

# Prospect for Radio Observations of comet 9P/Tempel 1, at cm to submm wavelengths, in support of Deep Impact mission

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## I Prospects for molecular observations and monitoring of outgassing rate

- *with Nancay, IRAM, CSO, JCMT, ODIN...*

## II Short-term detectability of an outburst

- H<sub>2</sub>O with ODIN and HCN(3-2) with IRAM

## III Comparison to previous campaigns

- 19P/Borrelly observations in support of Deep Space 1 encounter

- 10P/Tempel 2 observations,...

# Water outgassing monitoring of 9P/Tempel 1

Nançay: OH lines at 18cm

Daily monitoring of OH, but only feasible weeks before perihelion and encounter. Detection after several days

**Constraints:** 1h per day at transit time, when maser inversion favourable

ODIN: H<sub>2</sub>O line at 557GHz

1h observation per 96min. Orbit, any time of the day:

rms expected **0.13 Kkm/s per 1h-orbit** For a **1day 3x3 map**

Signal for  $Q_{\text{H}_2\text{O}}=10^{28}$ : **0.58 Kkm/s center S/N = 6**

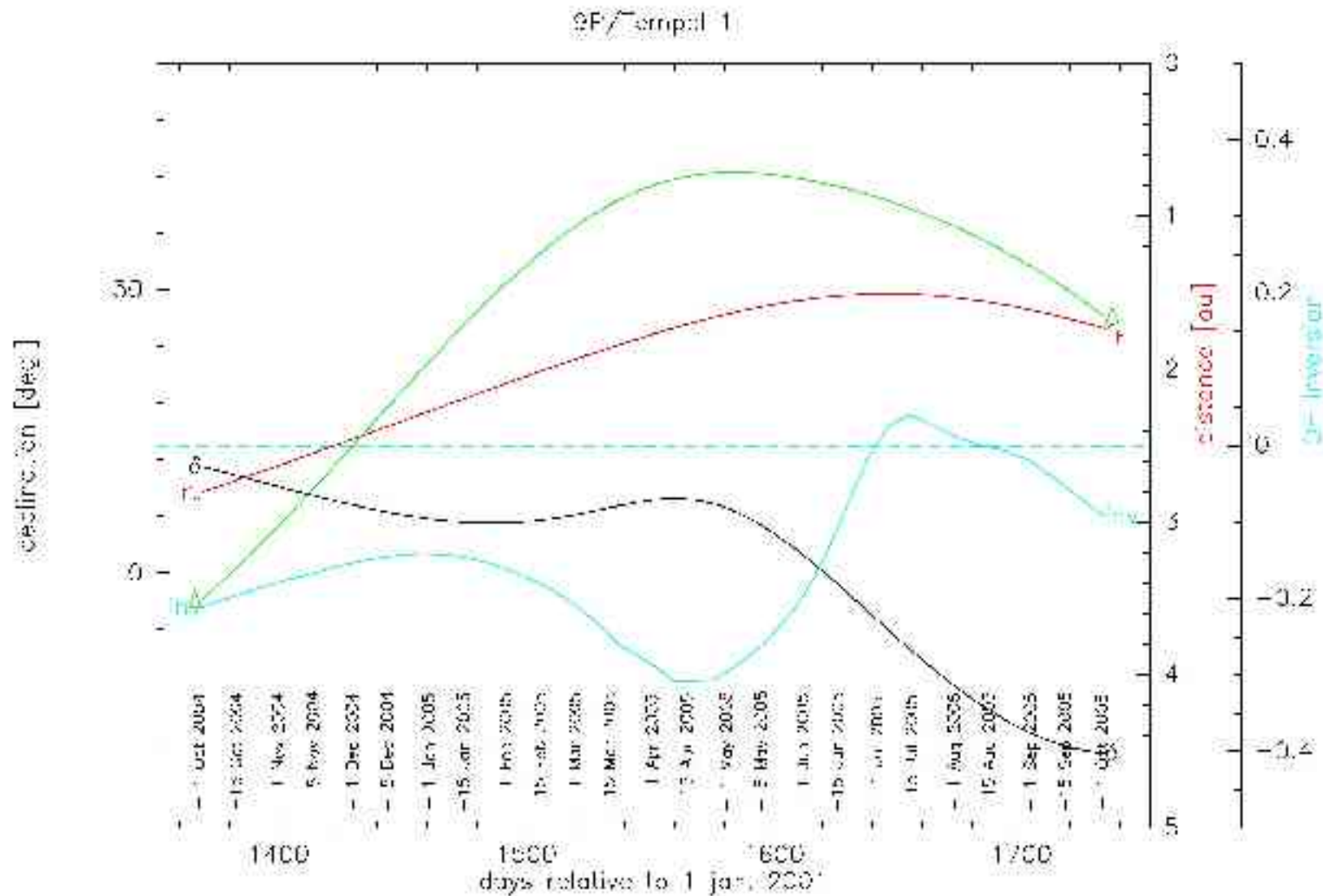
*(5 July 2005)* **0.38 at 60" S/N = 4 per point**

**0.24 at 90" S/N = 2.5 per point**

**Constraints:** when solar elongation between 60° and 120° (will be ok in June and July 2005), only one receiver in summer ("eclipse") period, if satellite still ok and funded. Half time dedicated to aeronomy.

## Observing conditions of 9P/Tempel-1:

The comet OH-lines at Nançay can be observed when the  $\Lambda$ -doublet maser inversion is not too close to 0, thus excluding the weeks around perihelion

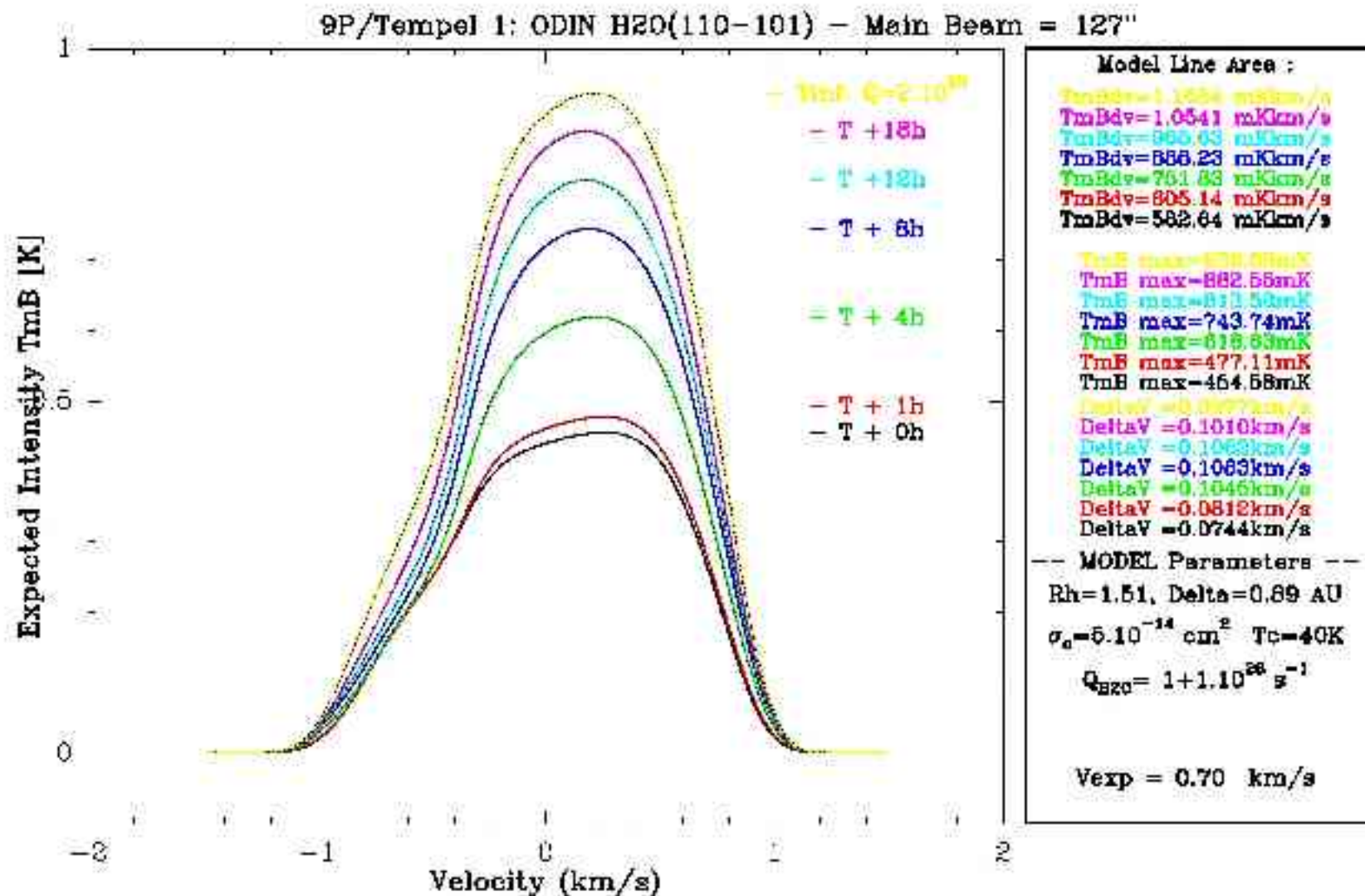


# Molecular lines:

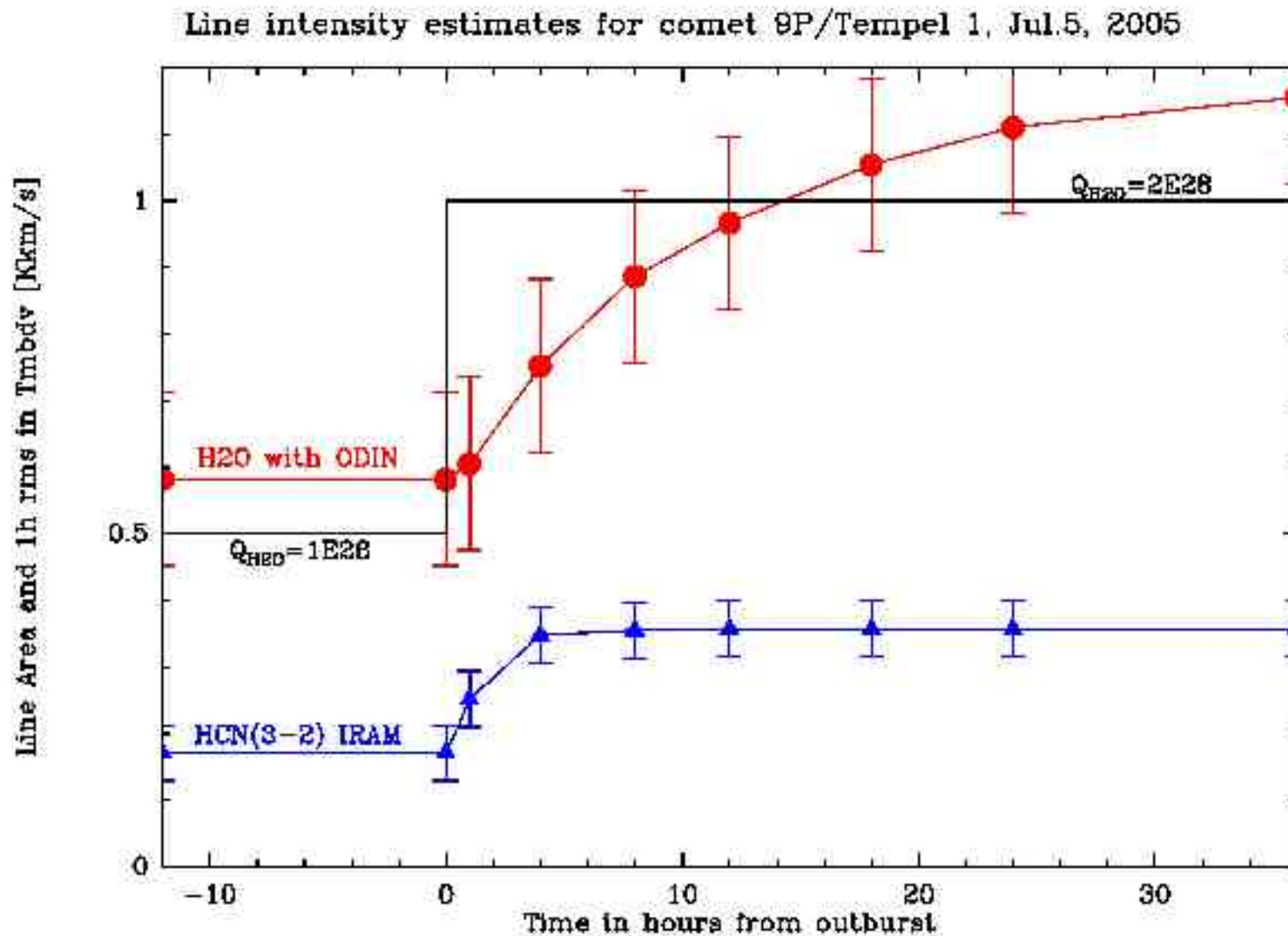
**Detectability in one observing shift (lines area in mKkm/s TmBdv)**

Molecule	Production/line	at IRAM	at JCMT	at CSO
<b>HCN</b>	1.10 <sup>25</sup>	<b>J1-0:</b> 27 S/N=3.5		
	0.1%	<b>J3-2:</b> 200 S/N=5	<b>84</b>	<b>49 S/N=4</b>
		<b>J4-3:</b>	<b>86</b>	<b>47 S/N=2</b>
<b>CS</b>	1.10 <sup>25</sup>	<b>J3-2:</b> 21 S/N=2.5		
	0.1%	<b>J5-4:</b> 51 S/N=2	<b>25</b>	<b>16 S/N=1.5</b>
		<b>J7-6:</b>	<b>22</b>	<b>13 S/N=0.5</b>
<b>CO</b>	1.10 <sup>27</sup>	<b>J2-1:</b> 19 S/N=1	<b>9</b>	<b>6 S/N=0.5</b>
	10%	<b>J3-2:</b>	<b>22</b>	<b>15 S/N=0.8</b>
<b>CH<sub>3</sub>OH</b>	3.10 <sup>26</sup>	<b>145GHz:</b> 31,20,... S/N=3,..		
	3 %	<b>157GHz:</b> 12-22 S/N=1-1.5		
		<b>241GHz:</b> 71,54,... S/N=3,...	<b>41,..</b>	<b>30,..S/N=2.5</b>
		<b>304/307 GHz</b>		<b>45/54 S/N=3/4</b>
<b>H<sub>2</sub>CO</b>	5.10 <sup>25</sup>	<b>225GHz:</b> 26 S/N=1.2	<b>14</b>	<b>9 S/N=0.8</b>
	extended 0.5%	<b>352GHz:</b>	<b>15</b>	<b>9 S/N=0.3</b>
<b>H<sub>2</sub>S</b>	5.10 <sup>25</sup>	<b>169GHz</b> 35 S/N=2		<b>(0.5%)</b>

# Simulated line profile for isotropic outgassing after a doubling of outgassing rate

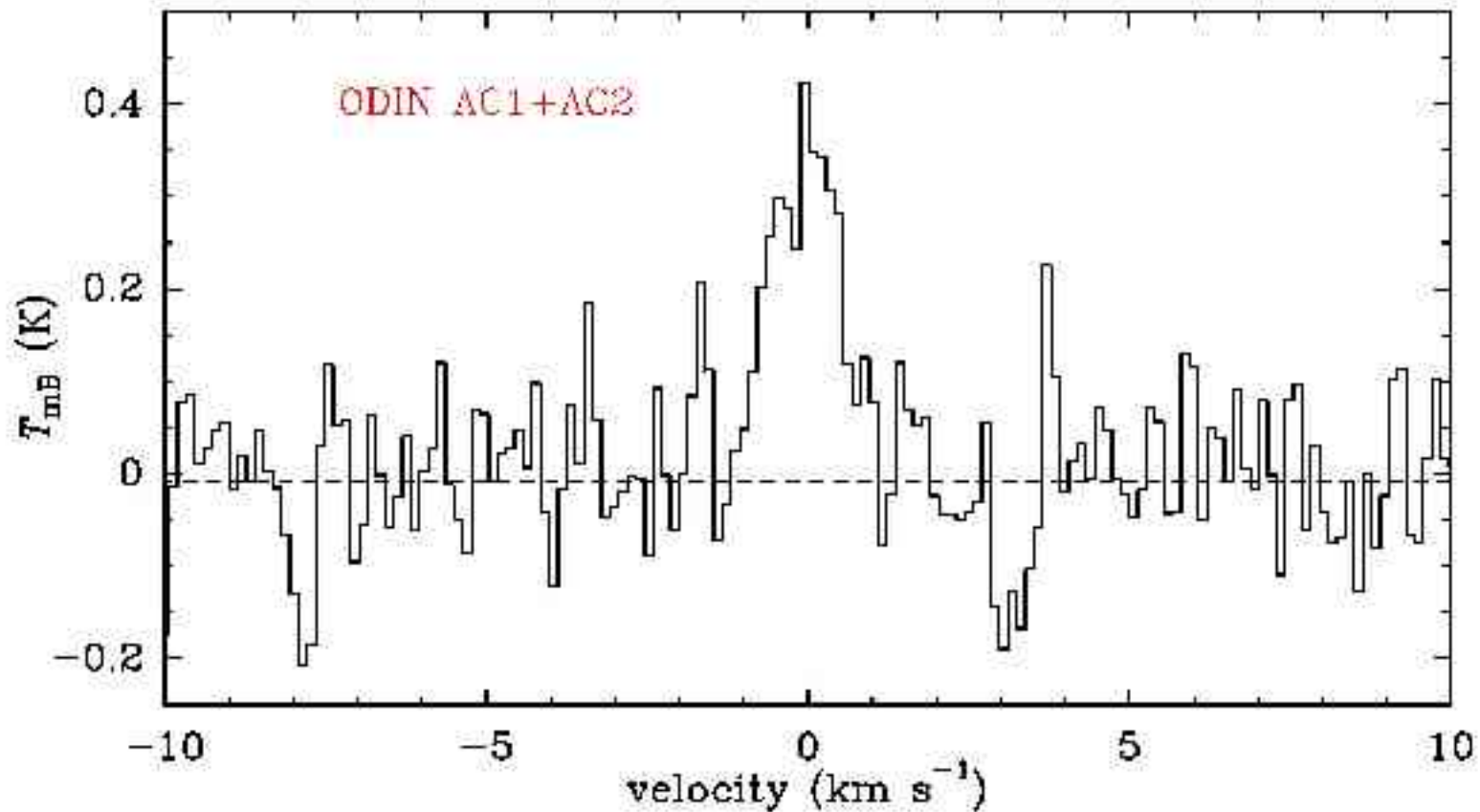


# Simulated line intensity evolution (Odin/IRAM) after a doubling of outgassing rate

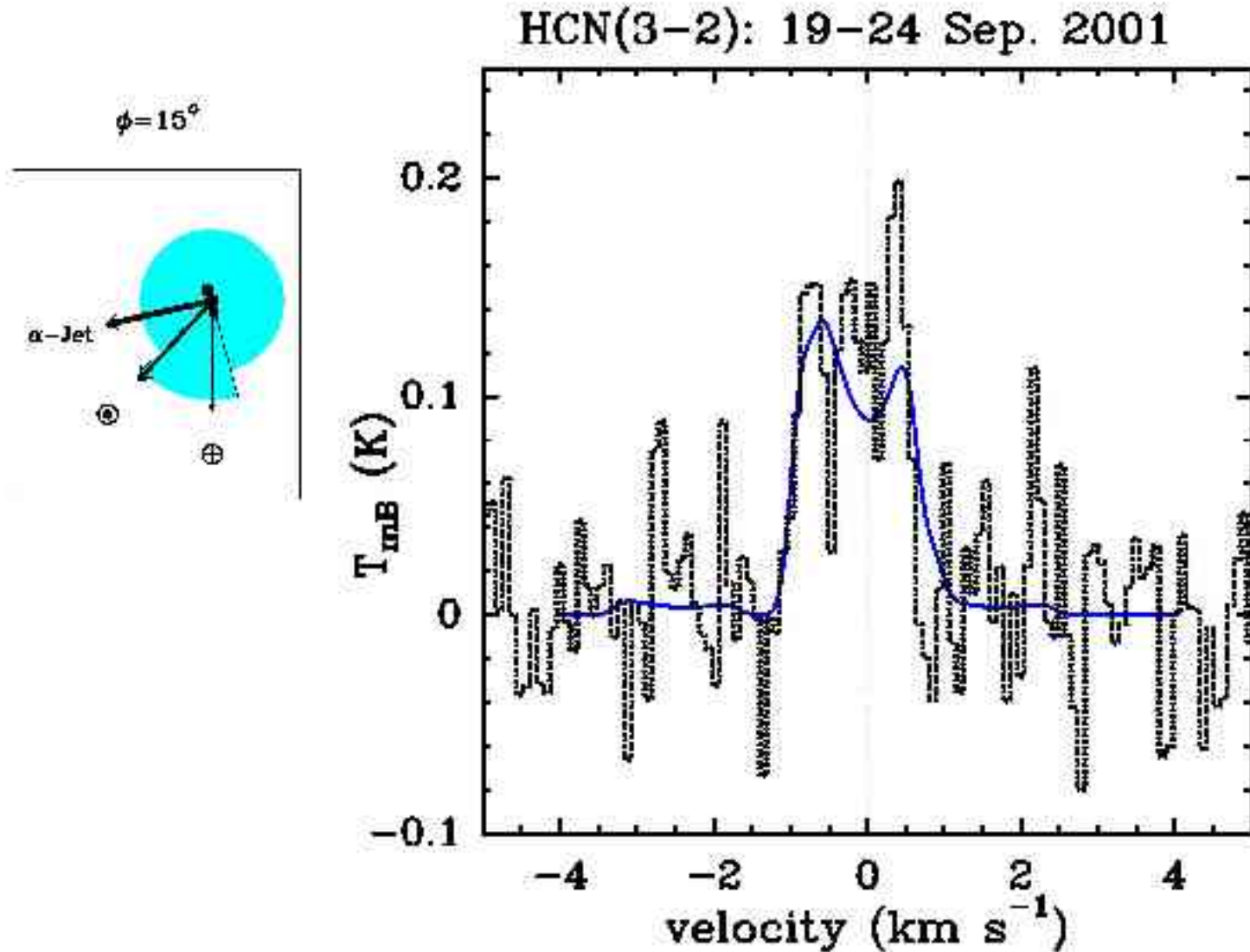


**Comparison to previous campaign: simultaneous observations of comet 19P/Borrelly at the time of Deep Space 1 encounter (Bockelée-Morvan et al. 2004, Icarus 167, 113)**

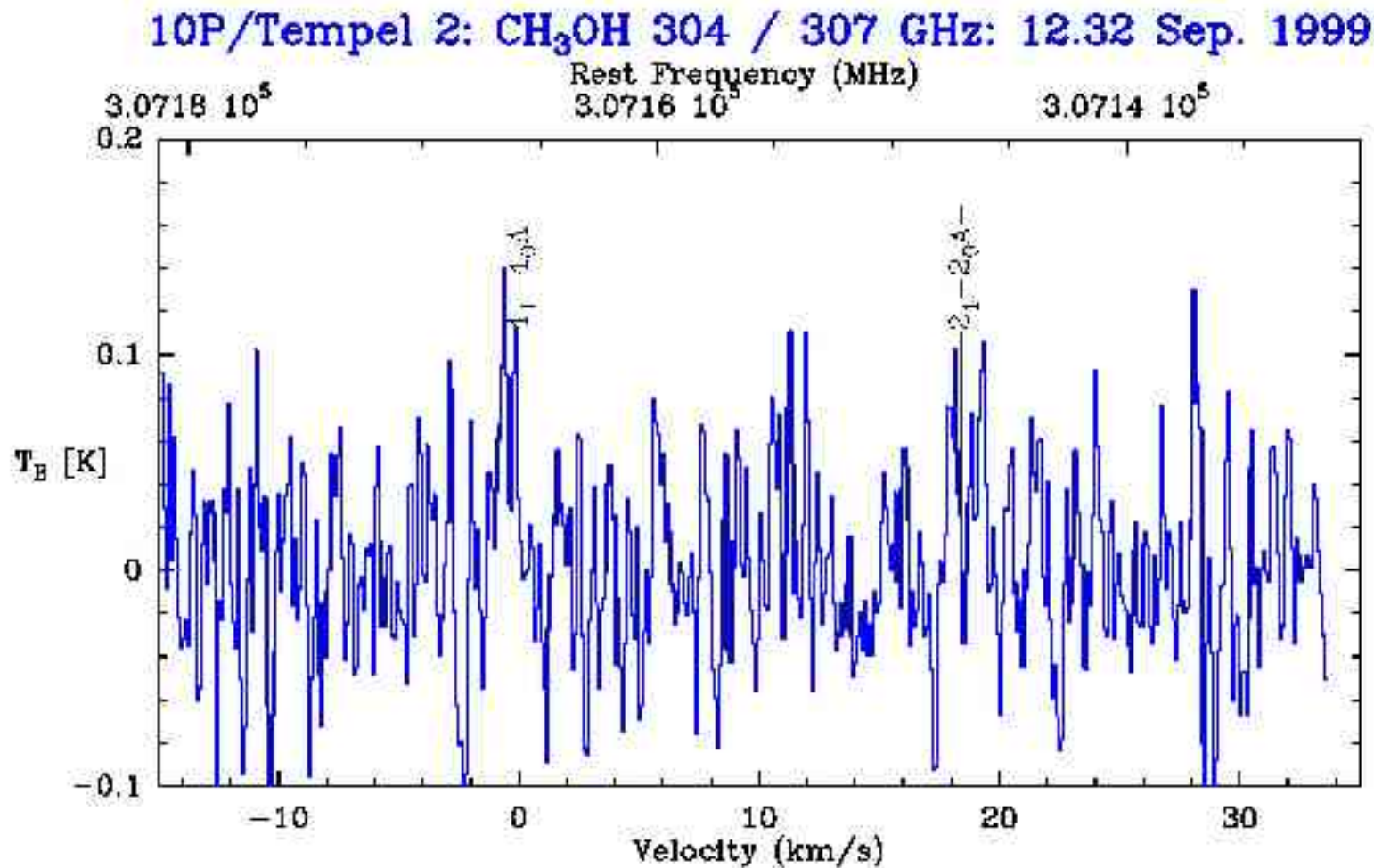
**19P/Borrelly: H<sub>2</sub>O(110–101) 557GHz: 22–24 Sep. 2001**



Simultaneous observations of comet 19P/Borrelly at the time of Deep Space 1 encounter (Bockelée-Morvan et al. 2004, Icarus 167, 113): Outgassing pattern from lineshape study (HCN(3-2) observed at IRAM - expected intensity for 9P in July 2005 is similar)



**Comparison to previous campaign: observations of comet 10P/Tempel 2 in 1999:  
similar line strengths and viewing conditions are expected for 9P/Tempel 1 in 2005  
Methanol lines at CSO (one single ~3h observation)**



**Comparison to previous campaigns: Observations of comet 10P/Tempel 2:**

**JCMT**

**CSO**

**JCMT**

**Observations of HCN showing a strong anisotropic outgassing towards the Sun (line blueshifted).**

**Similar jet activity can be expected from 9P/Tempel 1 in 2005.**

**Line intensities should also be similar**

