37. Planet-Disk Interactions
Sijme-Jan Paardekooper et al. in Protostars and Planets VII

38. The Role of Disk Winds in the Evolution and Dispersal of Protoplanetary Disks
Ilaria Pascucci, et al. in Protostars and Planets VII

39. Magnetic fields in star formation: from clouds to cores
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○ **40. Ionise hard: interstellar PO+ detection**
Víctor M. Rivilla, et al. Accepted in Frontiers in Astronomy and Space Sciences

○ **41. Precursors of the RNA-world in space: Detection of （Z）-1,2-ethenediol in the interstellar medium, a key intermediate in sugar formation**
Víctor M. Rivilla et al. Accepted for publication in The Astrophysical Journal Letters

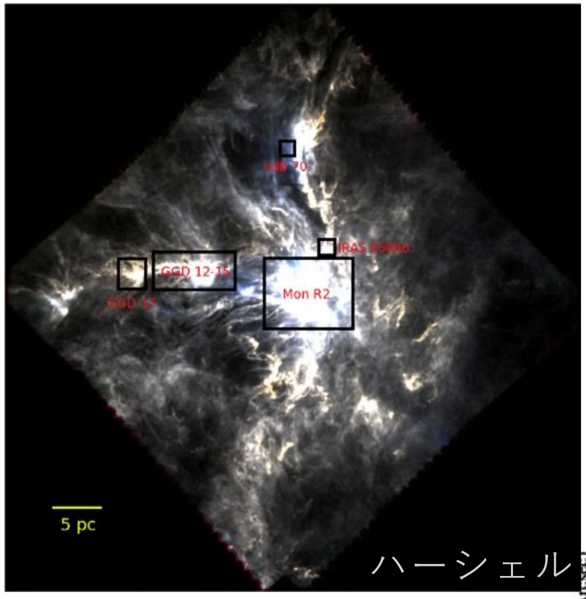
○ **42. Cluster Formation in GGD12-15: Infall Motion with Rotation of the Natal Clump**
Tomomi Shimoikura, et al. ApJ, 928:76(16pp)

42. Cluster Formation in GGD12-15: Infall Motion with Rotation of the Natal Clump

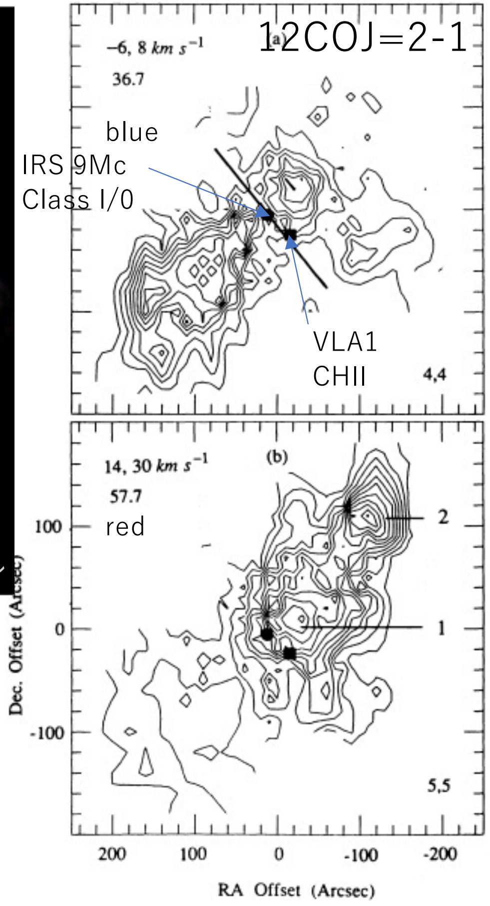
Tomomi Shimoikura, et al. ApJ, 928:76(16pp)

HC_3N J = 10 – 9 NRO
N_2H^+ J = 1 – 0 NRO
CCS J _N=8_7 - 7_6 NRO
CS J = 2 – 1 NRO
SO J _N=2_3 - 1_2
C^18O J = 1 – 0
^13CO J = 1 – 0
^12CO J = 1 – 0 NRO
C^18O J = 3 - 2 JCMT
^13CO J = 3 – 2 JCMT

GGD12-15



ハーシェル



12COJ=2-1

blue

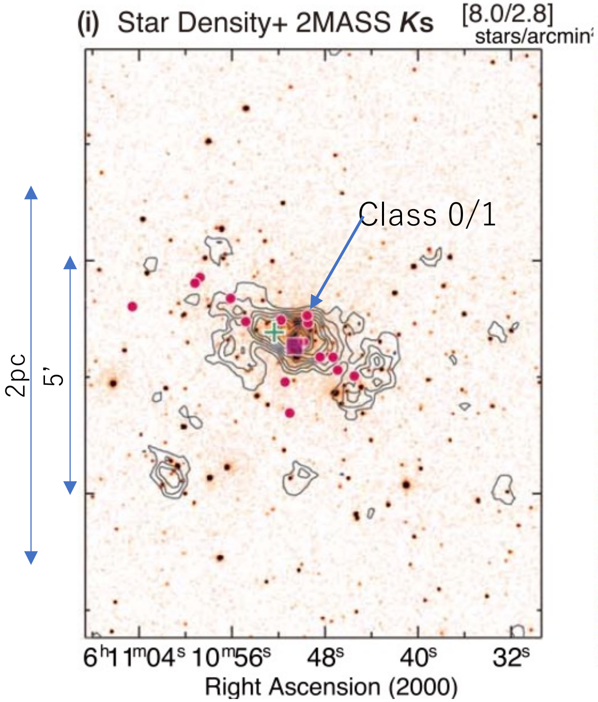
IRS 9Mc
Class I/0

VLA1
CHII

red

Little+1989

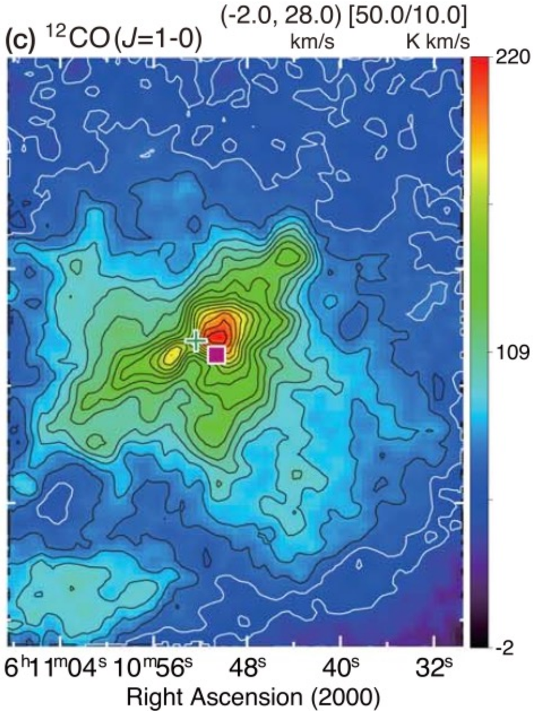
Compact HII　VLA1（B0.5）
双極分子流 6 ‘
駆動源　Class I/0のIRS 9Mc
Young cluster 98±10メンバ～4Myr
VLA1<1Myr



Class 0/1

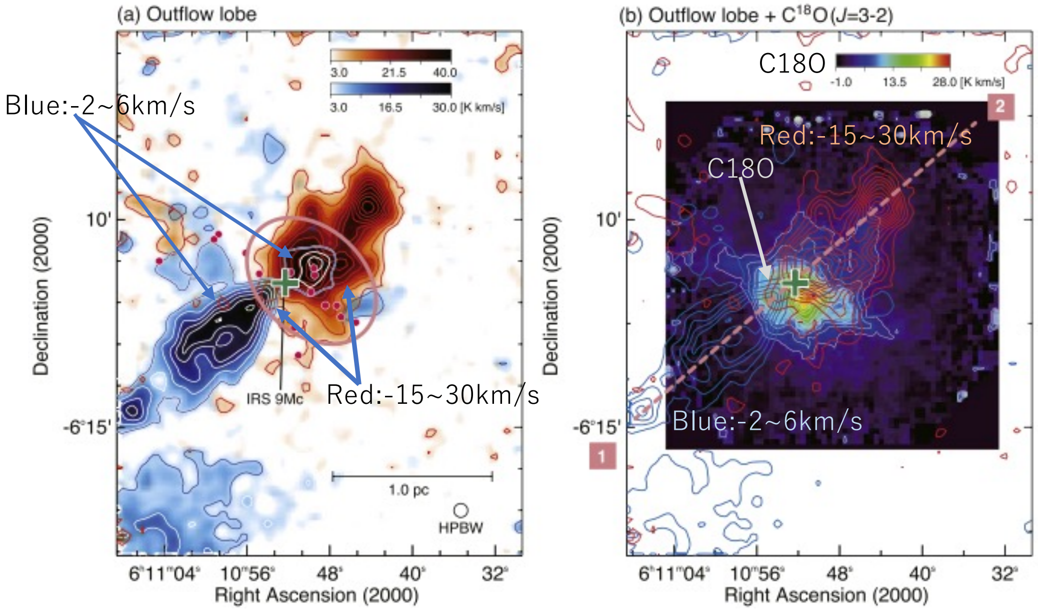
2pc

5’

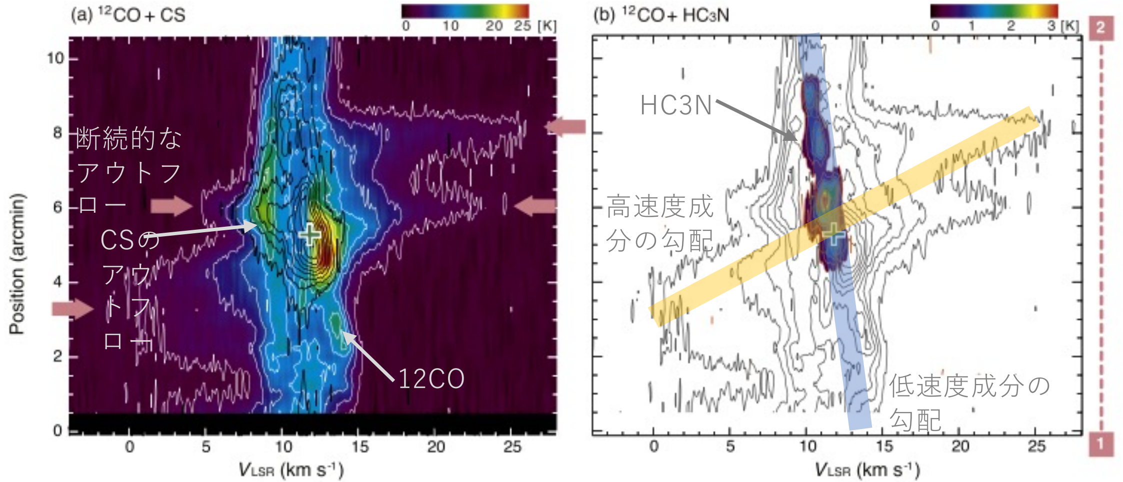


Clump
C18O(1-0)~2pc,2800M$_\odot$
C18O(3-2)~1pc
Core
C18O(3-2)~0.3pc, 530M$_\odot$

12CO （赤青別）積分強度図



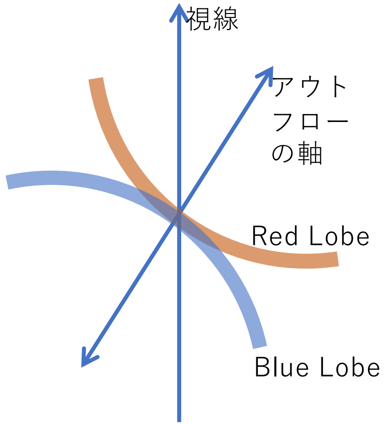
位置速度図１－２　　　★低速度成分は落下運動か➔回転しながら落下



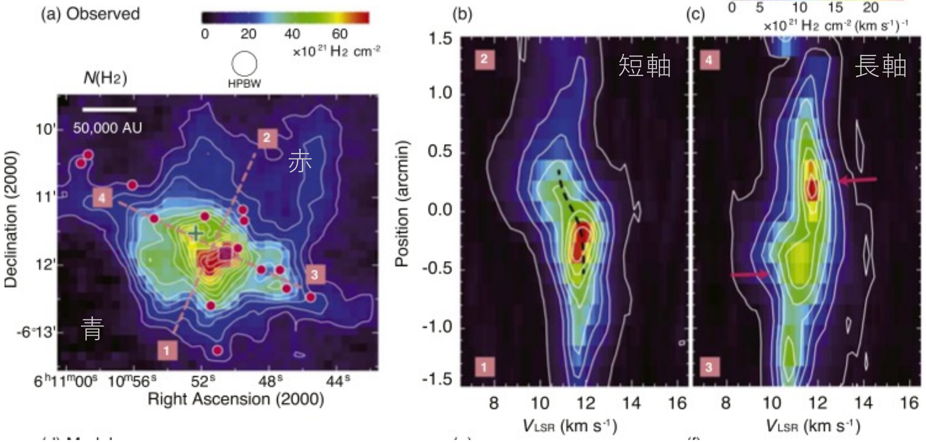
$$\rho(r) = \rho_0 \left[1 + \left(\frac{r}{R_d}\right)^2\right]^{-0.75} \left\{ \begin{array}{l} V_{\rm inf}(r) = V^0_{\rm inf}\left(\frac{r}{R_v}\right)\left[1 + \left(\frac{r}{R_v}\right)^2\right]^{-0.75} \\ V_{\rm rot}(R) = V^0_{\rm rot}\left(\frac{R}{R_v}\right)\left[1 + \left(\frac{R}{R_v}\right)^2\right]^{-1} \end{array} \right.$$

rは球座標の動径

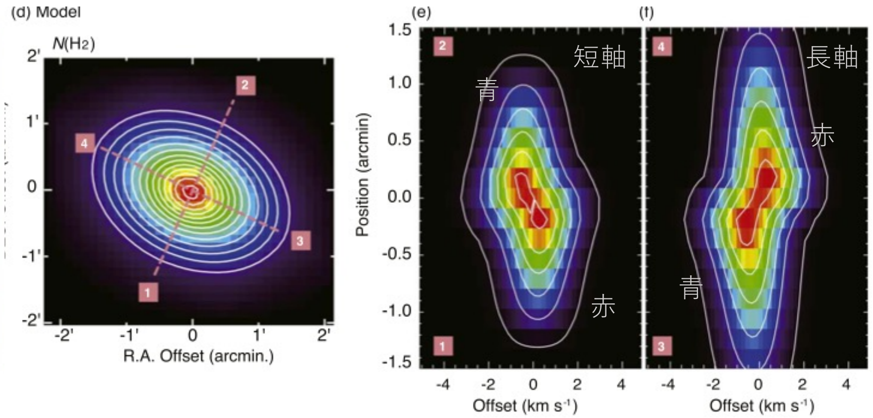
Rは円柱座標の動径



C18O(J=3-2)観測



C18O(J=3-2)モデル



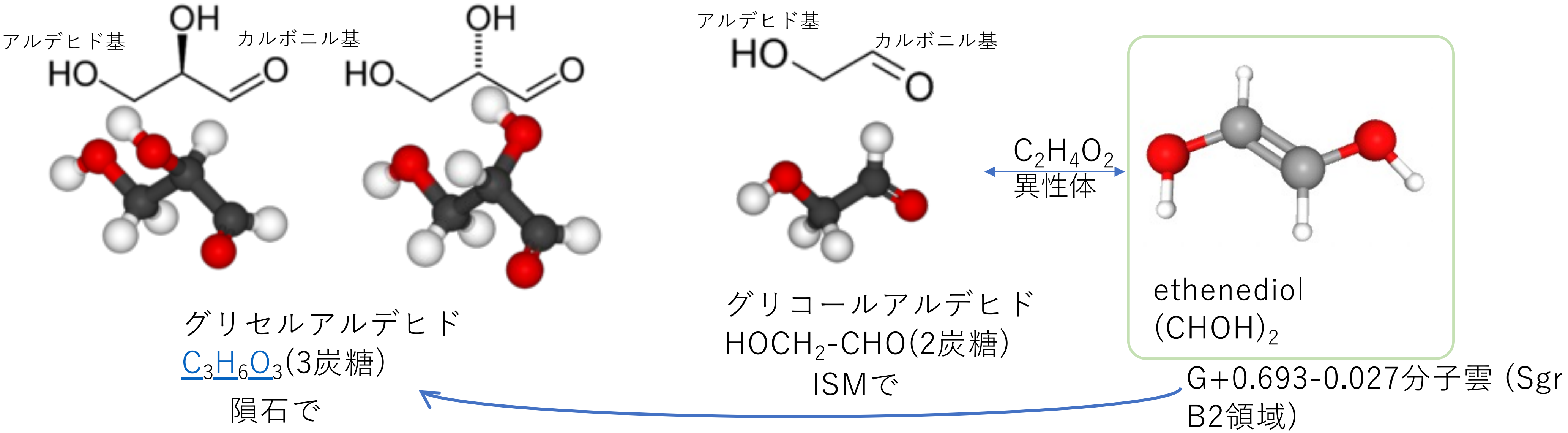
41. Precursors of the RNA-world in space: Detection of (Z)-1,2-ethenediol in the interstellar medium, a key intermediate in sugar formation

Víctor M. Rivilla et al. Accepted for publication in The Astrophysical Journal Letters

RNAワールド仮設：RNA (→リボ核酸) を遺伝子とする原始生命世界のこと。地球上の生物が現実に住んでいる世界 (DNAワールド) が出現する以前に，この地球上に存在していたと想定され，生命の起源や生物進化と関連して関心が高まっている。（コトバンク）

RNA：リボヌクレオチド＝リン酸基 - D-リボース（5炭糖） - 核酸塩基

RNAの前駆体は、初期の地球環境に供給されたか？あったか？



アルデヒド基

カルボニル基

グリセルアルデヒド
$C_3H_6O_3$(3炭糖)
隕石で

アルデヒド基

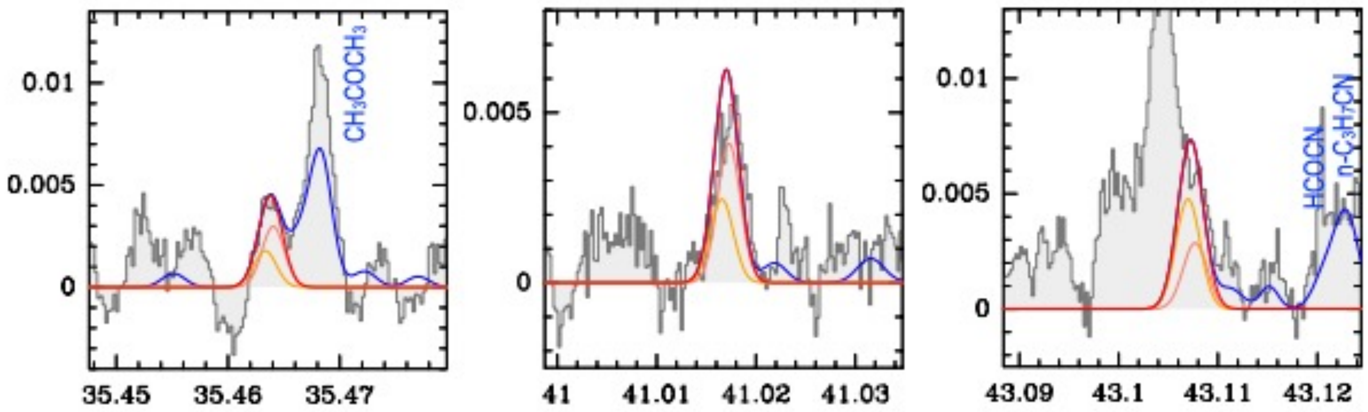
カルボニル基

グリコールアルデヒド
$HOCH_2$-CHO(2炭糖)
ISMで

$C_2H_4O_2$
異性体

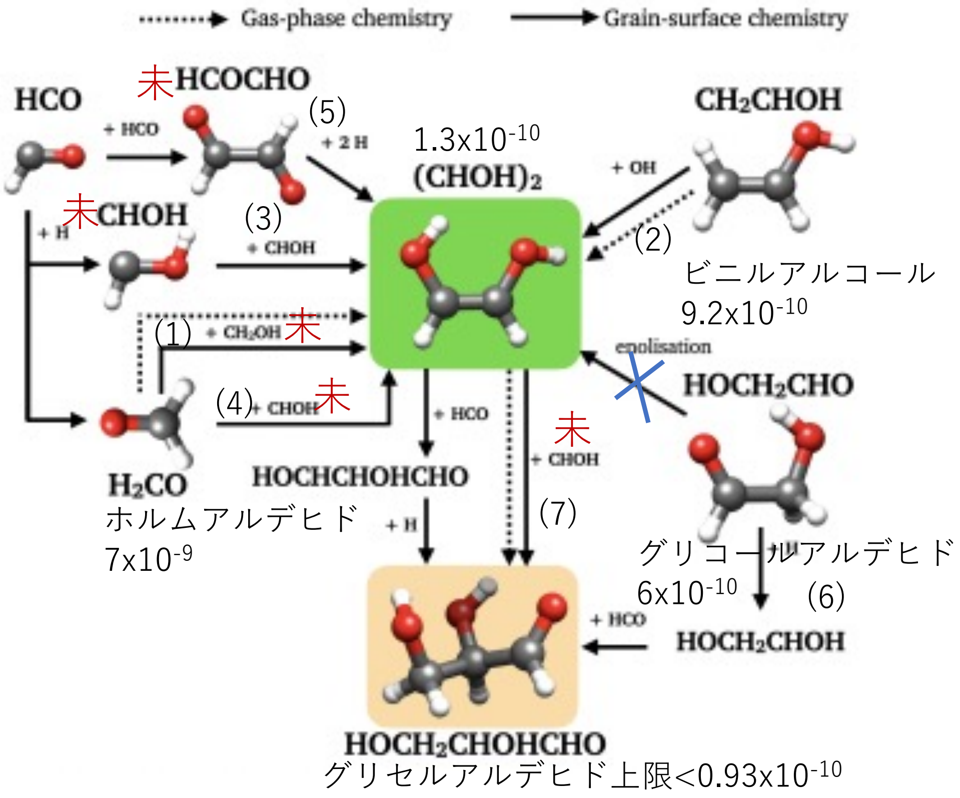
ethenediol
$(CHOH)_2$

G+0.693-0.027分子雲 (Sgr B2領域)
Yebes 40m + IRAM 30m



T_{ex}=8.5±0.6K
N_{mol}=(1.8±9.1)x10^{13}cm^{-2}
abundance=1.3x10^{-10}

C2H4O2 の異性体
CH3COOH 酢酸
HCOOCH3 ギ酸メチル
HOCH2CHO グリコールアルデヒド
(CHOH)2 ethenediol



Minimum energy principle （最も安定な分子が最も多く存在）は成り立たない。
個々の分子の生成パスを要検討

中性ーラジカル反応（気相でも可）

$$H_2CO + CH_2OH \longrightarrow (CHOH)_2 + H\,, \qquad (1)$$

$$CH_2CHOH + OH \longrightarrow (CHOH)_2 + H\,, \qquad (2)$$

ダスト表面

$$2\,CHOH \longrightarrow (CHOH)_2\,, \qquad (3)$$

２量化

$$CHOH + H_2CO \longrightarrow (CHOH)_2\,, \qquad (4)$$

$$2\,HCO \longrightarrow HCOCHO \xrightarrow{2H} (CHOH)_2\,. \qquad (5)$$

複雑な糖へ

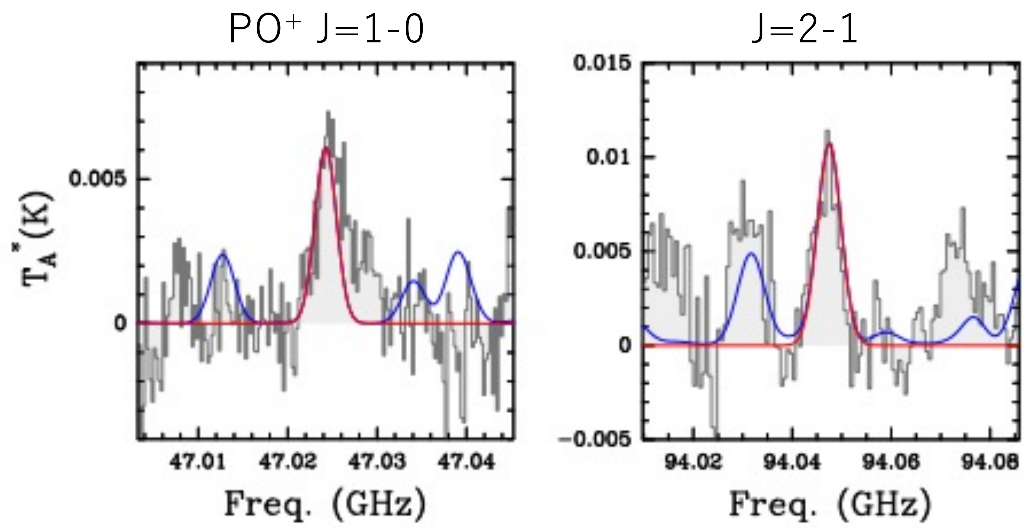
$$HOCH_2CHO \xrightarrow{H} HOCH_2CHOH \xrightarrow{HCO} HOCH_2CHOHCHO\,. \qquad (6)$$

$$(CHOH)_2 + CHOH \longrightarrow HOCH_2CHOHCHO\,. \qquad (7)$$

40. Ionise hard: interstellar PO+ detection

Víctor M. Rivilla, et al. Accepted in Frontiers in Astronomy and Space Sciences

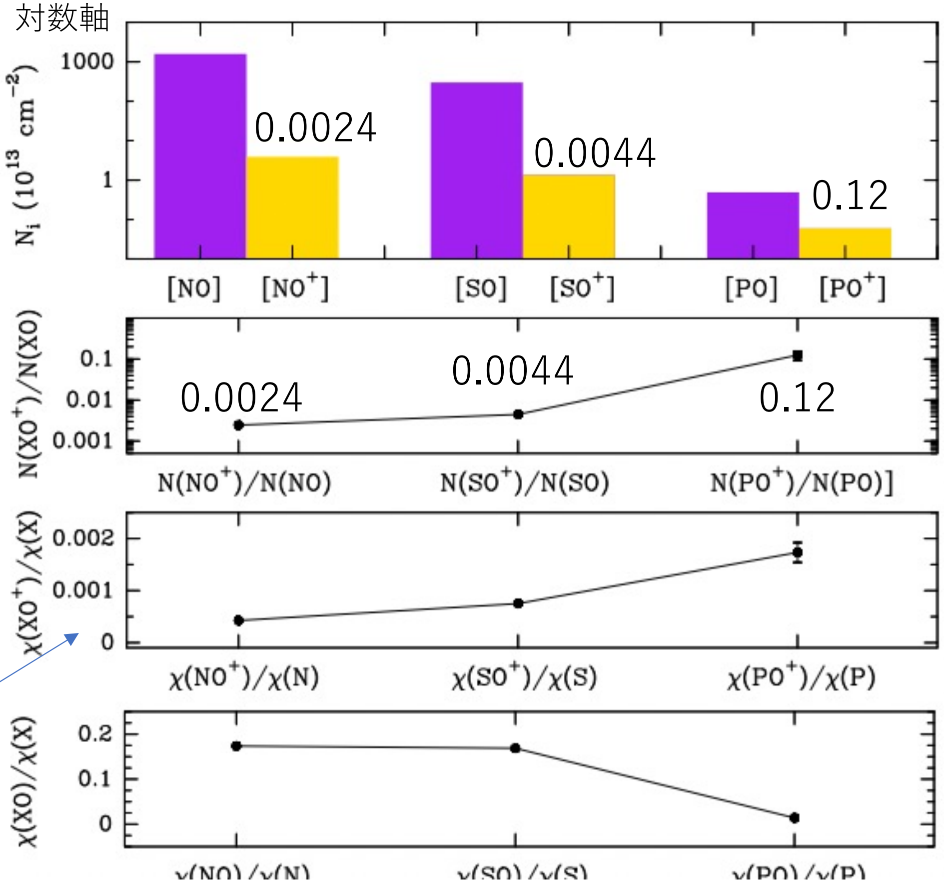
PO$^+$（１酸化リン）
G+0.693-0.027 Sgr B2領域
Yebes 40m, IRAM30m,APEX



PO$^+$ J=1-0

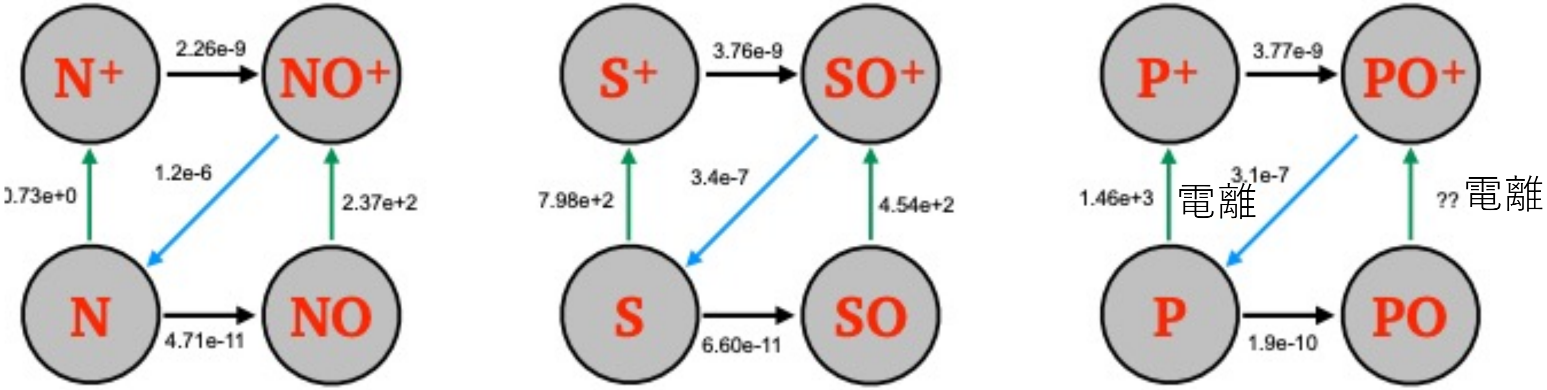
J=2-1

First Detection



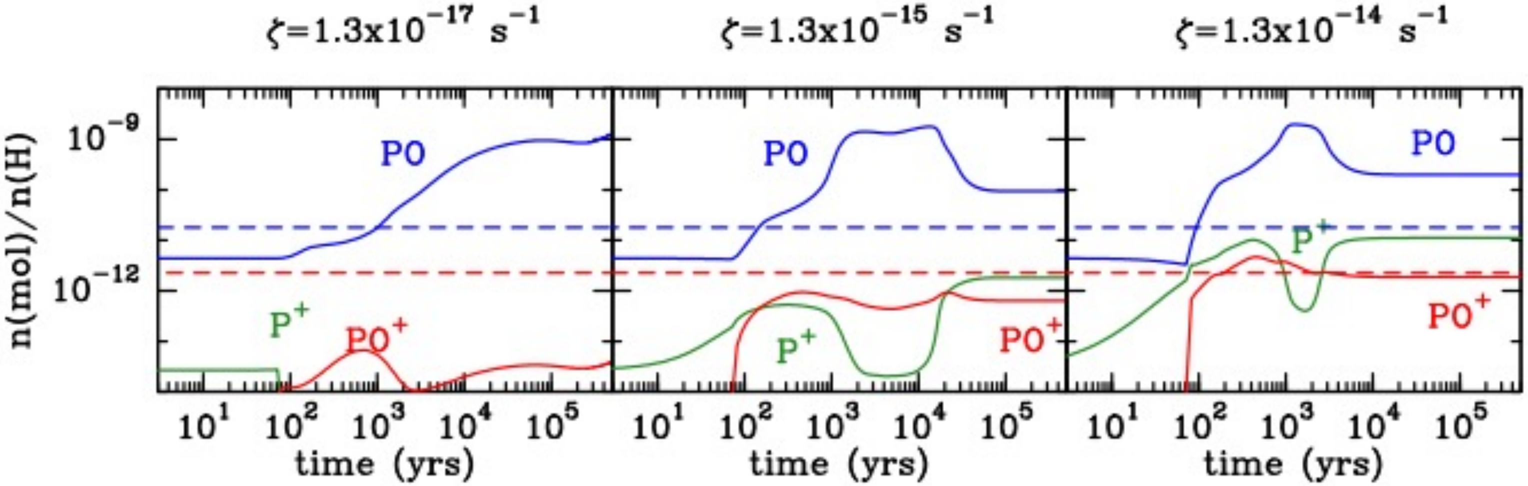
PO$^+$/P>NO$^+$/N, SO$^+$/S

$P^+ + OH \rightarrow PO^+ + H$



$P + OH \rightarrow PO + H$

$P + H_2O \rightarrow PO + H_2$



Cosmic ray ionization of PO
C-shock Vs=20km/s

37. Planet-Disk Interactions

Sijme-Jan Paardekooper et al. in Protostars and Planets VII

Planet-disk interactions, where an embedded massive body interacts gravitationally with the protoplanetary disk it was formed in, can play an important role in reshaping both the disk and the orbit of the planet. Spiral density waves are launched into the disk by the planet, which, if they are strong enough, can lead to the formation of a gap. Both effects are observable with current instruments. The back-reaction of perturbations induced in the disk, both wave-like and non-wavelike, is a change in orbital elements of the planet. The efficiency of orbital migration is a long-standing problem in planet formation theory. We discuss recent progress in planet-disk interactions for different planet masses and disk parameters, in particular the level of turbulence, and progress in modeling observational signatures of embedded planets.

38. The Role of Disk Winds in the Evolution and Dispersal of Protoplanetary Disks

Ilaria Pascucci, et al. in Protostars and Planets VII

The assembly and architecture of planetary systems strongly depend on the physical processes governing the evolution and dispersal of protoplanetary disks. Since Protostars and Planets VI, new observations and theoretical insights favor disk winds as being one of those key processes. This chapter provides a comprehensive review of recent observations probing outflowing gas launched over a range of disk radii for a wide range of evolutionary stages, enabling an empirical understanding of how winds evolve. In parallel, we review theoretical advancements in both magnetohydrodynamic and photoevaporative disk wind models and identify predictions that can be confronted with observations. By linking theory and observations we critically assess the role of disk winds in the evolution and dispersal of protoplanetary disks. Finally, we explore the impact of disk winds on planet formation and evolution and highlight theoretical work, observations, and critical tests for future progress.

39. Magnetic fields in star formation: from clouds to cores

Kate Pattle, et al. in Protostars and Planets VII

In this chapter we review recent advances in understanding the roles that magnetic fields play throughout the star formation process, gained through observations and simulations of molecular clouds, the dense, star-forming phase of the magnetised, turbulent interstellar medium (ISM). Recent results broadly support a picture in which the magnetic fields of molecular clouds transition from being gravitationally sub-critical and near equipartition with turbulence in low-density cloud envelopes, to being energetically sub-dominant in dense, gravitationally unstable star-forming cores. Magnetic fields appear to play an important role in the formation of cloud substructure by setting preferred directions for large-scale gas flows in molecular clouds, and can direct the accretion of material onto star-forming filaments and hubs. Low-mass star formation may proceed in environments close to magnetic criticality; high-mass star formation remains less well-understood, but may proceed in more supercritical environments. The interaction between magnetic fields and (proto)stellar feedback may be particularly important in setting star formation efficiency. We also review a range of widely-used techniques for quantifying the dynamic importance of magnetic fields, concluding that better-calibrated diagnostics are required in order to use the spectacular range of forthcoming observations and simulations to quantify our emerging understanding of how magnetic fields influence the outcome of the star formation process.