

# Building a PSM: Nanoscience at ASU

*John Venables*

*Program Director, PSM in Nanoscience*

(480) 965-1675, [john.venables@asu.edu](mailto:john.venables@asu.edu)

*Report to*

**CGS Workshop: Building and Gaining  
Recognition for PSM Programs**

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# Building a PSM: Nanoscience at ASU

- [PSM choice, Science masters, WRGP](#)
- [Courses and Faculty](#)
- [Establishment of an Advisory Board](#)
- [Initial Marketing and Enrollment](#)
- [Development of a relevant Website](#)
- [The 4+1 model: BS-PSM](#)
- [Internships, Jobs, Employment](#)
- [Futures and Discussion](#)



*John Venables,  
CGS Workshop,  
Scottsdale, Dec 7, 2011*



# Skill set for PSM Students

- Ability to read and understand cutting edge science
- *Technical experience with the tools of modern science*
- Superior analytical skills
- *Ability to communicate well in writing & by spoken word*
- Ability to grasp and apply legal concepts, wrt patent law

*CGS, PSM Guide to establishing programs, 2011 p 17*

## Initial timeline: PSM in Nanoscience

- Dec 06, early 2007: suggestion of MPhys in Nanoscience
- *Feb 07, JV chairs task-force, proposes PSM model*
- Authorization, Implementation proposals through 2007
- *Dec 07: First report to faculty (next two slides)*

## What do we need to do collectively?

- Publicity, getting the word out: Contact colleagues, students, local/national industry
- *I will circulate you with a draft email and initial flyer. Please use widely, and copy me email addresses so that we do not duplicate*
- Talk to colleagues and contacts locally: Pub-power, University, City and State officials. Spread by word of mouth, use as ASU/ CLAS/ Physics & Chemistry booster

## Some web addresses for publicity

- Flyer description at <http://physics.asu.edu/> More details forthcoming once we have ABOR approval (Jan 08).  
Leaflet to be prepared for wider circulation
- *The Professional Science Masters home page at <http://www.sciencemasters.com/>* We are applying to be added to this national list
- The Western Interstate Commission on Higher Education (WICHE) at <http://www.wiche.edu/> We are applying to be listed in the Western Region Graduate Program (WRGP) at <http://wrgp.wiche.edu>
- Finally, let me and the Chair know about anything that you know and we may not know...

# 12 month degree structure with 24 month P/T option

<b>Semester</b>	<b>Core + Elective Courses and Credits</b>
<b>Fall Evening (16 weeks)</b>	NAN 571: Quantum Physics (3 hours), as PHY 571 previously (summer semester not practical)
<b>Fall (16 weeks)</b>	3 elective graduate courses (9 hours) NAN 591 Professional Seminar (2 hours)
<b>Spring (16 weeks)</b>	2 elective graduate courses (6 hours) NAN 593 Applied Project (3 hours) NAN 591 Professional Seminar (0-2 hours) NAN 505 Science & Society (2 hours, option)
<b>Final Summer (5 weeks)</b>	NAN 506 Innovation & IP (2 hours, option) NAN 593 Applied Project (3 hours) Capstone conference with project presentation

Credit pattern  $(3) + 11 + 11 + 5 = 30$  hours

<b>Core Courses</b>	<b>Credits, timing and description</b>
NAN 571 Quantum Physics	(3 hours, Fall Evening), as PHY 571 previously given in Spring <i>Venables, Matyushov</i>
NAN 591 Professional Seminar	(2 hours, Fall and Spring), Interactive, using <a href="#"><u>visiting speakers</u>**</a> , incorporating this <a href="#"><u>seminar series</u></a> : <i>Sankey, Venables + Mujica, Yu</i>
NAN 593 Applied Project	(3 hours, Spring and final Summer) in wide range of nanoscience topics: from <i>Spring 2009, Faculty &amp; Projects on Nanoscience Web page</i>
NAN 505 & 506 <b>PSM 'Plus' Courses</b> (Science & Society issues)	(2 hours each, options) <i>Spring-Summer 2010</i> NAN 505: Nanoscience & Society <i>Ira Bennett</i> 506: Innovation & IP... <i>Ken Polasko (AzTE), Menkus, Lefere (TVSG, School of Law)</i>

**\*\*Fall 09, Spring, Fall '10, Spring 11: personal, Board involved**

# PSM Applied Projects (2009-11)

- 12 student projects 2009-10, 8 Spring-Fall 2011, wide spread see <http://nanoscience.asu.edu/projects>
- *Physics: Bennett, Marzke, Nemanich (2+1), Smith/McCartney, Tsen, Chen*
- *Biodesign Institute Lindsay, He, Meldrum, Hecht*
- *Chemistry: Gust(2), Levitus, Mujica, Ros, Seo, Williams*
- *Engineering: Goryll, Phelan (2), Tao, Yu*
- *Other/off Campus: Weissig, Polasko, Sukharev*
- Currently fixing projects for Spring-Summer 12: *students think/ explore topic/advisors Fall 2011, 8 new projects needed, almost complete as of now*



# Program of Study: Elective courses

- Web listings at <http://nanoscience.asu.edu/> *Three main broad options:*
  - 1) Nanomaterials and Nanoelectronics
  - 2) Biophysics and Bio-Nanotechnology
  - 3) Biophysics, Biochemistry and Sensors
- *Many Faculty involved in giving these courses to PhD, MS (Thesis) and PSM students across at least four Departmental Groupings: Physics (PHY), Chemistry & Biochemistry (CHM), Materials (MSE), Electrical & Electronic Engineering (EEE)*
- *Cross listing of Courses with Nanoscience (NAN) to give access to all such students and departments: Examples for Spring '11:*
  - PHY/NAN 512/MSE 527: Materials Physics II *Fernando Ponce*
  - NAN/PHY/CHM 544: Intro to Nanoscience *Stuart Lindsay*
  - EEE/NAN 598: Molecular Electronics *Nongjian Tao*

# PSM Advisory Board at April 2011

Third Annual meeting: Seminar, Dr John Wager  
*Engineering, Oregon State University, Corvallis, OR*

## **Solution-processed Inorganic Thin Films for Flexible and Printed Electronics**

*Hosted by Dr Stephen Goodnick (EECE)*

### External Board members (all PhD):

- Regan Stinnett (*Sandia, Albuquerque*), Board Chair
  - Travis Johnson (*Agilent, Chandler*)
  - Vladimir Noveski (*Intel, Chandler*)
    - Ken Polasko (*AzTE, SkySong*)
    - Nicholas Rizzo (*Everspin, Tempe*)
- Paul Weiss (*Director CNSI, UCLA, Los Angeles*)

# ASU personnel in attendance

## Collaboration: Physics, Chemistry and others

- Dr Robert Nemanich (*Chair, Physics Dept*)
- Dr William Petuskey (*Chair, Chemistry & Biochemistry*)
- Dr John Venables (*Program Director, PSM in Nanoscience*)
- Drs Vladimiro Mujica (*Chemistry liaison, PSM Associate Director*),
- Dr Hongbin Yu (*Electrical & Electronic Engineering, EEE liaison*)
- Dr Ralph Chamberlin (*Physics, Graduate Chair*)
- Dr Terry Alford (*Materials Science & Engineering, Graduate Chair*)

## and also by invitation

- Dr Clark Miller (*CNS-CSPO, Program Director PSM in Science Policy*)
- Dr Patrick Phelan (*EMTE, SoS, Program Director, PSM in Solar Energy*)
- Dr Stephen Goodnick (*EECE, Seminar Host*) + Dr John Wager (*Speaker*)

## Program Coordinator

- Ms Araceli Vizcarra (*Graduate Coordinator, Physics & Nanoscience*)

# PSM Nano: current state of play

- **May 2010: 16 students** on course: Andrew Walker graduated
- **Summer-Fall 2010: 8** more students graduated, total **9 alumni and 1 Withdrew, 1 academic W; 5 students** still on course
- **Fall 2010–Spring 2011: 6 more students** enrolled, i.e. **11** on course: provisions satisfied in one case, one other in progress
- **Spring '11: 135 enquiries** (total to date); **38** since June 2010, of which 2 current students, **4 acceptances** for **Fall 2011** so far
- Several more applications pending, including **3 likely** from ASU Physics Seniors and Juniors on Integrated BS-PSM. Note we are enrolling continuously; **Can always use more publicity!**
- **Broad subject base:** Current Alumni/ Students: 4 physics/materials, 6 chemistry/biochem, 2 nanotech MS, 8 EEE/IT

# PSM Nano: Admissions Statistics

Date of Initial Inquiry	Initial Inquiries	Formal Applications	Went Dead	Formal Reject	Acceptances	Declines
2007 (Dec)	1	1			1	
2008 (June)	3	2	1	1	1	
2008 (Dec)	18	7	11	2	4	1
2009 (June)	35	13	22	1	10	2
2009 (Dec)	18	2	16		1	1
2010 (June)	22	11	11	2	5	3
2010 (Dec)	22	7	13	1	4	2
Totals	119	43	74	7	26	9
2011 (June)	37	10	N/A	2	6	1

Dec 2010: 119 inquiries ~1/3 apply, ~2/3 of these are accepted, ~1/6 rejected or decline, rest go dead (50%)

## A new Web-site for publicity

- **Publicity, publicity, publicity, we need publicity.** So we decided (Drs Mujica, Nemanich: important contributions) on a new web-site at <http://nanoscience.asu.edu/> for all our needs. Links and FAQ's for current students, Alumni, Courses, Faculty, Admissions, Seminars, Departments. Email: [nanoscience@asu.edu](mailto:nanoscience@asu.edu) for applications
- **Please distribute Postcards**, we have 1000 to find homes for...
- University presence is emerging at <http://psm.asu.edu/> and an Arizona-wide PSM page at <http://arizonapsm.wordpress.com/>
- *The PSM home page* <http://www.sciencemasters.com/> We are members of this national organization, also NPSMA <http://www.npsma.org/> and the Western Region Graduate Program (WRGP/WICHE) at <http://www.wiche.edu/wrgp>

# PSM program funding

- Arizona and National funding to explore: needs effort
- ASU liaison: Andrew Webber (Graduate College), Pat Phelan (Eng & SoS: Solar Engineering); Clark Miller, David Guston, Ira Bennett (CNS-CSPO, Science Policy)
- Stimulus package (ARRA): \$15 Million NSF awarded; ASU's Solar Engineering program is funded as is NAU's Climate Change program: *short duration and then what?*
- AZ coordination of PSM programs, meeting Dec 2010 (Dr Mujica). *Governor's P-20 Council, SFAz, AZ Tech Council*
- *Meanwhile back at the Ranch: Students pay full fees. Our PSM brought in ~\$250k in Tuition 2009-10 : Where is it?*
- Program Fees probably available 2011-12, will know soon; *may get caught up in Tuition hike: ABOR this week*

*Please visit*

<http://nanoscience.asu.edu>

- Links and FAQ's for [Current students](#), [Alumni](#), [Course Offerings](#), [Faculty-Staff](#), [Future Students/Admissions](#), [Seminars](#), [Advisory Bd.](#)
- Email: [nanoscience@asu.edu](mailto:nanoscience@asu.edu) for initial applications. Coordinator and/or Director respond directly to Inquiries using their own email.
- Interdisciplinary course, so the new website is NOT underneath a particular Department. Departments are referred to as [Partnerships](#), under the home page tab. This widens the appeal (beyond Physics) especially as Physics is considered hard, and applicants have a range of Math, Physics and Chemistry background knowledge
- University presence is emerging at <http://psm.asu.edu/> and an Arizona-wide PSM page at <http://arizonapsm.wordpress.com/>



# Recent and ongoing Issues

- **Online teaching**: *two courses with online options offered in Fall 2010: MSE 518 (Tasooji) and MSE 550 (Alford). There is a demand to move more to Online, but...*
- **Program Fees**: *Proposal for \$500/semester Full-time and \$250/semester Part-time submitted August 2010. This is now agreed for new students from Spring 2012*
- **Integrated 4+1 BS Physics-PSM in Nanoscience** *submitted fast track January 2011, and is already in place Fall 2011; we have 2 students on course in final (4<sup>th</sup>) Undergrad year*
- **Integrated 4+1 BS-PSM in Nanoscience with Materials (MSE), Chemistry (CHM) & Biochemistry (BCH)** *in pipeline now, introduce in Spring 2012 for entry Fall 2012*

# 4+1 BSM-PSM details

- ***Integrated 4+1 BS Physics-PSM in Nanoscience*** in place Fall 2011; 2 students in final (4<sup>th</sup>) Undergrad year
- ***Choice of up to 3 courses (up to 9 credits) in common 4<sup>th</sup> and 5<sup>th</sup> years. Students save about 1 semester of FT work***
- ***Courses specified at 500-level or joint 400/500 level***  
*PHY/NAN 544: Introduction to Nanoscience, PHY/NAN 511+512: Materials Physics I & II; flexibility in practice?*
- ***Integrated 4+1 BS-PSM in Nanoscience with Materials (MSE), Chemistry (CHM) & Biochemistry (BCH) in pipeline now, introduce in Spring 2012 for entry Fall 2012***
- ***Specifying Courses now: differences between Colleges inevitable, something has to give: Engineering, Liberal Arts***

# Internships, jobs and OPT: state of play Fall 2010

<b>Student</b>	<b>Entry and FT/PT</b>	<b>Committee Members First destination job</b>	<b>NAN 505?</b>	<b>Graduation date/ NAN 506</b>
#1, Az Resident Male	<b>F 2008 PT</b>	Venables (Chair) Matyushov, <b>Oldjob on graduation</b>	Spring 09	Spring 2010
#2, International Male	<b>Transfer from Physics PhD FT</b>	Smith (Chair, advisor) McCartney, Venables <b>OPT on graduation</b>	Spring 10	Summer 2010 <b>NAN 506 (Electron Materials)</b>
#3, Az Resident Female	<b>F 2009 FT</b>	Sankey (Chair), Goryll (advisor), R. Ros <b>Newjob on graduation</b>		Summer 2010 <b>NAN 506 (Biosensors)</b>
#4, Domestic, Wiche, Male	<b>F 2009 FT</b>	Seo (Chair, advisor) Kouvetakis, Matyushov <b>PhD student at ASU</b>		Summer 2010 <b>NAN 506 (Materials Chemistry)</b>

*Not all students will want internships:*

- 1) those with previous or current work experience
- 2) Full-time students who try to finish in one year

## Internships, jobs continued at Fall 2010

<b>Student</b>	<b>Entry and FT/PT</b>	<b>Project Advisor First destination job</b>	<b>NAN 505?</b>	<b>Graduation date/ NAN 506</b>
#5, Non-resident, Male	<b>F 2009, FT</b>	Marzke (advisor) <b>Internship (AzTE)</b>	Spring '10	Fall 2010; <b>NAN 506 (AzTE, Physics)</b>
#6, International, Female	<b>F 2009, FT</b>	Nemanich (advisor) <b>Internship (Intel)</b>	Spring '10	Fall 2010 No NAN 506
#7, International, Female	<b>F 2009, FT</b>	Bennett (advisor) <b>US Job on graduation</b>	Spring '10	Fall 2010; no NAN 506
#8, International, Male	<b>F 2009, FT</b>	Lindsay (advisor) <b>US Job in 2011</b>	Spring '10	Fall 2010; <b>NAN 506 (Materials Physics)</b>
#9, International, Female	<b>F 2009, FT</b>	He (advisor) <b>Maternity plus move</b>	Spring '10	Fall 2010; no NAN 506

*Several students very much want internships:*

- 1) Those in need of work experience, including OPT/ CPT
- 2) Full-time students who can prolong degree to 16 months
- 3) Students who need money: TA/ RA not generally given

# Internships, jobs at Fall 2011

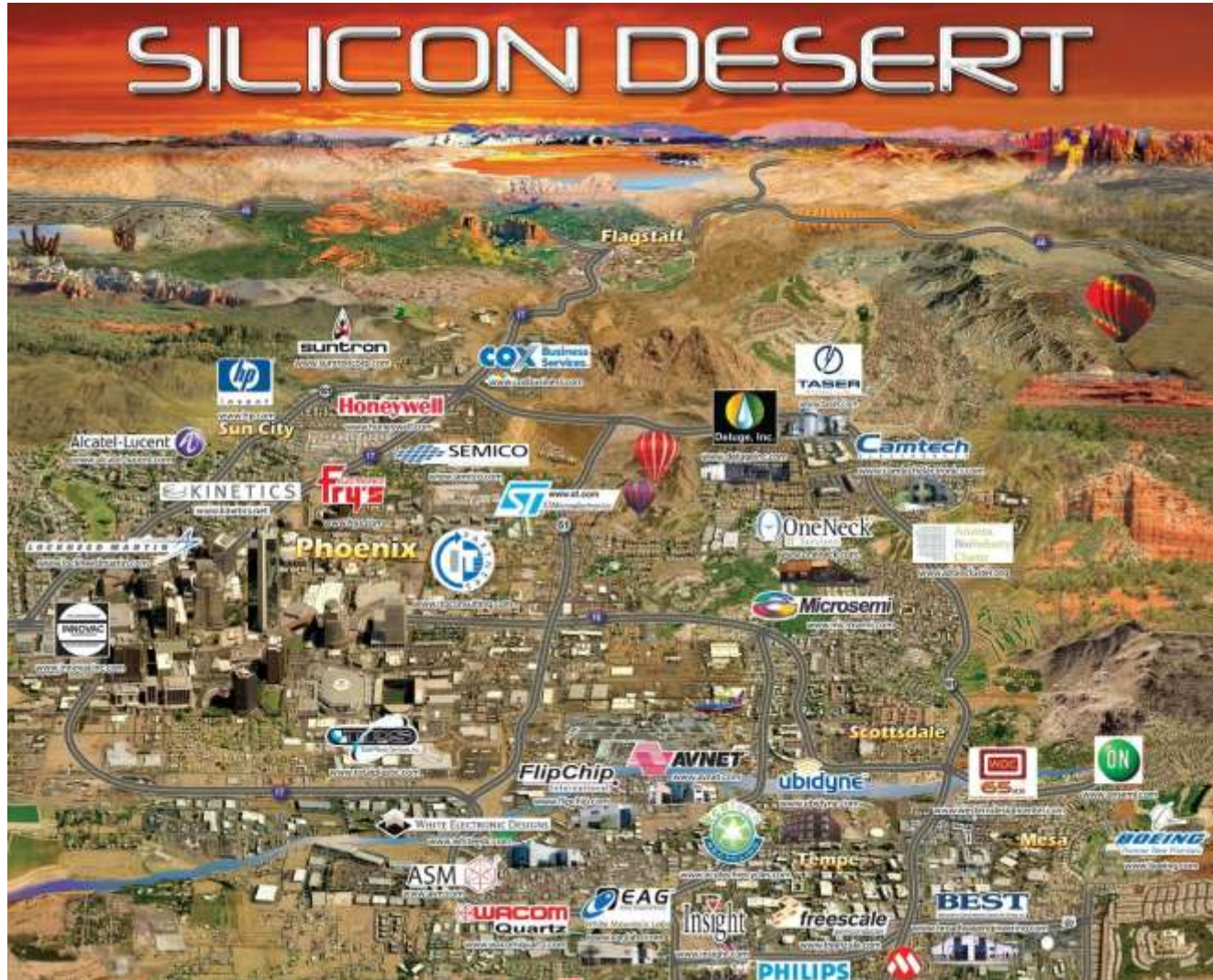
<b>Student</b>	<b>Entry and PT/FT</b>	<b>Advisor First destination job</b>	<b>NAN 505?</b>	<b>Graduation date/ NAN 506?</b>
#10, Az-Resident, Male	<b>S2010 FT</b>	Gust (advisor) <b>Job on graduation</b>		Spring 2011 <b>NAN 506</b>
#11, Non-resident, Male	<b>F 2010 FT</b>	Polasko (advisor) <b>Job on graduation</b>	Spring '11	Summer 2011 <b>NAN 506 (A)</b>
#12, Domestic Wiche, Male	<b>F 2010 FT</b>	Phelan (advisor) <b>Job on graduation</b>	Spring '11	Summer 2011 <b>NAN 506</b>
#13, Az-Resident Male	<b>F 2009 PT</b>	Phelan (advisor) <b>Oldjob on graduation</b>		Summer 2011 <b>NAN 506</b>
#14, Az-Resident Male	<b>F 2010 FT</b>	Nemanich (advisor) <b>Job obtained in 2011</b>	Spring '11	Fall 2011; No NAN 506
#15, Az-Resident Male	<b>F 2010 FT</b>	Gust (advisor) <b>Job on graduation</b>	Spring '11	Fall 2011; no NAN 506

*All students want Jobs!*

1) **All six 2011 graduates have jobs**; 2) **None did Internships...**



# Employment opportunities for future PSM program graduates in Arizona



# Employment opportunities

1) Arizona Silicon Desert map from

[http://www.siliconmaps.com/silicon\\_desert.html](http://www.siliconmaps.com/silicon_desert.html)

*But questions: a) does it just cover large industries?*

*b) are we looking more to SME's and Startups?*

2) Good synergy with Industrial Affiliates Program

*Win-win strategy is possible, but requires time from someone*

3) How best to approach Local Industries

*Can it really be done at department/ program level?*

*How does one cope with rapid change of industry personnel?*

*Role of the Advisory Board: they are all working pro-bono...*

## Strategy for on-line teaching and/or use of other programs' on-line courses

- Opinion is divided on Online courses, but (at least for a proportion) that's the way its going...
- ***Many NAN courses have an Online component already:*** Blackboard shells, Online discussion groups, Digital drop boxes, Email to groups, etc
- NAN 505: Nanoscience & Society *Ira Bennett*  
*Discussion topics, Off campus tele-presence teaching*
- NAN 544: Introduction to Nanoscience *Lindsay*  
*Book now published, Large enrollment, Use of YouTube*
- NAN 571: Quantum Physics *Matyushov*  
*Online assignments with Mathematica, Digital submission*
- NAN 591: Professional Seminar *Mujica, Venables, Yu*  
*Discussion groups, Projects, Reprint sharing, Networking*



## Strategy for on-line teaching and/or use of other programs' on-line courses

- Part-time students in particular welcome Online, as a perceived way to get through more material or courses; Some out-of-state students would join if *all Online*
- Probably a way to cope with larger classes: student interaction encouraged, but of course there are pitfalls
- Other professions/ schools are way ahead of us: e.g. Nursing, Social Work, Engineering (*Online MSE*)  
Opportunity for sharing Online provision if subject material is compatible
- Current aim to get some of the most popular courses Online, but all Online is not an immediate aim.

# Conclusions and Futures

- Early Days, but PSM (locally and nationally) is at an exciting stage. At [ASU](#) and in [Arizona](#) programs are at various stages of development and external recognition
- *PSM in Nanoscience is currently our Flagship program (I am very proud to have developed it to this stage...)*
- Government funding is important (e.g. NSF stimulus to ASU and NAU), but not the only way
- *Build it, they will come? Is this sufficient?*
- *Word of mouth publicity is the best, but there are a lot of potential students to reach out there: Partnerships/Wiche*
- Social Media: [Facebook](#), [Twitter](#), no, but maybe [LinkedIn](#); Early stage of discussion, not everyone wants in, but we are consulting students/alums