Signatures of M31-M32 Galactic Collision, *M. Dierickx et al*

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Introduction

- Striking star-forming ring structure of Andromeda's Disk could result from bar inestability or a **galactic collision**.
- The origin of the compact morphology and high surface brightness of M32-like galaxies is debated.
- Hydrodynamic Simulations and Test Particle Modeling

Results

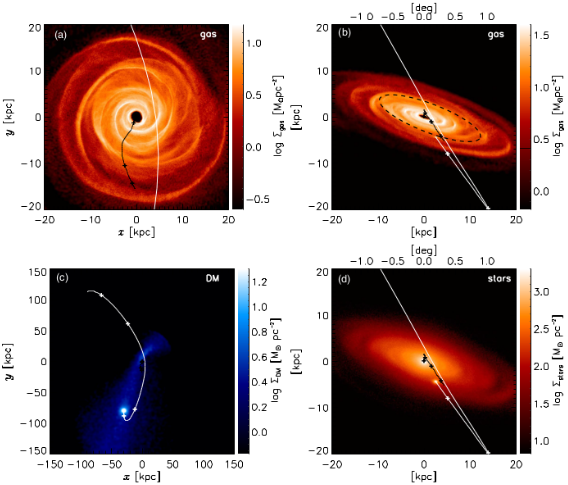

Figure 1. Simulated collision between Andromeda and M32 shown at the time of best match to current observations. Panels (a) and (b): gas morphology viewed face-on and in projection on the sky. Panel (c): face-on M32 dark matter density map (note the larger scale). Panel (d): stellar density map viewed in projection. In panel (b), a dashed ellipse marks the location of M31's 10 kpc pseudo-ring. The dim, incomplete outer ring tentatively identified in infrared images (Gordon et al. 2006) is also reproduced. Black and white lines indicate the trajectories of Andromeda and M32, respectively, and include plus signs spaced every 500 Myr. Angular scales are calculated assuming a distance to M31 of 780 kpc.

Figure 1: Simulated Collision between Andromeda and M32

Results

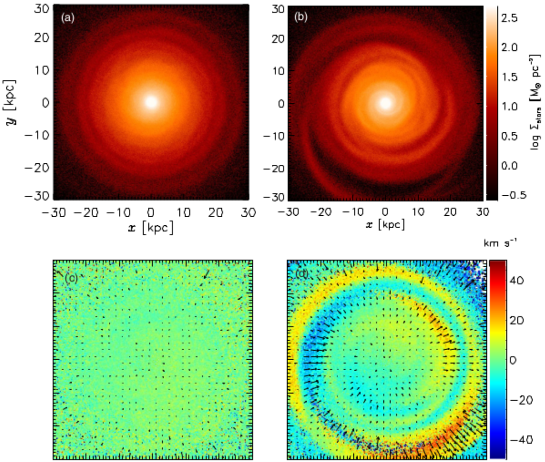

Figure 2. Kinematic structure of Andromeda's stellar disk seen face-on. Left panels: disk evolved in isolation. Right panels: disk after the interaction with M32 (prediction for the current time). The top row shows the corresponding stellar density maps. The bottom row presents the velocity structure of the stellar particles: velocity perpendicular to the disk plane (color scale) and in-plane component along the direction to M31's center (arrows). An arrow of length 1 kpc corresponds to a magnitude of 20 km s^{-1}. Included here are all particles within three scale heights of the disk midplane. The data in the right panels are rotated by $-3°$ around the x-axis and $3°$ around the y-axis in order to compensate for the disk tilt induced by M32's passage. The pseudo-ring features produced by the collision are traced out by velocity excursions.

Figure 2: Kinematic Structure of Andromeda's Stellar Disk seen Face-on

Results

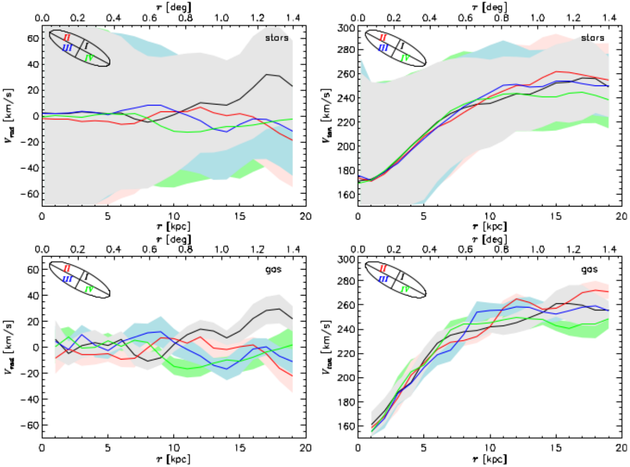

Figure 3. Components of azimuthally averaged star (top row) and gas (bottom row) particle velocities as a function of radius for different quadrants of Andromeda's disk in projection. The left panels present the radial component of the velocities, while the right panels show the tangential component. As in Figure 2, the data are rotated by -3° around the x-axis and 3° around the y-axis to compensate for the disk tilt induced by M32's passage. A color-quadrant location key is given in the top left corner of each panel. Colored bands correspond to the standard deviation of the velocity distribution in each quadrant. The increasing dispersion toward smaller radii in the stellar velocities is caused by the bulge component. Included here are all particles within three scale heights of the disk midplane. For the gas panels, the first radius bin is omitted as the density is too low near the center (a numerical artifact). Velocity excursions are related to the ring-like density enhancements seen in Figure 1; the fact that they are not collocated in radius is expected because velocity extrema do not correspond to where particles collect in space.

Figure 3: Components of Azimuthally Averaged Star and Gas Velocities

Summary / Conclusions

- An offcenter collision with M32 explains the apparent pseudo-ring morphology of Andromeda's disk.
- Under this scenario, M32's passage occurred 800 Myr ago and produce measurable velocity perturbation in Andromeda's disk.
- The associated tidal stripping is **insufficient** to produce an M32-like morphology, supporting an intrinsically compact origin for cEs.