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Ph.D., Astrophysics

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Profile

⊞ Scientist with 10+ years research experience in astrophysics on the faculty at a top-tier university actively seeking opportunities in *data science* to apply to real-world challenges my skills, talent and passion for data-driven quantitative analysis, modeling and interpretation.

⊞ Open-minded inquisitive problem-solver who dealt with broadly defined issues, analyzing, understanding, disaggregating them, identifying their core, and devising effective and practical approaches to solve them.

⊞ Defined and lead projects from raw data to results and communication. Able to keep the big picture perspective while zooming on the details, a strength nurtured by the experience leading and coordinating work with collaborators and students. Adept at interacting effectively with theorist, observers, and programmers.

⊞ Effective communicator, able to understand and engage with a wide variety of audiences, thanks to vast experience with collaborative work and delivering talks and lectures, from classrooms to international conferences.

Research Experience

▪ Made **influential** contributions to advancing the understanding of Active Galactic Nuclei (AGN), the most luminous objects in the universe, powered by gas accretion onto supermassive black holes at the center of galaxies.

  ▷ Worked on problems of different nature (e.g., time variability, population statistics, physics modeling), attacked with a multi-pronged approach encompassing observations (data analysis, data mining), theory, and simulations.

  ▷ Strived to create data-driven simulations, folding-in real-world effects to bring models close to the data.

▪ *Hands-on experience* on all aspects of a diverse *workflow* closely aligned with that of *data science*.

  ▷ Distill problems into good questions.   Frame and structure them into projects.

  ▷ Identify and collect the required data, from multiple sources.   Clean, integrate them.

  ▷ Multivariate data, often incomplete and biased, and requiring context-specific knowledge.

  ▷ Exploratory analysis, largely visualization-driven, interrogating the data about the story they are telling.

  ▷ Design and develop data analysis and modeling methods and codes.   Simulations of empirical and physical models.

  ▷ Interpretation, hypothesis-testing, predictions.

  ▷ Reporting, communication, dissemination (papers, reports, talks, proposals.)

▪ Top-level **astrophysics research** has many **parallels** with the best **data science**, for it requires (and develops):

  ▷ independence
  ▷ deductive reasoning (hypothesis-testing)
  ▷ adaptability

  ▷ curiosity and skepticism
  ▷ inductive reasoning (discovery)
  ▷ perseverance

  ▷ creativity / innovation
  ▷ *back-of-the-envelope* / heuristic reasoning
  ▷ will / ability to learn

and to exercise them in a quantitative scientific context, supported by strong computing, mathematics, statistics skills.

▪ My research followed two main themes, briefly summarized here highlighting some methods and major results:

  ▷ To identify and validate the fundamental laws underlying the phenomenology of AGNs.

    ∘ Populations studies: statistical analysis and modeling of multivariate properties of observed samples of objects, accompanied by population-synthesis simulations.

    ∘ **Discovered** global unifying property and formulated the *"power sequence"* hypothesis that transformed our understanding of these objects, laying the foundation of a new paradigm and leading subsequent major advancements.

  ▷ To understand the nature of cosmic jets, by characterizing their physical conditions and their variations.

    ∘ Multivariate variability studies of individual bright sources: multi-wavelength observations (time-series analysis) and simulations of time-dependent emission models.

    ∘ **First realistic simulations** of variable radiative emission from AGN jets, achieved by developing a state-of-the-art code combining Monte Carlo and Fokker-Planck methods.

▪ **Accomplishments / Impact**:

  ▷ Author of over 100 scientific **publications**, with 4,800+ **citations**, *h-index* of 29 [↬ **@myPapers**]

  ▷ Two papers among the most **highly cited** of the last 20 years in the field (top 10 of 5,200+) [↬ **@top10field**]

  ▷ Awarded more than 1 Million USD from highly competitive **NASA grants**.

  ▷ Research results included in undergraduate and graduate astronomy **textbooks**.

Related Professional Experience

Project management • Lead collaborative projects from inception to completion. Defined: scope, milestones, goals – Formulated suitable plan (data, modeling), within resource constraints – Executed/supervised/coordinated: analysis, interpretation, predictions, communication of results.

Scientific writing (and reviewing) • Grant proposals (*NASA*, *National Science Foundation*) – Telescope-time proposals (*NASA*, *ESA*) – Peer-reviewed articles in all major professional journals.

Presentations • Given talks at over 60 International Conferences and Universities.

Teaching • Taught for 10 years undergraduate and graduate courses at one of most selective US universities. Full responsibility for planning/preparing/delivering lectures, material, assessment.

Committees • Served on Department and University Committees, involved with faculty hiring, curriculum development, strategic planning and definition of policies and procedures.

Research mentoring • two Ph.D. students and several undergraduate students.

Technical Skills

Eclectic and flexible skill set, result of "organic growth" driven by need and curiosity (scientific and technical).
- Examples of *Data Science* work posted at ↪ `pedrosan.github.io`

Developed/worked with :
- Large simulation codes for empirical and physical models (also parallel) – Monte Carlo simulations
- Data analysis pipelines, from raw data to modeling
- Scripts – command line
- Applications for higher level analysis, statistical computing, and visualization (mostly with R)

Programming :
- Advanced : `R` – `perl` – `Fortran` – `awk` – `unix/linux shell scripting` – several astronomy packages.
- Worked w/: `python` – `C` – `MySQL` – `MatLab` – `IDL` – `Tcl` – `git`

Statistical / Machine Learning :
- regression: linear, non-linear, logistic – MARS – PCA – kNN – SVM – clustering – k-means – decision trees – random forest – some NLP work

Publishing :
- LaTeX – `knitr` – `Shiny` – `(R)markdown` – `HTML` – `CSS` – Open/LibreOffice – MS Office.

Employment

Rice University (Houston)	Research Scientist	2014 – 2015
Rice University (Houston)	Assistant Professor	2004 – 2014
European Southern Observatory (Chile)	Visiting Scientist	2009 (8–12)
Rice University (Houston)	Faculty Fellow	2001 – 2004
Univ. of California, San Diego	*CASS* Postdoctoral Fellow	1998 – 2001

Education and Training

Ph.D.	**Astrophysics**	International School for Advanced Studies (Trieste, Italy)	1998
Laurea (M.Sc.)	Physics	Università degli Studi di Milano (Milano, Italy)	1994

- Strengthened **data science skills** via *MOOCs* (66 weeks total):

  ▷ Coursera : *Johns Hopkins Bloomberg School of Public Health* – **Data Science Specialization**
  - The Data Scientist's Toolbox
  - R Programming
  - Getting and Cleaning Data
  - Data Science Capstone Project (NLP)
  - Exploratory Data Analysis
  - Reproducible Research
  - Statistical Inference
  - Regression Models
  - Practical Machine Learning
  - Developing Data Products

  ▷ Coursera : *Stanford*
  - Machine Learning

  ▷ edX : *CalTech*
  - Learning From Data

  ▷ edX : *MIT*
  - The Analytics Edge

Additional Personal Information

Citizenship • **USA** / Italy / Switzerland ☞ **Open to relocation**

Languages • English (fluent) / Italian (mother tongue) / Spanish (good verbal and reading, fair writing) / French (fair)