

PHYS205: Working with Physics II

Lecture 8

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Semester 2 overview

- Goal: master a basic set of research skills
- The ability to solve problems using a computer program
 - Approach the problem conceptually and come up with a model to solve it
 - Implement the solution using computer program (e.g. Matlab)
 - You need to plan, properly structure and test computer programs
- Learn to communicate your results using scientific language in these common formats
 - Written e.g. essay/paper
 - Oral (talks)
 - Poster
- Experience of working in a small group

This lecture

- Course structure and key dates
- Introduction to scientific communication skills
- Effective group work
- Problem sheet 6: journal analysis

Semester 2 structure

- This semester counts 50% of the total module marks
 - 4 × 1-hour lectures
 - 4 × 2 hour problem classes in group work
 - Poster in pairs
 - Individual essay and oral presentation on one common topic

Assessment

Subject	Format	% weighting
Journal Analysis (group work)	Workshop × 2	10
Data analysis (group work)	Workshop × 2	10
Poster (pair work)	Own time	10
Oral presentation	Own time	10
Written essay	Own time	10

Key dates

Detailed deadline (time and date) will be given for each assignment

Week	Week Starting	Thursday Problem class slot	Friday Lecture slot	Poster/ Talk/Essay	Hand in
1	29-Jan		L8		
2	5-Feb	P6 (Group)	-		
3	12-Feb	P6 (Group)	L9	Choose poster title and partner	
4	19-Feb	P7 (Group)	L10		P6
5	26-Feb	P7 (Group)	L11		
6	5-Mar				P7
7	12-Mar			Choose talk/ essay title	
8	9-Apr			Poster (Pair)	E-Poster
9	16-Apr				
10	23-Apr				E-Talk
11	30-Apr			Talk	
12	7-May				Essay

Problem class and group work overview

Problem class overview

- For the two workshops you'll be working in small groups (6 people)
 - List of groups are available on VITAL
 - Click on the 'My Groups' panel
 - There are a various group tools you can access (such as email, blog/wiki, file exchange...)
 - *Make sure you know which group you belong to before coming to the workshop next week*
- Week 2-3: Journal Analysis
 - Each group will be allocated a published journal
 - You will need to work together to evaluate the content of the journal, extract the essential substance of the article and make it accessible to a general physics audience
 - *Present your findings in a short 4 page group report*
- Week 4-5: Data Analysis
 - You will be given data from a half-life experiment taken from a neutron activated radioactive sample
 - You are expected to analyse this data using three different techniques, and discuss your results
 - *Present your work in a short group report (2500 words)*

Why group work?

- Every career will involve a large aspect of group work
 - It's important to understand how to work effectively in a group
- What are the benefits to working in groups?
 - Developing stronger communication skills
 - Planning and managing time
 - Sharing diverse perspectives
 - Challenging assumptions
 - Pooling knowledge and skills
 - Breaking complex tasks into parts and steps
 - Refining understanding through discussion and explanation
 - ...

Effective group work: **get organised**

- Agree on some basic organisation and how the group will work and communicate
 - e.g. how you will communicate, how often you need to meet
 - A key aspect of group organisation is everyone knowing what they are expected to do
- Have a clear timeline of the project and review it frequently
 - Important to get a realistic assessment of the work load and adjust if necessary
 - Allow room for contingency: rarely plan catches changes.
- Each time you meet
 - Start each session by assessing the current status of the project
 - Agreeing the objectives for the group
 - Ensure all group members know what they have to do
 - End by summarising what has been agreed
- Take notes and minutes
 - Either everybody takes their own or one person does and immediately shares them for correction, up to each group to decide

Effective group work: communicate

- Good group work depends on good communication
- Be a good listener
 - Concentrate on what the speaker is saying, don't interrupt
 - Make sure there is ONE conversation at each time
- Make contributions, but don't dominate
 - Build on people's ideas, suggest ideas that the whole group can comment on
 - “Why don't we...”, “what do you all think about..”
- Give constructive feedback
 - If you don't agree with someone, give constructive suggestions on how to improve instead of simply complaining
 - If you agree with someone, do not be shy to complement

Effective group work: be supportive and inclusive

- Avoid ‘sabotaging’ the group (unintentionally or otherwise)
 - Being late for the session (or absent)
 - Not preparing
 - Not concentrating when other people are speaking
 - Not considering other points of view
- Help the discussion to flow, valuable leadership skill
 - Encourage the group to keep to the subject
 - Make suggestions and share your ideas
 - Build on other people’s ideas: ‘That last point you made is important because ...’
 - Sum up for the group: ‘We have agreed on these points so far...’
- Be inclusive
 - Help all group members to feel involved
 - Be encouraging and try making them feel welcome by chatting before or after the group meets.
 - If someone is not participating, try asking their opinions or see if they’d like to take on a role

Scientific communication

Usage of scientific language

- Applicable to all scientific communications
 - Poster, essay, and oral presentations
- Use tables, figures, formulas and diagrams whenever appropriate
 - Make sure you describe those clearly, such as the axis in the graphs, main features etc
- Use quantitative statements
 - For example it is better to say the observed phenomena is *inconsistent with the theory prediction at level of X sigma level* rather than simply saying this is a significant observation
- Use references
 - Whenever quoting a number, a graph or a table, make sure proper references are given
 - Use formats as in your assigned journal

Poster

- You will work in pairs to produce and present an *A0 portrait poster (84×119cm)* on a topic chosen from a list (different from the list for essay/oral presentation)
 - Do not use landscape
- Important (deadline) dates
 - Choose *your partner* and *register your choice of title* on VITAL *before 16-Feb-2017 (W3)*
 - Instructions on how to register will be given in VITAL next week
 - Get in touch with me asap if you have difficulty finding a partner
 - Electronic submission deadline
 - You should upload an electronic version in A4 format by Wed 5pm on W8 (11-April)
 - This is when late submission penalty will kick in
 - Poster Day
 - Friday of Week 8, 13-April

Poster titles (Physics)

- The EMMA accelerator
- Measuring biological systems with Terahertz radiation
- The AMS-02 experiment
- The AGATA spectrometer
- Quantum entanglement in space experiments
- The anomalous magnetic moment of the muon
- Free Electron Lasers
- The origin of Ultra-High Energy Cosmic Rays
- Gravitational wave detectors
- Dark energy
- Atomic clock
- Efficient solar cells
- The Higgs boson discovery at the Large Hadron Collider

Poster title (Astrophysics)

- Core collapse supernovae
- Type Ia supernovae
- Gamma ray bursts
- Active galactic nuclei
- Tidal disruption events
- The square kilometer array
- James webb space telescope

Poster structure

- Title and author

- Title should be at no smaller than 55 point type
- Include your name and department

- Abstract

- A short paragraph (<100 words) overviewing the entire poster topic right after title and author

- Introduction

- Introduce the topic with background information
 - What this topic is? Why this is interesting?
 - This is different from abstract, you do not have to summarise the poster content later
 - Keep it concise: < 400 words and no more than 2 paragraphs

Poster structure

- Section(s) on methods, data analysis and results
 - This is the main content of the poster that deserves more space than other sections
 - You can decide yourself how many sections for this and appropriate section titles
 - Make sure you use scientific language: be as quantitative as you can
 - Data should be displayed in graphs or tables that are easy to read and clearly labelled
 - All figures and tables should be labelled and described in sufficient detail with captions
 - No further requirements on words or paragraphs beyond the natural limit from the poster size
- Conclusion
 - Summarise the main results of the research and the implications to the given field
 - Again this should be concise < 400 words and not be more than 2 paragraphs
- References
 - Make sure references are given and cited (you can use a relatively smaller font for references)

Poster assessment

- Research content (60%)
 - What is the physics content?
 - Have you covered the physics content well?
 - Have you used scientific statements to support the physics content?
 - Are appropriate references present?
- Poster layout (25%)
 - Does the poster have all the required sections?
 - Is the poster easy to read?
 - Font size appropriate?
 - Are figure and tables labelled and image qualities good enough?
 - Are the different sections organised clearly to guide an audience?
- Remember: you need to make your poster interesting to someone passing by in < 1 minute!
- Oral presentation and discussion (15%)
 - If asked, can you give a brief overview of your poster? Can you answer questions?

Searches for Heavy Diboson Resonances at $\sqrt{s} = 13$ TeV with the ATLAS Detector

Andreas Søgaard for the ATLAS Collaboration
University of Edinburgh
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1 Introduction

Several beyond the Standard Model (BSM) theories predict resonances decaying to pairs of vector bosons: WW , WZ , and ZZ . Four searches for heavy diboson resonances in final states with jets ($vvqq$, $lvqq$, $llqq$, and $qqqq$) have been carried out in 3.2 fb⁻¹ of 13 TeV data collected by the ATLAS experiment in 2015. The results are interpreted in terms of spin-0 (scalar singlet), spin-1 (heavy vector triplet – HVT), and spin-2 (bulk RS graviton – G*) signal models.

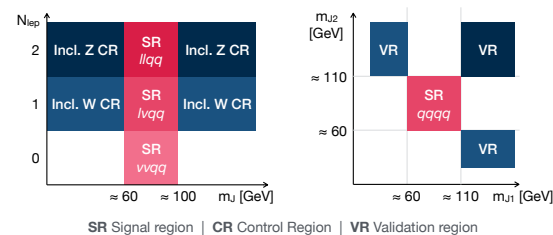
3 Background estimation

SM background composition in the semileptonic channels:



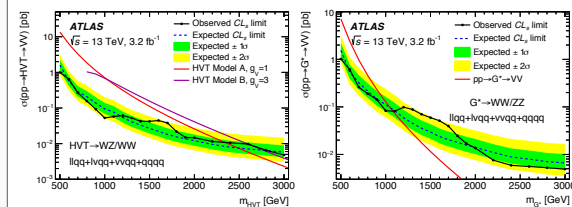
The $qqqq$ background is completely dominated by multijet events. Backgrounds estimated as follows:

Inclusive Z Control region ($vvqq/llqq$), m_{jj} sideband.
Inclusive W Control region ($vvqq/lvqq$), m_{jj} sideband.
Top Control region ($vvqq/lvqq$), requiring ≥ 1 b -jet.
Multijet Parametrised fit to data ($qqqq$), validated in dedicated regions (VR).



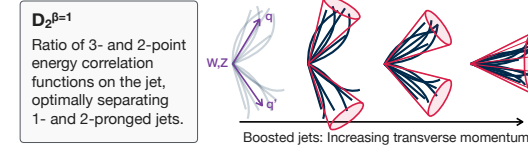
5 Combination

The individual analyses are combined by simultaneously fitting all final discriminant distributions in all channels with a single likelihood function. No single channel dominates sensitivity, justifying a combined search. The frequentist CLs approach is used to set 95% confidence cross section exclusion limits.



2 Final states and selections

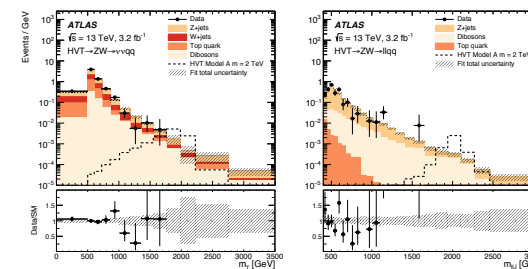
All searches focus on boosted topologies, reconstructing hadronically decaying bosons as single large-radius jets passing a $D_2^{B=1}$ substructure variable cut. Overlapping W and Z signal regions (SR) are defined by requiring the jet mass m_J to be close to the W/Z pole masses.



	$llqq$	$lvqq$	$vvqq$	$qqqq$
Trigger	Single lep.	E_T^{miss} or single el.	E_T^{miss}	Large-R jet
N_{jet}	≥ 1	≥ 1	≥ 1	≥ 2
N_{lep}	2	1	0	0
E_T^{miss}	—	> 100 GeV	> 250 GeV	< 250 GeV
Topology	$p_{T,lep,j}/m_{ll} > 0.4$ $m_{ll} \approx m_Z$	$p_{T,lep,j}/m_{lv} > 0.4$ b -jet veto	$ \Delta\phi(E_T^{miss}, J) > 0.6$	dijet p_T balance $ \Delta y_{JJ} < 1.2$
Discriminant	m_{ll}	m_{lv}	m_T	m_{JJ}

4 Results

Good overall agreement between data and expected background seen in all final discriminant distributions. m_T and m_{JJ} plots are shown below in the ZW SR for the 0- and 2-lepton channels. These are among the distributions entering the combination.



6 Conclusion

No significant excess is found in the combined search. Upper exclusion limits on resonance masses of 2650, 2500, and 1100 GeV are set for the spin-0, -1, and -2 models, resp. Studies show improvements in sensitivity of a factor of two at resonance masses of 2 TeV relative to Run 1 analyses with 20.3 fb⁻¹ at 8 TeV.

[1] $llqq$ conf. note: cds.cern.ch/record/2114843
[2] $lvqq$ conf. note: cds.cern.ch/record/2114847
[3] $vvqq$ conf. note: cds.cern.ch/record/2114840
[4] $qqqq$ conf. note: cds.cern.ch/record/2114845

[5] $D_2^{B=1}$ paper: arxiv.org/abs/1409.6298
[6] Run 1 combination: cds.cern.ch/record/2115337
[7] Run 2 combination: arxiv.org/abs/1606.04833

LHCP conference
winner in 2016

I would like you to
add an abstract on
top as well!

More details in
later lectures



LHCP 2016
Lund, Sweden · 14 June 2016

Preparation for poster

- There is a huge amount of resources online on how to produce a good poster.
 - It's worth doing some research and planning the layout of your poster very carefully
 - Helps to do a stretch on a piece of paper
- Powerpoint is the most widely used software for creating posters
 - For os users, keynote is also a popular option
 - There are lots of information/help/advice on how to do this online (ask google)
- Don't underestimate how long it takes to create a good poster: start now

Printing the poster

- You can print your poster from powerpoint using the University specialised printing service
 - This website gives details on how to print your poster
 - <https://www.liverpool.ac.uk/csd/printing/specialised-printing/creating-printing-a-poster/>
 - It also has a guide to producing a poster in powerpoint
- You will be credited with sufficient funds to print one A0 copy of your poster
- Plan at least a couple of days to print it before the poster day
 - Proof read it before you print it!
 - More details on poster preparation will be given through VITAL in closer time

Problem class 6

Problem sheet 6: journal analysis

- You will work in small groups to study the content of a journal article
 - Each group will be assigned a different article, assignment of group members are on vital
 - *Group name corresponds to the number in the journal list*
 - *List of journals will be uploaded to VITAL soon with an announcement!*
- You will extract the essential substance of the article and make it accessible to a general physics audience at your own level
- These journals will contain technical details beyond your current level
 - You should look at associated references in the article where appropriate
 - *Focus on the basic physics principle and impact of the journal*
 - Do not get carried away by non-important details (unless of course if you are very interested)
- You will (as a group) will present your findings as a short report (maximum 4 pages), plus an appendix describing individual contributions (more on this later)

Problem sheet 6: journal analysis

- You should find, print and read the article before the problem class on Thursday
 - There will be demonstrators available to help, but they won't be explaining the content of the papers for you. It's up to you to research them.
- You'll need to spend some time discussing the article, planning what tasks are needed and allocating them amongst yourselves.
 - Once you have a plan you should discuss it with the demonstrators
- DEADLINE: The report should be submitted by 5pm Friday 23/2/2016 (week 4)
 - One submission per group through Turnitin Assignments by Group on vital

More on the report

- Use a letter style similar to the one that is assigned to you
 - You are not obligated to use double-column
- Maximum 4 pages
 - 1 point (out of 10) per page deduction if it is under or above
- Make sure you include the following sections
 - Abstract
 - Introduction
 - Section(s) on data analysis and results, section titles can vary
 - Include the “most important” figure and/or table
 - Conclusion
 - References
- You are not meant to copy and paste

Accessing electronic journals

- Web of Science is a good source of electronic journals for physics publications
 - Navigate to <https://www.liverpool.ac.uk/library>
 - Select Database from Library Home
 - Select Web of Science
 - Search for what you need and download the papers as pdfs

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☐ 1. **Observation of a Four-Electron Auger Process in Near-K-Edge Photoionization of Singly Charged Carbon Ions**

By: Mueller, A.; Borovik, A., Jr.; Buhr, T.; et al.

PHYSICAL REVIEW LETTERS Volume: 114 Issue: 1 Article Number: 013002 Published: JAN 7 2015

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year	year:2000		
year range	year:2000-2005	refereed	property:refereed ?
full text	full:"gravitational waves"	astronomy	database:astronomy ?
publication	bibstem:ApJ ?	OR	abs:(planet OR star) ?

Electronic journal access summary

- Journal databases are by far the best way to find articles on a specific topic
- It's well worth spending a bit of time getting used to the databases and honing your skills
- If you have a reference for the article you want you can search specifically for that article
 - Navigate to <http://www.liverpool.ac.uk/library> and use the "DISCOVER" search to locate the text
- Or try typing the full reference into Google (often works, DOI references are designed to be computer friendly)

Summary

- This lecture
 - Structure and schedule of this semester
 - General introduction to scientific communications
 - Effective group work
 - Problem sheet 6 on the journal analysis
- Next week
 - No lecture next week
 - Problem class on Thursday 9-11 am CTL-6-PCTC-BLUE and CTL-6-PCTC-ORANGE
 - *Check your group assignment and get hold of the correct journal article before the problem class*
- Start work on your poster!