Cretaceous Research 75 (2017) 157–161

Contents lists available at ScienceDirect

Cretaceous Research

journal homepage: www.elsevier.com/locate/CretRes

Short communication

A new species of Oviparosiphidae (Hemiptera: Aphidomorpha) from the Lower Cretaceous of China

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ARTICLE INFO

Article history:
Received 27 October 2016
Accepted in revised form 26 March 2017
Available online 29 March 2017

Keywords:
Yixian formation
Developed ovipositor
Oviparity
Ovoviviparity

ABSTRACT

A new species *Oviparosiphum stictum* sp. nov. is described and assigned to the extinct family Oviparosiphidae from the Lower Cretaceous of Yixian Formation at the Huangbanjigou, Beipiao City, Liaoning, China. Well-developed ovipositors in several extinct families of Mesozoic aphids further demonstrates that oviparity is a plesiomorphic state.

1. Introduction

The Oviparosiphidae Shaposhnikov, 1979, is an extinct family that lived during the Late Mesozoic (Table 1). Records of fossil Oviparosiphidae are scarce and only nine unquestionable genera from the Upper Jurassic of China and the Lower Cretaceous of Mongolia and Russia have been reported (Żyła et al., 2015). One genus and species with uncertain relationship has also been assigned to this group: *Grimmenaphis magnifica* Ansorge, 1996, from the Lower Jurassic of Germany (Ansorge, 1996; Huang et al., 2015; Żyła et al., 2015). The oldest recorded species is *Daoaphis magnalata* Huang, Wegierek, Żyła & Nel, 2015, from the Middle Jurassic of Inner Mongolia, China. The main diagnostic morphological feature of the Oviparosiphidae is the presence of the ovipositor and siphunculi (Shaposhnikov, 1979; Żyła et al., 2015).

The Yixian Formation is considered as an important part of the Jehol Biota, yielding many beautifully preserved insects (Ren et al., 2010; Gao et al., 2013; Shi et al., 2015). Recently, we recovered one new fossil specimen of Oviparosiphidae from the Lower Cretaceous Yixian Formation (about 125 Ma; Ren, 1998) in Huangbanjigou, Chaomidian Village, Beipiao City, Liaoning Province, China. After *Sinoviparosiphum lini* Ren Lu, Guo & Ji, 1995, this is the second report of fossil aphids from the Yixian Formation.

2. Material and methods

The material studied herein was collected from the Huangbanjigou Village, Beipiao City, Liaoning Province, China (Fig. 1). The aphid imprint is preserved in dorsal view. Right part of head folded. Epicranial suture preserved. Right ocelli not preserved. Antennae not complete, number of segments unknown. One antenna folded under head. Margin of pronotum not clear. One fore leg lost. Fore tarsus missing. Outer margin of fore wing not preserved. Vein M poorly preserved. CuA_1 and CuA_2 just preserved base. Segment of abdomen not clear.

The specimen was examined under a Leica MZ12.5 dissecting microscope. The photos were taken with an attached Leica DFC500 digital camera. Line drawings were made using Adobe Illustrator CS6 software. All measurements are given in millimeter (mm).

3. Systematic palaeontology

Family Oviparosiphidae Shaposhnikov, 1979

Genus *Oviparosiphum* Shaposhnikov, 1979

Species ***Oviparosiphum stictum*** Fu, Yao & Qiao sp. nov. (Figs. 2, 3)

Etymology. stictum (Latin) means maculate, derived from the blotches on the abdomen. The gender neuter.
Holotype. No. CNU-Het-LB2016001 (female) (Fig. 2A, B)

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http://dx.doi.org/10.1016/j.cretres.2017.03.023
0195-6671/

Table 1
The ovipositor type of Oviparosiphidae.

Family	Species	Type of ovipositor	Horizon and Locality	Gender
Oviparosiphidae	*Oviparosiphum jakovlevi* Shaposhnikov, 1979	Well-developed, with four valves.	K_1, Mongolia.	♀
	Acanthotrichaphis paulisensoriata Shaposhnikov & Wegierek,1989	Less-developed, short.	K_1, Russia.	♀
	Dinaphis multisensoriata Shaposhnikov & Wegierek, 1989	Developed, narrow conical.	K_1, Russia.	♀
	Daoaphis magnalata Huang, Wegierek, Żyła & Nel, 2015	Invisible.	J_2, China.	♀
	Expansaphis laticosta Hong & Wang, 1990	Well-developed, accounting for 1/2 of the abdomen.	K_1, China.	♀
	E. ovata Hong & Wang, 1990	Well-developed, accounting for 1/2 of the abdomen.	K_1, China.	♀
	Khotontaphis lachnoides Shaposhnikov & Wegierek, 1989	Invisible.	J_3 - K_1, Mongolia.	UN
	Archeoviparosiphum baissense (Shaposhnikov & Wegierek, 1989)	Less-developed, short.	K_1, Russia.	♀
	A. camptotropum (Zhang, Zhang, Hou & Ma, 1989)	Less-developed, small.	K_1, China.	♀
	A. tuanwangense (Zhang, Zhang, Hou & Ma, 1989)	Well-developed, large and triangular.	K_1, China.	♀
	A. latum (Hong & Wang, 1990)	Well-developed, long and triangular.	K_1, China.	♀
	A. malacum (Zhang, Zhang, Hou & Ma, 1989)	Well-developed, large and triangular.	K_1, China.	♀
	A. opimum (Zhang, Zhang, Hou & Ma, 1989)	Developed, two triangular valves.	K_1, China.	♀
	Sinoviparosiphum lini Ren, 1995	Abdomen not preserved.	K_1, China.	UN
	Vitimaphis rasnitsyni Shaposhnikov & Wegierek, 1989	Developed, conical and pointed.	K_1, Russia.	♀
	Grimmenaphis magnifica Ansorge, 1996	Body not preserved.	J_3, Germany.	UN

*♀, female; UN, unknown.

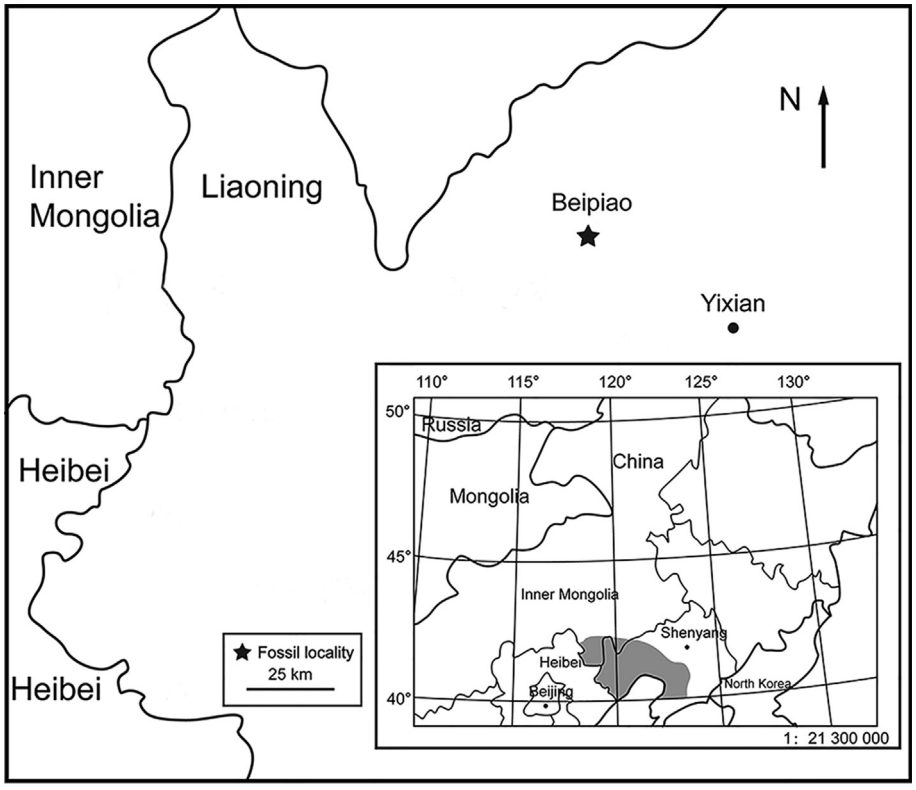

Fig. 1. Location map of the fossil site at Huangbanjigou Village, Beipiao City, Liaoning Province, China.

Locality and horizon. Huangbanjigou, Chaomidian Village, Beipiao City, Liaoning Province. Yixian Formation, Lower Cretaceous, ca. 125 Ma.

Diagnosis. Secondary rhinaria arranged in transverse rows. Vein Rs starting from proximal part of pterostigma. CuA_1 and CuA_2 close to each other, but not connected. Dorsal abdomen with nine blotches. Siphunculi in form of short truncate cones. Tip of abdomen trilateral. Ovipositor developed and large.

Description. Alate specimen. Body length 3.89 (from anterior part of head to apex of ovipositor). Anterior margin of head nearly straight. Lateral sutures present, reaching to middle of epicranium. Left ocelli 0.17 away from epicranial suture. Length of segment I 0.03. Segment II (0.05) longer than segment I. Segment III (0.35) enlongated, more thicker than other segments. Segment IV (0.18) nearly equal to half of segment III, almost three times as long as it is wide. Segment V (0.14) slightly shorter than segment IV. Segment VI incomplete. Segment III, IV, V with abundant rows of elliptical rhinaria (Fig. 4A–C). Mesothorax highly sclerotized. Mesoprephragma crescent-shaped, small. Praealare dark, connected with coxa of fore leg. Praescutum trilateral, length 0.24, width 0.49. Mesoscutum separate into two parts, distance between them 0.40. Mesoscutellum forms a curved slat, connecting two parts of mesoscutum.

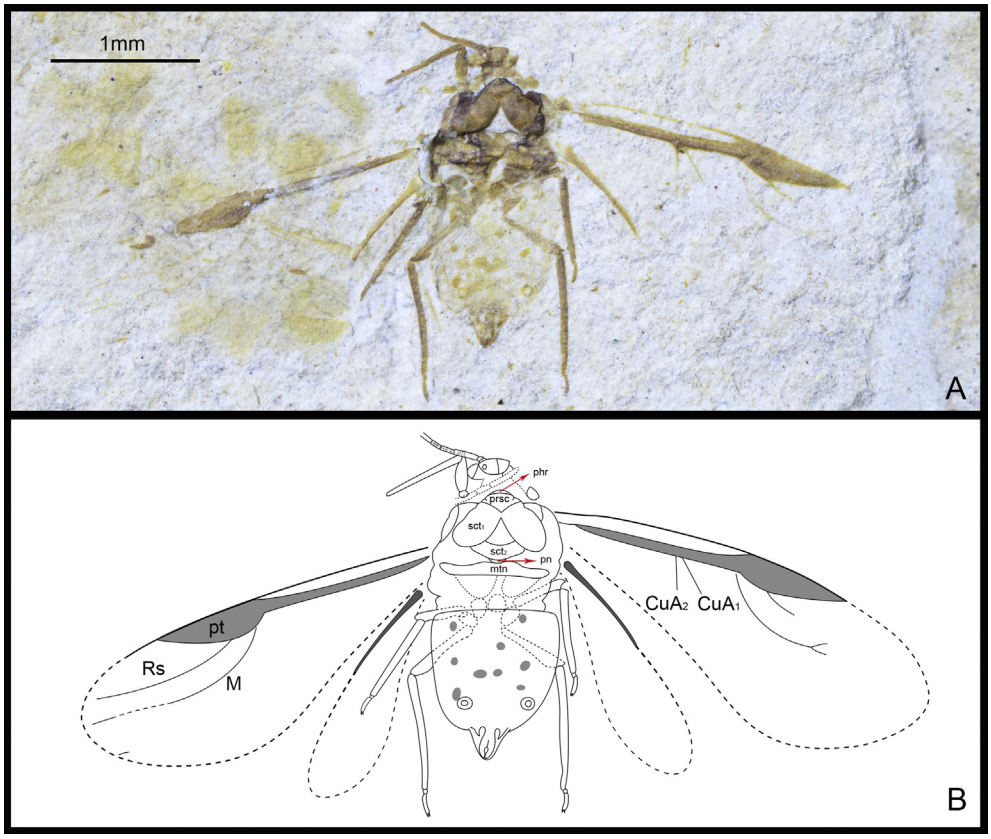

Fig. 2. *Oviparosiphum stictum* sp. nov. (Holotype, ♀, No. CNU-Het-LB2016001). A, photograph of dorsal view. B, line drawing of dorsal view. Abbreviation: phr – mesoprephragma, prsc – praescutum, sct_1 – mesoscutum, sct_2 – mesoscutellum, pn – mesopostnotum, mtn – metanotum, pt – pterostigma, Rs – radial vein, M– medial vein, CuA_1 – cubital vein, CuA_2 – cubital vein. Scale bar = 1 mm.

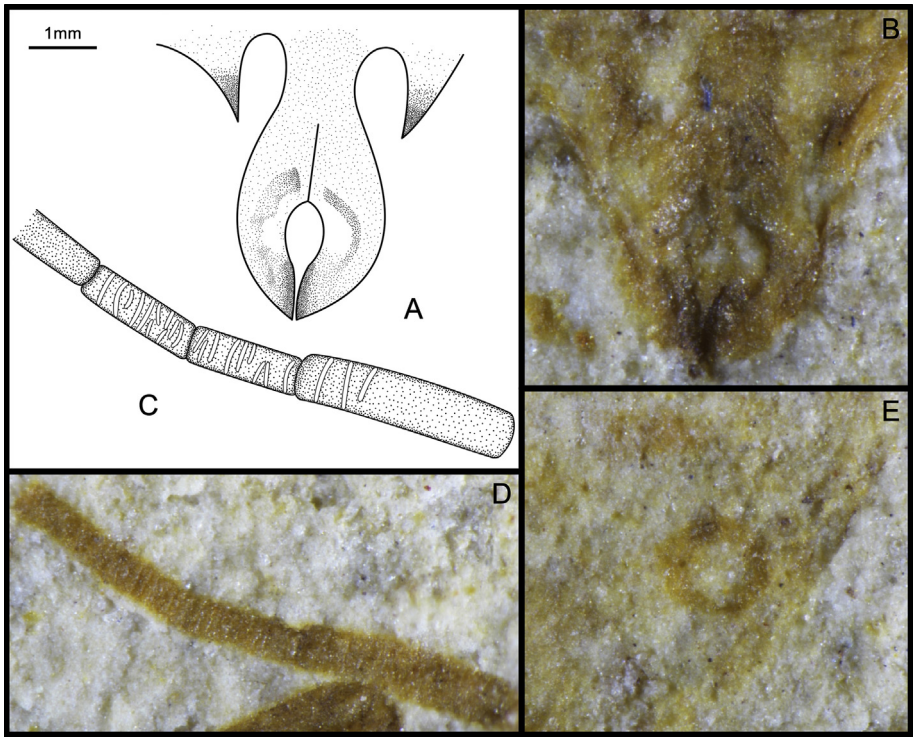

Fig. 3. *Oviparosiphum stictum* sp. nov. (Holotype, ♀, No. CNU-Het-LB2016001). A, line drawing of ovipositor. B, photograph of ovipositor. C, line drawing of antenna. D, photograph of antenna. E, photograph of Siphunculi. Scale bar = 1 mm. The scale is for all the images.

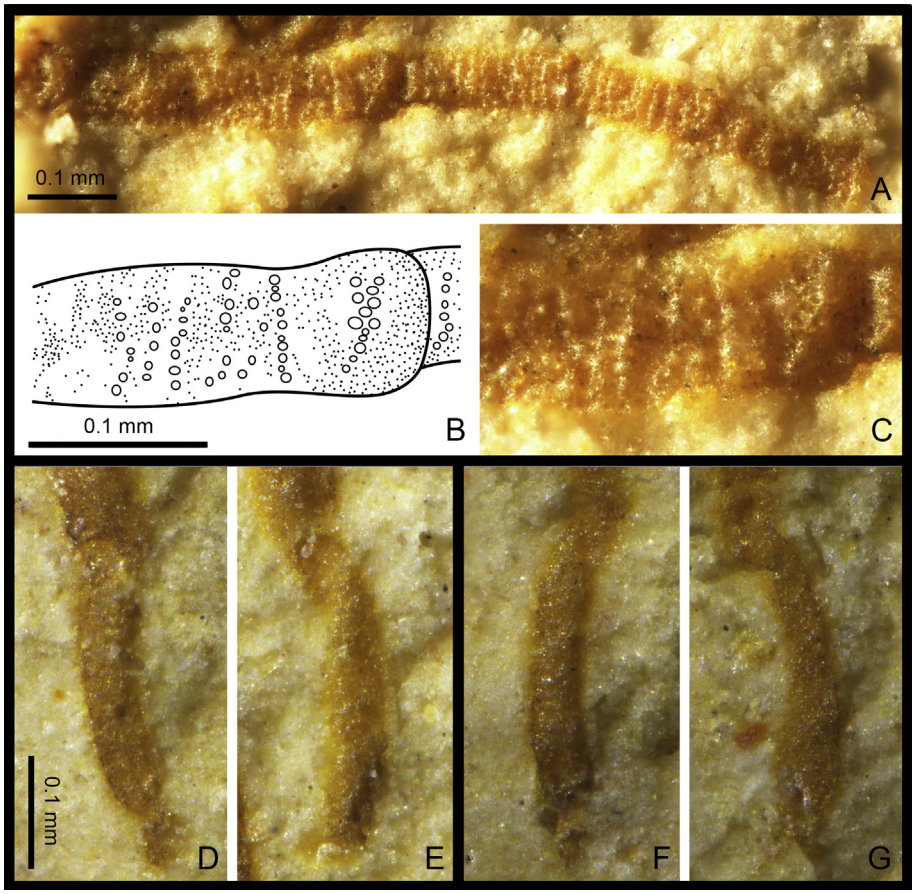

Fig. 4. *Oviparosiphum stictum* sp. nov. A, antenna. B, line drawing of details of antenna. C, photograph of details of antenna. D, left middle tarsus. E, right middle tarsus. F, left hind tarsus. G, right hind tarsus. Scale bar = 0.1 mm. The second scale is for B, C. The third scale is for D, E, F, G.

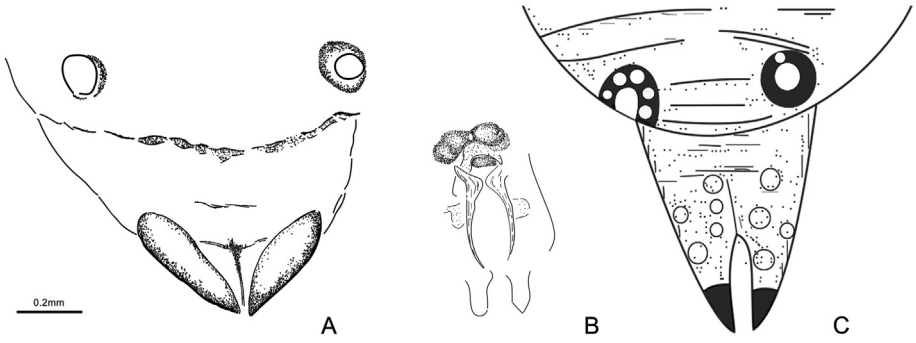

Fig. 5. Well-developed ovipositors. A, *Oviparosiphum jakovlevi* Shaposhnikov, 1979 (copy the example of Żyła et al., 2015). B. *Bajsaphis pulchra* Homan, Żyła & Wegierek, 2014 (copy the example of Homan & Wegierek, 2014). C. *Expansahphis ovate* Hong and Wang, 1990 (copy the example of Hong et al., 1990). Scale bar = 0.2 mm. The scale is for all the images.

Its length 0.19, width 0.72. Mesopostnotum crescent-shaped (0.22 wide), very small. Metanotum narrow and wide (1.37), extending over the margin of mesoscutum. Mesosternum present through body. Length of fore coxa 0.09; trochanter 0.10; fore femur 0.46; fore tibia 0.97; middle coxae close to each other. Length of middle coxae 0.21; middle femur 0.68; middle tibia 1.12, nearly two times longer than length of middle femur. Middle tarsus 0.21 (Fig. 4D, E). Two claws at end of middle tarsus, about 0.05 long. Hind legs long. Length of hind coxae 0.18; hind femur 0.94; hind tibia 1.47; hind tarsus 0.25 (Fig. 4F, G). Claws of hind tarsus 0.05, almost as long as claws length of middle tarsus. Distance from wing base to end of pterostigma 4.88. Pterostigma long and broad (1.36 long, 0.37 wide), its length about 3.5 times exceeding its greatest width. The bases of CuA_1 and CuA_2 extend from a main vein (Sc + R + M) and are very close to, but separate from each other. Vein M originating before base of pterostigma, but not connected with common trunk. Vein Rs (1.94) slightly curved, starting from proximal part of pterostigma. Main stem of veins on hindwings thick. Abdomen 1.67 wide. Dorsal side of abdomen pale with dark nine blotches. Basal diameter of siphunculus 0.19 (Fig. 3E). Ovipositor (0.40 long, 0.23 wide) well developed, two valves visible (Fig. 3A, B). Tip of abdomen trilateral, length 0.39, width 0.52.

4. Discussion

The Oviparosiphidae was erected by Shaposhnikov in 1979 to accommodate the genus *Oviparosiphum*. The two most important features of *Oviparosiphum* are the siphunculi and large ovipositor (Shaposhnikov, 1979; Żyła et al., 2015). After the description of *O. jakovlevi* Shaposhnikov, 1979, six more species belonging to *Oviparosiphum* were described. Żyła et al. (2015) redescribed the type species, *O. jakovlevi* Shaposhnikov, 1979, and transferred the other 6 species to the genus *Archeoviparosiphum* Żyła, Homan, Franielczyk & Wegierek, 2015, according to the form of siphunculi and ovipositor.

The new species, *O. stictum*, is classified as *Oviparosiphum* based on the following characters: secondary rhinaria arranged in transverse rows; siphunculi in the form of short truncate cones; ovipositor large with two valves visible; on the forewings, the bases of CuA_1 and CuA_2 are not connected but very close to each other. *Oviparosiphum stictum* sp. nov. most closely resembles *O. jakovlevi* Shaposhnikov, 1979, but can be easily distinguished from the latter in having a ratio between length and width of pterostigma about 3.68 mm in length (vs. ratio between length and width of pterostigma equal to 3 mm), and ratio between hind tibia and body length about 0.38 mm (vs. ratio between hind tibia and body length of 0.47 mm). In addition, nine blotches occur on the dorsal abdomen of the new species.

In extant aphids, the families Adelgidae and Phylloxeridae are the only two groups which are oviparous (Blackman and Eastop, 1984; Heie, 1987; Wojciechowski, 1992; Moran, 1992). All the other extant aphids are ovoviviparous and their ovipositors have degenerated into a genital plate and rudimentary gonapophyses (Qiao et al., 2009). Contrary to the living aphids, developed ovipositors occur in many fossil families of the Mesozoic (Heie and Wegierek, 2009). For instance, the notable feature of Oviparosiphidae (Shaposhnikov, 1979) and Bajsaphididae (Homan et al., 2014) is the well-developed ovipositor (Table 1). Ovipositor of *Oviparosiphum jakovlevi* Shaposhnikov, 1979, with well preserved valvae I and III (Żyła et al., 2015) (Fig. 5A); ovipositor of the new species with four valves; ovipositor of *Bajsaphis pulchra* Homan, Żyła, & Wegierek, 2014, very well-developed with all valves quite clear (Homan et al., 2014) (Fig. 5B); ovipositor of *Expansaphis ovata* Hong and Wang, 1990. accounting for 1/2 of its abdomen (Hong and Wang, 1990) (Fig. 5C). In the family Juraphididae, *Juraphis karataviensis* Żyła, Blagoderov & Wegierek, 2014, has a well-developed ovipositor as well (Żyła et al., 2014). The appearance of developed ovipositors in many extinct families further demonstrates that oviparity is a plesiomorphic state (Heie, 1987). In addition, our new fossil find provides a new evidence for the Cretaceous as a rapid radiation period of aphids (Von Dohlen & Moran, 2000; Heie & Wegierek, 2009).

5. Conclusion

A new species. *Oviparosiphum stictum* sp. nov., assigned to the family Oviparosiphidae (Shaposhnikov, 1979), is described. Developed ovipositors occur in many Mesozoic extinct families of aphids confirm again that oviparity is a plesiomorphic character.

Acknowledgments

We thank Professor Piotr Wegierek from the Department of Zoology, Silesian University, editor Eduardo Koutsoukos of Cretaceous Research and an anonymous reviewer for their comments to improve this paper. We are grateful to Di Tang and Lichao Guo who have also reviewed the manuscript. This research was funded by National Natural Science Foundation of China (Nos. 31372242, 31672323, 41688103).

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