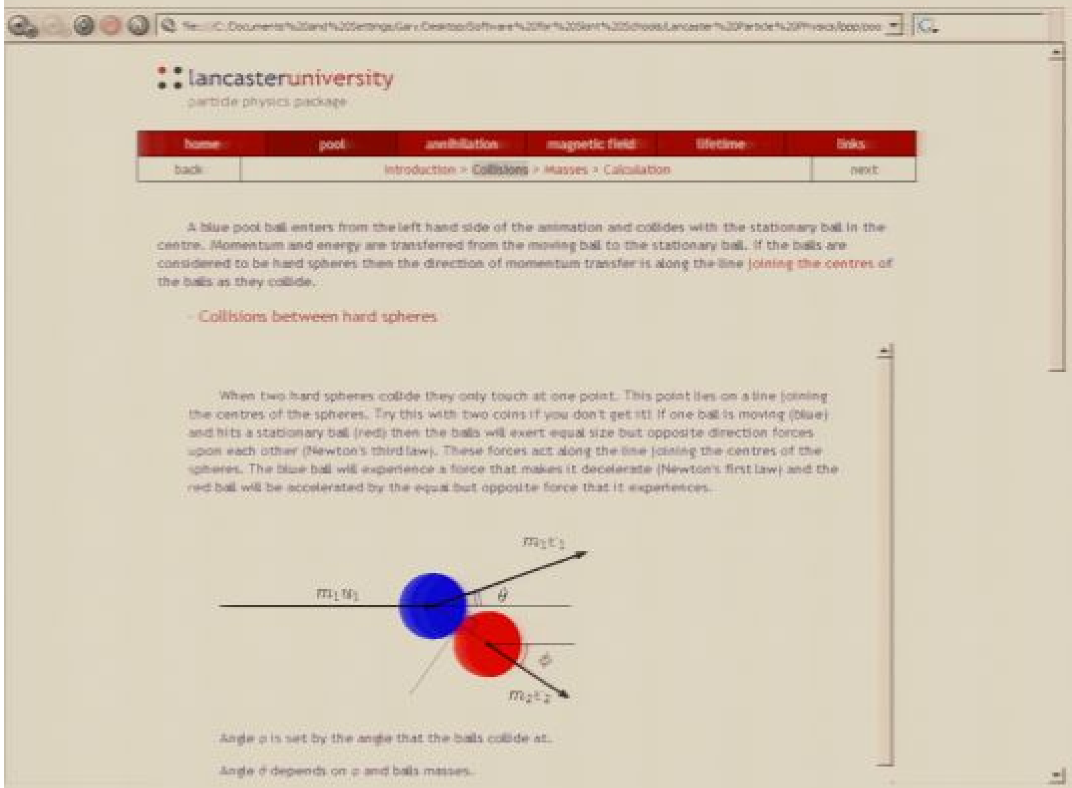


CLEA



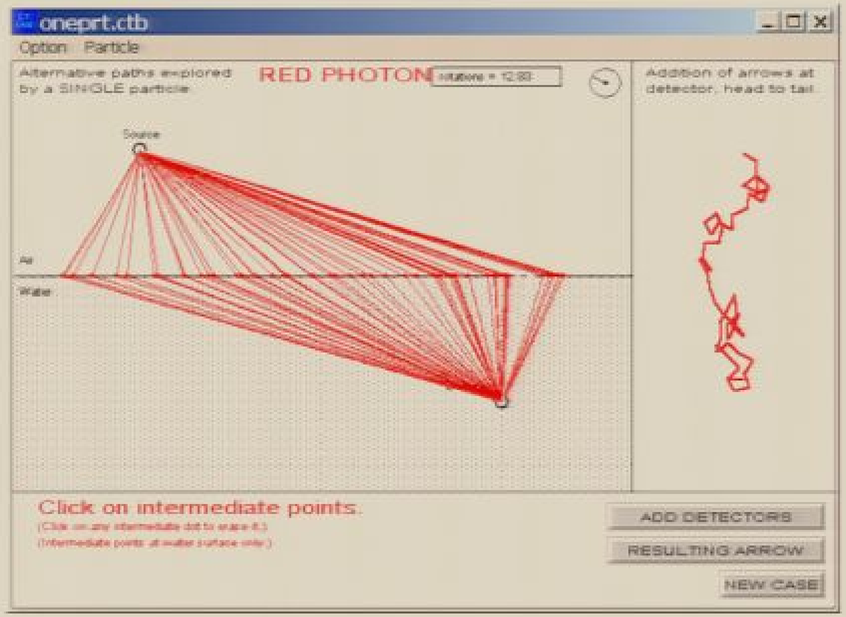
A number of very realistic astronomy simulations. More suited to older pupils.

Lancaster Particle Physics

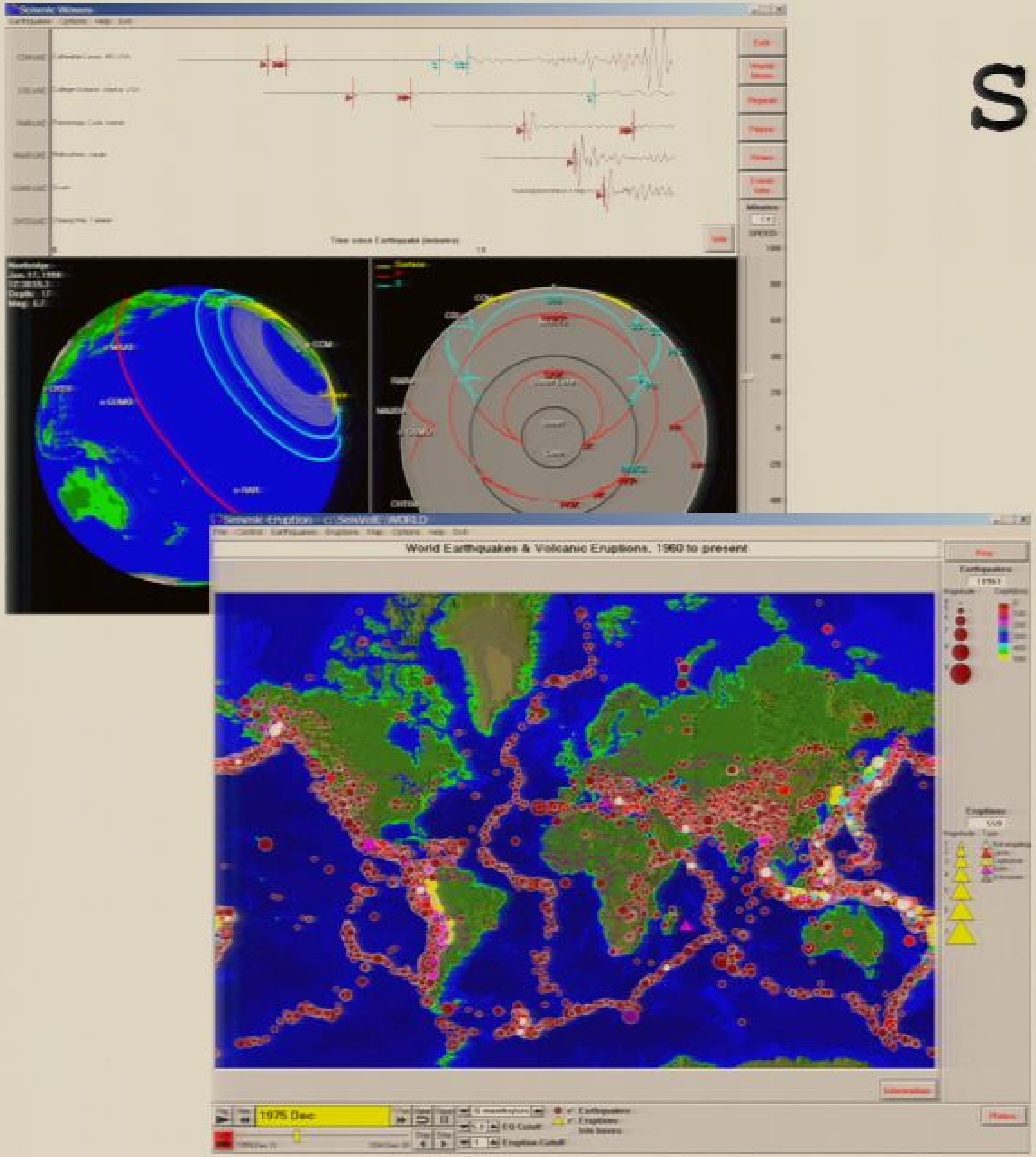


A tutorial based piece of software that explains the theory and gives some insight into the experimental side of particle physics

Many Paths



Draws all the possible paths of photons when teaching QED



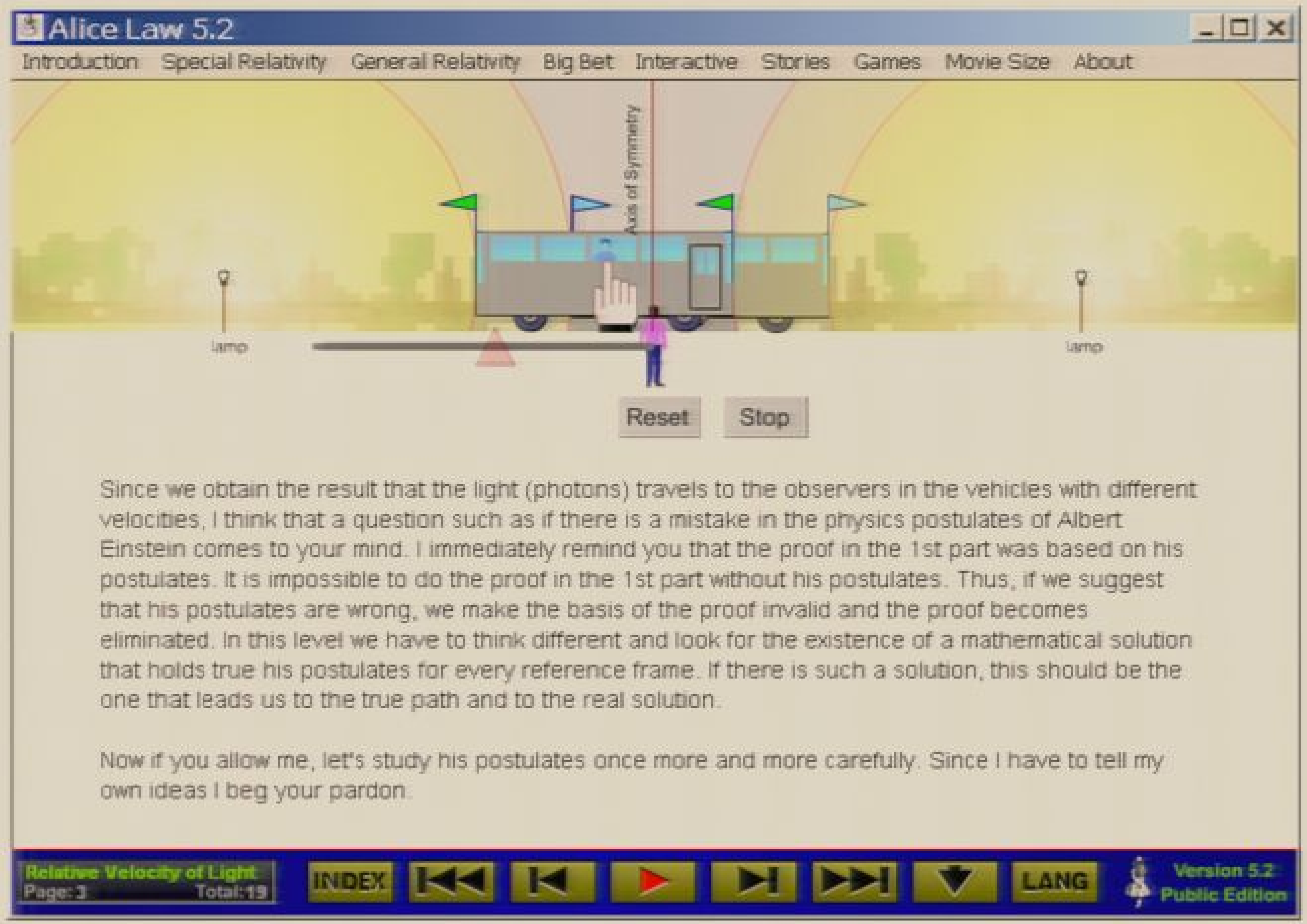
Seismology

Shows how P and S waves travel in the Earth and gives the locations of 1000's of earthquakes. Written by Alan L. Jones

Stellarium

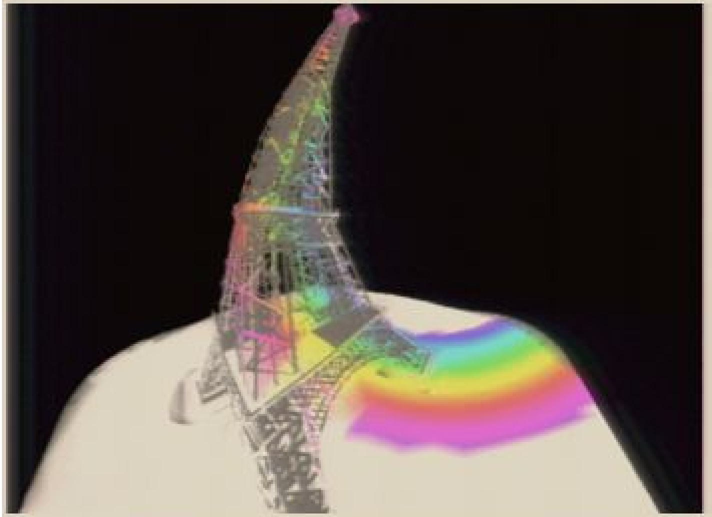
A planetarium that allows you to zoom in on galaxies and planets.

Alice Law



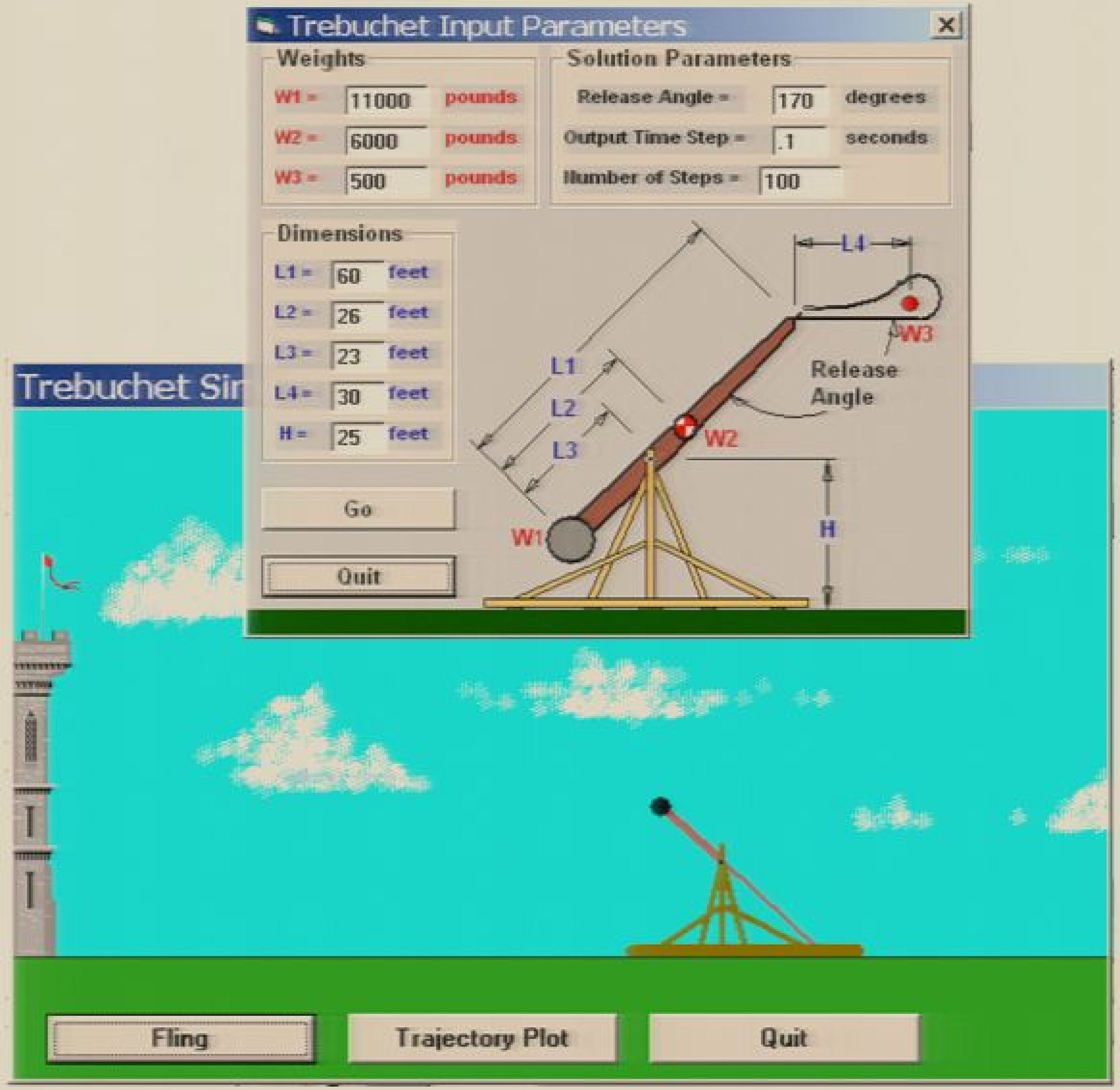
A tutorial that explains relativity using a variety of interactive animations.

Warp



Simulates what you might see if you moved past objects while travelling at or near the speed of light

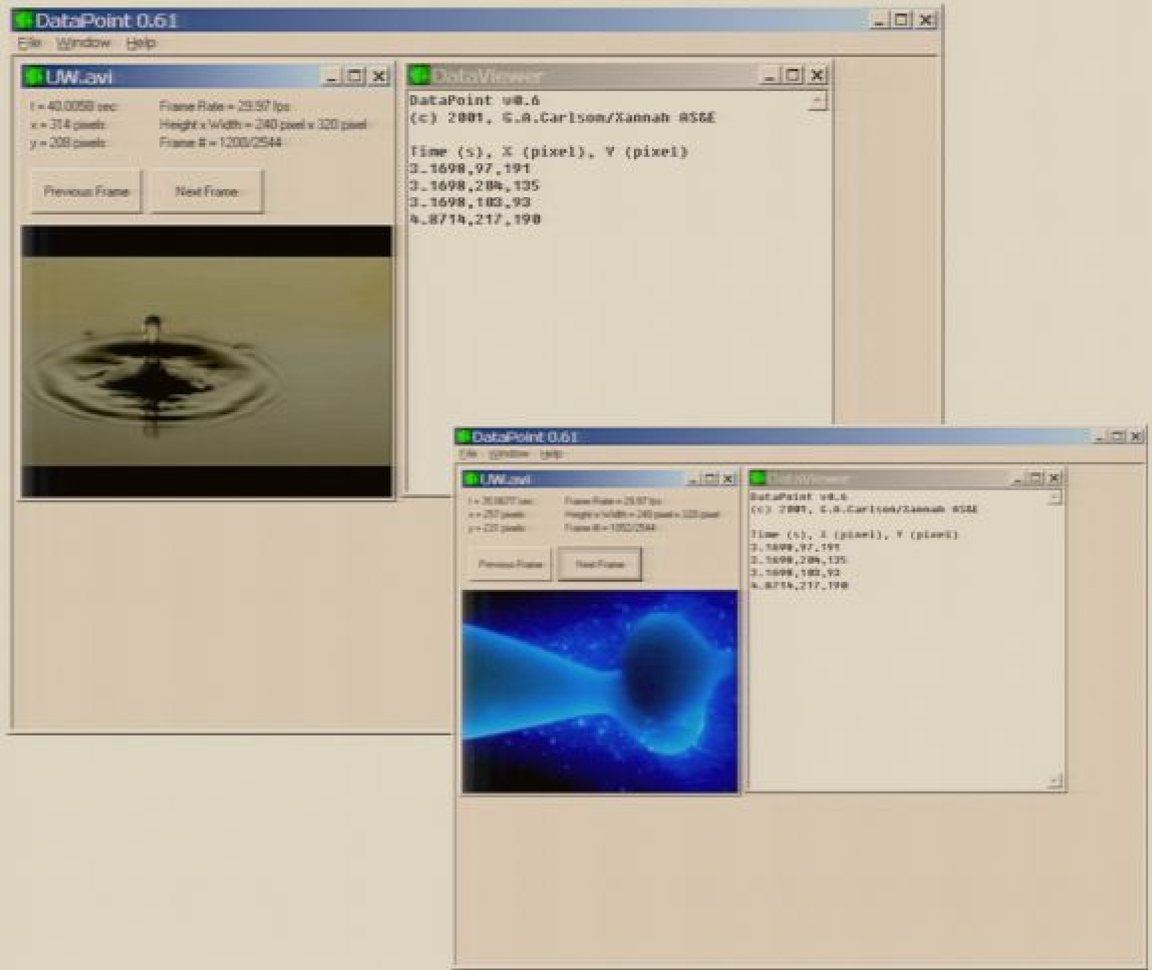
WinTreb



Change the dimensions of a trebuchet, fire it and measure the range and the maximum height of the projectile.

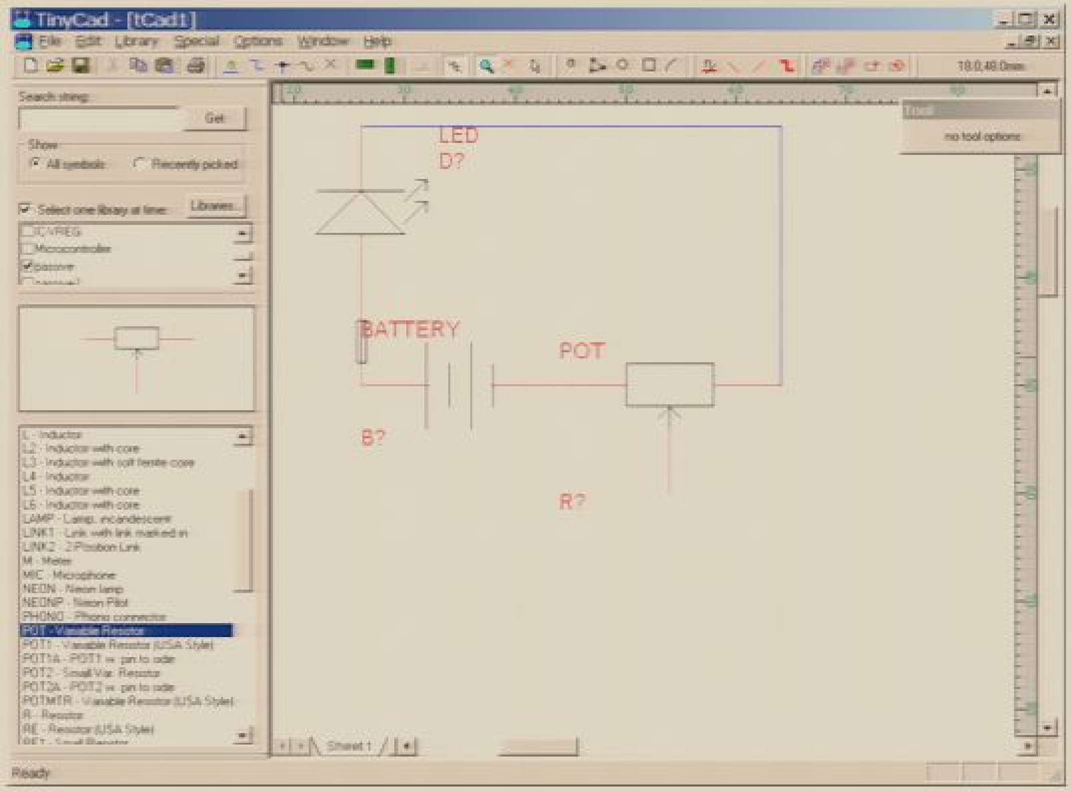
- **THERE IS NO SUPPORT AVAILABLE FOR THIS SIMULATION**

DataPoint



Allows you to move frame by frame through an avi file and collect data from the screen position. Written by Glenn A. Carlson

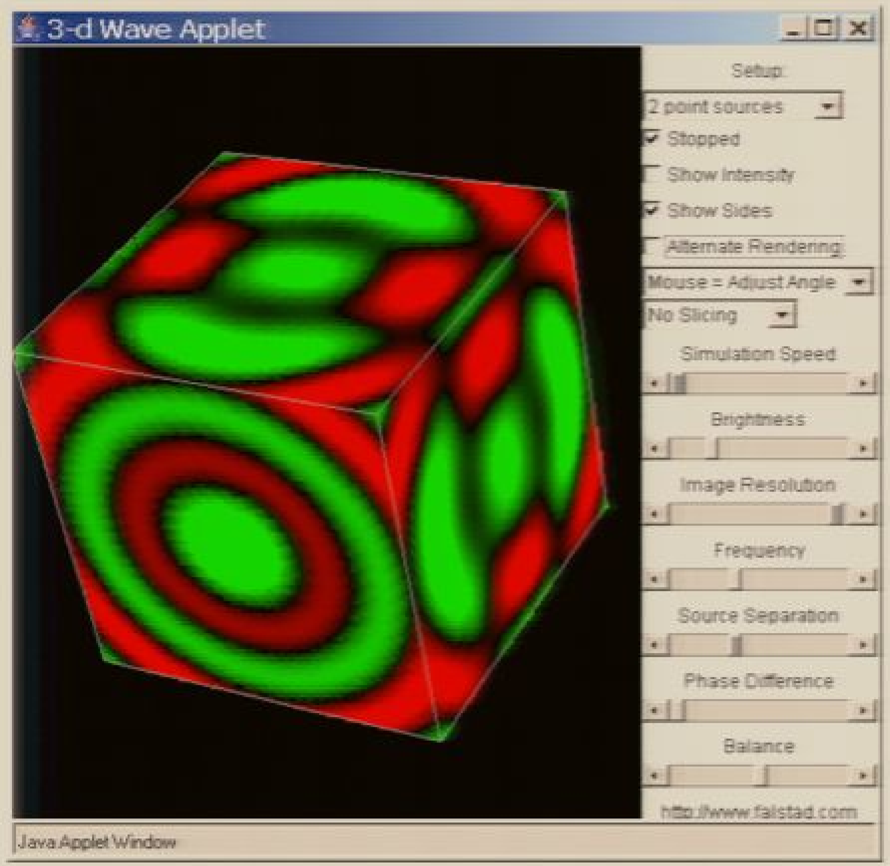
TinyCAD



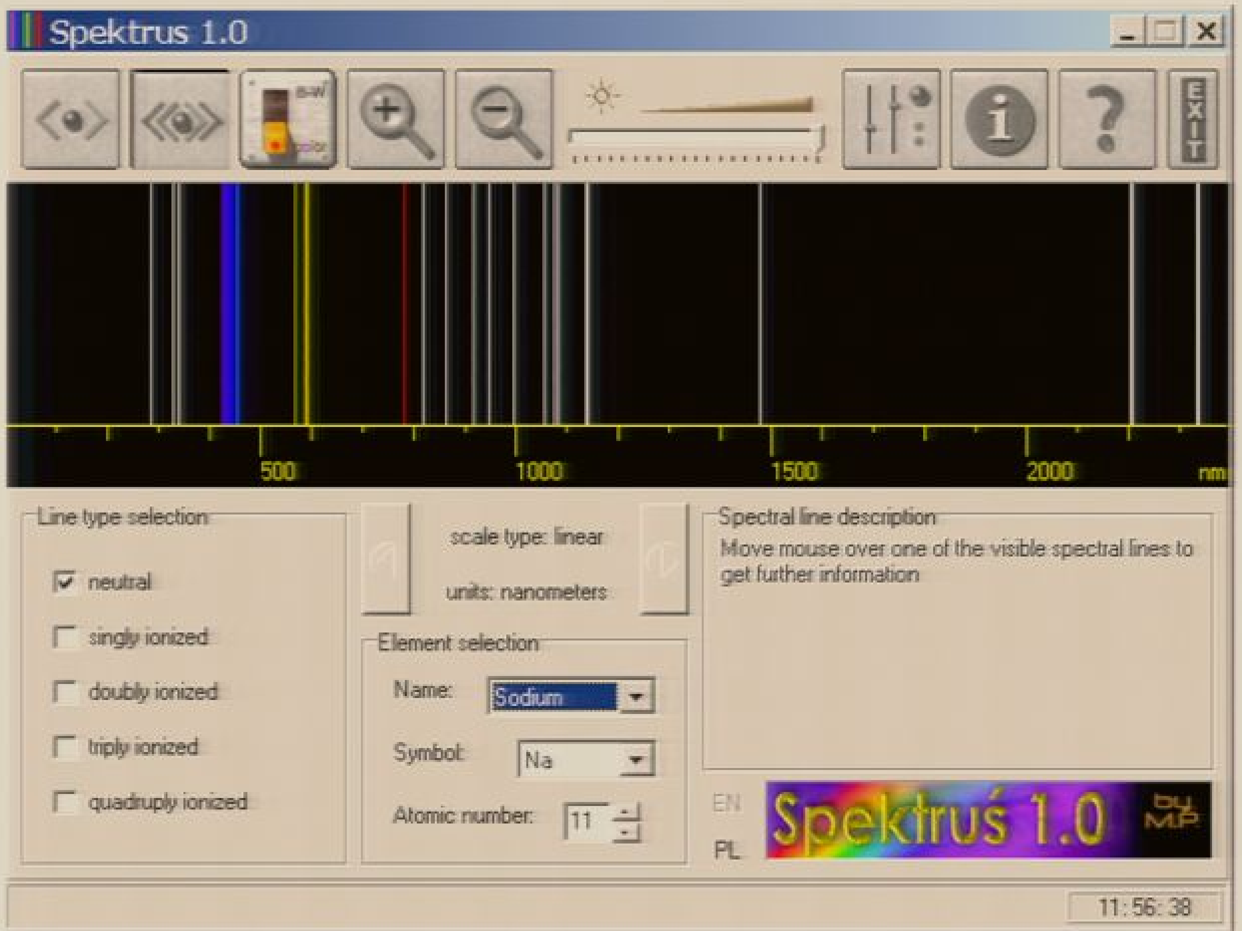
- Allows you to draw circuit diagrams, using a vast library, and to export them.

Falstad Applets

A set of applets that show a variety of things from acoustics to electrodynamics.



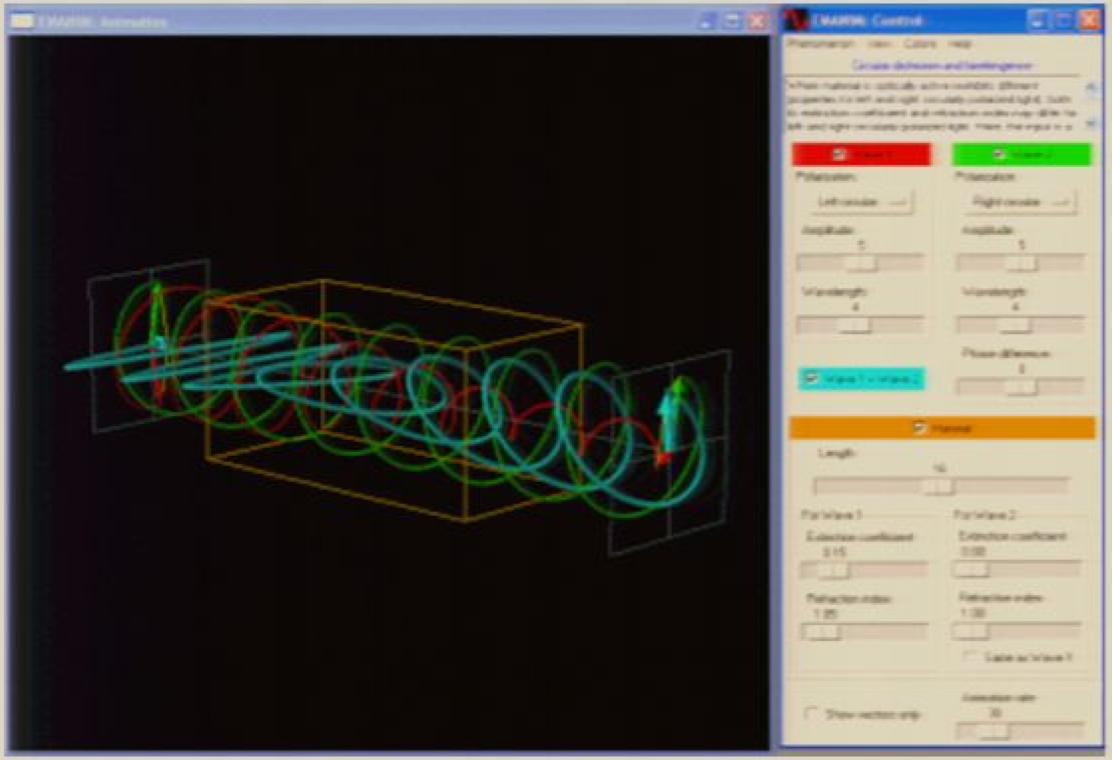
Spektrus



Shows the spectra of all of the elements and allows you to extract information about the emission lines.

Emanim

Visualises em waves and show different states of polarisation, interference, refraction etc



New Ideas?

A workshop from the
Institute of Physics
Teachers Network

Institute of Physics
Teaching Physics

08 March 2005

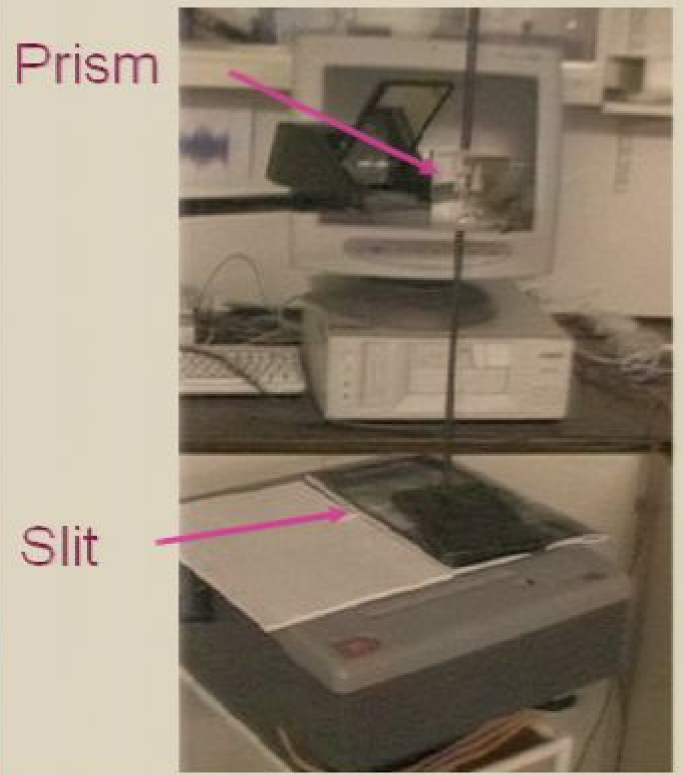
Title: **Prism and OHP**

Target: Any

Equipment and suppliers:

All you need is an ohp, large prism and two sheets of card or books that can be used to make a slit on the top of the ohp. You'll also need a clamp, stand and boss to hold the prism in place, a G-clamp can be used with the right ohp.

If your ohp is sitting doing nothing then now is the time to press it back into service for making rainbows.



Institute of Physics Teaching Physics

08 March 2005

Title: # Bendy Pencils

Target: 16 -18

Equipment and suppliers:

Try pound shops - the pencils come in packs of 8 - only 12.5p each. Longer pencils have high resistance and need a good ohmmeter.

Bendy pencils can be used to make a strain gauge. The pencils come in 2 lengths, 30cm and 200cm.

Institute of Physics
Teaching Physics

08 March 2005

Centrally resourced sessions

Title: # Bendy Pencils

Target: 16 -18

Equipment and suppliers:

Try pound shops - the pencils come in packs of 8 - only 12.5p each. Longer pencils have high resistance and need a good ohmmeter.

Bendy pencils can be used to make a strain gauge. The pencils come in 2 lengths, 30cm and 200cm.

Institute of Physics Teaching Physics

08 March 2005

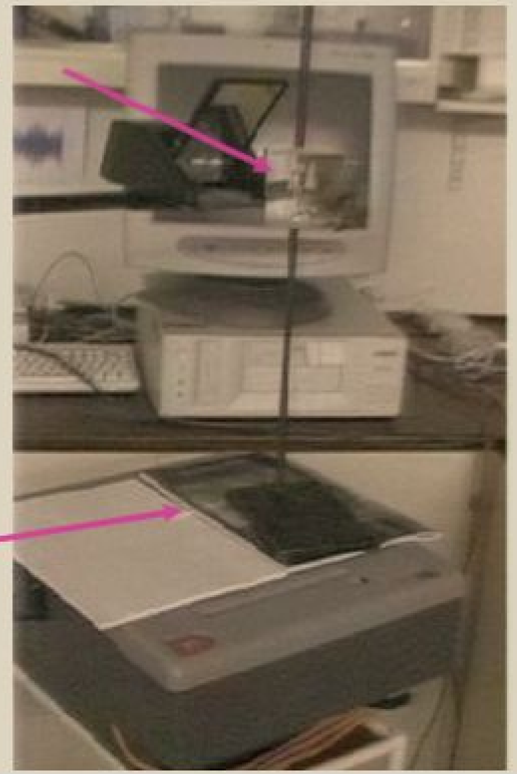
Title: **Prism and OHP**

Target: Any

Equipment and suppliers:

All you need is an ohp, large prism and two sheets of card or books that can be used to make a slit on the top of the ohp. You'll also need a clamp, stand and boss to hold the prism in place, a G-clamp can be used with the right ohp.

If your ohp is sitting doing nothing then now is the time to press it back into service for making rainbows.



08 March 2005

Son of New Ideas?

A workshop from the
Institute of Physics
Teachers Network

Institute of Physics
Teaching Physics

Title: **Wave changer**

Target: **Any**

Equipment and suppliers:

Marker pen, stick, wallpaper or A3 sheets taped together, old wire reel, clamp stand

Sound is a longitudinal wave - so why do we show images of transverse waves and say they're sound?

Show pupils how longitudinal waves are represented by transverse waves with this simple gadget.

Institute of Physics
Teaching Physics

Son of New Ideas?

Title: **Wave changer**

Target: **Any**

Equipment and suppliers:

Marker pen,
stick,
wallpaper
or A3 sheets
taped
together,
old wire reel,
clamp stand

Sound is a longitudinal wave - so why do we show images of transverse waves and say they're sound?

Show pupils how longitudinal waves are represented by transverse waves with this simple gadget.

Institute of Physics
Teaching Physics

Son of New Ideas?

Title: **Eggs**

Target: **14-18**

Equipment and suppliers:

Eggs supplied by chickens!
Tray from local supermarket - 79p
Using crème eggs is less messy

A variation on the bucket of water trick. Use a tray for boiling eggs and a length of rope. Make sure the folding handle is securely in place. Whirl round in circular fashion without breakages - but stopping is the difficult bit!

Son of New Ideas?

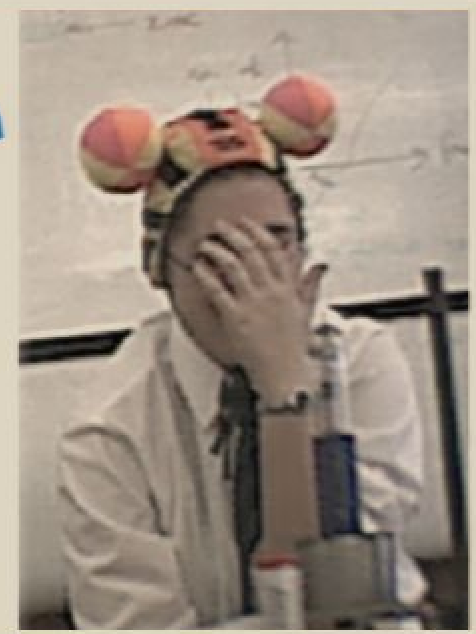
Title: **Butthead**

Target: 16-18

This game can be used to explain the photoelectric effect. The work function is the amount of energy needed to remove the ball from the head; the rest of the energy is transformed into KE.

Equipment and suppliers:

Butt head game (£9.99 from Hawkin.com) or homemade Velcro equivalent, foam disc gun (£9.99 & £4.99) and an airzooka.



08 March 2005

Title: **Eggs**

Target: **14-18**

Equipment and suppliers:

Eggs supplied by chickens!
Tray from local supermarket - 79p
Using crème eggs is less messy

A variation on the bucket of water trick. Use a tray for boiling eggs and a length of rope. Make sure the folding handle is securely in place. Whirl round in circular fashion without breakages - but stopping is the difficult bit!

Son of New Ideas?

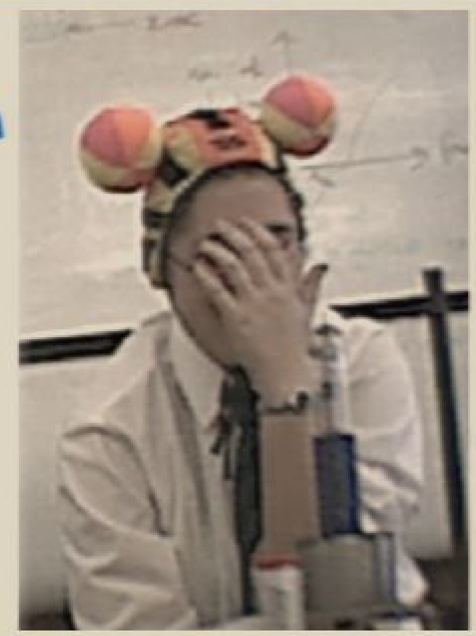
Title: **Butthead**

Target: 16-18

This game can be used to explain the photoelectric effect. The work function is the amount of energy needed to remove the ball from the head; the rest of the energy is transformed into KE.

Equipment and suppliers:

Butt head game (£9.99 from Hawkin.com) or homemade Velcro equivalent, foam disc gun (£9.99 & £4.99) and an airzooka.



08 March 2005

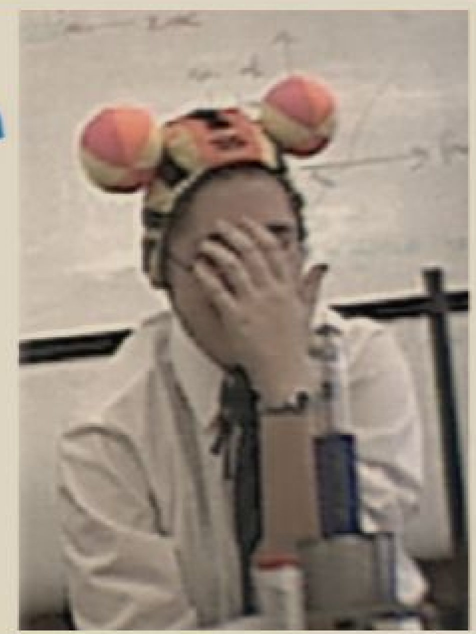
Title: **Butthead**

Target: 16-18

Equipment and suppliers:

Butt head game (£9.99 from Hawkin.com) or homemade Velcro equivalent, foam disc gun (£9.99 & £4.99) and an airzooka.

This game can be used to explain the photoelectric effect. The work function is the amount of energy needed to remove the ball from the head; the rest of the energy is transformed into KE.



08 March 2005

Thank You!