MINOR MERGERS AND THEIR IMPACT ON THE KINEMATICS OF GALAXY DISKS

P. DI MATTEO, Y. QU, M. D. LEHNERT, W. VAN DRIEL
OBSERVATOIRE DE PARIS, FRANCE

C. J. JOG
INDIAN INSTITUTE OF SCIENCE, BANGALORE, INDIA

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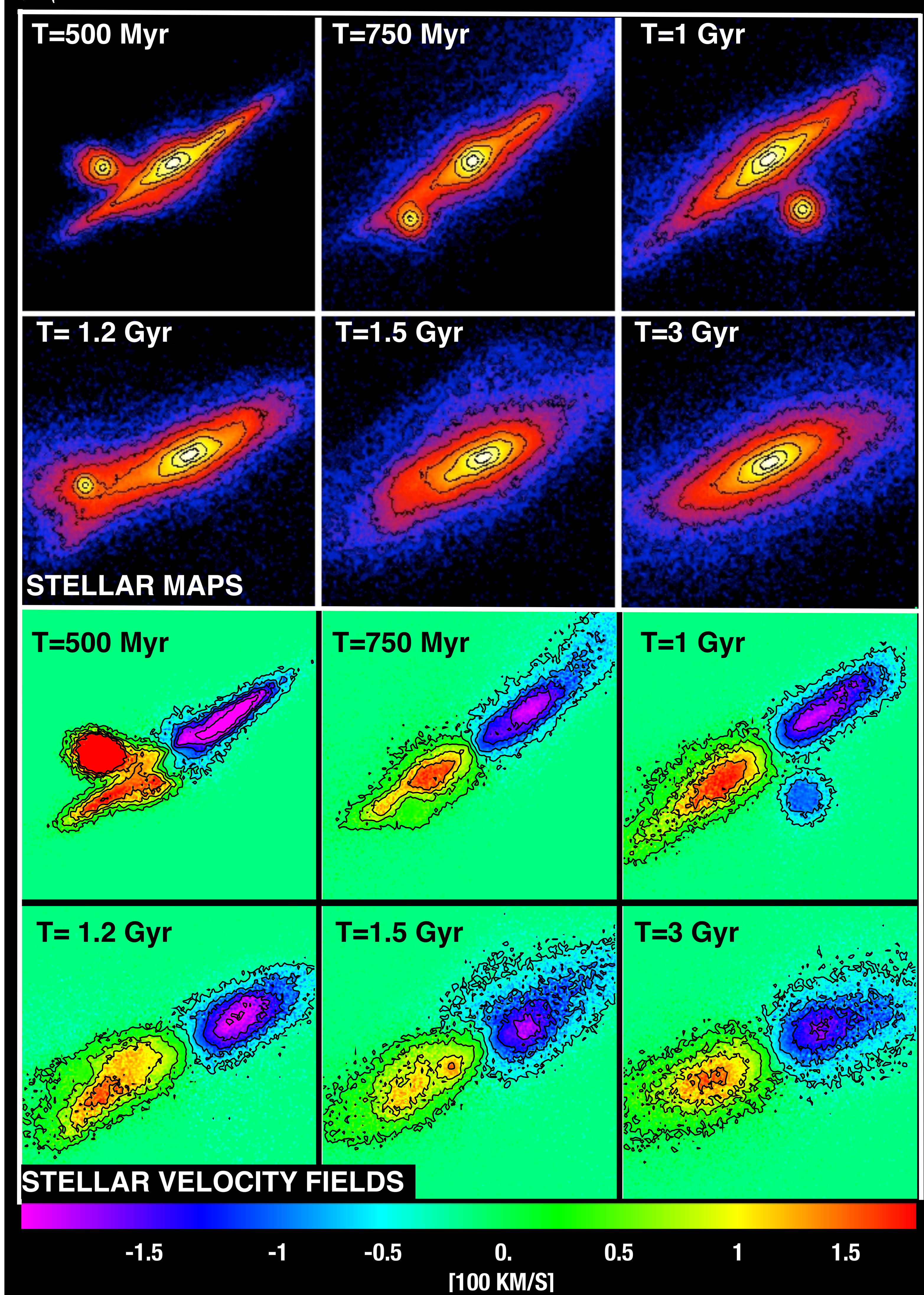
BY MEANS OF N-BODY SIMULATIONS, WE HAVE INVESTIGATED THE **IMPACT OF MINOR MERGERS ON THE ANGULAR MOMENTUM CONTENT AND KINEMATICAL PROPERTIES OF A DISK GALAXY**. OUR SIMULATIONS COVER A RANGE OF INITIAL ORBITAL CHARACTERISTICS AND THE SYSTEM CONSISTS OF A MASSIVE GALAXY WITH A BULGE AND A STELLAR DISK MERGING WITH A MUCH LESS MASSIVE (10:1 OR 20:1) GASLESS COMPANION. OUR RESULTS SHOW THAT:

- DURING THE PROCESS OF MERGING, THE DISK OF THE PRIMARY GALAXY BECOMES KINEMATICALLY HOTTER AND THICKER
- **ITS SPECIFIC ANGULAR MOMENTUM ALWAYS DECREASES**, INDIPENDENT OF THE ORBIT OR MORPHOLOGICAL PARAMETERS OF THE SATELLITE GALAXY
- THE DECREASE IN THE ROTATION VELOCITY OF THE PRIMARY GALAXY IS ACCOMPANIED BY A CHANGE IN THE **ANISOTROPY OF THE STELLAR ORBITS, WHICH BECOME INCREASINGLY RADIALLY DOMINATED AS THE MERGER ADVANCES**
- **THE RADIAL VELOCITY DISPERSION INCREASES AT ALL RADII**, BUT PARTICULARLY IN THE OUTERMOST REGIONS. AT THE SAME TIME, **THE TRANSVERSE VELOCITY DISPERSION DECREASES THROUGHOUT THE WHOLE DISK, EXCEPT IN THE INNER REGION** (INSIDE $0.5R_{50}$), WHERE THE CONTRIBUTION OF BULGE STARS, WHICH ACQUIRE AM DURING THE INTERACTION, LEADS TO AN INCREASE OF σ_t.

THE FULL PHASE-SPACE COORDINATES PROVIDED BY GAIA FOR HUNDREDS OF MILLIONS OF STARS SHOULD SHED LIGHT ON THE HISTORY OF ASSEMBLY OF THE GALACTIC THICK DISC, AND ON ITS KINEMATICAL PROPERTIES.

FIG. 1



SLOWING DOWN OF STELLAR DISKS

As a result of the action of tidal torques and dynamical friction, the satellite loses its angular momentum (AM) and spirals into the gravitational field of the primary galaxy, where it dissolves completely.
During the process of merging, the disk of the primary becomes kinematically hotter and thicker (Fig. 1 top panel), and it slows down (Fig. 1, bottom panel).

The slowing down of the stellar disk of the primary galaxy is accompanied by a redistribution of the orbital AM into internal AM of the stellar and dark matter components, as shown in Fig. 2.

- Near the first pericenter passage, the two dark matter halos (primary and satellite) acquire part of the orbital AM, leading to rotation of a halo that initially was not rotating.
- Also the stellar component of the satellite absorbs orbital AM; for retrograde orbits this conversion is a mechanism for creating a counter-rotating stellar component in a merger remnant.
- The evolution of the AM of the stellar disk of the primary galaxy is quite different: in all the simulated orbits, it loses AM during the interaction (solid red lines, Fig. 2). On average, the relative change of the internal AM is ~ 10% for mergers with a mass ratio 10:1.

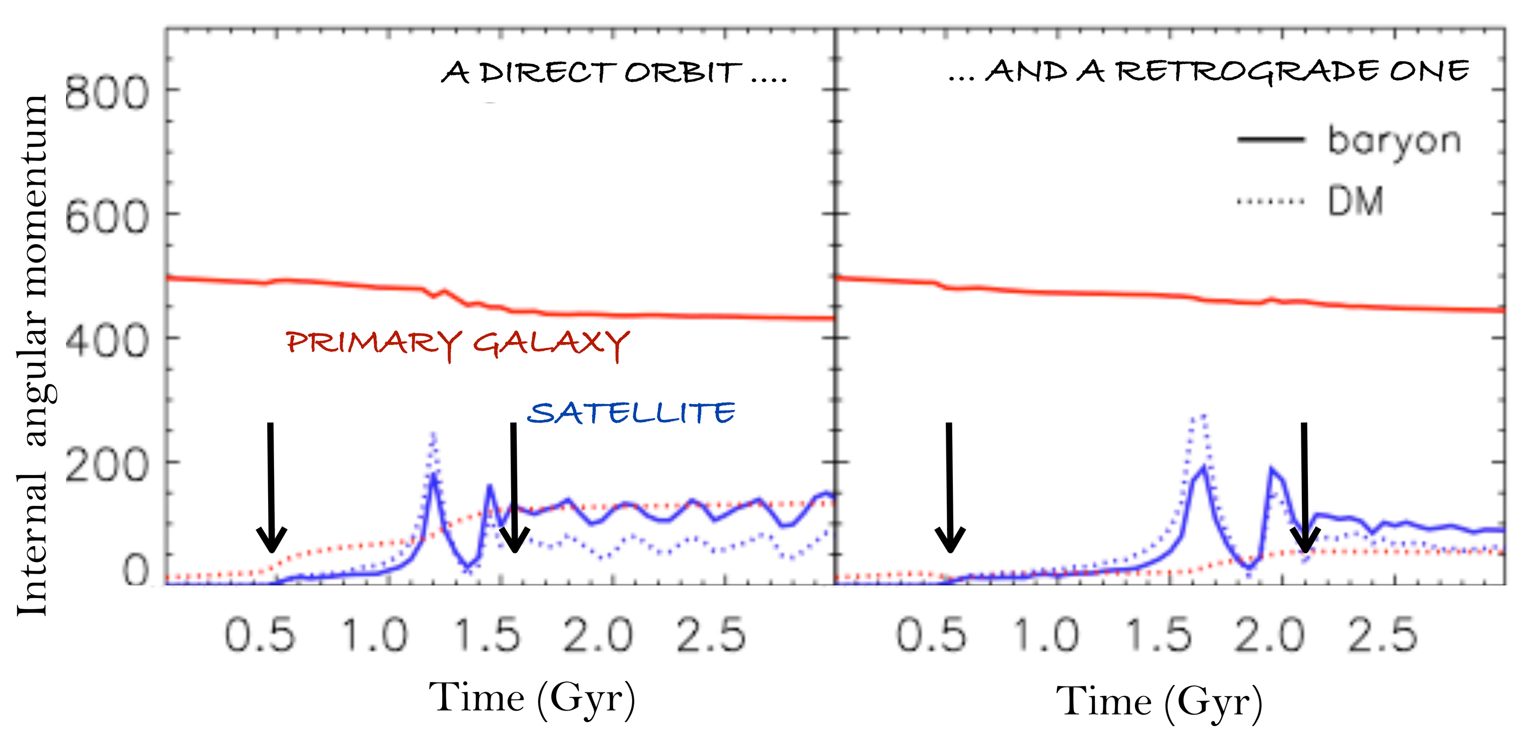


FIG. 2: Evolution, vs time, of the absolute value of the internal angular momentum of the stellar and dark matter components of a disk galaxy (solid and dotted red lines) and of its satellite (solid and dotted blue lines) for two 10:1 mergers. First pericenter passage and merging phase are indicated by black arrows. The angular momentum is in units of 2.3×10^{11} Msunkpc km/s

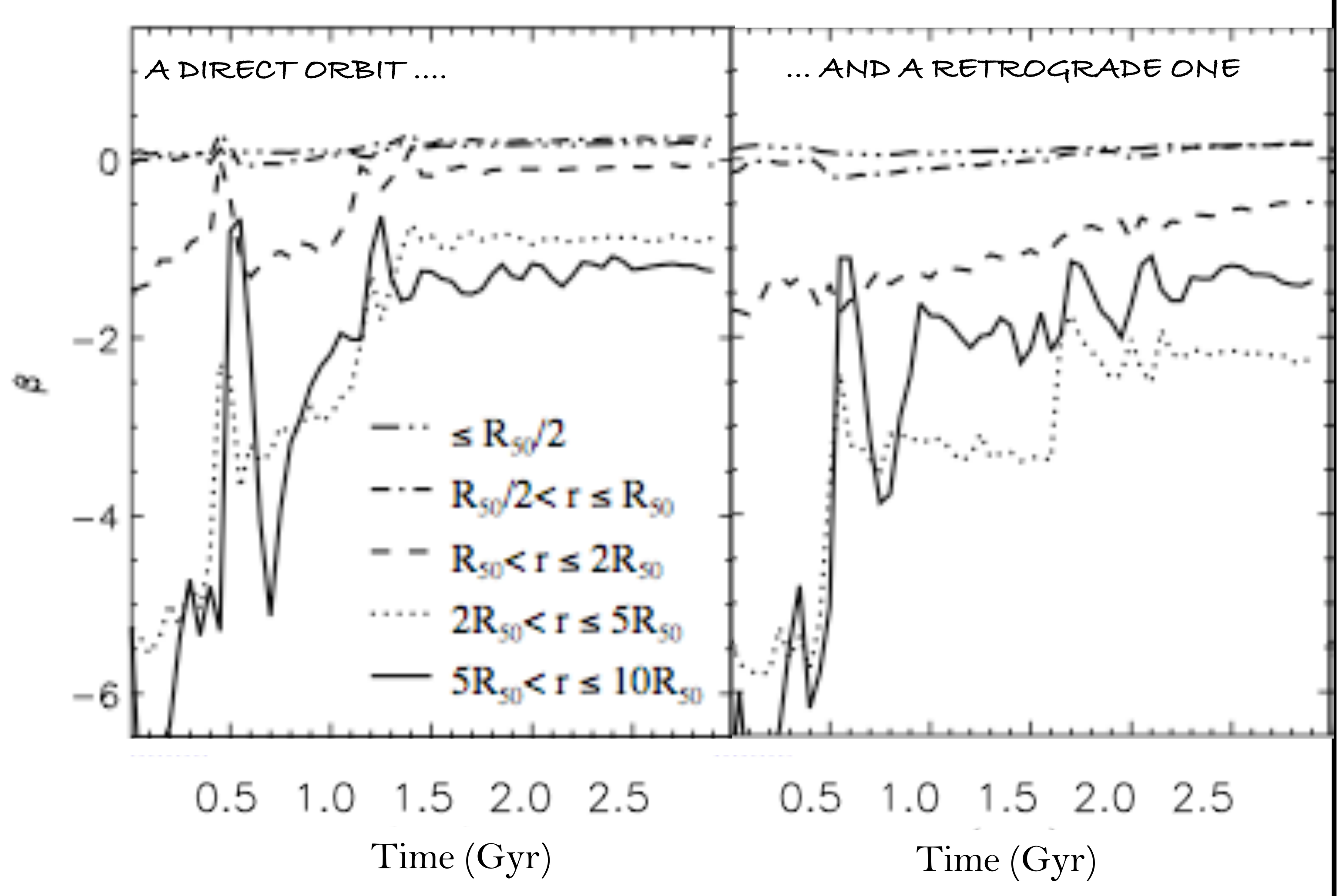


FIG. 3: Evolution, vs time, of the anisotropy parameter of stars in the primary galaxy for the two merger simulations whose internal AM is shown in Fig. 2. The anisotropy has been evaluated in 5 different radial regions relative to the half mass radius.

ANISOTROPY OF THE STELLAR ORBITS

The merging process is accompanied by an evolution of the anisotropy parameter (AP)of stars in the primary disk (Fig.3). The change in the AP is particularly large outside R_{50}, the baryonic half-mass radius. In these outer regions, the stellar orbits, which before the interaction were dominated by tangential motions, tend to become increasingly radially dominated, as the merger advances. While the outermost region, $r > 2R_{50}$, of the merger remnant is still dominated by tangential orbits, the motion of stars in the region $R_{50} < r < 2R_{50}$ can become nearly isotropic due to the interaction with the satellite.