

# THE GALACTIC BAR AND SPIRAL ARMS

O.E. GERHARD, P. ENGLMAIER

*Astronomisches Institut, Venusstr. 7, CH-4102 Binningen*

**Abstract.** The inner Galaxy light distribution recovered non-parametrically from the COBE/DIRBE surface brightness data shows an elongated bulge set in a highly non-axisymmetric disk. Gas flows computed in the potential of the COBE bar/bulge and disk have been compared with HI and CO line observations. For the best values of the NIR mass-to-light ratio and pattern speed a good match to the tangent point locations of the inner Galactic spiral arms is obtained.

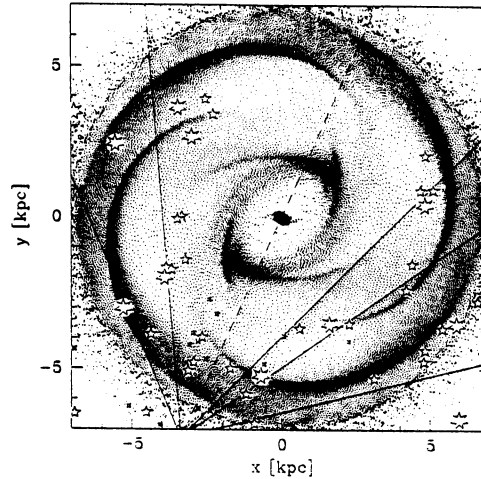
## 1. Introduction – The Galactic Bar Project

There is substantial, and still growing, evidence for a bar in the inner Galaxy (reviewed, e.g., in Gerhard 1996). This includes the NIR light distribution, various source counts, the atomic and molecular gas morphology and kinematics, and (probably) the large optical depth to microlensing.

A project is under way to construct a quantitative model within which the various observational facts can be coherently explained. This is based on a non-parametric deprojection of the dereddened NIR surface brightness distribution from COBE/DIRBE, assuming triaxial symmetry (Binney, Gerhard & Spergel 1997). Depending essentially on the bar angle only, one thus obtains the three-dimensional L-band luminosity distribution of the bar and disk. Remaining uncertainties due to unknown details of the in-plane dust distribution and due to the algorithm's inability to reliably deproject spiral arms mainly affect the derived inner disk model.

Assuming constant  $M/L_L$ , models for the mass distribution and gravitational potential of the inner Galaxy have been constructed, and quasi-equilibrium gas flow models have been computed. Comparing with the observed terminal velocities fixes the value of  $M/L_L$ . Then also the microlensing optical depth to Baade's window is determined (Bissantz et al. 1997).

In this talk, it is not possible to discuss all aspects of this project. Only some results from the gas flow and spiral arm models of Englmaier & Gerhard (1997) will be described. For a more extensive discussion see the



*Figure 1.* Gas flow in the inner Galaxy. The SPH particle distribution is plotted to trace the spiral arm shocks. The solid lines from the position of the Sun denote tangent point directions of Galactic spiral arms, located approximately at  $l \simeq 48^\circ$ ,  $l \simeq 30^\circ$ ,  $l \simeq -21^\circ$  (the '3kpc arm'),  $l \simeq -31^\circ$ ,  $l \simeq -52^\circ$ . References in Englmaier & Gerhard (1997). Stars denote the positions of HII regions from Georgelin & Georgelin (1976).

special sessions on the Galactic bar and disk in Joint Discussion 15 during this General Assembly.

## 2. Gas flow and Galactic spiral arms

The figure shows our current best gas flow model for the central 7kpc of the Galaxy. This was computed using an effective 20000 SPH particles in two dimensions, and assuming point symmetry with respect to the Galactic center. At this resolution the transition between  $x_1$  and  $x_2$  orbit flow is barely resolved, but the spiral arm shocks are clearly visible. Their tangent directions agree approximately with the observed spiral arm tangents. The 3kpc arm is one of the arms emanating from the nearby end of the bar. This model includes a dark component with asymptotic circular velocity  $v_c = 200 \text{ km s}^{-1}$ ; the galactocentric solar radius is  $R_\odot = 8 \text{ kpc}$ , and the bar angle and corotation radius are  $\phi_{\text{bar}} = 20^\circ$  and  $R_{\text{corot}} = 3.4 \text{ kpc}$ .

## References

- Binney J.J., Gerhard O.E., Spergel D.N., 1997, MNRAS 288, 365  
 Bissantz N., Englmaier P., Binney J.J., Gerhard O.E., 1997, MNRAS 289, 651  
 Englmaier P., Gerhard O.E., 1997, in preparation.  
 Georgelin Y.M., Georgelin Y.P., 1976, A&A 49, 57  
 Gerhard O.E., 1996, in: *Unsolved Problems of the Milky Way*, IAU Symp. 169, eds. L. Blitz, P. Teuben, Kluwer, Dordrecht, 79.