



## Introduction and discussion prompt

Daniel Hynds, on behalf of many

## History and motivation

Whole discussion brought into focus again with PPTAP

- Most universities give little provision for training instrumentation students - most work done on-the-job
- Too few students in any one place to put on an extensive set of courses

In an ideal world, all of our PhD students would end up knowing TCAD, SPICE, could design PCBs, perform R&D on different detector families, etc.

- Seem to be missing technical skills, particularly a UK problem given the limited detector funding
- Feeds into difficulty in employing post-docs (in the rare case we are in a position to hire one)
  - *Training efforts should also include postdocs and permanent staff*
- Very little co-ordinated effort in the UK outside of experiment working groups

Hope that this will be a community effort to improve the training we give to our students and increase what we can do in the UK (ie. none of us will get paid for this)

## Institute feedback

University of Birmingham - L. Gonella

University of Bristol - J. Goldstein

University of Cambridge - B. Hommels

University of Edinburgh - S. Eisenhardt

University of Glasgow - R. Bates

Imperial College London - A. Tapper

University of Liverpool - J. Taylor

University of Manchester - S. de Capua

Queen Mary University of London - A. Bevan

RAL - C. Sawyer

University of Warwick - T. Latham

### **Could still contact:**

University of Lancaster

Open University

University of Sheffield

Others?

### **Main comments:**

Most institutes keen for students to take part, willing to volunteer effort to provide lectures

Several institutes keen to provide training for postdocs  
getting involved in hardware projects

## What we would like to achieve

Student training in instrumentation - a set of online (zoom) lectures covering all of the topics that we would like our students to be well-versed in

- At the moment focussing on our own field (silicon, see later)
- Including tutorials/problems to let students practice what they have learned

The courses cannot cover absolutely everything, but introductions to the tools that are available, and ways to contact people when going into greater depth would be extremely useful

- We would already like to begin in this academic year - not all courses will be possible to set up in that time, and content will surely change moving forwards. But good to get something off the ground now

## Thoughts on timing

Again, just back-of-the-envelope thoughts on how this could fit into the academic schedule:

- Many universities have their own (particle physics) lecture series, typically in the first semester (Sep - Dec)
- Summer schools, in particular the “RAL school” tend to fall June - August

Of course we would like students to get up to speed as quickly as possible. Trying hard not to change the above boundary conditions:

- Lectures some time in the period Jan - April, most likely February and March
  - This depends on the number, length and intensity of courses

## Example list of courses (completely open for discussion)

### **Semiconductor theory**

- Physics of semiconductors
- Interaction of particles with matter
- Radiation damage, dose calculations

### **Fabrication and device layout**

- Wafer growth, doping, implantation, device fabrication
- Detection structures: HV-/HR-CMOS, LGAD, SiPMs, 3D, etc.

### **Electronics and DAQ**

- General electronics, amplifier designs, noise and grounding
- Circuit and PCB design
- FPGA overview

### **TCAD simulations**

### **Mechanics and cooling**

- CAD and technical drawing
- Mechanical structures, vibration analysis
- Cooling systems and interfaces
- FE analysis tools

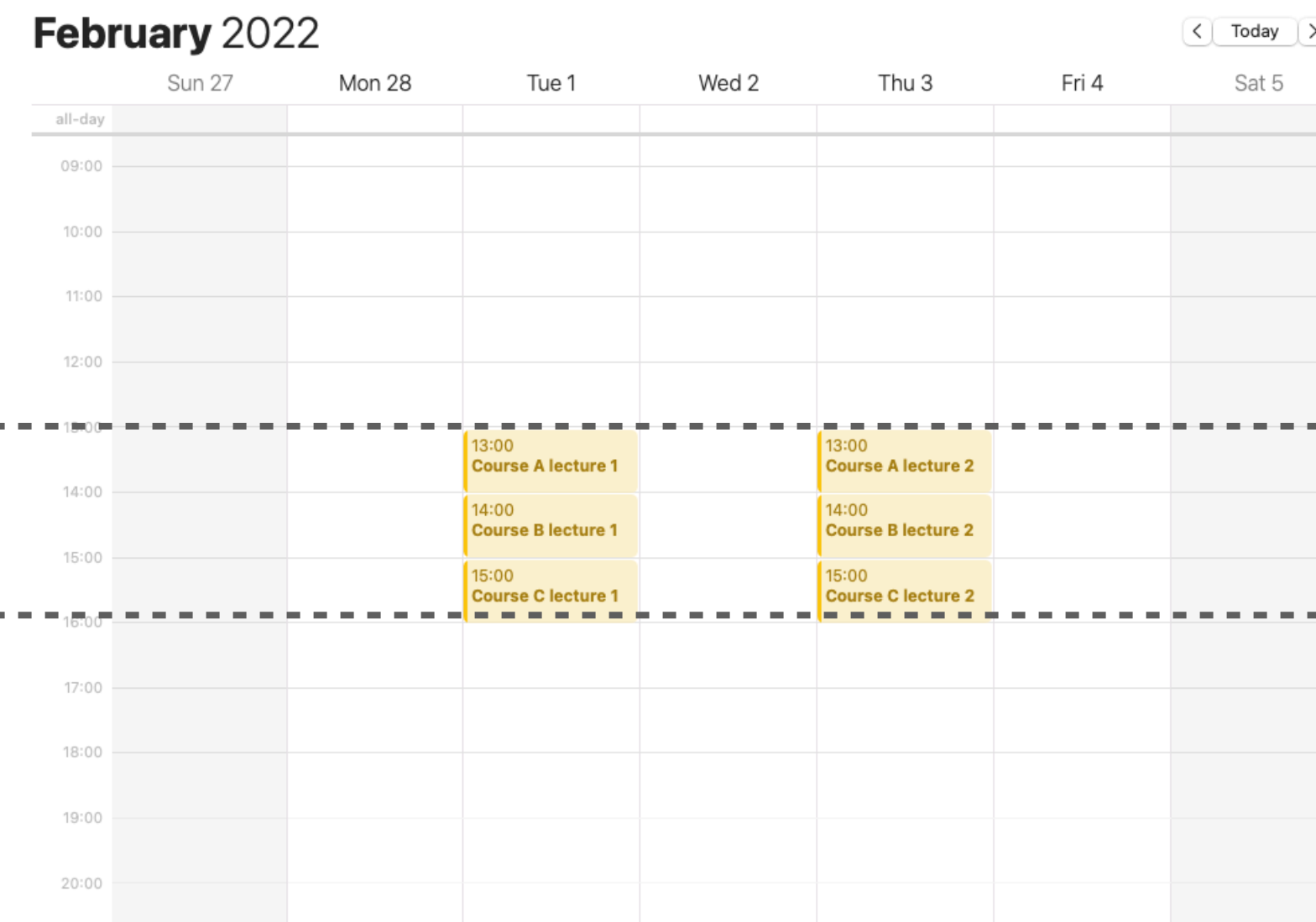
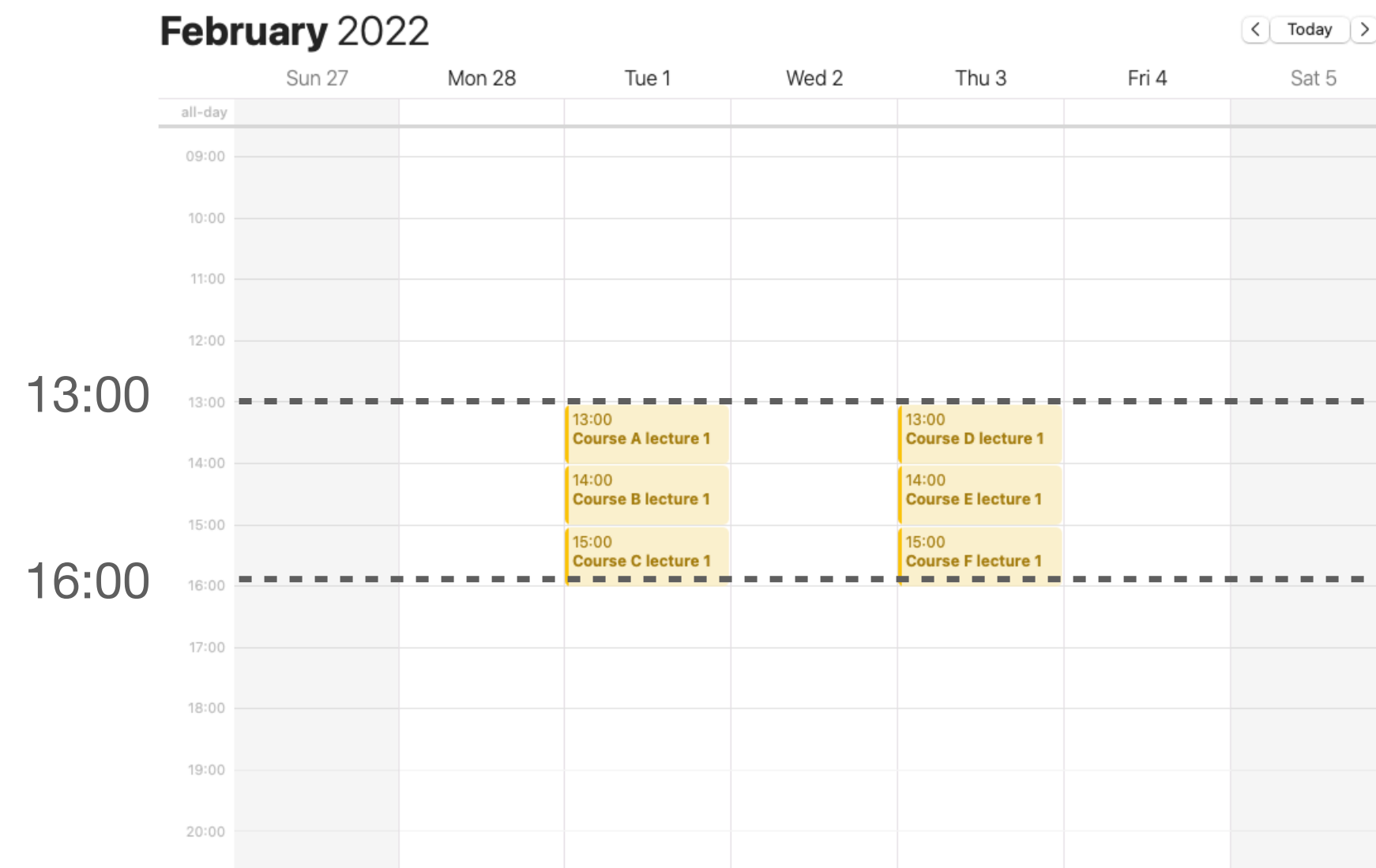
### **Software tools**

- Geant4
- Testbeam reconstruction
- Electronic simulations eg. SPICE

# How to split things up

Each of the lecture courses could be 8-hours long, split into 4-hour chunks

- Each lecturer then gives 4 hours worth of lectures - tutorials/exercises for between lectures?
- Reserve two fixed slots per week for the lectures to make them regular, each course has 1 lecture/week and lasts 8 weeks? 2 lectures/week and staggered?



# Open questions

There are several things that it would be good to decide today/soon:

- List of courses that we would like to provide (eg. Bristol suggestion: separate FPGA programming course)

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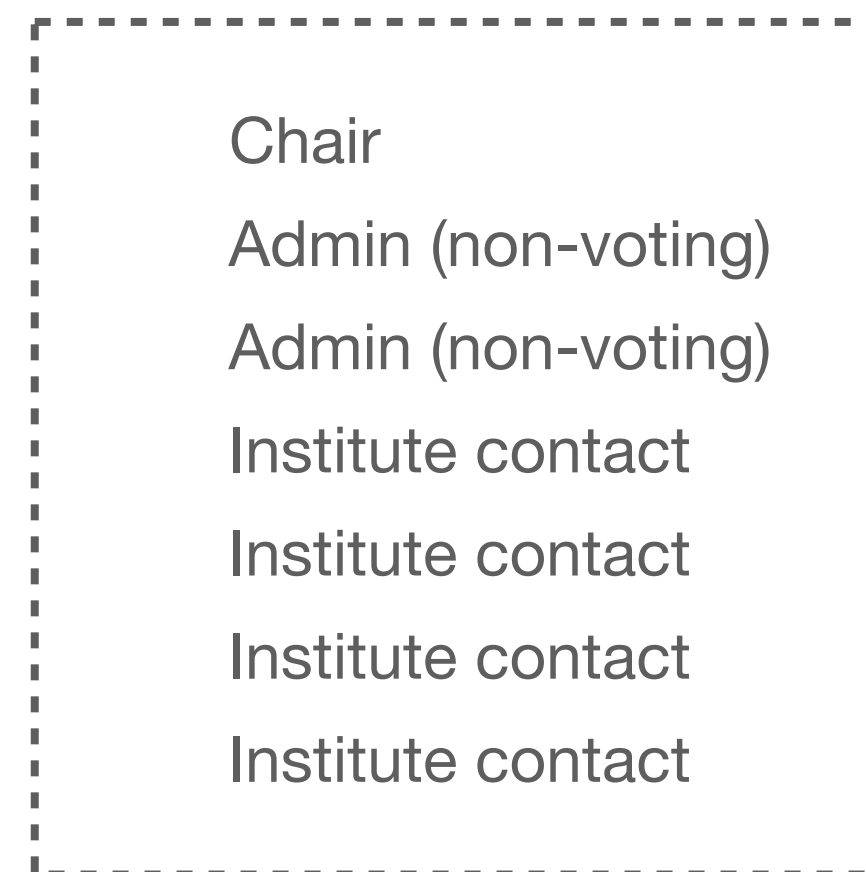
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### Steering board



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- Who is the audience? Inclusive of postdocs and above? Extension to non-silicon particle physics instrumentation? Photon science? Astrophysics? Try to estimate numbers for this academic year?

## Following the discussions

Mailing list set up for this: **uk-advanced-instrumentation-training@cern.ch**

- Go to <https://e-groups.cern.ch/e-groups/EgroupsSearchForm.do>
- Search for “uk-advanced-instrumentation-training”
- Alternatively email me to be added manually

Minutes from today will be sent to this group (and attached to agenda), should be used for all future communication

- Please encourage interested colleagues to sign up

## Next steps

Have a list of institute representatives by Nov. 19

- Meeting around Nov 26 to discuss courses, timescale, kick off the hunt for lecturers?
- Meeting around Dec 10 to finalise list of courses and lecturers?
- Lecturers will have Dec-March to prepare?

### November

M	T	W	T	F	S	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	1	2	3	4	5
6	7	8	9	10	11	12

### December

M	T	W	T	F	S	S
29	30	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	1	2
3	4	5	6	7	8	9