

Spiral arms: trailing vs. leading



Spiral Galaxy NGC 7424
(VLT MELIPAL + VIMOS)

ESO PR Photo 33c/04 (1 December 2004)

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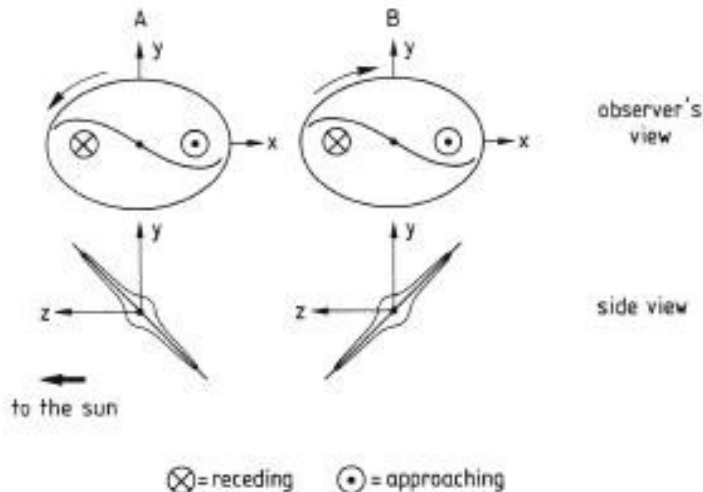


Figure 6-6. The appearance of leading and trailing arms. Galaxy A has leading arms, while galaxy B has trailing arms, but both exhibit the same pattern on the sky and the same radial velocity field.

(from Binney & Tremaine, GD)

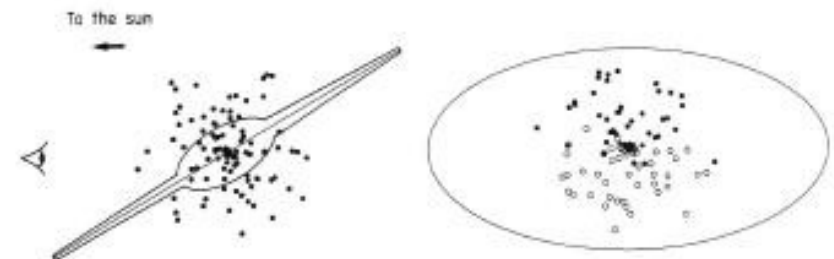


Figure 6-7. Distinguishing near and far sides of a disk galaxy. The dots represent objects such as novae or globular clusters. There is an obscuring dust layer in the central plane of the disk which is shown as a line in the side view at left. In the observer's view, at right, objects behind the dust layer are fainter and are shown as open circles.

Swing amplification (Toomre 1981)

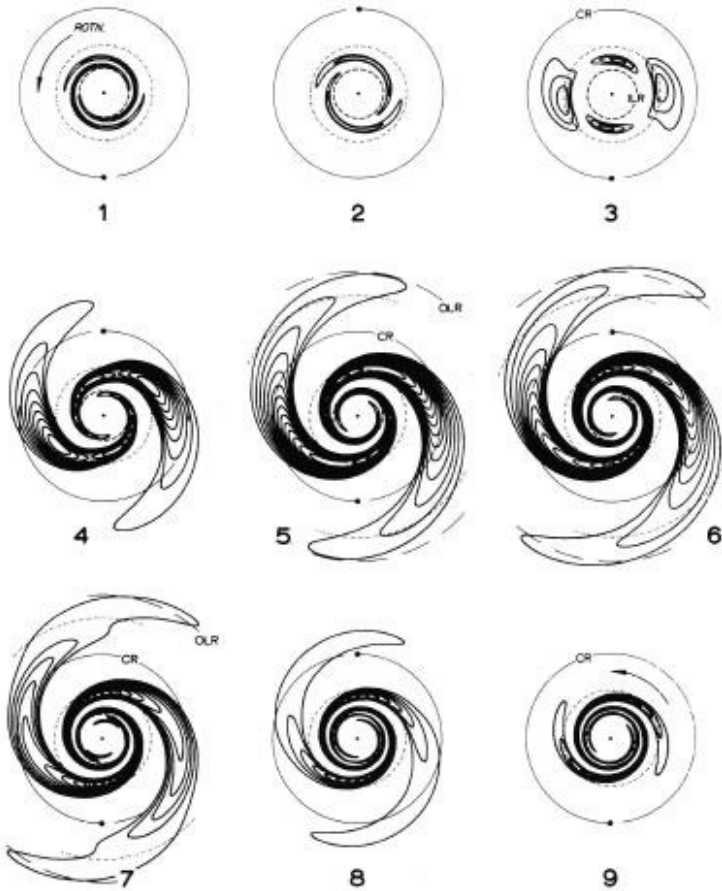
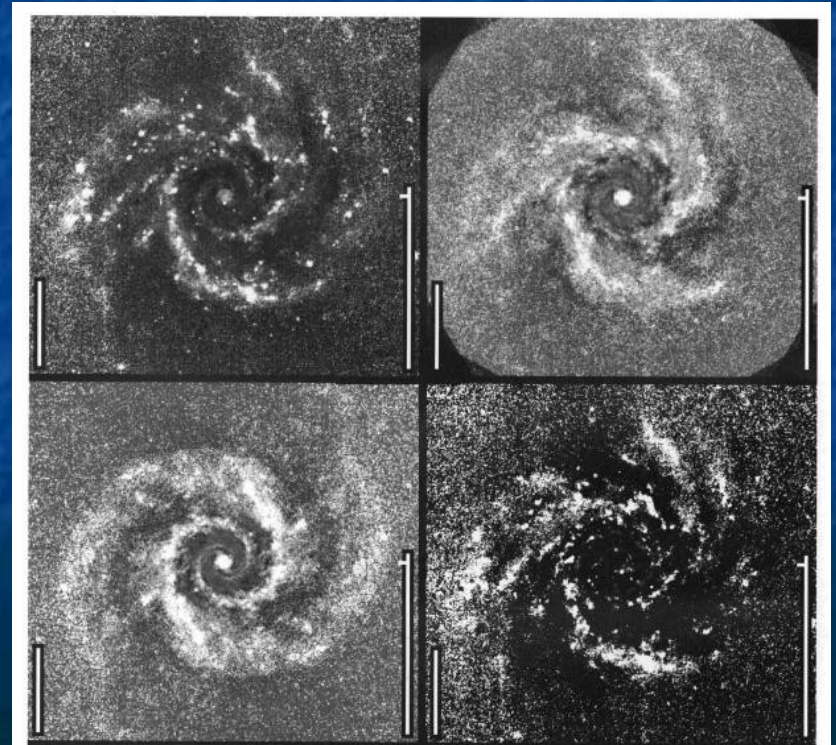
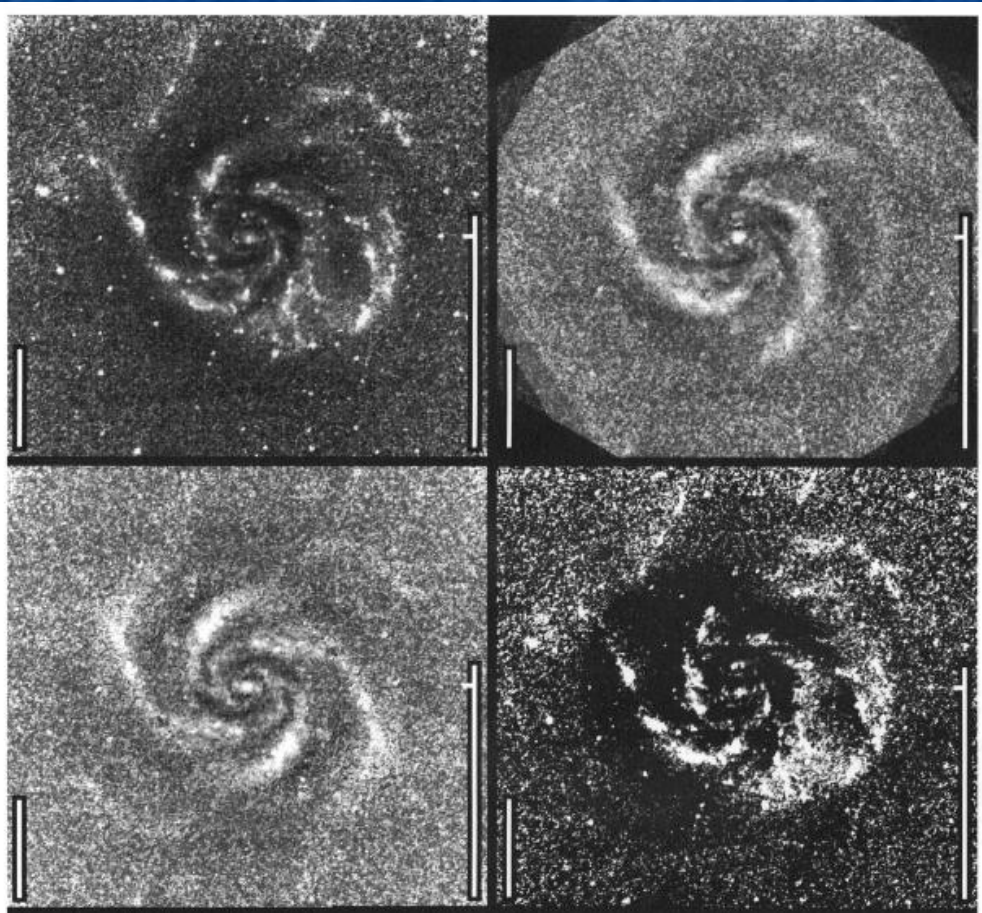


Figure 6-17. Evolution of a packet of leading waves in a stellar Mestel disk with $Q = 1.5$ and $f = 1$. Contours represent fixed fractional excess surface densities; since the calculations are based on linear perturbation theory, the amplitude normalization is arbitrary. Contours in regions of depleted surface density are not shown to minimize confusion. The time interval between diagrams is one-half of a rotation period at corotation. From Toomre (1981), by permission of Cambridge University Press.

(from Binney & Tremaine, GD)

Multiple spiral patterns (Elmegreen et al. 1992)



Grand-design spirals vs. flocculent (stochastic) spirals

M 81

SA(s)ab



NGC 2841

SA(r)b



Credit: M81:
NGC 2841:

Stefan Seip/Adam Block/NOAO/AURA/NSF, <http://www.noao.edu/outreach/aop/observers/m81.html>
Peter Kukol/Adam Block/NOAO/AURA/NSF, <http://www.noao.edu/outreach/aop/observers/n2841.html>

Kinematické hustotní vlny

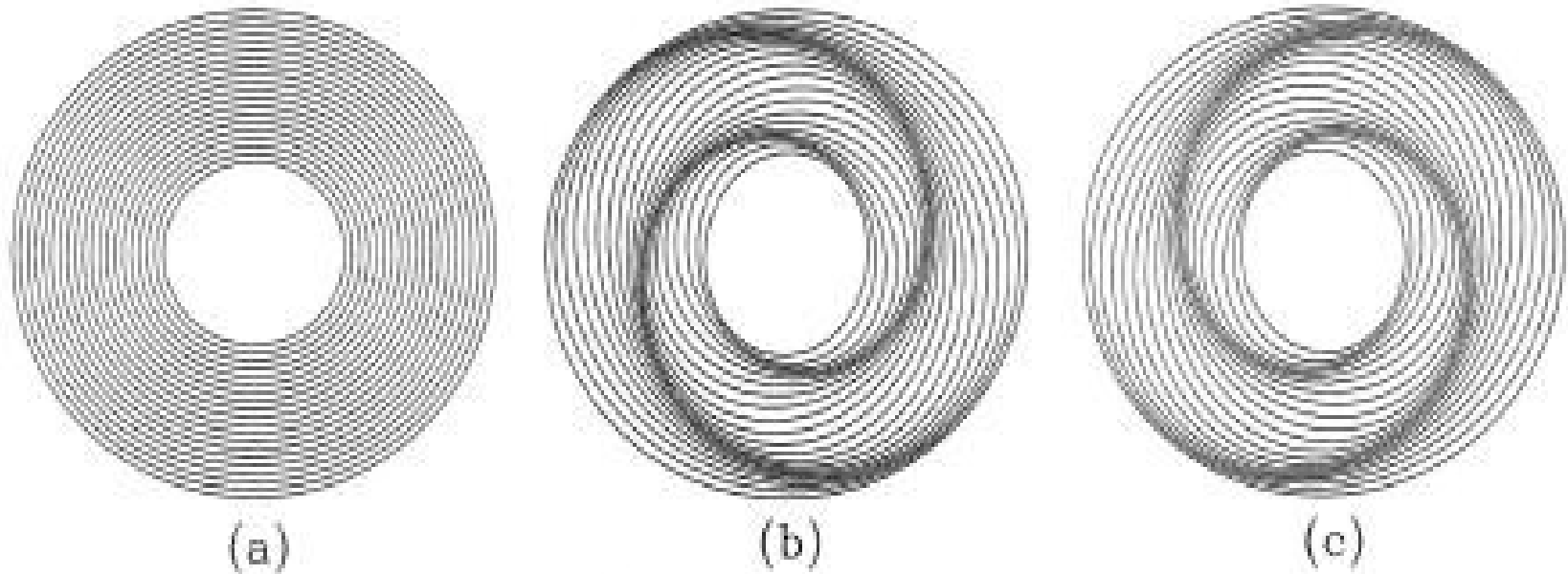
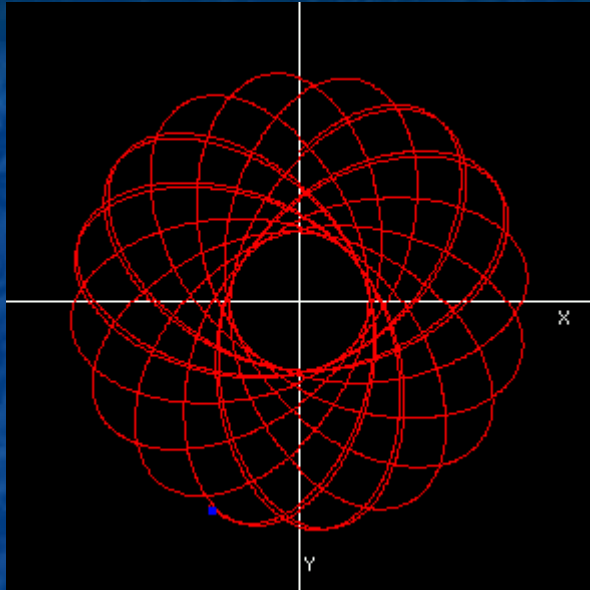
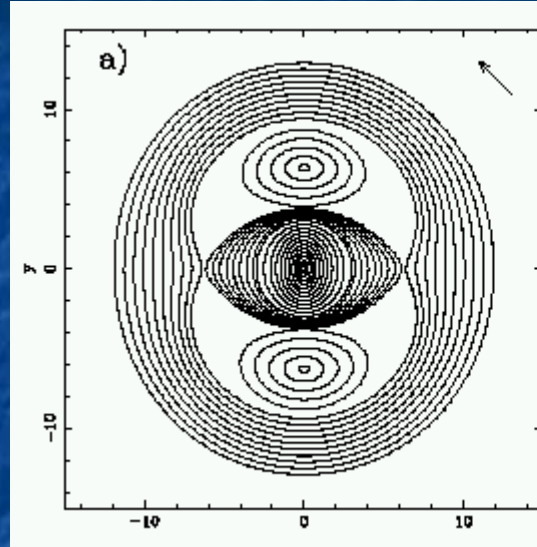


Figure 6-11. Arrangement of closed orbits in a galaxy with $\Omega - \frac{1}{2}\kappa$ independent of radius, to create bars and spiral patterns (after Kalnajs 1973).

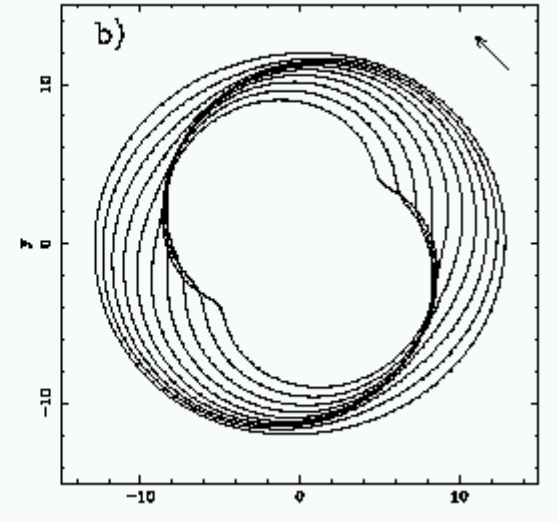
Dráhy plynu a hvězd v galaxiích bez příčky a s příčkou



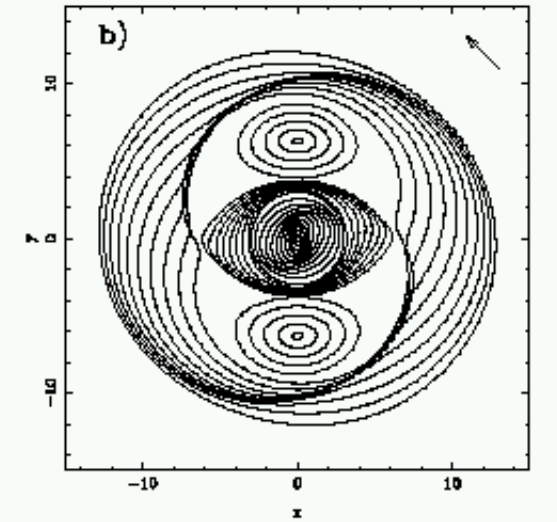
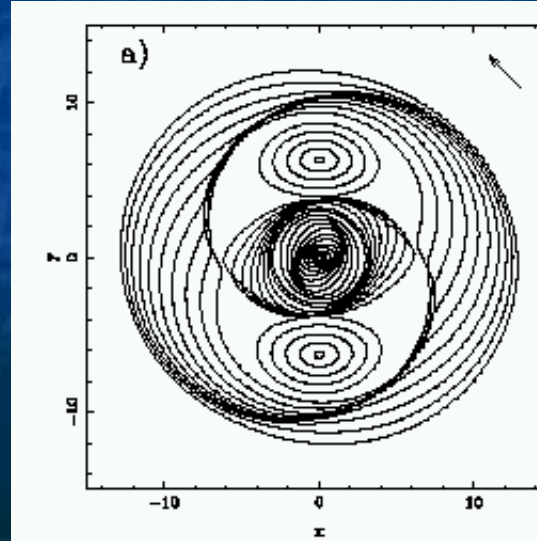
Hvězdy



Plyn



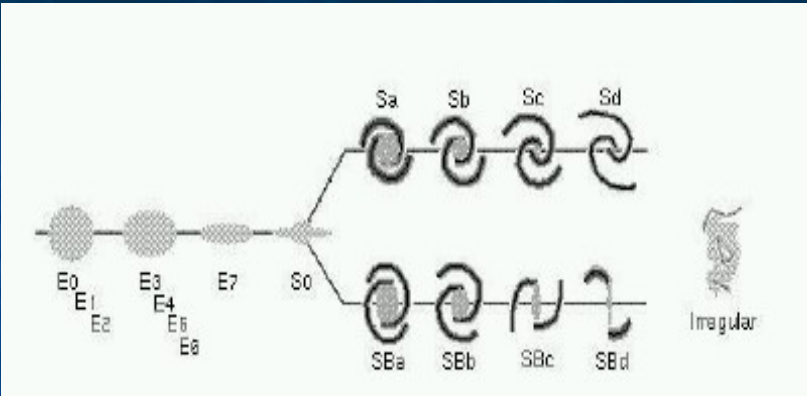
Plyn



(Combes 2003)

Bars in spiral galaxies – Příčky ve spirálních galaxiích

> 2/3 (and perhaps more than 80%) of disk galaxies are barred



“normal”
(unbarred)

barred



Spiral Galaxy Messier 83
(FORS / VLT)



Spiral Galaxy NGC 7424
(VLT MELIPAL + VIMOS)

ESO PR Photo 33c/04 (1 December 2004) © European Southern Observatory



Spiral Galaxy NGC 1097
(VLT MELIPAL + VIMOS)

Prstence

Rings in spiral galaxies (nuclear, inner, outer)

NGC 7020 (Buta & Combes 1996)



The Colossal Cosmic Eye NGC 1350
(FORIS/VLT)

ESO PR Photo 31a/05 (September 27, 2005)



Spiral Galaxy ESO 269-57
(VLT ANTU + FORIS)

ESO PR Photo 25c/99 (30 April 1999)



Příčková nestabilita (bar instability)

Hohl 1971, $N=100\ 000$

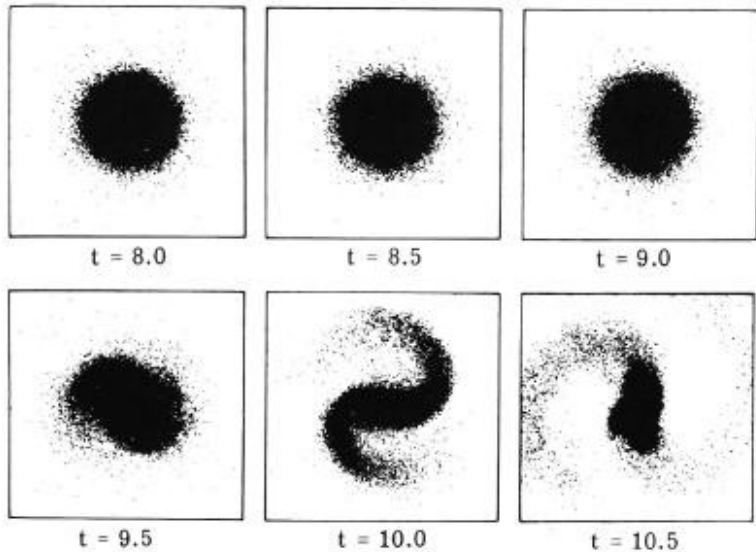


Figure 6-16. Evolution of the disk in Figure 6-15 without the constraint that the disk remain axisymmetric. The initial condition is the disk in Figure 6-15 at $t = 8.0$. Reprinted from Hohl (1971), by permission of *The Astrophysical Journal*.

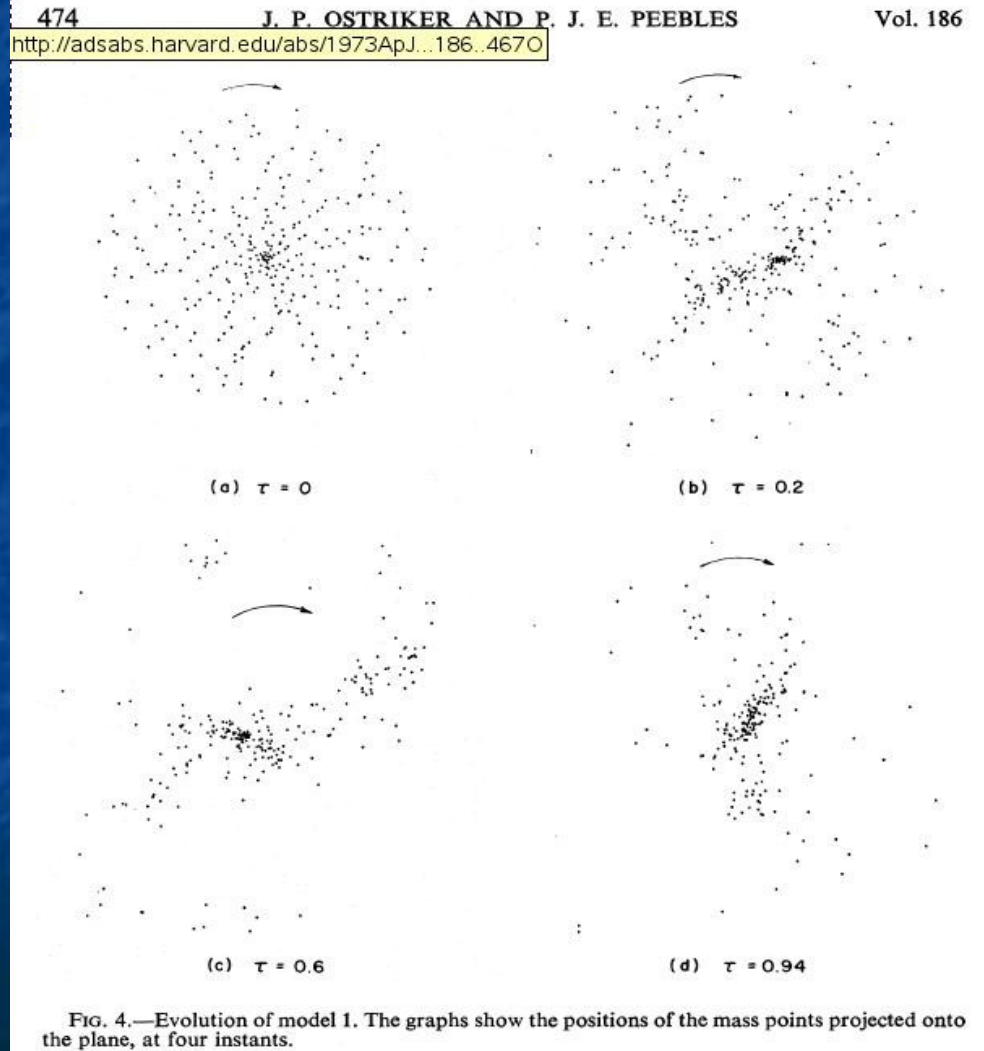


FIG. 4.—Evolution of model 1. The graphs show the positions of the mass points projected onto the plane, at four instants.

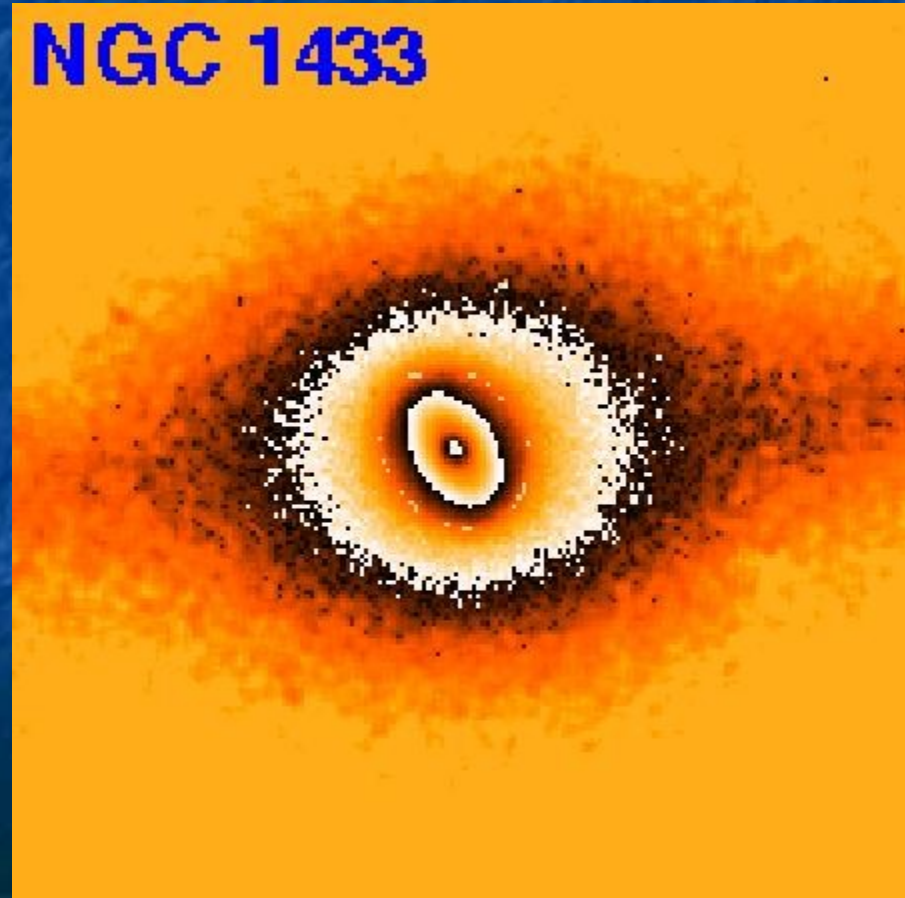
Dvojpríčky - Double bars (baby bars, bars-in-bars) Double bar in NGC 1433

(B band, Buta & Combes 1996)

(H band, JCA, 1997)



NGC 1433



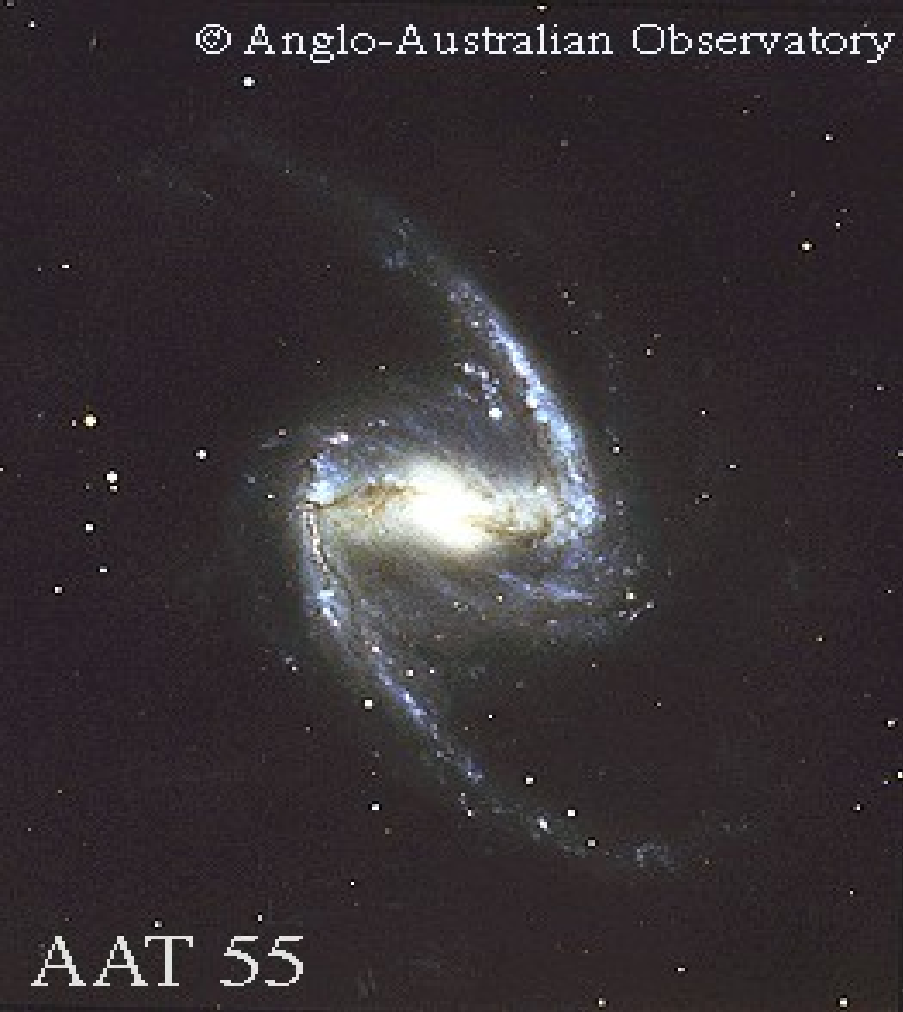
Nuclear ring in NGC 1097



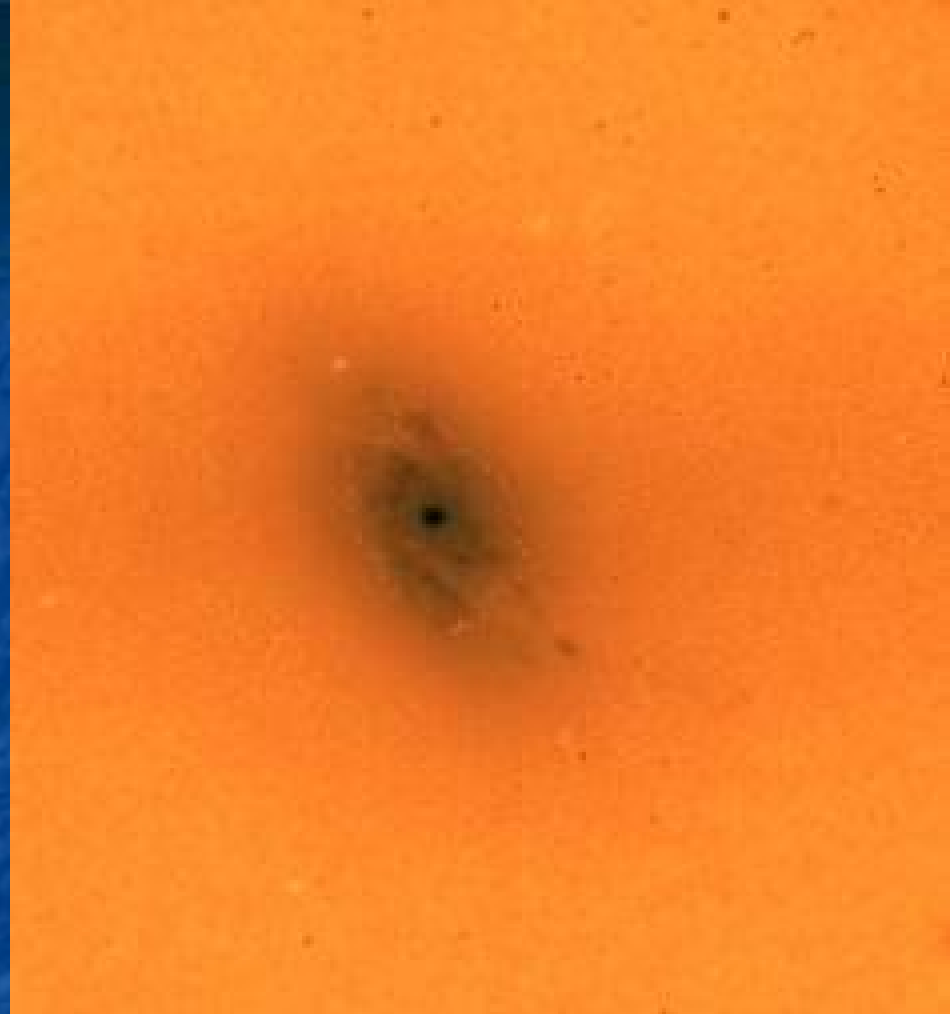
Spiral Galaxy NGC 1097
(VLT MELIPAL + VIMOS)



The Centre of the Active Galaxy NGC 1097
(NACO/VLT)



AAT 55



(JCA 1997)

Nuclear spiral in NGC 1365 (H-band)

Interakce galaxií



Cosmic Ballet or Devil's Mask? - Galaxy Triplet NGC 6769-71
(VLT MELIPAL + VIMOS)

ESO PR Photo 12/04 (28 April 2004)

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Giant Interacting Galaxies NGC 6872 / IC 4970
(VLT ANTU + FORS1)

ESO PR Photo 28/99 (30 April 1999)

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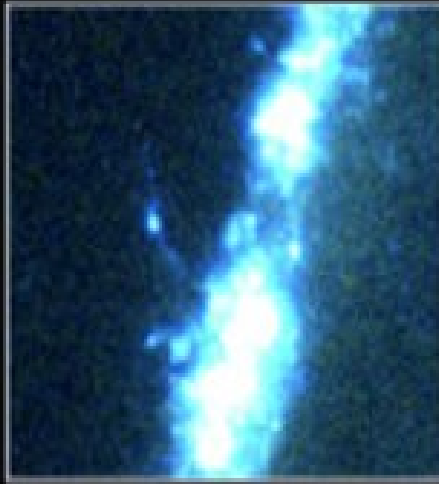


Galaxy Pair NGC 5090 + 5091
(VLT ANTU + FORS1)

ESO PR Photo 23/99 (30 April 1999)

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Cartwheel Galaxy

PR95-68 - ST Sc - CPO - January 1995 - K. Boros (ST Sc), NASA

HST · WFPC2

12/22/94 zgl

Polar-Ring
Galaxy
NGC 4650A



PRC99-12
Space Telescope
Science Institute
Hubble Heritage Team
(AURA/STScI/NASA)

Hubble
Heritage

Hoag's Object



Hubble
Heritage