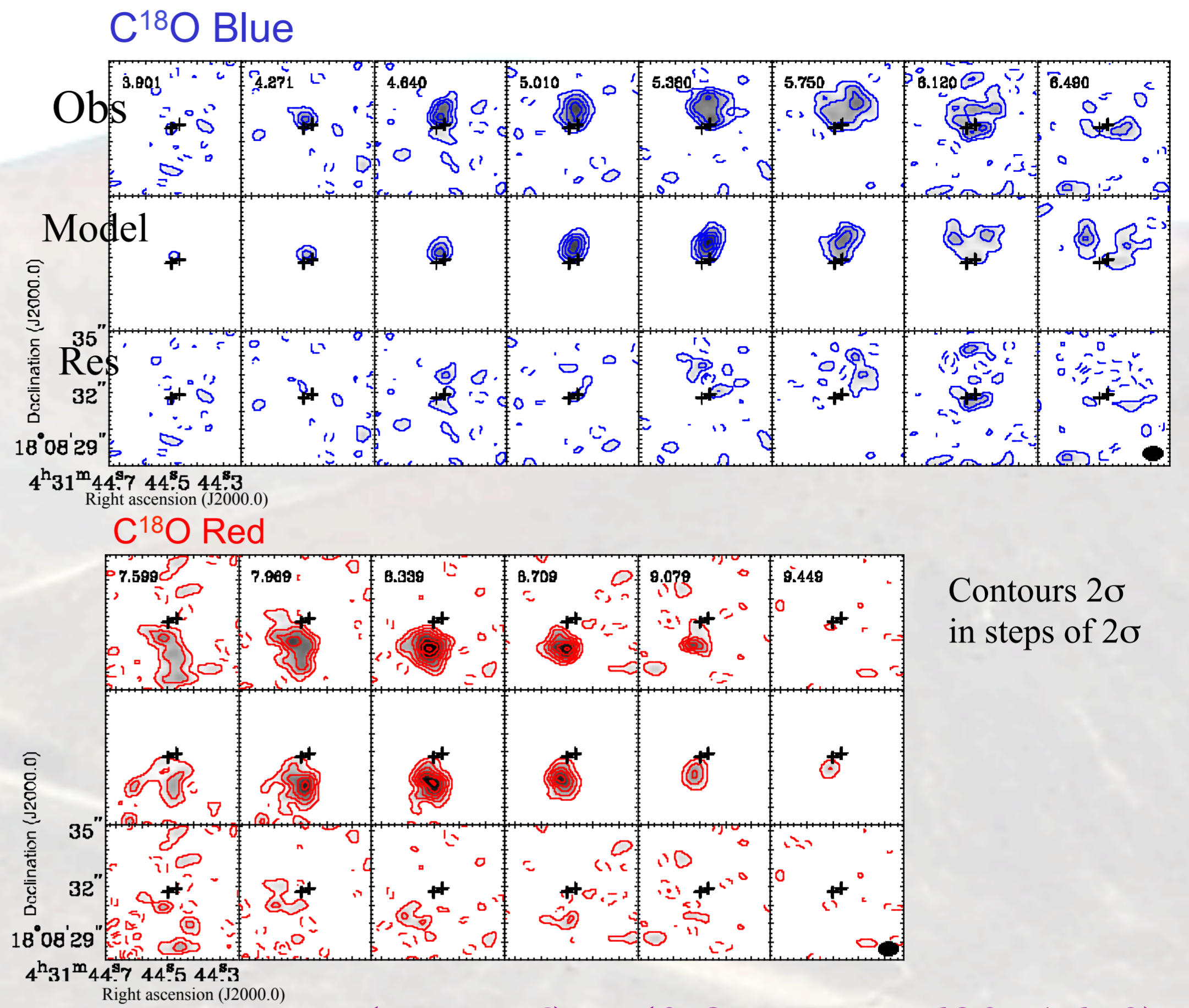
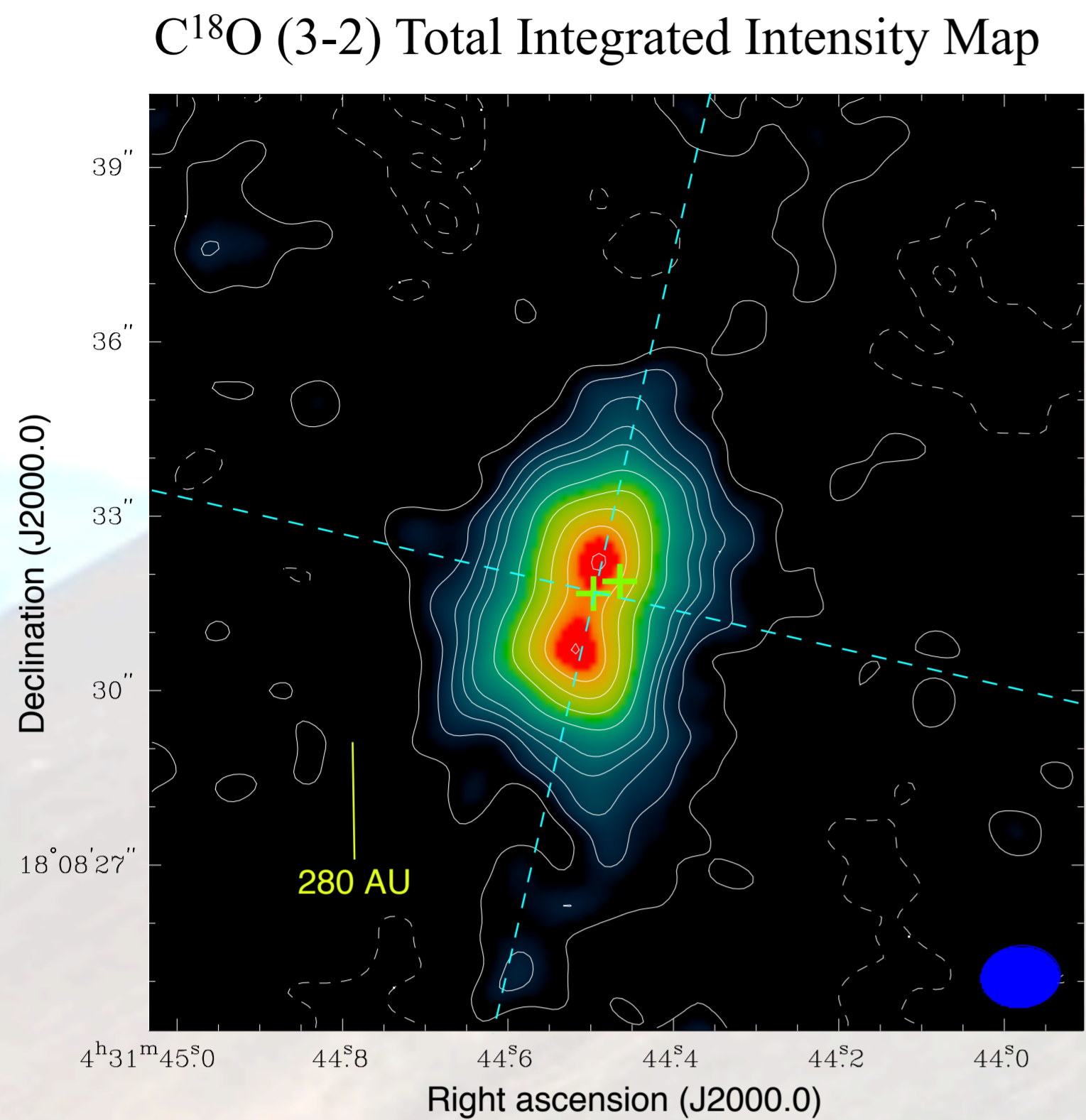


Direct SMA Imaging of the Transition from the Infalling Envelopes to the Keplerian Disks around the Protostellar Binaries L1551 IRS 5 and NE

Shigehisa Takakuwa, Ti-Lin Chou (ASIAA), Masao Saito, Kazuya Saigo (NAOJ), et al.

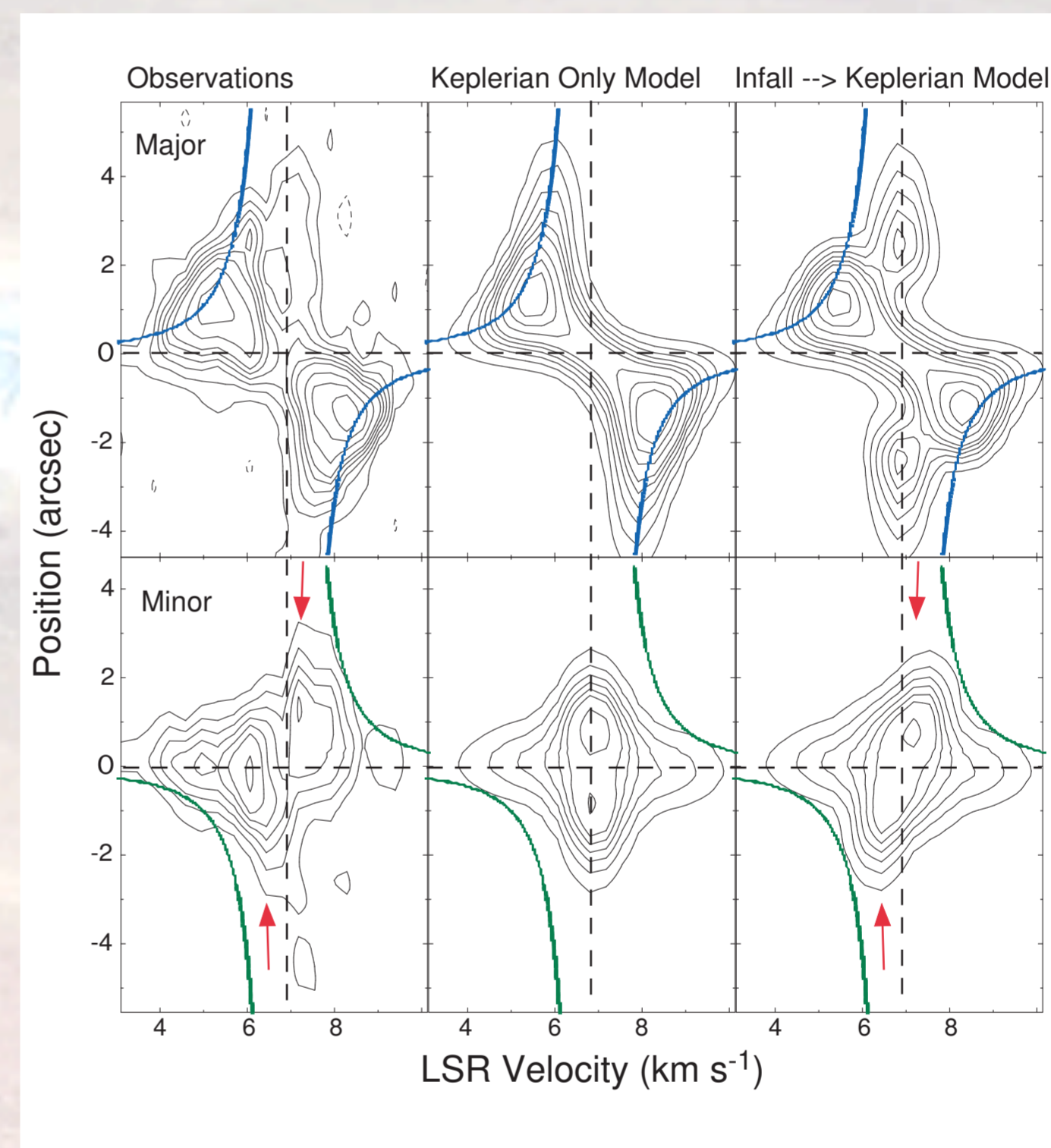
SMA C¹⁸O (3-2) Observations of L1551 NE



Contours 2 σ
in steps of 2 σ

$$\rightarrow (M_*, i, \theta) = (0.8 M_{\text{solar}}, -62^\circ, 167^\circ)$$

L1551 NE is a prototypical Class I binary protostellar system located in Taurus ($d \sim 140$ pc). Our SMA observations of L1551 NE in the C¹⁸O (3-2) emission show a 1000 x 800 AU scale, circumbinary material elongated along the NW-SE direction, approximately perpendicular to the associated Fe II jets (upper left figure). In the high-velocity (> 0.5 km s⁻¹) regime, the C¹⁸O velocity channel maps are well-modeled with a $r \sim 300$ AU scale Keplerian disk with the central stellar mass of $0.8 M_{\text{solar}}$ (upper right figure). The velocity feature in the lower velocity (< 0.5 km s⁻¹) region, on the other hand, cannot be explained by the Keplerian rotation. Adding the infalling gas component at the outer end of the Keplerian disk could explain the observed velocity feature in the low-velocity region (Observed and Model P-V diagrams in the right figure). Interestingly, the infalling velocity is much smaller than the free-fall velocity (green curves), suggesting deceleration of the infalling motion as the gas moves close to the central Keplerian disk.



SMA + ASTE CS (7-6) Observations of L1551 IRS 5

L1551 IRS 5 is another Class I binary protostellar system located $\sim 2.5'$ southwest of L1551 NE. Our combined SMA+ASTE observations of L1551 IRS 5 in CS (7-6) show again that the high-velocity (> 1.5 km s⁻¹) CS emission is modeled with a $r \sim 60$ AU scale Keplerian disk with the central stellar mass of $0.5 M_{\text{solar}}$ (bottom-left figure.). The kinematics of the outer envelope is consistent with an rotating and infalling envelope with a conserved angular momentum (bottom-right figure). The infalling velocity is, however, much smaller than the free-fall velocity (light blue curves), suggesting the deceleration as in the case of L1551 NE.

