サブグループ1：惑星系の起源の研究

分子雲

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相川、伊藤、大朝、立原
竹内、今枝、中川、岩山
野村

惑星形成

伊藤、大朝、竹内、中川

太陽系

岡田、阿倍、Mann, 向井

系外惑星系

伊藤、竹内、大朝、中川

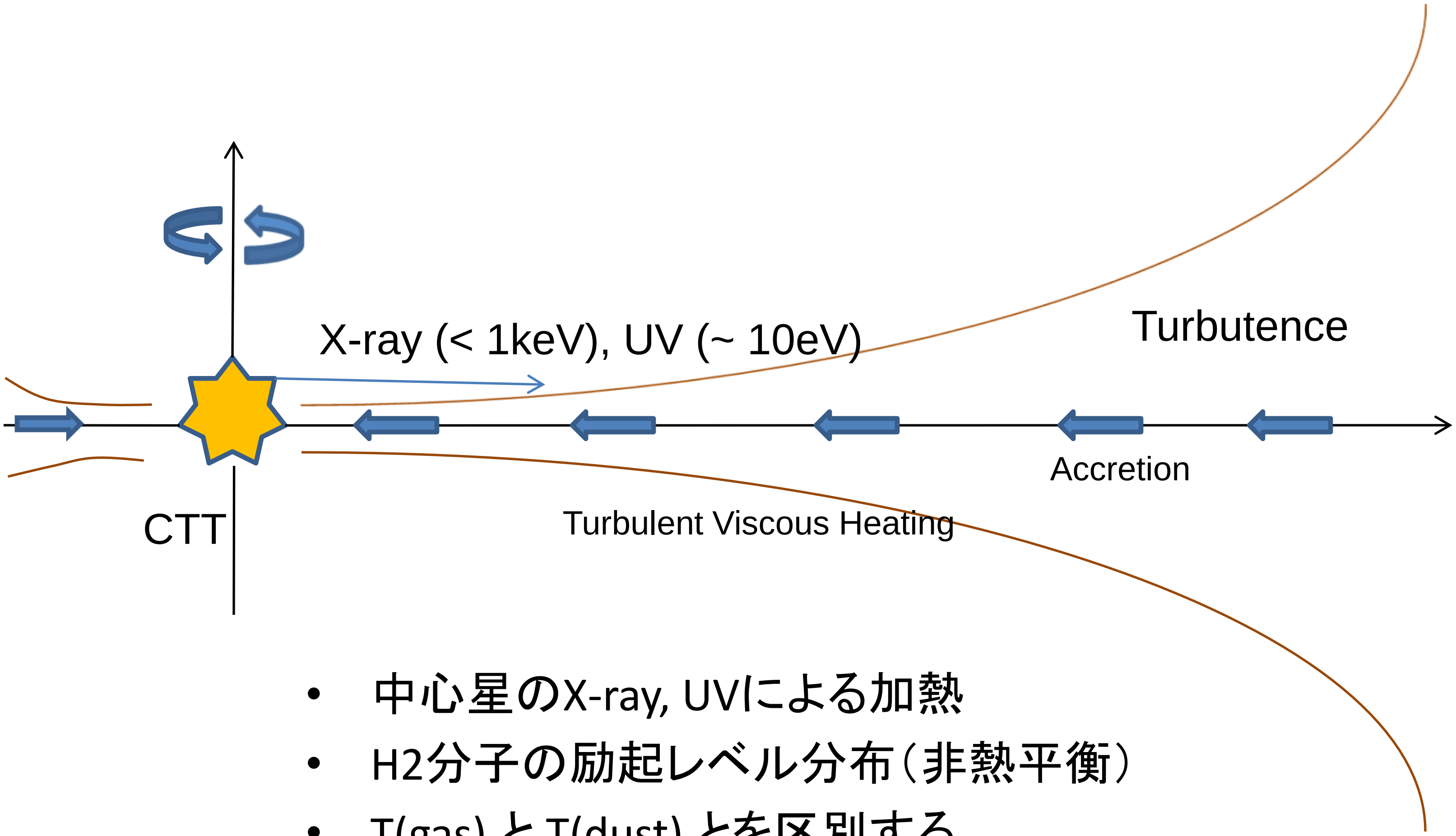
1. Detailed Models of Protoplanetary Disks

   Nomura, H., Aikawa, Y., Tsujimoto, M., Nakagawa, Y., and Millar, T.J. Astrophys. J., **661**, 334-353, 2007.

2. A Planetesimal Accretion Zone around Binary Stars

   Moriwaki, K. and Nakagawa, Y. Astrophys. J., **640**, 1099-1109, 2006.

1. Detailed Models of Protoplanetary Disks



- 中心星のX-ray, UVによる加熱
- H2分子の励起レベル分布（非熱平衡）
- T(gas) と T(dust) とを区別する
- Dust の成長
- 輻射輸送を解く

Disk の詳細構造

- 温度 T(gas), T(dust) の鉛直分布

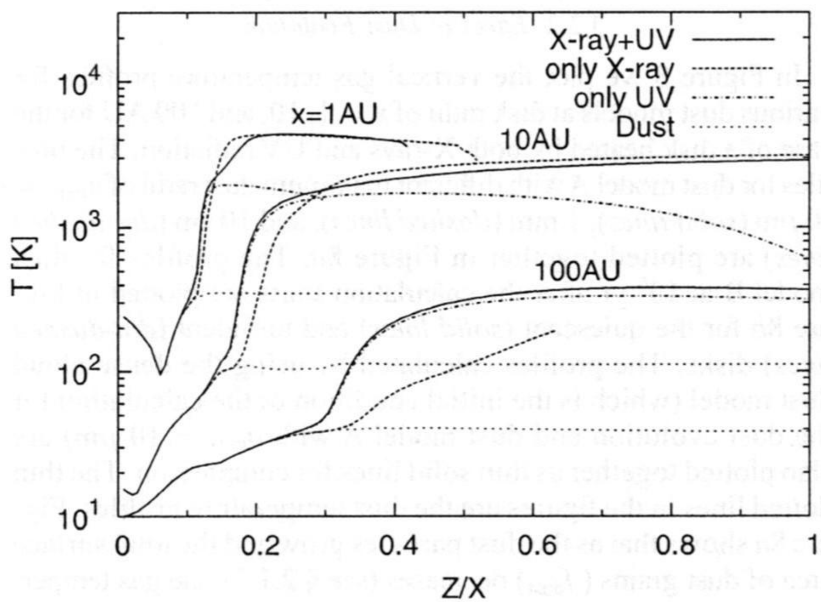


FIG. 5.—Vertical temperature profiles of dust (*thin dotted lines*) and gas at the disk radii of $x = 1$, 10, and 100 AU for the irradiation models of X-rays+UV (*solid lines*), X-rays only (*dashed lines*), and UV only (*dot-dashed lines*). Dust model A with $a_{max} = 10\ \mu m$ is used. The X-ray heating is dominant at the inner region and the very surface layer of the disk, while the FUV heating dominates in the middle layer and the outer region of the disk.

H2の輝線スペクトル

- H2分子の励起レベル分布

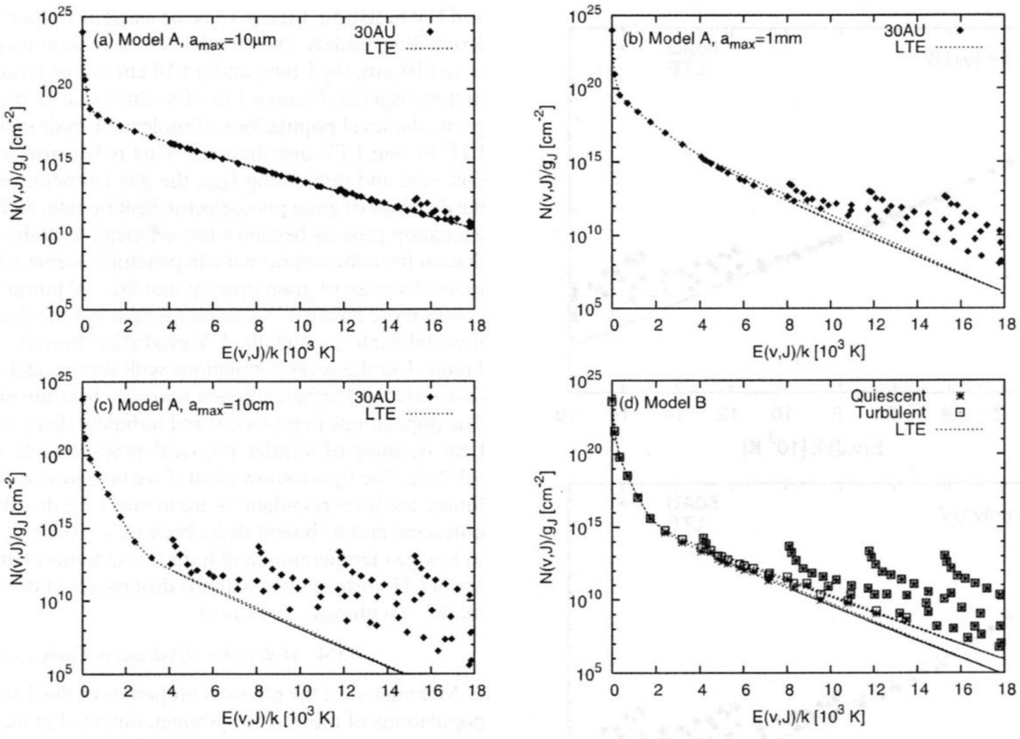


FIG. 13.—Level populations of molecular hydrogen at a disk radius of 30 AU for dust model A (*filled diamonds*) with a_{max} of (*a*) 10 μm, (*b*) 1 mm, and (*c*) 10 cm and (*d*) model B in quiescent (*asterisks*) and turbulent (*open squares*) disks. The irradiation model of X-rays+UV is used here. The level populations change from LTE to non-LTE as dust particles grow or settle toward the disk midplane, and since the gas temperature drops while the UV photons in the disk increase.

H2分子輝線スペクトル (IR)

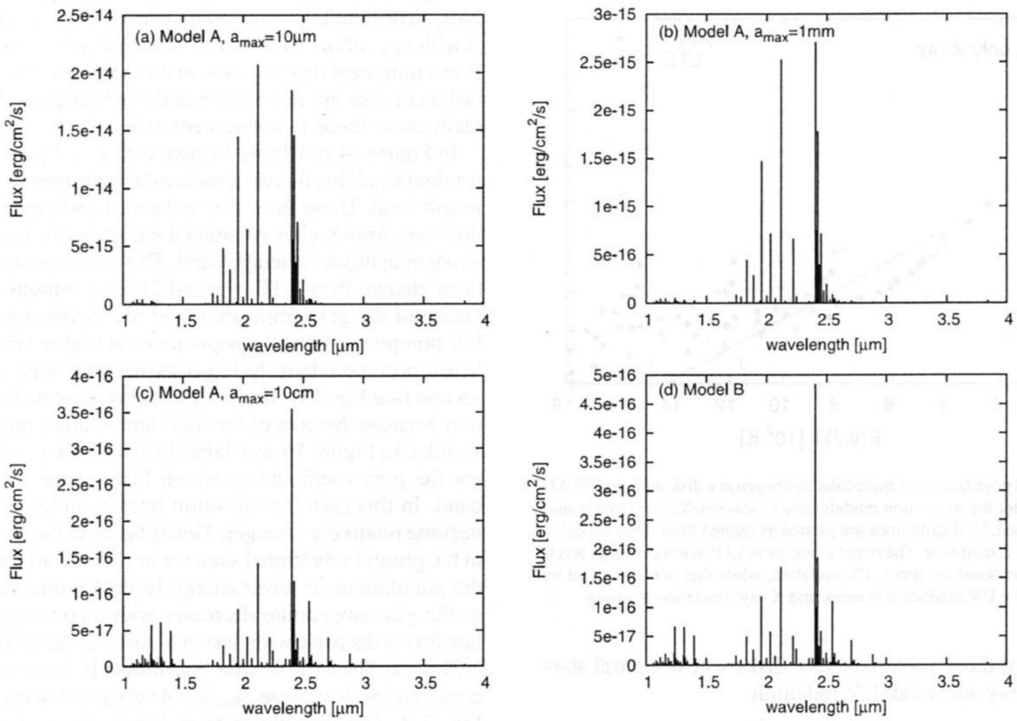


FIG. 14.—NIR ($1\ \mu m < \lambda < 4\ \mu m$) spectra of rovibrational transition lines of molecular hydrogen from the disks for dust model A with a_{max} of (a) 10 μm, (b) 1 mm, and (c) 10 cm and (d) model B in a quiescent disk. The irradiation model of X-rays+UV is used here. The distance to the disk is set to be $d = 56$ pc. The lines from higher energy levels become relatively stronger as the dust particles evolve and the level populations change from LTE to non-LTE.

H2 分子輝線スペクトル (UV)

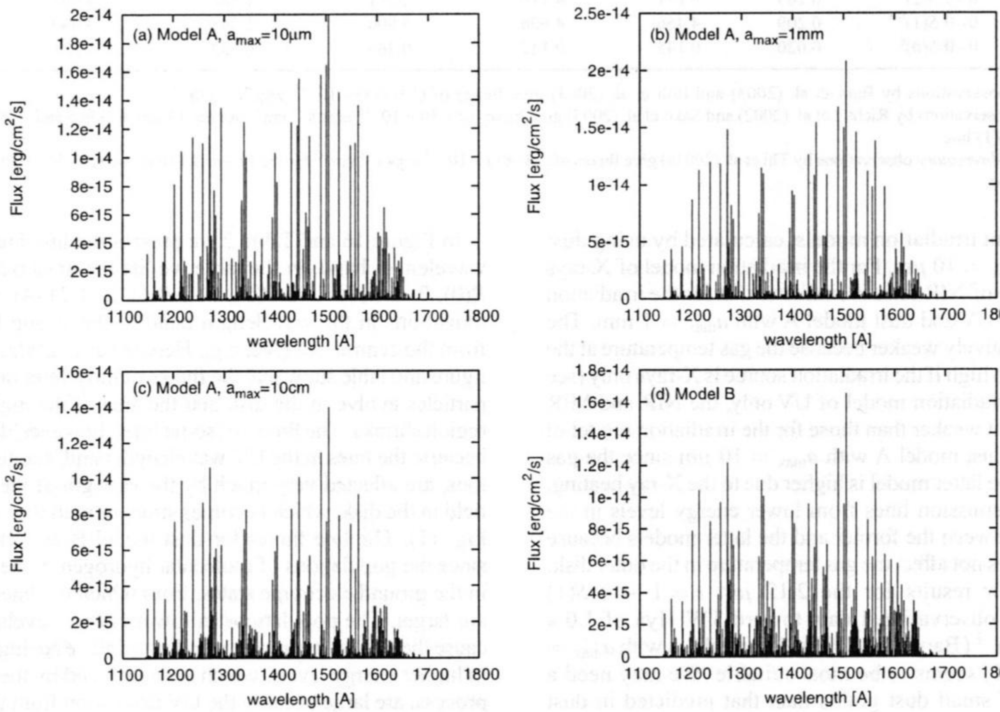


FIG. 16.—Same as Fig. 14, but for the UV (1100 Å < λ < 1800 Å) emission lines. The line fluxes of transitions originally pumped from higher energy levels seem to be relatively weaker as dust particles evolve and the gas temperature decreases. The lines are also affected by the strength of UV radiation field in the disk.

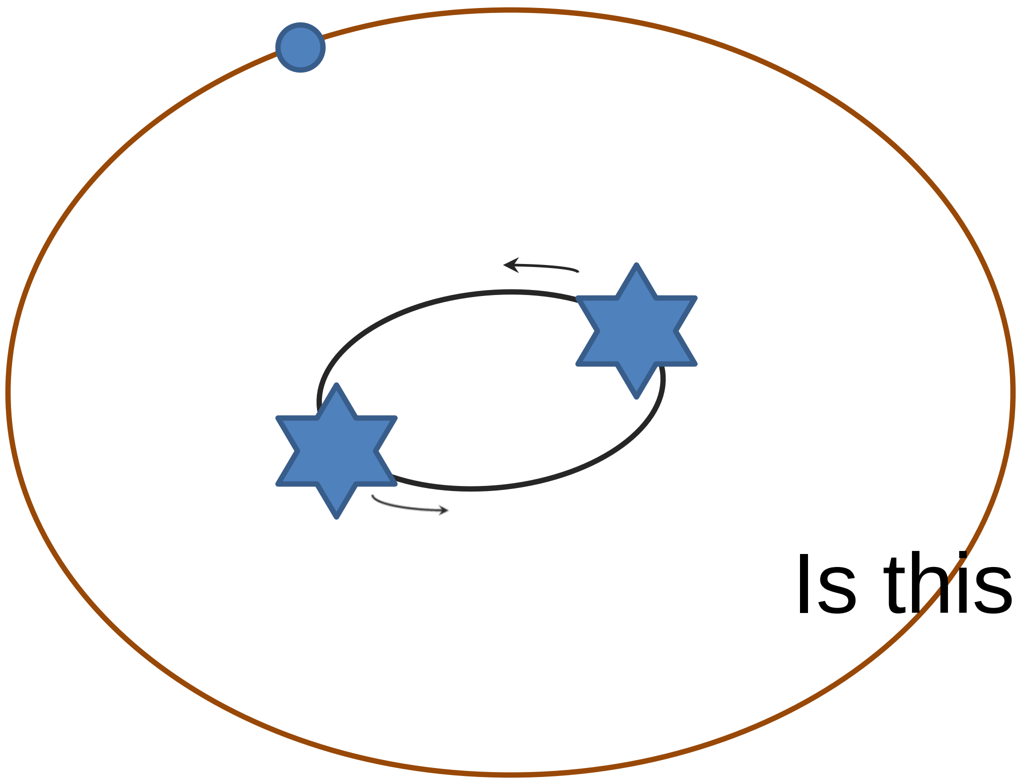
H_2 分子輝線(IR)観測の試み

- Protoplanetary Disks からのH_2分子輝線をとらえる：Subaru 望遠鏡へプロポーザル提出中

  PI: H. Nomura
  CI: Y. Itoh, Y. Aikawa, Y. Nakagawa, etc.

- 採用されれば今年5月に観測実施

2. A Planetesimal Accretion Zone around Binary Stars

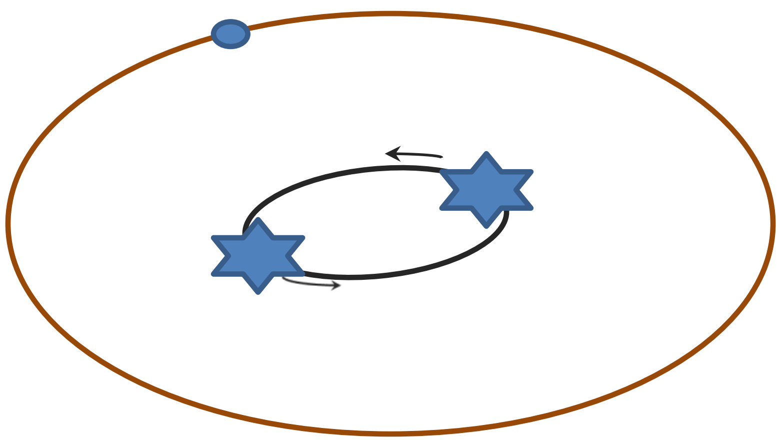


Is this possible?

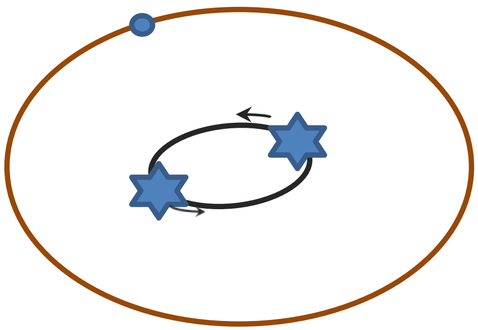
集積条件

- 衝突後の速度 ＜ 脱出速度

離心率 e ＜ e（限界値）



連星周回による微惑星の *e* の進化



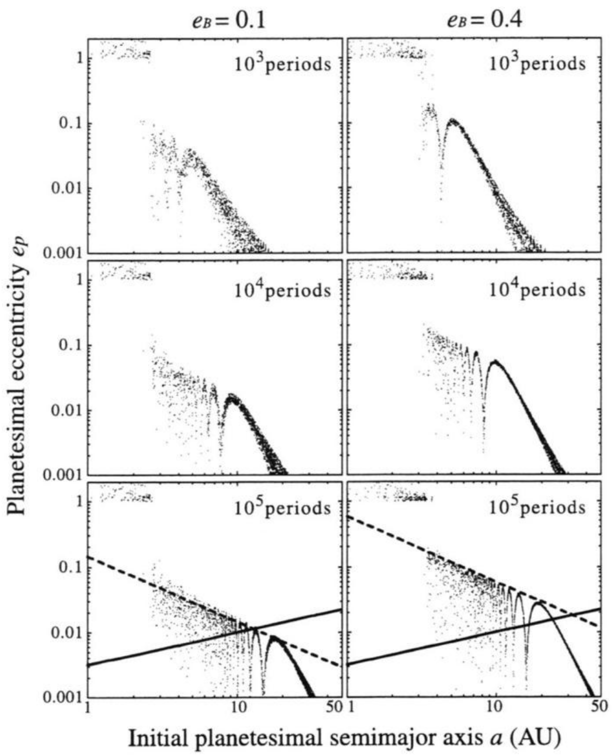


FIG. 1.—Time evolution of eccentricity of planetesimals as a function of the initial semimajor axis in units of AU in the case of $\mu = 0.2$. Left panels show the case of $e_B = 0.1$ and right panels show the case of $e_B = 0.4$. In both cases, we assume that $a_B = 1$ AU. The dashed lines in the bottom panels at 10^5 binary periods show $e_{\rm pump}$ given by eq. (9) and the solid lines show $e_{\rm esc}$ given by eq. (6).

集積可能領域

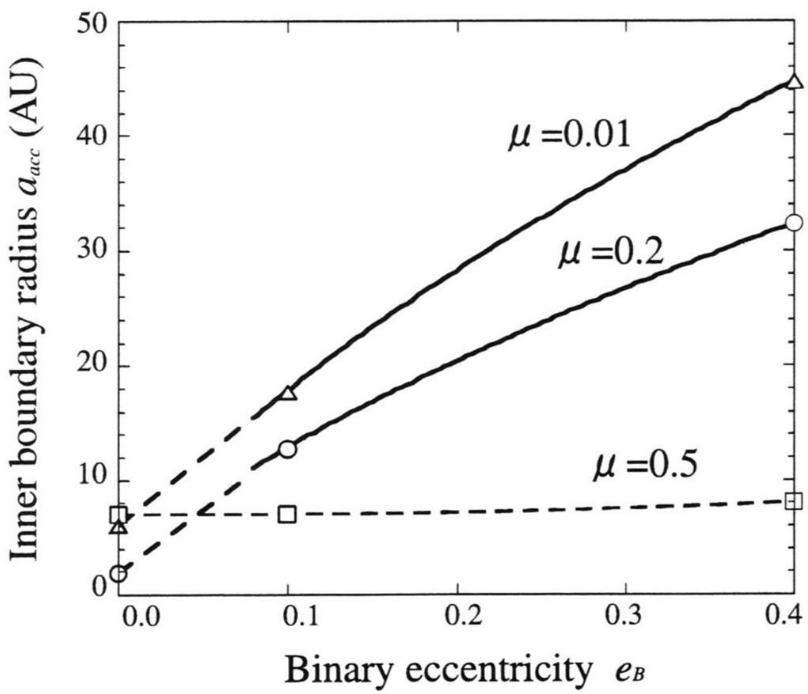


FIG. 5.—Inner boundary radii of the accretion zone a_{acc} in units of AU as a function of e_B in the three cases of $\mu = 0.01$ (*triangle*), 0.2 (*circle*), and 0.5 (*square*). The solid curves are given by eq. (10) derived from the secular perturbation theory.