

# PHYS 557 A Wi 18: High Energy Physics

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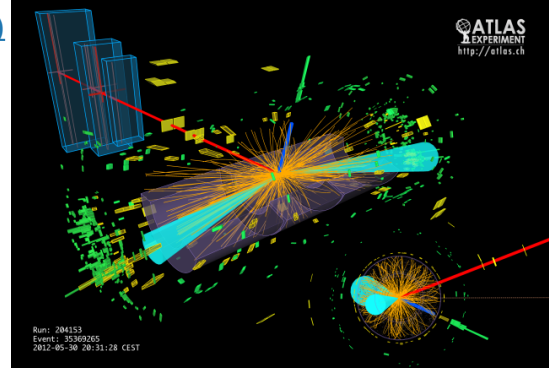
Prof. [Steve Sharpe](http://faculty.washington.edu/srsharp/) (<http://faculty.washington.edu/srsharp/>)  
([srsharp@uw.edu](mailto:srsharp@uw.edu) (<mailto:srsharp@uw.edu>))

MWF 12:30-1:20 PAB: A114

Office hour: W 1:30-2:30, PAB B406

TA: Kyle Aitken ([kaitken@uw.edu](mailto:kaitken@uw.edu) (<mailto:kaitken@uw.edu>)),

TA Office hour: Th 2:30-3:30, PAB B426



(The picture above is of a Higgs decay to tau-antitau from the ATLAS detector. Courtesy of CERN. <http://cds.cern.ch/record/1631395>  
(<http://http://cds.cern.ch/record/1631395>))

Welcome to PHYS 557 (Winter 2018). This course is aimed at graduate students wanting to learn about the present state of particle physics--about what the standard model is, and its successes and failures. I will also emphasize learning how to calculate some simple decay rates and scattering cross sections. It should be accessible to **all** graduate students, not only those doing research in particle and nuclear physics.

The course does **not** assume knowledge of quantum field theory---my aim is for the material to be complementary to that in the QFT course, emphasizing phenomenology and calculations rather than basic formalism. We will use Feynman diagrams to do some simple calculations, but these will be introduced as a tool kit. What is assumed is knowledge of special relativity and relativistic kinematics using 4-vectors, of Lagrangian mechanics, of angular momentum in quantum mechanics, and of how symmetries are represented in quantum mechanics. The first year graduate classes provide this background. An undergraduate course in particle physics would be helpful (but not essential if you do some background reading).

An advanced undergraduate who has taken PHYS 226 and/or 422 as well as undergraduate QM, EM and Classical mechanics and is willing to do some background reading should be able to take this course. Please contact me if you are in this situation and we can arrange a meeting.




For information about texts, homeworks, exams and grading see [COURSE INFORMATION \(PHYS 557\)](#) (which is also on the "Pages" link).


For useful links see [LINKS](#).





For some fun images see [IMAGES](#), and for the latest news see [NEWS](#). Please email suggestions for images or links to add.

Here is the the tentative schedule, based on last year's course. It will be tweaked as the quarter progresses.

## Course Summary:

Date	Details	
Wed Jan 3, 2018	 <a href="https://canvas.uw.edu/calendar?event_id=1073932&amp;include_contexts=course_1126325">Lecture: Introduction (read Ellis lec. 2) (https://canvas.uw.edu/calendar?event_id=1073932&amp;include_contexts=course_1126325)</a>	12:30pm to 1:20pm
Fri Jan 5, 2018	 <a href="https://canvas.uw.edu/calendar?event_id=1073918&amp;include_contexts=course_1126325">Lecture: decay rates &amp; cross sections (https://canvas.uw.edu/calendar?event_id=1073918&amp;include_contexts=course_1126325)</a>	12:30pm to 1:20pm
Mon Jan 8, 2018	 <a href="https://canvas.uw.edu/calendar?event_id=1073931&amp;include_contexts=course_1126325">Lecture: 2-&gt;2 kinematics; Intro. to Dirac equation (https://canvas.uw.edu/calendar?event_id=1073931&amp;include_contexts=course_1126325)</a>	12:30pm to 1:20pm
Wed Jan 10, 2018	 <a href="https://canvas.uw.edu/calendar?event_id=1073917&amp;include_contexts=course_1126325">Lecture: more on Dirac equation: general solutions, spin, helicity, antiparticles, parity, chirality (https://canvas.uw.edu/calendar?event_id=1073917&amp;include_contexts=course_1126325)</a>	12:30pm to 1:20pm
Fri Jan 12, 2018	 <a href="https://canvas.uw.edu/calendar?event_id=1073962&amp;include_contexts=course_1126325">Lecture: continuation using this week's notes (https://canvas.uw.edu/calendar?event_id=1073962&amp;include_contexts=course_1126325)</a>  <a href="https://canvas.uw.edu/courses/1126325/assignments/3943430">HW1 (https://canvas.uw.edu/courses/1126325/assignments/3943430)</a>	12:30pm to 1:20pm due by 1:20pm
Wed Jan 17, 2018	 <a href="https://canvas.uw.edu/calendar?event_id=1073916&amp;include_contexts=course_1126325">Lecture: Feynman rules for fermion scattering in a Yukawa theory (https://canvas.uw.edu/calendar?event_id=1073916&amp;include_contexts=course_1126325)</a>	12:30pm to 1:20pm
Fri Jan 19, 2018	 <a href="https://canvas.uw.edu/calendar?event_id=1073926&amp;include_contexts=course_1126325">Lecture: Complete Yukawa scattering; Introduction to QED (https://canvas.uw.edu/calendar?event_id=1073926&amp;include_contexts=course_1126325)</a>  <a href="https://canvas.uw.edu/courses/1126325/assignments/3943431">HW2 (https://canvas.uw.edu/courses/1126325/assignments/3943431)</a>	12:30pm to 1:20pm due by 1:20pm
Mon Jan 22, 2018	 <a href="https://canvas.uw.edu/calendar?event_id=1073930&amp;include_contexts=course_1126325">Lecture: QED Feynman rules &amp; electron-muon scattering (https://canvas.uw.edu/calendar?event_id=1073930&amp;include_contexts=course_1126325)</a>	12:30pm to 1:20pm
Wed Jan 24, 2018	 <a href="https://canvas.uw.edu/calendar?event_id=1073925&amp;include_contexts=course_1126325">Lecture: chirality vs. helicity; angular distributions in electron-muon scattering (https://canvas.uw.edu/calendar?event_id=1073925&amp;include_contexts=course_1126325)</a>	12:30pm to 1:20pm
Fri Jan 26, 2018	 <a href="https://canvas.uw.edu/calendar?event_id=1073963&amp;include_contexts=course_1126325">Lecture: crossing symmetry; e+ e- annihilation theory and experiment (https://canvas.uw.edu/calendar?event_id=1073963&amp;include_contexts=course_1126325)</a>  <a href="https://canvas.uw.edu/courses/1126325/assignments/3943432">HW3 (https://canvas.uw.edu/courses/1126325/assignments/3943432)</a>	12:30pm to 1:20pm due by 1:20pm
Mon Jan 29, 2018	 <a href="https://canvas.uw.edu/calendar?event_id=1073915&amp;include_contexts=course_1126325">Lecture: Deep inelastic scattering and parton distribution functions (https://canvas.uw.edu/calendar?event_id=1073915&amp;include_contexts=course_1126325)</a>	12:30pm to 1:20pm
Wed Jan 31, 2018	 <a href="https://canvas.uw.edu/calendar?event_id=1073924&amp;include_contexts=course_1126325">Lecture: More on PDFs: sum rules, universality and universality (https://canvas.uw.edu/calendar?event_id=1073924&amp;include_contexts=course_1126325)</a>	12:30pm to 1:20pm
Fri Feb 2, 2018	 <a href="https://canvas.uw.edu/calendar?event_id=1073964&amp;include_contexts=course_1126325">Lecture: Hadrons, symmetries and QCD (https://canvas.uw.edu/calendar?event_id=1073964&amp;include_contexts=course_1126325)</a>	12:30pm to 1:20pm

Date	Details	
	 <a href="https://canvas.uw.edu/courses/1126325/assignments/3943433">HW4 (https://canvas.uw.edu/courses/1126325/assignments/3943433)</a>	due by 1:20pm
Mon Feb 5, 2018	 <a href="https://canvas.uw.edu/calendar?event_id=1073929&amp;include_contexts=course_1126325">Lecture: Introduction to QCD (https://canvas.uw.edu/calendar?event_id=1073929&amp;include_contexts=course_1126325)</a>	12:30pm to 1:20pm
Wed Feb 7, 2018	 <a href="https://canvas.uw.edu/calendar?event_id=1073923&amp;include_contexts=course_1126325">Lecture: Properties of QCD--running coupling, asymptotic freedom, heavy quarkonium, lattice QCD (https://canvas.uw.edu/calendar?event_id=1073923&amp;include_contexts=course_1126325)</a>	12:30pm to 1:20pm
Fri Feb 9, 2018	 <a href="https://canvas.uw.edu/calendar?event_id=1073965&amp;include_contexts=course_1126325">Lecture: continuation using this week's notes (https://canvas.uw.edu/calendar?event_id=1073965&amp;include_contexts=course_1126325)</a>	12:30pm to 1:20pm
	 <a href="https://canvas.uw.edu/courses/1126325/assignments/3943434">HW5 (https://canvas.uw.edu/courses/1126325/assignments/3943434)</a>	due by 1:20pm
Mon Feb 12, 2018	 <a href="https://canvas.uw.edu/calendar?event_id=1073914&amp;include_contexts=course_1126325">Lecture: Introduction to weak interactions; pion and muon decays (https://canvas.uw.edu/calendar?event_id=1073914&amp;include_contexts=course_1126325)</a>	12:30pm to 1:20pm
Wed Feb 14, 2018	 <a href="https://canvas.uw.edu/calendar?event_id=1073922&amp;include_contexts=course_1126325">Lecture: Finish pion decays; lepton universality; basic neutrino properties (https://canvas.uw.edu/calendar?event_id=1073922&amp;include_contexts=course_1126325)</a>	12:30pm to 1:20pm
Fri Feb 16, 2018	 <a href="https://canvas.uw.edu/calendar?event_id=1073966&amp;include_contexts=course_1126325">Lecture: continuation using this week's notes (https://canvas.uw.edu/calendar?event_id=1073966&amp;include_contexts=course_1126325)</a>	12:30pm to 1:20pm
Wed Feb 21, 2018	 <a href="https://canvas.uw.edu/calendar?event_id=1073928&amp;include_contexts=course_1126325">Lecture: complete neutrino oscillations and masses (https://canvas.uw.edu/calendar?event_id=1073928&amp;include_contexts=course_1126325)</a>	12:30pm to 1:20pm
	 <a href="https://canvas.uw.edu/courses/1126325/assignments/3943435">HW6 (https://canvas.uw.edu/courses/1126325/assignments/3943435)</a>	due by 1:20pm
Fri Feb 23, 2018	 <a href="https://canvas.uw.edu/calendar?event_id=1073921&amp;include_contexts=course_1126325">Lecture: weak interactions of quarks---CKM matrix and CP violation (https://canvas.uw.edu/calendar?event_id=1073921&amp;include_contexts=course_1126325)</a>	12:30pm to 1:20pm
Mon Feb 26, 2018	 <a href="https://canvas.uw.edu/calendar?event_id=1073913&amp;include_contexts=course_1126325">Lecture: Electroweak unification (I): W boson decay, need for Z, SU(2) gauge theory (https://canvas.uw.edu/calendar?event_id=1073913&amp;include_contexts=course_1126325)</a>	12:30pm to 1:20pm
Wed Feb 28, 2018	 <a href="https://canvas.uw.edu/calendar?event_id=1073920&amp;include_contexts=course_1126325">Lecture: electroweak unification (II): B boson, mixing to produce Z and photon, Z properties (https://canvas.uw.edu/calendar?event_id=1073920&amp;include_contexts=course_1126325)</a>	12:30pm to 1:20pm
Fri Mar 2, 2018	 <a href="https://canvas.uw.edu/calendar?event_id=1073967&amp;include_contexts=course_1126325">Lecture: continuation using this week's notes (https://canvas.uw.edu/calendar?event_id=1073967&amp;include_contexts=course_1126325)</a>	12:30pm to 1:20pm
	 <a href="https://canvas.uw.edu/courses/1126325/assignments/3943436">HW7 (https://canvas.uw.edu/courses/1126325/assignments/3943436)</a>	due by 11:59pm
Mon Mar 5, 2018	 <a href="https://canvas.uw.edu/calendar?event_id=1073927&amp;include_contexts=course_1126325">Lecture: electroweak symmetry-breaking and the Higgs (part 1) (https://canvas.uw.edu/calendar?event_id=1073927&amp;include_contexts=course_1126325)</a>	12:30pm to 1:20pm

Date	Details	
Wed Mar 7, 2018	 <a href="https://canvas.uw.edu/calendar?event_id=1073919&amp;include_contexts=course_1126325">Lecture: Higgs mechanism, Yukawa couplings an Higgs decays (https://canvas.uw.edu/calendar?event_id=1073919&amp;include_contexts=course_1126325)</a>	12:30pm to 1:20pm
Fri Mar 9, 2018	 <a href="https://canvas.uw.edu/calendar?event_id=1073968&amp;include_contexts=course_1126325">Lecture: continuation using this week's notes (https://canvas.uw.edu/calendar?event_id=1073968&amp;include_contexts=course_1126325)</a>	12:30pm to 1:20pm
	 <a href="https://canvas.uw.edu/courses/1126325/assignments/3943437">HW8: ( I'm happy to give you more time if you'd like---just ask) (https://canvas.uw.edu/courses/1126325/assignments/3943437)</a>	due by 1:20pm
Fri Mar 16, 2018	 <a href="https://canvas.uw.edu/courses/1126325/assignments/3943429">Course grade (https://canvas.uw.edu/courses/1126325/assignments/3943429)</a>	due by 11:59pm