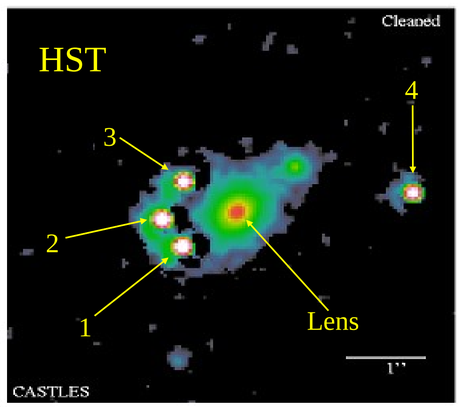
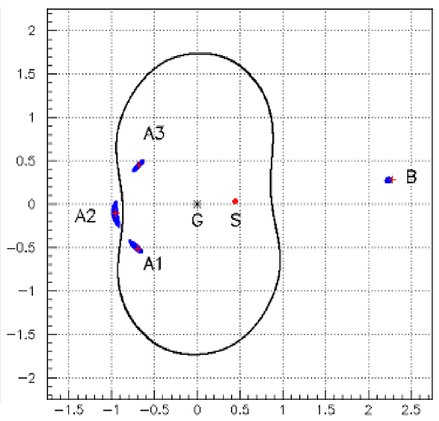
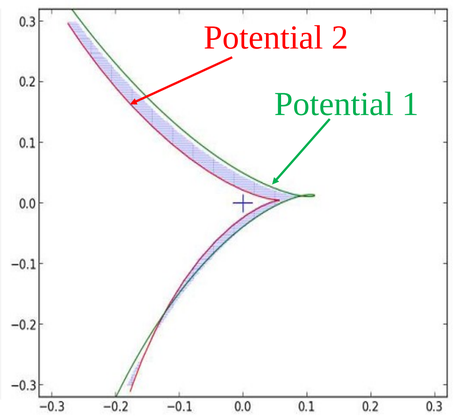
RESOLVING THE MOLECULAR GAS AROUND THE GRAVITATIONALLY LENSED QUASAR RX J0911

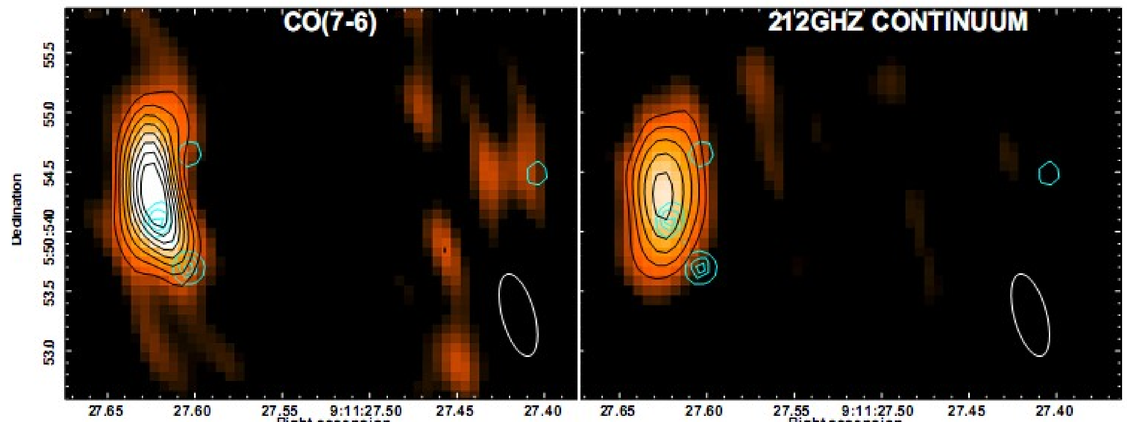
P.Tuan Anh, D.T. Hoai, P.T. Nhung, P. Darriulat, P.N. Diep, N.T. Thao
VATLY/INST, 179 Hoang Quoc Viêt, Cau Giay, Ha Noi, Viêt Nam

We have observed the host galaxy of a distant quasar, RX J0911. The study of such galaxies (here z=2.8) contributes to a better understanding of the formation and evolution of structures at the epoch of galaxy assembly during which most stars have been formed. High resolution observations of CO(7-6) emission have been made possible thanks to the gravitational lensing offered by the presence of a galaxy in the foreground and to the quality of the Plateau de Bure Interferometer.

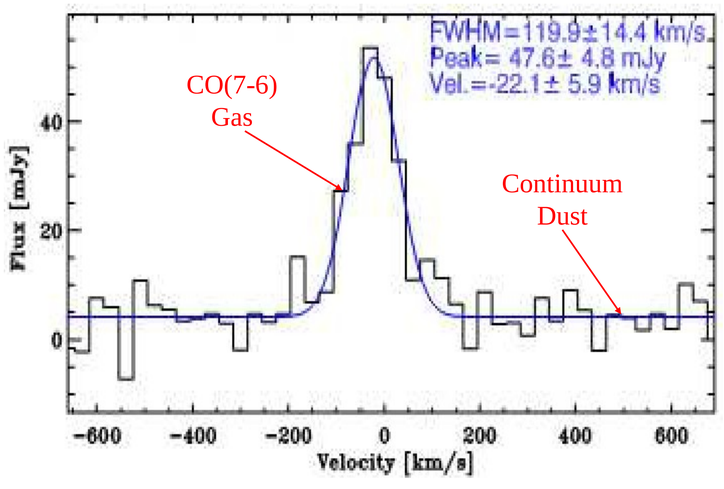


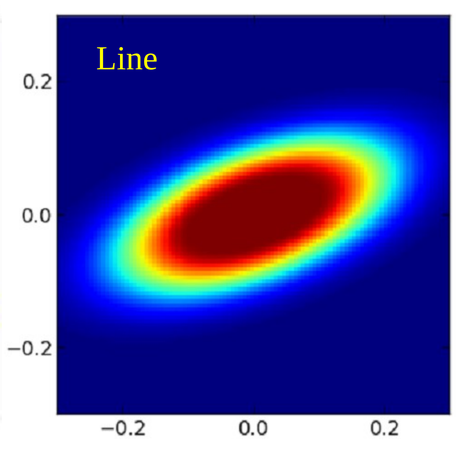


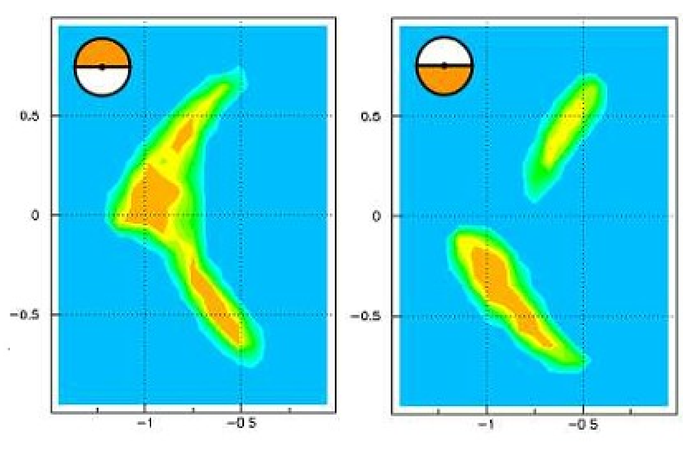


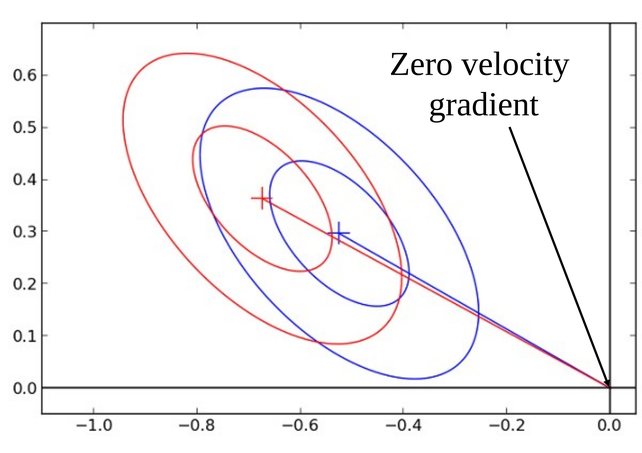


The quasar and its host galaxy are lensed into four images by a galaxy in the foreground. As often the case with large magnifications, the source happens to be in the vicinity of the lens caustic, in fact to overlap it. A consequence is a strong dependence of the magnification on the precise position of point sources in the galaxy, resulting in significantly different magnifications for the gas, the dust and the central QSO. Moreover, the morphology of the observed images is distorted in addition to being amplified. Two different lensing potentials have been used, offering complementary advantages and weaknesses, and the comparison between their predictions has provided a deeper understanding of the lensing mechanism than would have been possible otherwise, and an evaluation of systematic uncertainties.

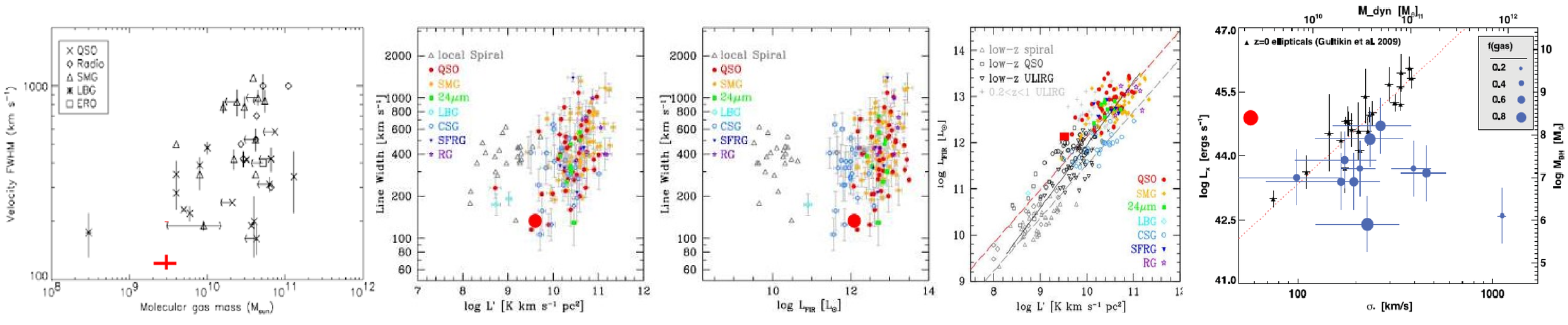








The CO(7-6) line stands out clearly above continuum, allowing for reliable measurements of the gas and dust luminosities. Detailed studies of the images allow for resolving the source in both line and continuum with rms radii of 106±15 and 39±18 mas respectively, corresponding to 0.85±0.12 kpc and 0.31±0.14 kpc respectively. In the line case, the quality of the data have further provided evidence for an ellipticity of the source, with an ellipticity parameter (square root of the ratio between major and minor axes) of 1.60 (+0.35−0.18) and a position angle (of the major axis) of 111°±9°, 3.3 standard deviations away from a circular source hypothesis. Moreover, evidence for a velocity gradient correlated with the source ellipticity has been obtained at the level of 4.5 standard deviations.



A remarkable feature of the CO(7-6) line is its very small width, typically a factor 2 to 3 lower than for similar quasar hosts. As a result, the dynamical mass is very low. Indeed, both gas and dust mass evaluations also fall on the low side of the normal high-z quasar host population. The large star formation efficiency places RX J0911 on the high side of both low-z and high-z galaxies, suggesting that it is in a state where much of its gas has been exhausted after an intense star formation period, leaving it at the border between high-z and low-z quasar hosts. This pleads against an interpretation of the small line width being the result of the disk being seen face-on and adds to the argument of a significant source ellipticity to suggest that RX J0911 is indeed at the border between high-z and low-z quasar hosts.