

The Emilio Segre Distinguished
Lectures in Physics of the Raymond
and Beverly Sackler Foundation

ההרצאות המיוחדות בפיזיקה
ע"ש אמיליו סגרה, מיסודה
של קרן ריימונד ובברלי סאקלר

Professor Yaron Oz, Co-ordinator

פרופ' ירון עוז, מתאם

TEL AVIV UNIVERSITY



אוניברסיטת תל-אביב

**The John Bahcall
Lecture in Astrophysics– 2013/2014**

**הרצאה באסטרופיזיקה
ע"ש ג'ון בקל – 2013/2014**

*Introductory Remarks: Prof. Dan Maoz
Astronomy & Astrophysics Department*

*דברי פתיחה : פרופ' דן מעוז
החוג לאסטרונומיה ולאסטרופיזיקה*

*Presentation:
The John Bahcall Fellowship to
Mr. Ofer Doron, undergraduate Physics student
The John Bahcall Astrophysics Prize to
Mr. Simchon Faigler, Ph.D student*

*הענקת המלגה ע"ש ג'ון בקל
למר עופר דורון, תלמיד לתואר ראשון
הענקת הפרס באסטרופיזיקה ע"ש ג'ון בקל
למר שמחון פייגלר תלמיד לתואר שלישי*

**Prof. Frank Shu
Department of Physics
National Tsing Hua University
Taiwan**

**פרופסור פרנק שו
המחלקה לפיזיקה
אוניברסיטת צינג הוואה
טייוואן**

"FIFTY YEARS OF SPIRAL DENSITY WAVE THEORY"

Abstract:

This year marks the fiftieth anniversary of the publication of the paper "On the Spiral Structure of Disk Galaxies" by C. C. Lin and Frank H. Shu. How well has it fulfilled its promise to explain the systematics of the Hubble sequence of spiral and barred spiral galaxies (which John Bahcall regarded as its most attractive theoretical feature)? In this talk, I review the linear and nonlinear theory of spiral density waves, starting from the hypothesis of quasi-stationary spiral structure (QSSS), its observational consequences and early tests, before moving to the theory of resonantly forced spiral density waves and its applications to structure formation in planetary rings, planet migration in protoplanetary disks, and bar forcing in the central regions of active galaxies with supermassive black holes. Adopting the QSSS hypothesis, we also study the development of parasitic, self-gravitating, magnetohydrodynamic instabilities that can develop secondary spiral-arm structures such as branches, spurs, and feathers. The last may revolutionize our conception of objects such as giant molecular clouds. I then discuss spontaneously growing normal modes based on the concepts of (1) spiral density waves with negative and positive densities of wave energy and angular momentum, (2) over-reflection at corotation by the mechanisms of wave-amplification by the stimulated emission of radiation (WASER) and Swing, and (3) feedback from the central regions. New semi-analytic results, numerical simulations, and observations in the near-infrared of grand-design and flocculent spiral galaxies, suggest that growing stellar density waves can saturate by nonlinear effects, thereby supplying the missing justification for the original QSSS hypothesis.

The lecture will take place on Sunday,
12 January 2014, at 16:10, in Melamed
Hall (No. 6), Shenkar Physics Building,
Tel Aviv University, Ramat Aviv.

ההרצאה תתקיים ביום ראשון, 12
בינואר 2014, בשעה 16:10, באולם
מלמד (מס' 6), בניין שנקר לפיזיקה,
אוניברסיטת תל אביב, רמת אביב.

Light refreshments will be served
at 15:45 before the lecture

כיבוד קל יוגש בשעה 15:45
לפני ההרצאה