Realism in Practice: Implementation, Critique, and Scaling of Research Group-Based Taught Master's Learning

IOP Higher Education Group Community Meeting, 15 May 2019

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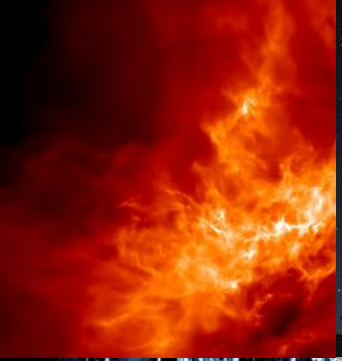
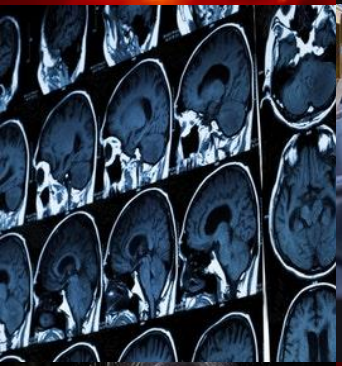
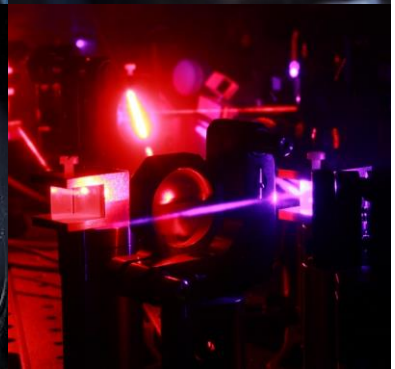
Cardiff University School of Physics and Astronomy (PHYSX)





Summary of MSc activity at Cardiff PHYSX

Programmes

- MSc Physics
- MSc Data-Intensive Physics
- MSc Compound Semiconductor Physics
- MSc Astrophysics
- MSc Data-Intensive Astrophysics
- MSc Gravitational Wave Physics (from 2019/20)

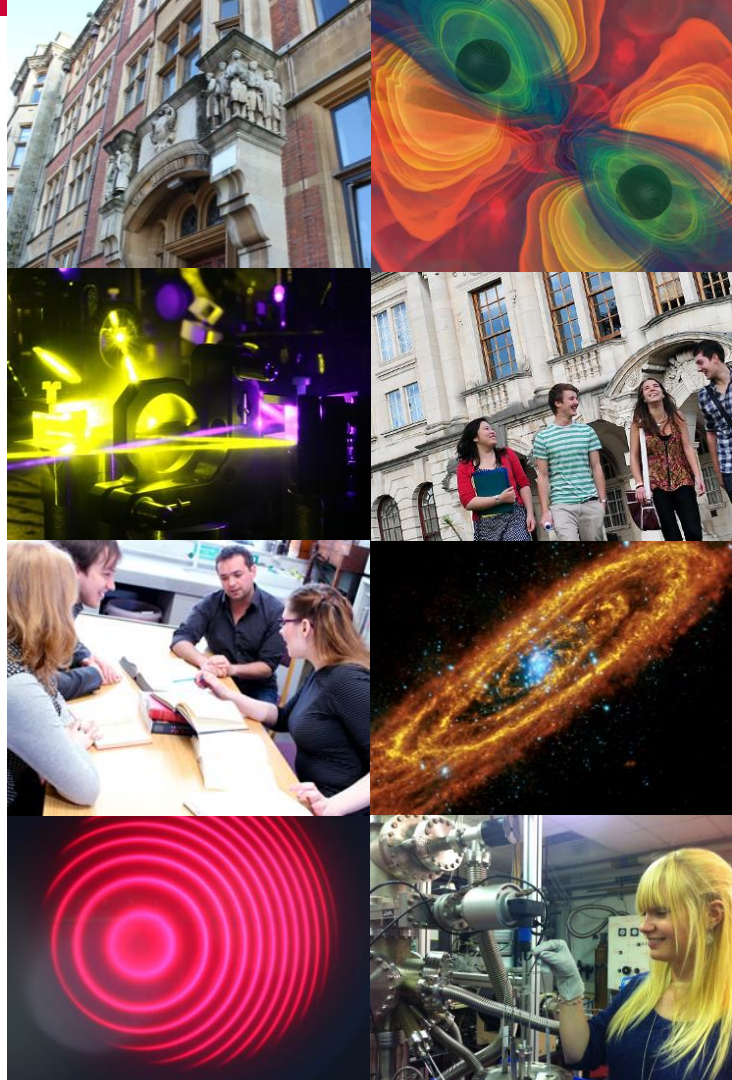
Cohort of 2018/19

- **24 students** (11 Physicists, 13 Astrophysicists)
- 2:1 minimum entrance requirement
- Dedicated co-located MSc teaching facilities
- 180cr full-time only
- 2x 20cr core modules, 80cr electives, 60cr project

Timeline of MSc activity at PHYSX

AY	MScs	Students	Notes
2012/13	1	2	Biophotonics only (since 2005/6)
2013/14	1	2	
2014/15	1	7	
2015/16	3	14	Physics, Astrophysics
2016/17	2	22	Biophotonics withdrawn
2017/18	5	21	DI Physics, DI Astro, CS Physics
2018/19	5	24	
2019/20	6	35 (est.)	GW Physics, CS CDT
2020/21	6	40 (est.)	
2021/22	7	50 (est.)	Brain Imaging

Long-term target: **50 students**
Current teaching model optimised for: **25 to 30 students**



Research group-style teaching and learning

Environment: dedicated teaching facilities

- Student ownership of space, 24/7 access
- Co-location with MSc coordinators
- Blurring of instructor / student distinction

Ethos: research group structure and accountability

- Problem- and project-based learning in core modules
- Responsibilities delegated to students
- Peer-accountability, establish the MSc community

Development of practicing scientists: core modules

- Autumn: project-based learning, practical skills
- Spring: problem-based learning, research skills
- Summer: application to research project
- Formal reflections and planning twice a semester

Student performance summary (core module: autumn)

Autumn	Cohort mean				Cohort standard deviation			
	2015/16	2016/17	2017/18	2018/19	2015/16	2016/17	2017/18	2018/19
Questionnaires	80.7	80.9	80.2	94.7	7.2	11.8	9.5	9.1
Diaries	82.2	81.8	76.9	74.9	11.3	12.7	11.5	12.2
Exercises	73.7	66.5	76.1	78.0	9.2	11.8	4.9	17.1
Reports	68.0	65.3	68.8	56.6	7.6	13.7	13.8	13.0
Presentations	69.0	59.0	76.5	68.3	10.8	14.4	6.4	7.6
Overall	**73.4**	**69.7**	**73.8**	**70.8**	**7.3**	**11.4**	**8.4**	**7.3**

- Micro-projects introduced
- Cohort feedback for diaries after first submission
- Physics and Astrophysics cohorts merged
- Diaries marked in parts
- Mid-semester recess introduced

- PXT101/201 “Advanced Experimental Techniques in Physics” / “Techniques in Astrophysics”
- Project-based module, integral LabVIEW / NXG programming course
- 10% questionnaires, 20% diaries, 20% exercises, 40% final report, 10% final presentation
- Originally Physics and Astrophysics separate; merged in 2018/19

Student performance summary (core module: spring)

Spring	Cohort mean			
	2015/16	2016/17	2017/18	2018/19
Assignments	58.9	59.6	67.7	64.7
Project Proposal	71.6	60.7	65.0	66.1*
Presentation	71.6	62.5	72.1	66.6
Overall	**65.2**	**60.3**	**65.9**	**67.7***

Cohort standard deviation			
2015/16	2016/17	2017/18	2018/19
16.8	14.7	8.2	10.2
10.7	16.3	11.6	11.1
14.0	18.5	12.4	9.7
10.2	**11.8**	**9.6**	**5.5**

- Assignments reduced from 3 to 2 and increased in length
- Two fewer contact sessions
- Former MSc students no longer attended
- Proposal length increased from 8 to 15 pages
- Former MSc students used as demonstrators
- MSc students received additional training
- Mid-semester Q&A session introduced

- PXT102/202 “Research and Study Skills in Physics / Astrophysics”
- Problem-based module, half dedicated to project-specific training, generation of project proposal
- 50% assignments, 40% project proposal, 10% project proposal presentation
- Taught to the entire MSc cohort since its introduction

- Module form essentially optimised by 2017/18

Student performance summary (summer research projects)

Summer	Cohort mean			
	2015/16	**2016/17**	**2017/18**	**2018/19**
Supervisor grading	78.8	75.3	76.3	-
Dissertation	70.6	68.0	69.2	-
Presentation	65.9	72.1	71.0	-
Overall	**71.6**	**71.4**	**71.9**	**-**

Cohort standard deviation			
2015/16	**2016/17**	**2017/18**	**2018/19**
14.4	16.2	12.0	-
7.8	14.3	12.8	-
10.8	10.3	7.6	-
9.2	**10.0**	**8.3**	**-**

- Changed from long- to short-form dissertations
- Short form: 24 pages limit, "extended paper" format

Reweighting of module to:
70% dissertation
15% supervisor assessment
15% presentation

- Changed from double to single marking plus panel

Changed from 50 pages plus "traditional" format

- PXT999 "Research Project"
- 3 month research project, proposed in spring core module
- 30% supervisor grading, 40% dissertation, 30% final presentation (up to 2017/18)

- Transformative, positive effect on student stress levels by changing dissertation type for 2017/18

Critique of research group model: strengths

Strengths to retain

- Immediately builds and sustains an MSc community
- About as close to a real-life experience as possible
- Student ownership of learning on a challenging course
- Students involved in all aspects of core activity
- High student evaluations and excellent feedback
- Excellent student outcomes (classification and employability)

Student module evaluation scores

AY	Autumn	Spring
2015/16	94	85
2016/17	90	88
2017/18	94	91
2018/19	86	-

"My year at Cardiff was extremely rewarding. It was the first time I felt like a real astrophysicist, contributing towards my chosen field of star formation."

Outcomes	Cohort mean				Cohort standard deviation			
	2015/16	2016/17	2017/18	2018/19	2015/16	2016/17	2017/18	2018/19
Taught	72.6	64.7	68.6	-	6.1	9.0	7.4	-
Research	71.6	71.4	71.9	-	9.2	10.0	8.3	-
Overall	**72.3**	**67.0**	**69.7**	**-**	**6.7**	**8.5**	**7.3**	**-**

"The best thing about the MSc is the support offered that just isn't present at undergraduate. I came into the MSc as a student, and left it feeling more like a research scientist."

"The MSc course has provided me with essential skills which have proved extremely useful when moving into the business world."

Critique of research group model: issues and scaling

Issues to consider

- Risk of exclusive cliques as numbers scale above 30
- PGT and PGR communities do not overlap
- Most core activities require intrinsic motivation to work well
- Realism aspect can be difficult for students to adapt to
- Very time- , space and resource-intensive model

Scaling beyond 30 students (short-term)

- Autumn: larger micro-project groups, formalise accountability
- Spring: as for autumn, implement joint PGT-PGR activities
- Stronger and earlier alignment with research projects
- Standardise pairing of students for research projects

- Former MSc students as instructors, developed as (A)FHEA
- Basic logistical concerns: additional equipment, etc.

Summary and outlook

- Highly-effective research group-based teaching and learning model
- Optimised for up to 30 students, but target is 50 students

- Proactively implementing changes at both programme and core module level
- Confident a transition can be made in 2019/20 without sacrificing quality

- Questions / critique / suggestions welcomed! :)

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Case studies, presentations

Unifying MSc Physics and MSc Astrophysics problem-based learning with LabVIEW NXG: A critical review.

Transitioning MSc Physics Teaching to LabVIEW NXG 2.0: From Drills to DAQ-First (NI AUF 2018)

LabVIEW as a Common Language for Community and Skill Building (NI AUF 2016, NIWeek 2017)

MSc Physics Students Take Ownership of their Learning with LabVIEW (NI EIA 2016)

Bringing the Research Group Ethos into Taught Masters Learning (VICE/PHEC 2016)