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INDUCED STAR FORMATION IN THE SYSTEM ARP 298

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RESUMEN

El sistema Arp 298 está formado por el par espiral NGC 7469 e IC 5283. La primera es una bien conocida galaxia espiral de tipo temprano con núcleo Seyfert. Tiene un anillo circunnuclear con brotes de formación estelar y muestra signos de interacción con su compañera. IC 5283 es una espiral de tipo tardío con signos de formación estelar activa. Hemos obtenido una imagen CCD profunda en R, usando el Telescopio Optico Nórdico en condiciones de visibilidad extremadamente buenas, y también, imágenes V y R para construir un mapa del índice de color $V-R$ del sistema. En nuestra imagen $V-R$ confirmamos la existencia de una región interna en forma de anillo, con un radio de aproximadamente 1.2″, rodeando al núcleo de NGC 7469. También detectamos gas en emisión alrededor de este anillo. En IC 5283 encontramos una estructura nudosa de regiones de formación estelar distribuidas por todo el disco galáctico. Estos fenómenos pueden ser explicados en términos de perturbaciones externas, sin simetría axial, actuando sobre el potencial de cada espiral y produciendo diferentes tipos de actividad de acuerdo con el tipo morfológico de las galaxias.

ABSTRACT

The system Arp 298 consists of the spiral pair NGC 7469 and IC 5283. The first one is a well-known early-type spiral with a Seyfert 1 nucleus. It has a circumnuclear starburst ring and shows signs of interaction with its companion. IC 5283 is a late-type spiral with signs of star formation activity. We obtained a deep R band CCD-image of IC 5283 with the Nordic Optical Telescope under extremely good seeing conditions, and also V and R band images to construct a $V-R$ color index map of the system. In our $V-R$ image we confirm the existence of an inner ring-shaped region with a radius of about 1.2″ surrounding the nucleus of NGC 7469. We also detect emission clouds around this ring. A knotty structure of star-forming regions distributed along the whole galaxy was found in IC 5283. These phenomena could be explained in terms of external non-axisymmetric perturbations acting on the potential of each spiral and producing different kinds of activity in accordance with the morphological type of the galaxies.

Key words: **GALAXIES: ACTIVE — GALAXIES: INTERACTIONS — GALAXIES: STARBURST**

1. INTRODUCTION

The mechanisms to produce Seyfert and starburst activities in galaxies are not yet clearly understood. NGC 7469 is a well-studied galaxy where we find both phenomena. It has a Seyfert 1 nucleus and a circumnuclear starburst ring (see Mauder et al. 1994 and references therein). Several authors (see Shlosman 1994 and other

papers in the same proceedings), have made models in which large-scale events, such as tidal interactions between galaxies, drive gas into the inner ~1 Kpc of a spiral galaxy due to non-axisymmetric perturbations to the potential. The accumulation of gas in the center of the galaxy will produce circumnuclear star formation and/or nuclear activity. This seems to be the case for NGC 7469, which has high concentrations of molecular gas in its center (Meixner et al. 1990), and has a very near companion at ~ 80″ (Burbidge, Burbidge, & Pendergast 1963). IC 5283 is a very disrupted Scd galaxy (Márquez & Moles 1994), with a tidal tail in the SW direction.

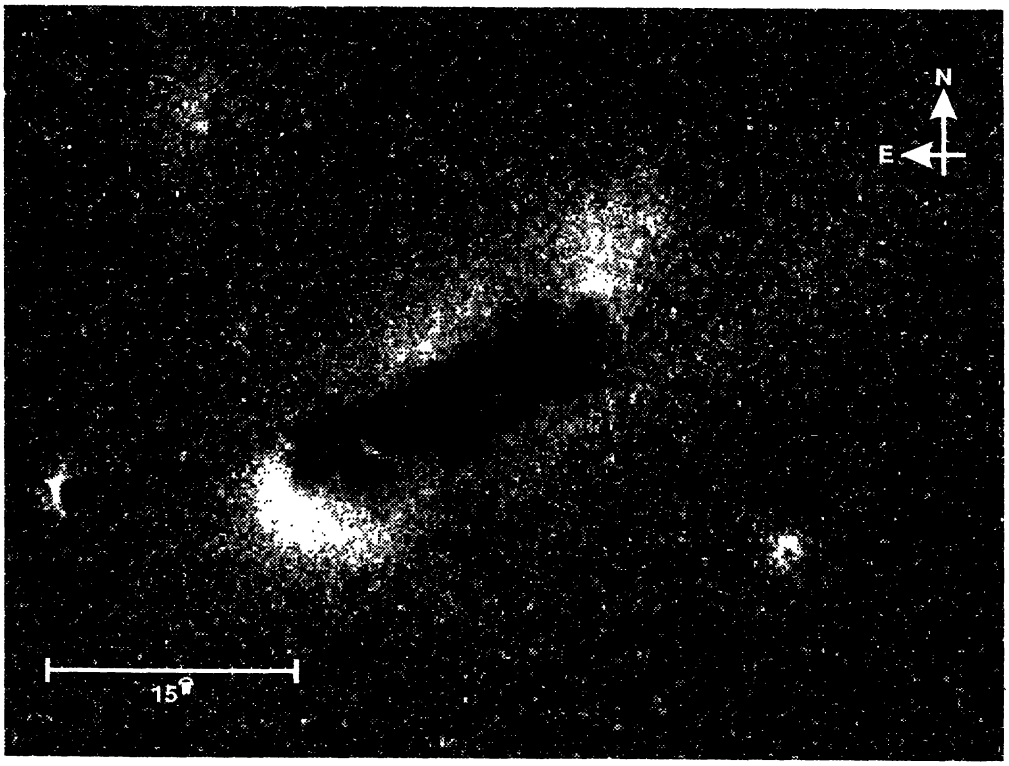

Fig. 1. *V*–*R* map of IC 5283

2. OBSERVATIONS

V and *R* images of the system were taken in September 1994, with the 2.5-m Nordic Optical Telescope at La Palma, Spain. We used a 1124 × 1024 pix CCD detector, with a scale of 0.176″ per pixel. All images were taken under excellent seeing conditions, ~ 0.8″. In Figure 1 we present a $V-R$ map of IC 5283 and we can see a thick dust lane along the nearly edge-on disk. In Figure 2 we show a deep (20 minutes) *R* image of IC 5283 where the star-forming regions are seen through the dust over the entire disk. In this image we can easily see a tidal tail in the SW direction of the galaxy, which has been considered to be the proof of dynamical interaction between the pair. In Figure 3 we present a $V-R$ map of the system Arp 298, and we notice a well-defined inner ring surrounding the Seyfert nucleus of NGC 7469. A blow-up of this ring is shown in Figure 4.

3. DISCUSSION

The case of Arp 298 illustrates in a very neat way the effects of non-axisymmetric perturbations in the potentials of early and late-type spirals (see Moles, Márquez, & Pérez 1995). Evidence for the physical interaction between the two spirals is given by Dahari (1985). NGC 7469 is an early type spiral: (R')SAB9(rs)a (de Vaucouleurs et al. 1991); we have detected an inner ring of radius 1.2″ (~380 pc for D=68 Mpc, where a value of H_o=75 has been adopted), which agrees in size with the ring found by Mauder et al. (1994). On the contrary, IC 5283 is a late-type edge-on spiral (Petrosyan et al. 1992) with star-forming regions distributed all over the disk. Since NGC 7469 has a large bulge, it can respond coherently to the non-axisymmetric perturbation

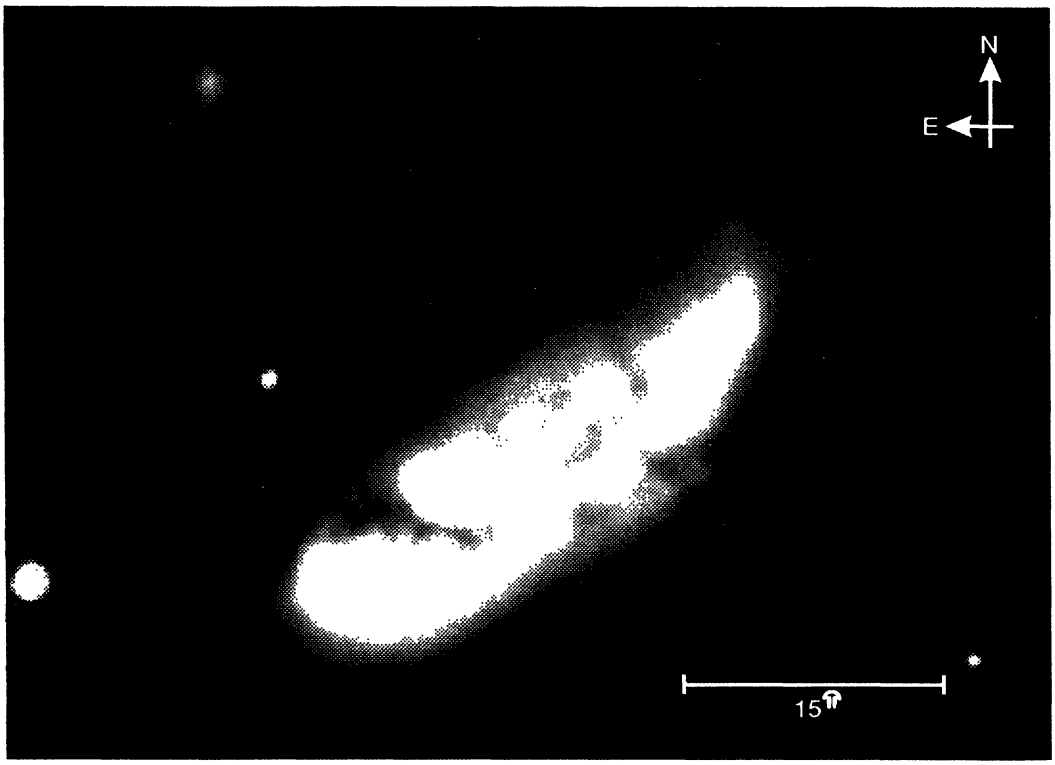

Fig. 2. *R* band image of IC 5283

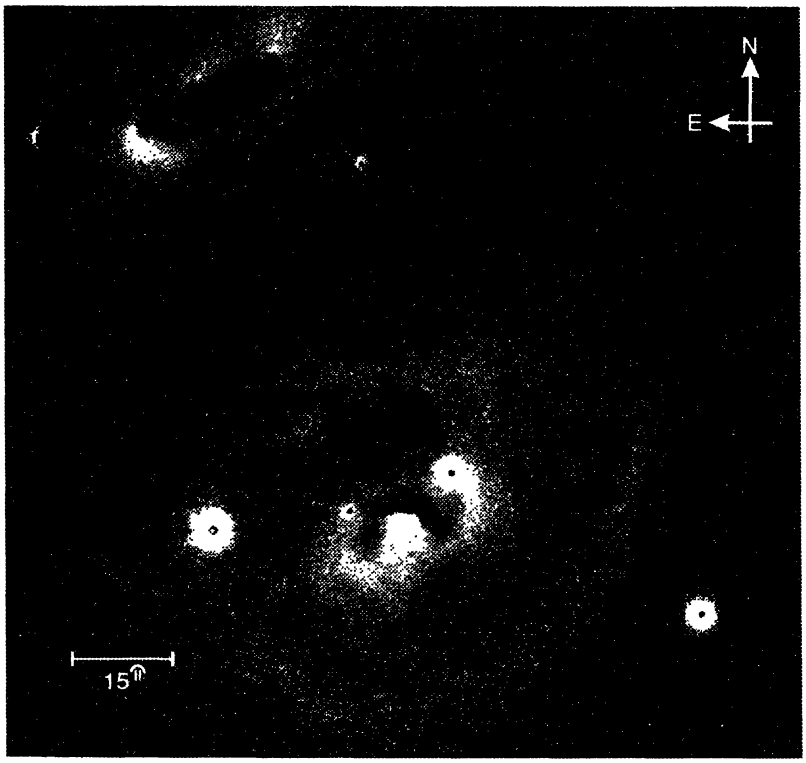

Fig. 3. *V–R* map of the system Arp 298

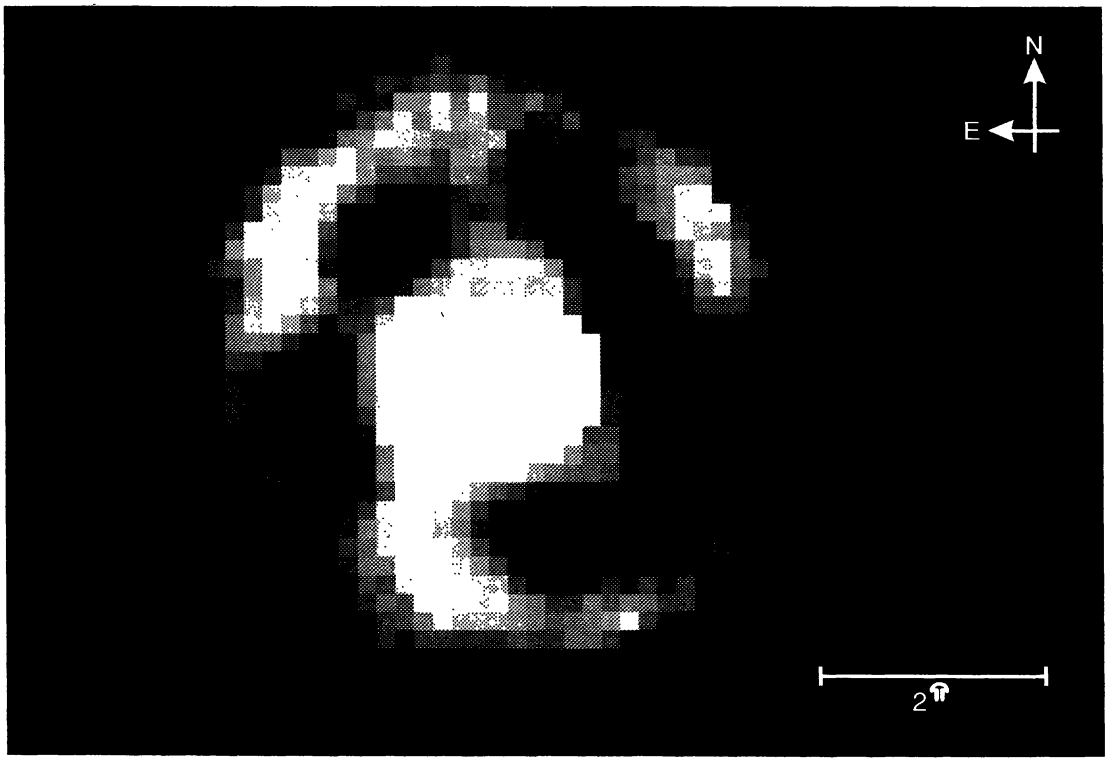

Fig. 4. Blow-up of Fig. 3 showing the circumnuclear ring of NGC 7469

(Márquez & Moles 1994), forming a bar and carrying gas to the center. High density also favors the formation of an inner Lindblad resonance where starbursts can form by gravitational collapse of the accumulated gas (Elmegreen 1994).

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